

Research on Brand Crisis Management Based on Social Media Big Data

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Abstract. With the popularity of social media, brand crises often quickly ferment in a very short period of time, with negative emotions and algorithmic recommendation mechanisms overlapping, posing unprecedented challenges to corporate reputation. Traditional crisis management theories are mostly based on static analysis and are difficult to adapt to the non-linear and multimodal evolution of public opinion dissemination characteristics in the social media environment. This article systematically reviews the research on brand crisis management based on social media big data, and constructs a theoretical framework covering the entire chain of monitoring, analysis, response, and governance around four core links: crisis identification and warning, evolution mechanism analysis, response strategy formulation, and reputation repair. The research focuses on the collection and multimodal fusion processing of multi-source heterogeneous data, fine-grained sentiment mining and dynamic threshold warning technology, diffusion path research based on social network analysis, and empirical modification of lifecycle models. The research results indicate that big data technology significantly improves the sensitivity of crisis identification and the adaptability of strategic response, promoting the transformation of crisis management from empirical judgment to data-driven. At the same time, the study also revealed practical challenges such as data barriers, algorithmic biases, and privacy protection. This article promotes the dynamic reconstruction of classic crisis communication theory at the theoretical level and provides methodological references for enterprises to build data-driven crisis resilience systems at the practical level. Future research needs to focus on the catalytic role of generative artificial intelligence in crisis propagation, as well as the application of privacy computing technology in cross platform data collaborative governance.

Keywords: Social media, big data, brand management, crisis management.

1. Introduction

In the context of the in-depth reshaping of the communication pattern of mobile Internet, social media has evolved from a simple information-sharing platform to the "first scene" of brand crises emerging and spreading. Unlike linear communication in the traditional media era, brand crisis in the social media environment presents the characteristic of a large number of negative comments and emotional expressions erupting in a very short period of time, forming a non-linear public opinion impact. This transformation has made brand crisis no longer just a public relations problem for enterprises, but has evolved into a complex information game. With the rise of platforms such as Weibo, Xiaohongshu, and TikTok, fragmented information flows and algorithmic recommendation mechanisms have amplified the public's emotional attribution, causing brand reputation to collapse within hours. Therefore, researching the use of social media big data for brand crisis management is not only a cutting-edge topic in the intersection of marketing and communication, but also a survival resilience that enterprises must build in digital transformation.

The academic community has accumulated rich theoretical achievements in brand crisis management. The classic situational crisis communication theory (SCCT) established the analytical framework for attributing public responsibility, while the image restoration theory (IRT) provides guidance for discourse strategies after a crisis. In recent years, with the development of computational social sciences, scholars have begun to introduce natural language processing (NLP) and network science methods, making significant progress in areas such as emotion recognition and propagation path modeling. However, traditional theories such as SCCT are mostly based on static experiments

or retrospective surveys, making it difficult to explain the rapidly changing dynamic attribution process on social media and lacking theoretical reconstruction in the context of big data. The existing monitoring research mostly focuses on text content, and the research on automated parsing and emotional mapping of multimodal information, such as short videos and emoticons is still in its infancy, resulting in blind spots in early warning. Most research is limited to "describing crises" or "analyzing communication", and there are few literature that systematically discusses how to use real-time feedback generated by big data to guide enterprises in a closed-loop manner to carry out long-term reputation capital repair from the perspective of Resource Conservation Theory (COR).

This article aims to provide a systematic review of brand crisis management research based on social media big data. The research will focus on exploring the empowerment of big data technology on traditional crisis management models. This article not only enriches the theoretical connotation of crisis communication studies but also provides a new perspective for understanding public psychology and polarization of public opinion in the digital environment.

2. Research on Crisis Identification and Early Warning Based on Big Data

2.1. Collection and multimodal fusion processing of multi-source heterogeneous data

In the social media environment, the carrier of brand crisis information has achieved a leap from a single text to images, short videos, and live broadcasts. Research has shown that relying solely on text monitoring can miss over 40% of potential crisis signals. Existing research often adopts technologies such as distributed crawlers and API interface integration to obtain real-time streaming data from platforms such as Weibo and Xiaohongshu. When dealing with the challenges of data collection in the current complex network environment, the research focus should first be on breakthroughs in anti-crawling mechanisms and optimization of data cleaning methods, including avoiding anti-crawling strategies through dynamic proxies, request disguises, and other means, and preprocessing multi-source data, such as deduplication and noise reduction, to improve data quality and availability. On this basis, multimodal fusion technology has become a research hotspot in the past three years, providing a new solution path for identifying crisis content in short videos. Scholars have initially constructed an image recognition module based on CNN for detecting brand logos and illegal scenes in images, while introducing audio transcription (ASR) technology to parse semantic information in speech content [1].

2.2. Deep research on sentiment mining and semantic analysis

The traditional binary classification of "praise and criticism" is no longer able to cope with the complex public relations environment. Current research is transitioning towards "fine-grained" and "context-aware" approaches.

Transitioning from early bag-of-words models and support vector machines (SVM) to BERT, RoBERTa, and GPT series pre-trained models. These deep learning models can capture long-range dependencies in the context of social media and accurately identify hidden negative emotions such as "high-level blackness" and "irony".

Dahlberg et al. found that negative emotions such as anger, disappointment, and disgust are mediating variables for changes in consumer brand evaluation after corporate scandals occur - that is, what truly damages the brand is not the scandal itself, but the emotional reactions triggered by the scandal. Research has found that compared to simple "dissatisfaction", "disappointment" often indicates long-term brand loss, while "anger" is the core driving force for short-term crisis outbreaks.

2.3. Construction of Early Warning Model and Reshaping of Indicator System

The ultimate goal of technological empowerment lies in the realization of "warning" capabilities. Previous studies have shown that crisis warning research has shifted from the traditional empirical judgment paradigm to the algorithm-based dynamic threshold warning paradigm, which means that

the core logic of warning systems has been upgraded from "rule matching" to "anomaly discovery" [3].

Existing research has gradually condensed a set of key indicators for crisis warning on social media. One is the volume surge rate, which is used to monitor abnormal changes in the discussion volume of specific topics within a unit of time and is the most intuitive indicator for identifying signals of crisis outbreak. The sudden increase in volume not only captures the starting point of a crisis, but also reflects the secondary catalytic effect of brand response behavior on public opinion heat. Secondly, KOL/KOC engagement is an indicator that evaluates whether social nodes with high centrality are involved in topic dissemination, which directly determines whether the crisis can break through the original circle and achieve cross-group diffusion. KOL engagement is not only a predictive indicator of crisis expansion, but also a critical signal for the escalation of crisis nature from "user dissatisfaction" to "brand trust crisis". Thirdly, the degree of emotional polarization, which measures whether there is a highly consistent negative tendency in the comment section rather than diverse discussions. Research has shown that when emotions rapidly converge from diverse expressions to a single negative polarity, it often indicates that a crisis is about to enter a stage of concentrated outbreak. The above three indicators constitute a progressive warning framework from "quantitative change" (sudden increase in volume) to "structural qualitative change" (KOL intervention) and then to "emotional qualitative change" (polarization).

The traditional fixed threshold warning method has significant shortcomings in false positives and false negatives - the fixed judgment criteria are difficult to adapt to the differences in public opinion baselines of different brands, periods, and event types. In response, scholars have begun to introduce machine learning-based dynamic anomaly detection techniques. The Isolation Forest algorithm has become an important tool in the field of crisis warning due to its efficiency and interpretability in unsupervised scenarios. The core logic of this method is that outliers are often sparse and easily "isolated" in the data space, so it has a shorter path length in randomly partitioned decision trees. Zhu Weiyu et al. combined autoregressive models with isolated forest algorithms and applied them to anomaly detection in water quality monitoring time series. The results showed that this method can achieve a false alarm rate of only 9.7% when the detection rate reaches 80% [4]. This methodology can be applied to social media public opinion warning scenarios: using the brand's "daily public opinion baseline" (such as regular volume range, normal emotion distribution, and regular KOL activity) as a reference frame, using the Isolation Forest algorithm to identify abnormal observations that significantly deviate from the baseline, thereby achieving intelligent dynamic threshold adjustment [5]. In the field of financial fraud detection, Kim further proposed a stability-aware dynamic threshold strategy, which smooths threshold fluctuations through exponential weighted moving average (EWMA), significantly reducing the instability of early warning systems while maintaining detection performance. This approach has important reference value for the engineering implementation of public opinion warning systems - overly sensitive warnings can lead to "alarm fatigue", while overly slow warnings may miss the window of crisis intervention. Dynamic Time Warping (DTW) technology provides another technical path for temporal similarity matching. By calculating the optimal alignment distance between the current public opinion evolution curve and the historical crisis template, it is possible to identify development trajectories that are highly similar to typical crisis patterns in the early stages [6].

3. Research on the Evolution Mechanism of Social Media Crisis

3.1. Research on Diffusion Paths Based on Social Network Analysis (SNA)

The operational foundation of social media lies in the "connection relationship between nodes". With the help of big data technology, researchers are able to accurately depict the diffusion structure of crisis information in social networks. Opinion leaders play a crucial role in the process of crisis communication. Previous studies have shown that the spread of crises is not evenly driven by the general public but relies on a few nodes with high intermediary centrality. These nodes play a bridging

role in the flow of information, and their participation directly affects the scope and speed of crisis propagation.

Zhang Jiyang et al. conducted empirical research on the diffusion path of the Xinjiang cotton incident using social network analysis software such as Gephi or Pajek. It was found that the starting point of the crisis was not traditional official media, but rather triggered by several vertical domain bloggers with strong discourse guidance abilities. After further using the K-shell hierarchical algorithm for node-level analysis, researchers found that once opinion leaders at the core layer of the network participate in discussions, the speed of crisis diffusion will increase exponentially [7].

The value of social network analysis methods lies in their ability to intuitively reveal "who is driving the crisis", thereby providing a theoretical basis for enterprises to identify and intervene in key communication nodes and block the spread path of the crisis. However, this method also has obvious limitations, mainly manifested in the lag of analysis results. The analysis of large-scale network topology structures usually relies on offline processing of complete data collected afterwards, making it difficult to complete fast calculations during the real-time stage of crisis outbreak.

3.2. Revision of Lifecycle Model in Real-time Big Data Environment

In traditional public relations theory, the development of a crisis is usually divided into four stages: "latent outbreak diffusion decline". However, in the social media environment, algorithmic recommendations and information fragmentation significantly compress the lifecycle of crises and present new features of "multimodal evolution". The speed of crisis outbreak has significantly increased, accompanied by a long-lasting 'long tail effect'. Monitoring based on big data shows that the time window from crisis incubation to official outbreak has been shortened from the past "days" to the "hour" level.

Taking the "Tesla brake failure" incident as an example, some scholars conducted a one-year continuous tracking of the event and used time series analysis methods to revise the traditional model, ultimately proposing the "periodic pulse evolution model". This model reveals that even if the crisis has entered a superficial decline period, the algorithm recommendation mechanism may still reactivate public opinion and trigger multiple rounds of "secondary outbreaks" whenever similar new accidents occur or brand officials make tough responses, thus forming multiple volatile peaks of public opinion. The research value of this case lies in its demonstration that big data methods can dynamically correct traditional static theories and provide a reasonable explanation for why certain crises are difficult to completely resolve. However, this model also has certain limitations, mainly manifested in the failure to fully consider the impact of uncontrollable factors in platform algorithm strategies, such as manual intervention to reduce hot search behavior.

3.3. Driving mechanism of public psychology and behavioral characteristics

Technology provides a carrier for the spread of crises, while group psychology is the fundamental driving force behind the evolution of crises. Big data analysis reveals that group psychology amplifies crises through algorithmic mechanisms. Specifically, this process is mainly reflected in two aspects. The first is the conformity effect and emotional contagion. When negative public opinion reaches a high intensity, users who originally held a neutral attitude tend to express their stance through likes or shares, which in turn exacerbates emotional polarization. The second is the echo wall effect. Recommendation algorithms will actively gather users with similar negative emotions together, continuously reinforcing their inherent impression of the brand as "arrogant" or "fraudulent", and hindering the clear information released by the brand from entering the vision of these users.

4. Research on Brand Crisis Response and Management Strategies

4.1. Dynamic Response Based on Big Data

In the social media environment, the "golden 4 hours" or even "golden 1 hour" principle of public relations response has become a consensus in the industry. With the help of big data technology,

brands can flexibly adjust their response strategies based on real-time feedback from public opinion. Brands can use real-time sentiment analysis to determine the public's acceptance of the previous response, thereby achieving adaptive adjustments in tone and release frequency. This real-time feedback loop plays an important role in detecting and correcting policy deviations in a timely manner. However, it should be noted that if a brand frequently adjusts its strategy without the support of a unified underlying value system, the public can easily interpret it as "fickle" or "lacking sincerity".

4.2. Hierarchical Management and Differentiated Communication Based on User Profile

One important advantage of big data is its ability to accurately model the user groups involved in crisis discussions. Related studies have found that if a brand responds to all comments indiscriminately, it is actually more likely to further escalate conflicts. To address this issue, brands can use clustering algorithms to divide users into different levels: first, loyal defenders (Brand Evangelists), second, neutral observers (Bystanders), and third, malicious attackers (Haters/Rolls). By implementing precise content delivery to different types of users, brands can significantly reduce public relations costs while avoiding meaningless debates with malicious attackers. However, this strategy also has certain limitations. If a brand leaves too obvious traces of human operation in the process of user segmentation management, it is easy to be accused of "manipulating public opinion" or "differential treatment" by the outside world.

5. Brand reputation restoration and long-term governance

5.1. Long-term emotional monitoring and dynamic repair after crisis

The end of a crisis does not equate to the automatic restoration of brand reputation. Research has shown that reputation damage can lead to sustained 'aftershock effects', which can typically last for months or even years. Enterprises need to leverage big data technology to conduct long-term latency monitoring of public emotions in order to reconstruct emotional baselines. The key to this process is to identify the "psychological imprint" that the public has on the brand. In other words, companies need to identify which emotional dimensions have been most severely damaged.

Taking the reputation restoration research after the Samsung Note 7 battery explosion incident as an example, scholars conducted time-series sentiment analysis on Twitter data spanning two years. The research results show that through big data methods, brands can accurately locate the most severely damaged emotional dimensions, namely "safety" and "reliability". On this basis, the brand has taken two main repair measures: first, high-frequency dissemination of technology transparency information, and second, continuous push of third-party authoritative testing reports. These efforts ultimately helped the brand achieve a slow recovery in reputation value [9].

The research value of this case lies in its demonstration that quantitative indicators can provide an accurate "progress bar" for reputation repair strategies. However, this method also has limitations. Due to the existence of algorithmic recommendation mechanisms, long-term accumulated negative memories are easily reawakened. Once a similar security incident occurs in the same industry, old crisis data may be re-correlated by algorithms, causing another impact on the brand [10].

5.2. Governance Loop: From Public Opinion Data to Business Restructuring

Truly advanced crisis management is not just about calming public opinion, but about transforming the vast amount of data generated during the crisis into a knowledge graph for the enterprise, thereby guiding product iteration and service upgrades.

The core of this governance model lies in achieving data-driven business feedback. Enterprises can use natural language processing (NLP) technology to cluster and analyze tens of thousands of consumer complaints collected during crises, in order to extract inherent defects in product design from them. In October 2025, the third-party evaluation account "Dad Evaluation" released a video saying that the Huaxizi brand face cream was detected to contain Sudan IV (a chemical stain with genotoxicity and potential cancer risk), which was officially prohibited by the state. This ingredient

is suspected to come from a composite raw material group, which contains extracts of snakehead intestine, Indian toon leaves, and Moringa seed oil [11]. Huaxizi quickly removed the products involved, stating that it has launched a strict investigation into the relevant raw material supply enterprises and suspended the sale of related products to protect consumer rights. This reflects the brand's quick response strategy in the face of ingredient doubts, while also exposing the regulatory blind spot of the complexity of "composite ingredient groups" in the raw material supply chain management of the beauty industry. Some media comments have pointed out that the incident exposed the path dependence of some brands that prioritize marketing over research and development. The brand has achieved a complete governance loop from "public opinion monitoring" to "product optimization" and then to "trust reshaping". Through this big data-based organizational learning mechanism, companies can extract defensive "immunity" capabilities from crises, rather than just verbal modifications at the public relations level.

6. Conclusion

This article systematically reviews the research on brand crisis management based on social media big data. The study shows that brand crises in the social media environment have shifted from traditional linear communication to complex public opinion events with non-linear and multi-modal evolution. Its core driving force not only comes from the event itself, but also from the rapid polarization of public emotions and the amplification effect of algorithm recommendation mechanisms on negative information. Big data technology provides the possibility for crisis management to transition from "experience judgment" to "data-driven", significantly improving the sensitivity of crisis identification and the adaptability of strategic response. At the same time, research has also revealed deep-seated challenges in current practice, such as data barriers, algorithm biases, and privacy boundaries, which limit the universality and fairness of warning models and governance loops.

This article provides a methodological reference for enterprises to build a data-driven crisis resilience system. Future research should focus on the catalytic effect of generative AI on the production and dissemination speed of crisis content, especially the interference of deeply forged information on public attribution judgments. On the other hand, it is necessary to explore the application of privacy computing technologies, such as federated learning, in crisis data sharing and collaborative governance while ensuring user privacy.

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