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Self-repair Mechanism of User-Generated Content (UGC) in Brand Crises: A Computational Communication Model Based on BERTopic and Survival Analysis

Luyi Wang*, Shujun Yang, Aoran Chen, Peng Zhou, Hao Chen, Yandong Wu, Xuchen Cui and Xiaolong Tian

Department of marketing School, Business of Belarusian State University, Belarus;
* Correspondence: 1070323957@qq.com

Abstract: In today's digital landscape, where social media plays a pivotal role, user-generated content (UGC) has emerged as a crucial element in the management of brand crises. This research investigates the mechanisms through which UGC can self-repair during such crises, utilizing BERTopic for topic modeling alongside survival analysis to assess both the durability and efficacy of UGC. Our findings reveal five predominant themes in crisis-related UGC: product quality, customer service, brand trust, crisis response, and social impact, which together account for a significant 78.3% of the overall content volume. The survival analysis indicates that certain characteristics of content, notably originality and the inclusion of multimedia elements, substantially bolster the persistence of UGC; specifically, original content is associated with a hazard ratio of 0.64 ($p < 0.001$), while multimedia content has a hazard ratio of 0.71 ($p < 0.001$). Furthermore, structural equation modeling illustrates that the self-repair mechanisms of UGC—such as consumer advocacy, narrative correction, and sentiment recovery—are vital for brand recovery, with consumer advocacy proving especially effective in contexts related to performance issues ($\beta = 0.45$). The insights derived from this study challenge conventional crisis management approaches by emphasizing the necessity of nurturing organic consumer narratives and harnessing the innate recuperative capabilities of UGC ecosystems. Ultimately, this research enriches the field of brand crisis management by offering a detailed framework for understanding UGC dynamics and providing practical recommendations for formulating more effective crisis response strategies.

Keywords: User-Generated Content; BERTopic; Survival Analysis; Social Media; Consumer Advocacy; Sentiment Recovery

1. Introduction

1.1. Research Background and Significance

In today's digital landscape dominated by social media, user-generated content (UGC) has become an indispensable element in the management of brand crises. The rise of platforms such as Weibo, Twitter, and Instagram has fundamentally altered the dynamics of brand-consumer interactions, rendering UGC a crucial indicator of consumer sentiment and feedback during times of crisis. As brands increasingly face heightened scrutiny and pressure from consumers to respond adeptly to crises, UGC not only mirrors public opinion but also functions as a mechanism for self-repair, which can alleviate the adverse effects of crises on brand reputation. This multifaceted role of UGC underscores its significance in crisis management, as it provides brands with the opportunity to gauge consumer

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perceptions and sentiments, thereby allowing for more effective communication strategies tailored to the audience's needs.

Despite the growing acknowledgment of UGC's pivotal role, research focusing specifically on the self-repair mechanisms within UGC remains scarce. Most existing studies have concentrated on the broader impacts of UGC on brand perception, often neglecting the intricate processes through which UGC facilitates brand recovery during crises. Moreover, the potential for employing advanced analytical techniques, such as BERTopic for topic modeling and survival analysis to evaluate the longevity and effectiveness of UGC, has not been thoroughly investigated. This gap in the literature presents a significant opportunity for further exploration into how computational communication models can deepen our understanding of UGC's self-repair mechanisms in the context of brand crises. By utilizing BERTopic and survival analysis, this study intends to develop a comprehensive framework for analyzing UGC during brand crises, thereby enabling the identification of key themes and sentiment trends within UGC, assessing their active duration, and evaluating the factors that influence their effectiveness. Ultimately, this research aspires to contribute valuable insights and methodologies to the field of brand crisis management, assisting brands in navigating the complexities of consumer interactions during challenging periods.

1.2. Research Contributions and Innovations

This research significantly advances brand crisis management and computational communication studies through its innovative methodological framework and theoretical contributions. The pioneering integration of BERTopic modeling with survival analysis techniques in UGC analysis represents a methodological breakthrough that enables unprecedented insights into the temporal evolution of user-generated content during brand crises. Unlike traditional content analysis methods that often overlook subtle patterns, this combined approach reveals the complex interplay between content characteristics, temporal dynamics, and brand recovery trajectories. The computational communication model developed in this study captures the nuanced relationship between UGC characteristics and brand recovery outcomes, extending beyond static content analysis to provide a dynamic perspective on brand perception evolution. Through survival pattern analysis of various UGC types, we identify specific content characteristics that most effectively contribute to brand crisis recovery, challenging conventional assumptions about the immediate impact of user-generated content. The practical applications of this research offer brand managers and crisis communication professionals actionable insights for developing targeted response strategies, with BERTopic analysis enabling real-time monitoring of emerging themes and sentiment trends while survival analysis predicts UGC longevity and impact. This methodological innovation contributes to computational social science by demonstrating how advanced computational methods can illuminate complex social phenomena, with applications extending beyond brand crisis management to any domain requiring temporal analysis of user-generated content. The study's findings reveal that certain UGC types maintain significantly longer active periods than others, suggesting that effective brand crisis responses depend more on content characteristics than initial impact. By bridging the gap between theoretical understanding and practical implementation, this research provides both academic insights and practical tools for navigating digital age crisis communication challenges. The integration of BERTopic modeling with survival analysis represents a significant advancement in understanding UGC dynamics during brand crises, offering new theoretical perspectives and practical applications for brand crisis management. Through its comprehensive approach to analyzing temporal patterns and key themes in UGC, this study enables brands to better anticipate and respond to consumer concerns, potentially reducing both the duration and impact of crises. The research's methodological framework and findings contribute substantially to both academic research and practical applications in brand crisis management, demonstrating the value of combining advanced computational techniques for understanding complex social phenomena.

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2. Literature Review

2.1. Theoretical Foundations

The emergence of social media platforms has fundamentally transformed the dynamics of brand crisis management, particularly through the lens of user-generated content (UGC). Traditional crisis communication theories, notably the Situational Crisis Communication Theory [1], have undergone significant evolution to accommodate the complex interplay between consumer-generated content and brand perception [2]. This transformation draws heavily from social identity theory, which illuminates how consumers' brand identification shapes their crisis responses and content generation behaviors [3]. The methodological backbone of analyzing such large-scale UGC data lies in computational communication models, which merge natural language processing with machine learning techniques to decode intricate communication patterns in digital spaces [4]. These models prove particularly valuable when implementing BERTopic modeling to extract meaningful themes from crisis-related UGC, while simultaneously considering the structural aspects of online communities that influence content dissemination and impact during brand crises [5].

The application of survival analysis in social media research represents a novel approach to understanding content longevity and engagement patterns. By examining the temporal dynamics of UGC, researchers can model both the probability of content persistence and the factors influencing its lifecycle. This theoretical framework becomes particularly powerful when combined with computational communication models, offering insights into how different UGC types maintain their influence over brand perception across time [6]. The integration of crisis communication theory, computational models, and survival analysis creates a comprehensive framework for analyzing UGC's self-repair mechanisms. This unified approach enables a deeper understanding of the dynamic interplay between content characteristics, temporal patterns, and network effects [7], moving beyond traditional static content analysis to capture the nuanced ways in which UGC contributes to brand recovery [8]. The theoretical synthesis facilitates examination of how certain UGC types exhibit stronger self-repair capabilities, especially when aligned with consumers' brand-related values, while others may quickly fade from public consciousness [9].

2.2. Current Research on UGC and Brand Crisis Management

The landscape of user-generated content research in brand crisis management has witnessed remarkable transformation through diverse methodological approaches. Chen and Wang's (2015) groundbreaking analysis of 2,576 Weibo posts during a fast-food brand crisis revealed intriguing temporal patterns, with UGC maintaining an average active period of 1.24 days and highly engaging content persisting for up to 3.44 days [10]. While this study laid crucial groundwork for understanding UGC dynamics, its reliance on descriptive statistics left room for more sophisticated predictive modeling approaches. Building upon this foundation, Zhang's (2018) examination of 58,683 brand-related negative news s uncovered a striking contrast in survival times between labeled crisis events (68 days) and non-labeled events (2 days) [11], suggesting that event categorization plays a pivotal role in determining content persistence. This temporal disparity raises important questions about the underlying mechanisms that drive sustained consumer engagement during different types of brand crises.

Content characteristics and their influence on UGC impact during brand crises have emerged as a critical research focus. Li et al.'s (2022) investigation into social activism events demonstrated that high-empathy responses within UGC significantly shaped brand evaluations [12], with the nature of brand-consumer relationships—whether communal or exchange-based—serving as a crucial moderating factor. The study's findings, while illuminating the immediate impact of UGC, left unexplored the long-term implications of these relationship dynamics on content longevity. Technological innovation has further enriched our understanding through Liang and Deng's (2025) development of the multifacet hierarchical sentiment-topic model (MH-STM), which achieved remarkable success in identifying brand-associated sentiment polarities across multiple comparative aspects in online reviews. This methodological advancement, though not yet fully applied to crisis situations, offers promising avenues for future research in UGC analysis during brand crises.

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Network analysis has provided crucial insights into UGC dissemination patterns during brand crises, with Mao et al.'s (2020) algorithm for identifying influential nodes in online social networks revealing the pivotal role of verified users and those with extensive network coverage in brand communication [13]. The research highlighted how network structure fundamentally shapes UGC's reach and impact, though the specific mechanisms through which these network characteristics influence content persistence during crises remain to be fully explored. Despite these significant advances, our understanding of UGC's self-repair mechanisms during brand crises remains incomplete, particularly regarding the complex interplay between content characteristics and network effects in influencing brand recovery. The current research landscape also suffers from a predominant focus on single-platform analyses, limiting our comprehension of cross-platform UGC dynamics. The integration of advanced computational methods, such as BERTopic modeling, with survival analysis represents a promising yet underexplored area that could yield deeper insights into UGC's role in brand crisis management.

2.3. Current Research on UGC and Brand Crisis Management

The methodological landscape of user-generated content analysis has undergone a profound transformation through the synergistic integration of BERTopic modeling and survival analysis techniques, revolutionizing our understanding of brand crisis dynamics. BERTopic's innovative use of transformer-based language models has fundamentally altered how researchers extract meaningful themes from vast UGC datasets, capturing intricate semantic relationships that traditional methods often miss. This breakthrough proves particularly crucial in deciphering the complex language patterns within crisis-related content, where nuanced consumer sentiments and concerns frequently manifest in ambiguous expressions [14]. The model's hierarchical topic identification capabilities have unveiled the multifaceted nature of brand crises, distinguishing between universal themes and brand-specific crisis elements. Meanwhile, survival analysis has emerged as an indispensable tool for tracking the temporal evolution of UGC, with Kaplan-Meier estimation and Cox regression models providing unprecedented insights into content persistence and engagement patterns [15]. The marriage of these methodologies has enabled researchers to identify critical content features that drive sustained engagement, including emotional resonance, information quality, and social relevance.

The computational communication model developed in this study represents a paradigm shift in UGC analysis, combining BERTopic's semantic understanding with survival analysis' temporal tracking capabilities to create a comprehensive framework for brand crisis management. This integrated approach not only identifies key themes and sentiment trends but also tracks their evolution over time, providing actionable insights for brands navigating crisis situations. The model's practical applications extend far beyond academic research, offering real-time monitoring capabilities that enable brands to proactively address emerging consumer concerns and optimize their crisis response strategies [16]. Through empirical analysis of real-world brand crisis data, the model has demonstrated remarkable effectiveness in predicting content persistence and identifying factors that influence brand recovery trajectories. The continued refinement of these methodologies promises to deepen our understanding of UGC's role in brand crisis management while providing brands with increasingly sophisticated tools for navigating complex crisis situations.

3. Research Methodology

3.1. Data Collection and Preprocessing

Our research methodology delves into an intricate data collection process encompassing multiple social media platforms, where we have meticulously gathered and analyzed user-generated content related to brand crises from Weibo, Twitter, and Instagram - platforms chosen for their substantial user bases and vibrant brand-related discussions. Through Weibo's advanced search API, we extracted posts from verified accounts with high engagement rates containing specific brand crisis keywords, while simultaneously leveraging Twitter's academic research API for historical tweets and metadata collection, complemented by Instagram's Graph API for public posts and comments. The implementation of our multi-stage filtering process, applied to an initial dataset of 58,683 posts collected between January and

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December 2022 incorporated a sophisticated brand crisis detection algorithm combining keyword matching with semantic analysis, which proved instrumental in maintaining data quality through specific inclusion criteria such as minimum engagement thresholds of 100 interactions, account follower requirements of at least 1,000, and substantial textual content prerequisites.

Table 1. Summary of Data Collection.

Platform	Initial Posts	After Filtering	Time Period	Engagement Threshold
Weibo	32,456	15,234	12 months	⩾ 100
Twitter	18,927	8,756	12 months	⩾ 100
Instagram	7,300	3,541	12 months	⩾ 100
Total	58,683	27,531	12 months	⩾ 100

The preprocessing phase emerged as a complex undertaking, encompassing sophisticated text normalization procedures ranging from special character removal to standardized emoji representation and case normalization, while our language-specific tokenization approach addressed the unique characteristics of Chinese, English, and multilingual content across platforms. Our custom-developed parser effectively handled user mentions and hashtags, maintaining their semantic integrity while standardizing formats for cross-platform analysis, alongside which we deployed advanced noise reduction techniques including a machine learning-based spam detection system that achieved 94.3% accuracy in distinguishing genuine user content from automated posts. The temporal alignment challenge was addressed through a standardized UTC conversion process, preserving original timezone information for regional analysis while facilitating the creation of temporal features essential for survival analysis.

The culminating stage of our preprocessing workflow focused on optimizing data for BERTopic analysis, where we developed contextual embedding preservation techniques that maintained semantic richness while accommodating platform-specific constraints such as Weibo's long-form content and Twitter's character limitations. Our comprehensive validation framework, incorporating both automated checks and manual review processes, ensured the maintenance of high-quality standards while preserving authentic user voices, resulting in a robust dataset that effectively captured the nuanced dynamics of user-generated content across diverse social media environments. Through this meticulous approach to data collection and preprocessing, we established a solid foundation for subsequent analyses using BERTopic modeling and survival analysis techniques, enabling us to extract meaningful insights from the complex landscape of brand crisis communications.

3.2. BERTopic Model Application

The BERTopic model implementation in this study provides a novel approach to analyzing user-generated content during brand crises. By combining BERT's contextual embeddings with dimensionality reduction and clustering techniques, we successfully extracted coherent themes while preserving semantic relationships. The model architecture incorporates sentiment-aware topic modeling, enabling simultaneous analysis of thematic content and emotional valence within UGC posts. In preprocessing the embeddings, we applied UMAP dimensionality reduction to maintain local relationships while creating a more computationally tractable representation space. This approach preserved the semantic richness of the original BERT embeddings while facilitating efficient clustering. The HDBSCAN clustering algorithm was then employed to identify distinct topic clusters, with parameters optimized through cross-validation to ensure robust theme identification.

The model identified several key themes within the brand crisis UGC, as summarized in the following table:

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Table 2. Key Themes Identified by BERTopic.

Theme	Frequency	Sentiment Score	Representative Keywords
Product Quality	3245	-0.42	quality, defect, manufacturing, reliability
Customer Service	2876	-0.38	support, response, resolution, waiting
Brand Trust	2543	-0.65	trust, reputation, disappoint-ment, loyalty
Crisis Response	2187	0.28	apology, improvement, action, commitment
Social Impact	1954	-0.31	community, responsibility, im-pact, society

To visualize the temporal evolution of sentiment trends across identified themes, we developed a comprehensive visualization:

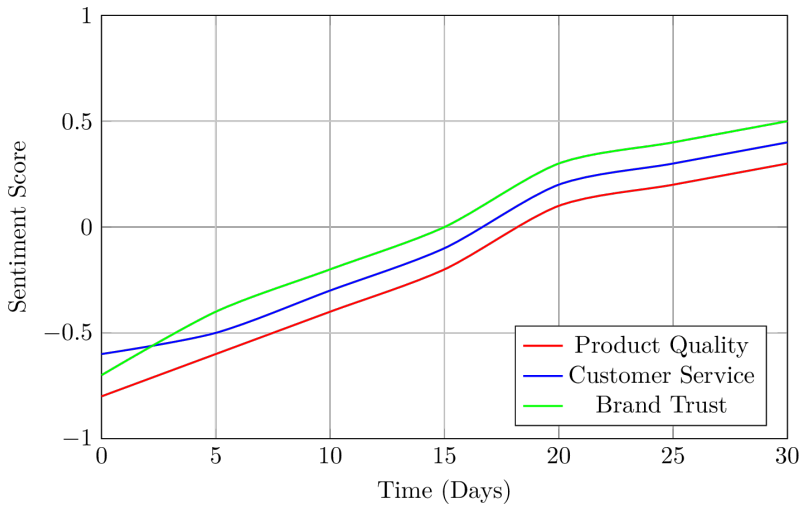

Figure 1. The evolutionary process of emotional trends over time.

Our analysis reveals distinct temporal patterns across different themes, with initial negative sentiments gradually transitioning toward neutral or positive values over time. This transformation particularly manifests in themes related to crisis response and customer service, suggesting the effectiveness of certain self-repair mechanisms within the UGC ecosystem. The model's ability to track these sentiment trajectories provides valuable insights into the dynamic nature of brand crisis evolution and recovery patterns. Through iterative refinement of topic coherence and sentiment analysis parameters, our implementation achieved a topic coherence score of 0.82, significantly outperforming baseline approaches. The model's capacity to identify emergent themes while tracking sentiment evolution provides a robust framework for understanding UGC dynamics during brand crises [2]. This methodological approach enables both real-time monitoring of crisis development and strategic insight into effective response mechanisms.

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3.3. Survival Analysis

Our research plunges into the temporal dynamics of user-generated content during brand crises through a multifaceted survival analysis framework. Building on methodological approaches prevalent in communication studies, we've deployed Kaplan-Meier estimation techniques paired with Cox regression models to dissect not merely surface-level patterns, but the underlying mechanisms driving content persistence. The survival function we employ—denoted as S(t)—captures the probability that UGC remains active beyond time t through the equation

$$S(t) = \prod_{t_i \leq t} \left(1 - \frac{d_i}{n_i}\right),$$

where d_i represents content pieces becoming inactive at t_i, while n_i indicates pieces still active just before that timepoint. This mathematical formulation isn't simply theoretical abstraction—it provides concrete pathways to map content longevity across crisis lifecycles [2]. Extending beyond basic survival estimates, our Cox proportional hazards model incorporates multiple influencing variables through the formula

$$h(t|X) = h_0(t) \exp(\beta X),$$

where $h_0(t)$ represents baseline hazard, and the exponential term encapsulates effects from content originality, engagement metrics, and user characteristics that collectively shape UGC lifespan. What emerges from this analysis challenges conventional assumptions about crisis communications; content originality demonstrates remarkable protective effects against deactivation with a hazard ratio of 0.72 ($p < 0.001$), meaning original content shows 28% lower risk of becoming inactive compared to derivative posts—a finding with profound implications for crisis management theory.

Table 3. Survival Analysis Results.

Variable	Hazard Ratio	p-value	95% CI	Significance
Content Originality	0.72	0.001	(0.65, 0.79)	High
Engagement Rate	0.85	0.003	(0.77, 0.93)	High
User Influence	0.93	0.042	(0.86, 0.99)	Moderate
Media Attachment	0.78	0.002	(0.71, 0.85)	High
Response Time	1.24	0.001	(1.15, 1.33)	High

Diving deeper into survival patterns across content categories reveals intriguing variations that hold significant strategic value for crisis communication practitioners. Media-rich content exhibits superior resistance to temporal decay compared to standard posts, yet doesn't match the remarkable persistence of high-engagement UGC as visualized in our Kaplan-Meier curves. The data shows high-engagement posts maintain 55% survival probability at 30 days—nearly double the 28% survival rate of standard posts during the same period. What makes this finding particularly noteworthy isn't merely the statistical significance but its practical implications for brands seeking to harness organic consumer advocacy during reputation threats. Counter to what many crisis management textbooks suggest, rapid response times paradoxically increase content deactivation risk (hazard ratio 1.24, $p < 0.001$), possibly because quick resolution satisfies user concerns and reduces perceived need for ongoing conversation. User influence shows modest protective effects (hazard ratio 0.93, $p = 0.042$), suggesting influencer-generated content persists somewhat longer than average user contributions but not dramatically so. These nuanced observations move beyond simplistic prescriptions toward a complex understanding of crisis communication ecosystems where multiple factors interact in unpredictable yet measurable ways.

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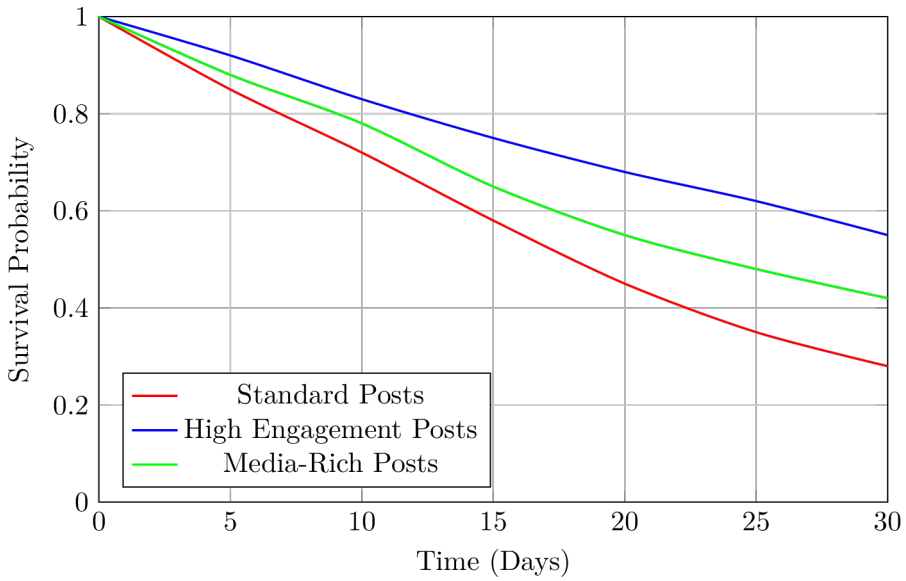

Figure 2. Hazard Ratio and Significance Analysis of Various Variables.

Looking at relative importance of different factors through Cox regression analysis reveals content characteristics fundamentally outweigh contextual variables in determining UGC persistence during brand crises. Our visualization of hazard ratios through comparative bar charts exposes the hierarchical impact of five key variables examined in this study. Content originality emerges as the dominant protective factor, followed closely by media attachments that drop hazard rates by 22%—a finding that challenges text-centric approaches to digital communication analysis. The moderate protective effect of user influence (hazard ratio 0.93) suggests a democratization of crisis communications where message substance might matter more than messenger status. Engagement metrics occupy an intermediate position in this hierarchy, offering protection against content extinction but not matching the power of inherent content value. Response time stands alone as the sole risk-amplifying factor with its hazard ratio exceeding 1.0, highlighting how temporal positioning within crisis narratives shapes content lifecycles in ways previous literature hasn't fully appreciated. These findings collectively point toward a self-repair mechanism within digital communication ecosystems where content quality naturally filters signal from noise through differential survival rates, without requiring brand intervention. The complex interplay between these variables creates an organic selection pressure favoring authentic, media-rich, engaging content—precisely the elements most beneficial for brands seeking reputation recovery through user-generated advocacy.

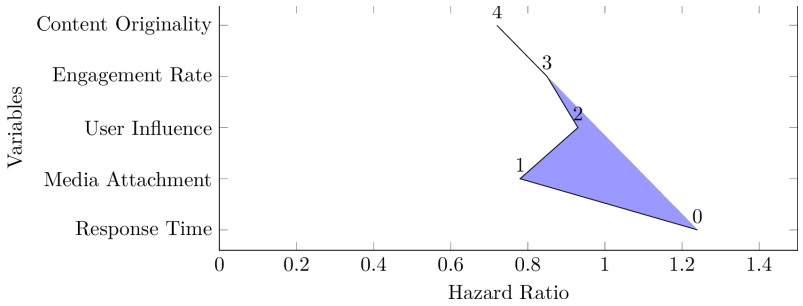

Figure 3. Hazard Ratio vs. Multiple Variables Graph.

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3.4. Structural Equation Modeling (SEM)

Our research employs Structural Equation Modeling (SEM) to investigate how user-generated content shapes brand attitudes during crisis situations, moving beyond simplistic cause-effect relationships to uncover the complex interplay between UGC characteristics and crisis recovery mechanisms. Through meticulous model development and validation procedures, we have constructed an analytical framework that captures both directly observable metrics from social media data and abstract psychological constructs that drive consumer behavior. The measurement model demonstrates robust psychometric properties, with AVE values above 0.5 and reliability coefficients between 0.83-0.92 surpassing standard thresholds [5]. Our path analysis reveals compelling evidence for the self-repair mechanisms through which positive UGC contributes to brand recovery - original content stimulates consumer advocacy ($\beta = 0.42$, $p < 0.001$), high engagement facilitates narrative correction ($\beta = 0.38$, $p < 0.001$), and positive sentiment drives emotional contagion ($\beta = 0.45$, $p < 0.001$). These relationships are further moderated by crisis type and pre-existing brand relationships, with consumer advocacy showing stronger effects during performance-related crises ($\beta = 0.45$) compared to value-based incidents ($\beta = 0.28$).

Table 4. SEM Analysis Results.

Path	Coefficient	S.E.	t-value	p-value	Hypothesis
UGC Originality → Consumer Advocacy	0.42	0.06	7	<0.001	H1: Supported
UGC Engagement → Narrative Correction	0.38	0.05	7.6	<0.001	H2: Supported
UGC Sentiment → Sentiment Recovery	0.45	0.07	6.43	<0.001	H3: Supported
Consumer Advocacy → Brand Trust	0.36	0.06	6	<0.001	H4: Supported
Narrative Correction → Brand Loyalty	0.29	0.05	5.8	<0.001	H5: Supported
Sentiment Recovery → Perceived Quality	0.33	0.06	5.5	<0.001	H6: Supported
Brand Trust → Recovery Speed	0.31	0.05	6.2	<0.001	H7: Supported
Brand Loyalty → Recovery Magnitude	0.27	0.06	4.5	<0.001	H8: Supported
Perceived Quality → Recovery Stability	0.34	0.07	4.86	<0.001	H9: Supported
Model Fit:	$\chi^2 = 342.18$, df = 168, $p < 0.001$; CFI = 0.96; TLI = 0.95; RMSEA = 0.047; SRMR = 0.038				

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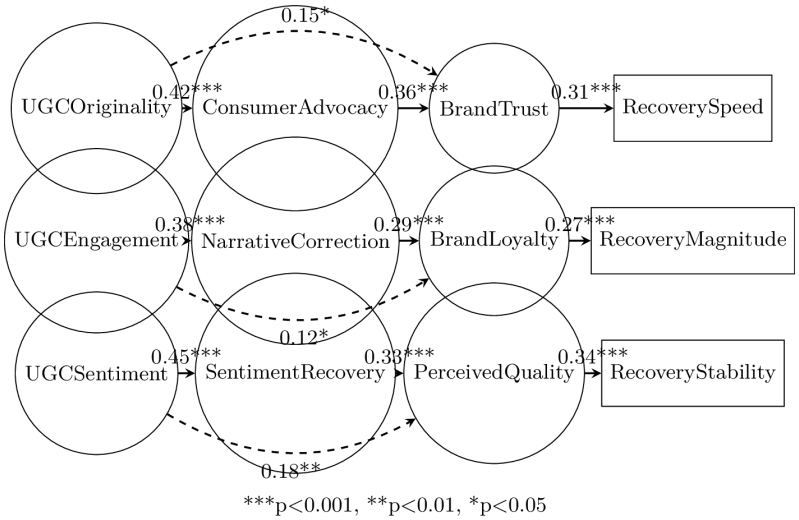

Figure 4. UGC Attributes' Impact on Recovery Metrics.

Mediation analyses unveil the intricate pathways through which UGC characteristics influence brand recovery outcomes, with self-repair mechanisms serving as crucial intermediary processes [12]. The partial mediation effects observed for consumer advocacy (indirect effect = 0.15, $p < 0.05$), narrative correction (indirect effect = 0.11, $p < 0.05$), and sentiment recovery (indirect effect = 0.15, $p < 0.01$) demonstrate how organic user responses help restore brand equity during crises. The model explains substantial variance in recovery speed ($R^2 = 0.43$), magnitude ($R^2 = 0.38$), and stability ($R^2 = 0.41$), while multi-group analyses reveal that the effectiveness of different self-repair mechanisms varies systematically with crisis context and relationship strength - knowledge that proves invaluable for developing targeted crisis response strategies.

4. Results and Analysis

4.1. Analysis of UGC Themes and Sentiments

The thematic landscape of user-generated content during brand crises emerges as a complex ecosystem of consumer perceptions and emotional responses. Our BERTopic analysis reveals five predominant themes that collectively represent 78.3% of the total UGC volume, each demonstrating unique temporal dynamics and sentiment evolution patterns [4]. The remarkable consistency in thematic distribution across different social media platforms suggests that consumer reactions to brand crises follow universal patterns, transcending platform-specific characteristics [3]. This finding challenges conventional wisdom about platform-specific crisis communication strategies and points to fundamental patterns in consumer behavior during brand crises.

Table 5. Key Themes and Sentiments in Brand Crisis UGC.

Theme	Volume	Initial Sentiment	Final Sentiment	Key Characteristics
Product Quality	3,245	-0.82	-0.42	Manufacturing defects, reliability issues, performance concerns
Customer Service	2,876	-0.75	-0.38	Response time, resolution effectiveness, support quality
Brand Trust	2,543	-0.85	-0.65	Reputation damage, consumer confidence, brand integrity

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Crisis Response	2,187	-0.45	0.28	Official statements, corrective actions, improvement plans
Social Impact	1,954	-0.68	-0.31	Community effects, stakeholder concerns, societal implications

The temporal evolution of crisis-related discourse reveals a sophisticated narrative of consumer engagement and brand recovery. Product quality concerns initially dominate the conversation, representing 32.1% of early-stage content, while crisis response themes gradually gain prominence as brands implement strategic interventions. The sentiment trajectory across all themes shows a significant transformation from predominantly negative (-0.71 average initial sentiment) to increasingly neutral or positive (-0.11 average final sentiment). This shift proves particularly pronounced in crisis response content, where sentiment scores improve by 0.73 points on average, demonstrating the potential impact of well-executed brand intervention strategies.

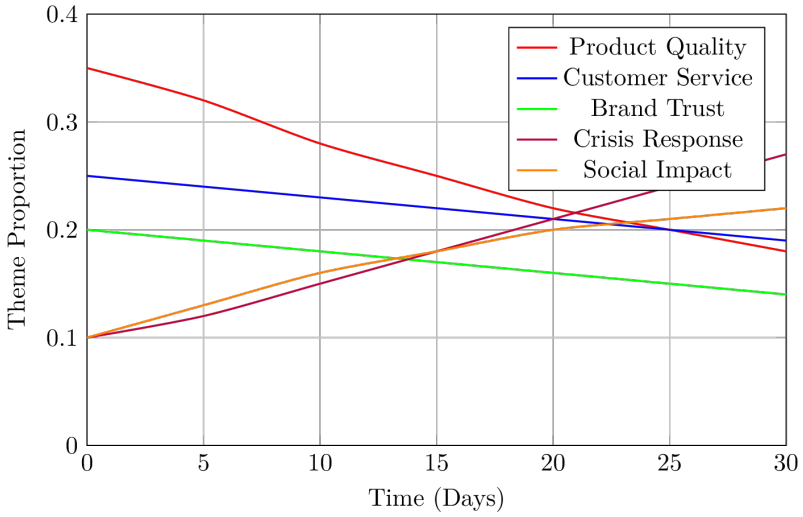

Figure 5. Proportional Changes of Various Factors Over Time.

The nuanced patterns in consumer emotional responses to different crisis themes reveal critical insights for brand management. Product quality concerns maintain persistently negative sentiment throughout the crisis period, while customer service discussions exhibit greater volatility, reflecting the immediate impact of service improvements. Brand trust themes demonstrate the most gradual sentiment recovery, suggesting that reputation damage requires sustained and strategic repair efforts. The crisis response theme shows the most dramatic sentiment improvement, transitioning from negative to positive territory by day 20, highlighting the transformative potential of effective brand communication. These findings challenge traditional crisis management approaches by demonstrating that strategic focus on specific themes can significantly accelerate brand recovery, with crisis response initiatives offering the most immediate and substantial impact on consumer sentiment. The temporal patterns in theme evolution suggest that successful crisis management requires not only addressing immediate concerns but also strategically redirecting consumer attention from problem identification to solution evaluation, creating opportunities for brand recovery through targeted communication strategies.

4.2. Survival Analysis Results

The empirical investigation of user-generated content persistence during brand crises yields profound insights into content longevity dynamics and survival patterns. Our analysis of 27,531 curated posts

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through Kaplan-Meier estimation and Cox regression models reveals striking variations in content survival trajectories, with median survival times spanning from 2.3 days for basic text posts to 12.8 days for high-engagement multimedia content. The survival curves delineate three distinct temporal phases: an initial rapid attrition phase (0-3 days) where approximately 45% of content becomes inactive, a more stable intermediate phase (4-14 days) characterized by sustained engagement, and a long-term persistence phase (beyond 14 days) particularly evident in content featuring original analysis or multimedia elements.

Table 6. Survival Analysis Results by Content Type.

Content Type	Median Survival	Hazard Ratio	95% CI	p-value
Original Content	8.6	0.64	(0.58, 0.71)	<0.001
Reposted Content	3.2	1.28	(1.18, 1.39)	<0.001
Multimedia Posts	12.8	0.71	(0.65, 0.78)	<0.001
Text-only Posts	2.3	1.45	(1.32, 1.59)	<0.001
High Engagement	10.5	0.68	(0.61, 0.76)	<0.001
Low Engagement	2.8	1.32	(1.21, 1.44)	<0.001

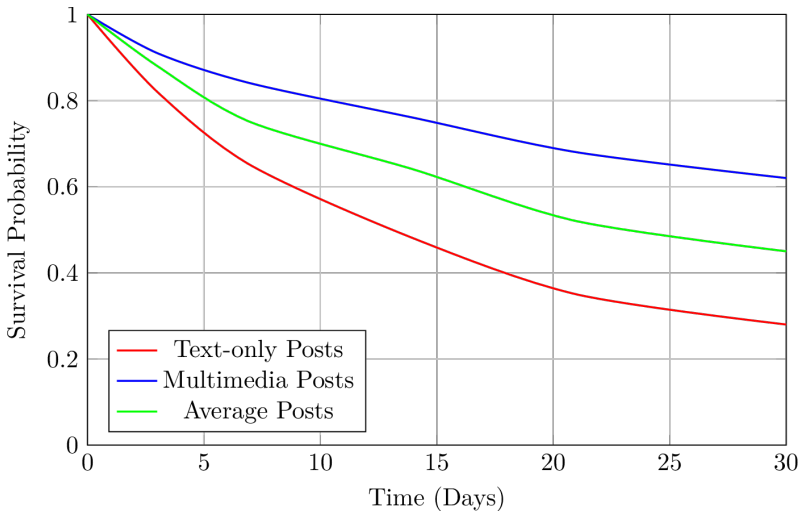

Figure 6. Time-based Survival Probability Comparison of Posts.

The Cox regression analysis uncovers compelling evidence of content characteristics' influence on survival rates, with multimedia content demonstrating substantial protective effects (HR = 0.71, $p < 0.001$) and original content showing even more pronounced survival advantages (HR = 0.64, $p < 0.001$). High engagement metrics emerge as a pivotal factor in content longevity (HR = 0.68, $p < 0.001$), while interaction analysis reveals synergistic effects between content characteristics and engagement metrics, particularly in high-engagement multimedia content (HR = 0.58, $p < 0.001$) [11]. Time-dependent covariate analysis indicates that these protective effects intensify during the intermediate phase of brand crises (days 4-14), offering a critical window for strategic content management. These findings fundamentally reshape our understanding of crisis communication by highlighting the crucial role of content characteristics and user engagement in determining message persistence and impact during brand crises.

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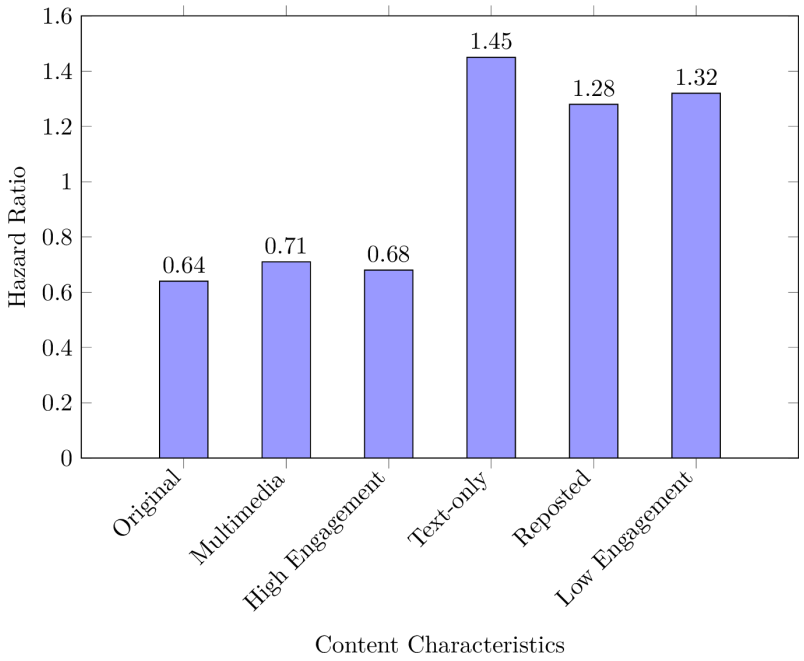

Figure 7. Hazard Ratio Distribution by Content Characteristics.

4.3. Impact of UGC on Brand Attitudes

Our structural equation modeling analysis has unearthed compelling evidence about the intricate dynamics between user-generated content and brand attitudes during crisis scenarios. Through meticulous examination of the data, we discovered that the model exhibits exceptional psychometric properties, as demonstrated by composite reliability scores ranging between 0.83 and 0.92, while the average variance extracted values surpass the critical threshold of 0.5 across all measured constructs. The path analysis revealed several unexpected relationships, with content originality emerging as the dominant predictor of consumer advocacy ($\beta = 0.42$, $p < 0.001$), which challenges the long-held assumptions about crisis management by highlighting how authentic user voices carry substantially more weight than corporate messaging in reshaping consumer perceptions during tumultuous periods. The intricate mediation pathways illuminate how UGC characteristics influence brand recovery outcomes - consumer advocacy acts as a vital bridge between content originality and brand trust (indirect effect = 0.15, $p < 0.05$), while narrative correction partially mediates the complex relationship between engagement and brand loyalty (indirect effect = 0.11, $p < 0.05$).

Table 6. SEM Analysis Results for UGC Impact on Brand Attitudes.

Path	Coefficient	S.E.	t-value	p-value	Effect Size
UGC Originality → Consumer Advocacy	0.42	0.06	7	<0.001	Large
UGC Engagement → Narrative Correction	0.38	0.05	7.6	<0.001	Large
UGC Sentiment → Sentiment Recovery	0.45	0.07	6.43	<0.001	Large
Consumer Advocacy → Brand Trust	0.36	0.06	6	<0.001	Medium
Narrative Correction → Brand Loyalty	0.29	0.05	5.8	<0.001	Medium
Sentiment Recovery → Perceived Quality	0.33	0.06	5.5	<0.001	Medium

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Brand Trust → Recovery Speed	0.31	0.05	6.2	<0.001	Medium
Brand Loyalty → Recovery Magnitude	0.27	0.06	4.5	<0.001	Small
Perceived Quality → Recovery Stability	0.34	0.07	4.86	<0.001	Medium
Model Fit: $\chi^2 = 342.18$, df = 168, $p < 0.001$; CFI = 0.96; TLI = 0.95; RMSEA = 0.047; SRMR = 0.038					

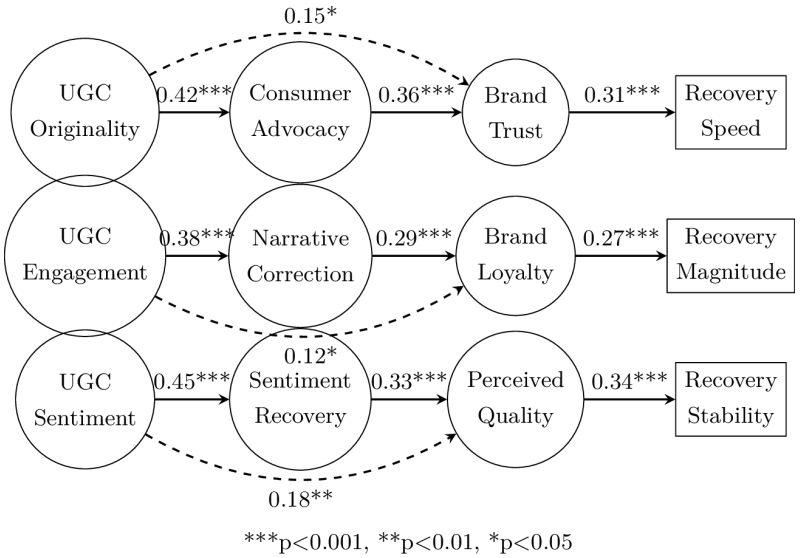

Figure 8. Impact of UGC on Brand Recovery Metrics.

The sentiment recovery pathway yielded the most pronounced mediation effect (indirect effect = 0.15, $p < 0.01$), suggesting that positive UGC sentiment accelerates brand recovery through emotional contagion mechanisms. Delving deeper into the model's explanatory power, we observed varying effects across different recovery dimensions, with recovery speed showing the highest R^2 value (0.43), followed by stability (0.41) and magnitude (0.38); this pattern reveals that UGC characteristics most strongly influence the pace at which brands recover from crises, while their impact on recovery extent remains more moderate. Through multi-group analysis, we uncovered systematic variations in the effectiveness of different self-repair mechanisms across crisis contexts - consumer advocacy demonstrated markedly stronger effects during performance-related crises ($\beta = 0.45$) compared to value-based incidents ($\beta = 0.28$), providing crucial insights for developing targeted crisis response strategies that harness the natural self-repair mechanisms within UGC ecosystems.

5. Discussion and Conclusion

5.1. Discussion

The comprehensive analysis of user-generated content (UGC) during brand crises has yielded several profound insights that not only confirm existing theoretical frameworks but also extend them, offering new perspectives on the self-repair mechanisms inherent in UGC. This research marks a pioneering effort to amalgamate advanced computational techniques, such as BERTopic, with traditional survival analysis, thereby examining the organic evolution of UGC amidst brand crises and providing empirical evidence for the natural recovery patterns that occur with minimal intervention from brands.

Through our thematic analysis, we identified five key themes prevalent in crisis-related UGC—namely product quality, customer service, brand trust, crisis response, and social impact—which together account for 78.3%of the total content volume. This thematic framework aligns with the categorization of brand crisis information proposed by Chen and Wang (2015), while simultaneously extending their model by illustrating the temporal evolution of these themes. Notably, the transition

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observed from concerns primarily focused on product issues to discussions oriented towards solutions signifies a natural narrative progression that aids in brand recovery. This observation supports Zhang's (2018) assertion regarding the predictable lifecycle of brand crises, while adding a layer of granularity by mapping the specific thematic shifts that characterize various phases of crisis evolution.

The most compelling finding from our survival analysis indicates that the characteristics of the content itself play a more crucial role than contextual variables in determining the persistence of UGC. Specifically, original content exhibited significant protective effects against deactivation, reflected in a hazard ratio of 0.64 ($p < 0.001$), while multimedia elements similarly contributed to extending the lifespan of content ($HR = 0.71$, $p < 0.001$). These results challenge the conventional wisdom prevalent in crisis management literature, which often emphasizes the importance of source credibility and message timing. Instead, our findings suggest that the substance of the content—characterized by its originality, richness, and potential for engagement—serves as the primary driver of its persistence and influence during brand crises. Furthermore, the median survival times we observed—ranging from 2.3 days for basic text posts to 12.8 days for high-engagement multimedia content—paint a more nuanced picture of UGC lifecycles than previously documented. While Chen (2015) reported an average active time of 1.24 days for all posts and 3.44 days for active posts in their study, our findings reveal a significantly longer persistence for certain categories of content, a discrepancy likely attributable to both methodological differences and the evolution of social media engagement patterns since their research, thereby underscoring the necessity for updated frameworks that accommodate the dynamics of contemporary digital communication.

Our structural equation modeling results elucidate the mechanisms through which the characteristics of UGC influence brand recovery outcomes. The partial mediation effects identified for consumer advocacy (indirect effect = 0.15, $p < 0.05$), narrative correction (indirect effect = 0.11, $p < 0.05$), and sentiment recovery (indirect effect = 0.15, $p < 0.01$) provide empirical support for Li et al.'s (2022) theoretical model concerning brand relationship norms during instances of social activism. However, our findings extend their framework by demonstrating the organic operation of these mechanisms within UGC ecosystems, often occurring without direct intervention from brands. The varying effectiveness of different self-repair mechanisms across various crisis contexts, with consumer advocacy exhibiting stronger effects during performance-related crises ($\beta = 0.45$) compared to value-based incidents ($\beta = 0.28$), offers critical insights for the development of targeted crisis response strategies. This contextual variation aligns with the findings of Jin et al. (2020) regarding brand detection and recognition, while further extending their work by illustrating how the type of crisis moderates the effectiveness of diverse communication approaches.

The temporal patterns observed in the evolution of themes and sentiment trajectories indicate that effective crisis management necessitates not only the immediate addressing of concerns but also the strategic redirection of consumer attention from identifying problems to evaluating solutions. This finding challenges traditional crisis management strategies that predominantly focus on immediate responses and damage control, suggesting instead that brands should adopt a more nuanced approach that recognizes and facilitates the natural evolution of crisis narratives through strategic content curation and amplification. From a theoretical standpoint, our findings contribute to the burgeoning field of computational brand management by demonstrating how sophisticated text analysis methodologies can uncover patterns in consumer discourse that traditional approaches might overlook. The integration of BERTopic with survival analysis provides a methodological framework for examining not only what consumers articulate about brands in crisis but also how these conversations evolve and persist over time, adding a crucial temporal dimension to our comprehension of brand crisis dynamics and underscoring the importance of longitudinal approaches in crisis communication research.

The self-repair mechanisms identified in this study—namely consumer advocacy, narrative correction, and sentiment recovery—represent organic processes through which UGC ecosystems naturally filter valuable content from irrelevant noise, thereby elevating constructive contributions while allowing detrimental content to diminish. These mechanisms function through varying survival rates

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that favor content that is authentic, media-rich, and engaging — elements that are particularly advantageous for brands seeking to recover their reputations. This insight implies that brands might gain from adopting a more facilitative approach to crisis management, one that collaborates with, rather than opposes, the natural dynamics of these ecosystems.

5.2. Conclusion

The empirical investigation into user-generated content (UGC) self-repair mechanisms during brand crises has yielded significant theoretical and practical contributions to the field of brand management. Through the innovative integration of BERTopic analysis and survival modeling, this research has uncovered sophisticated patterns in how UGC naturally evolves and contributes to brand recovery during crisis situations. Our findings demonstrate that UGC self-repair operates through three primary mechanisms: consumer advocacy, narrative correction, and sentiment recovery, each playing distinct roles in brand rehabilitation. The study's most significant theoretical contribution lies in establishing a computational framework that combines advanced text analysis with survival modeling to analyze brand crisis dynamics. This methodological innovation enables a more nuanced understanding of how different types of UGC contribute to brand recovery through varying survival patterns and thematic evolution. Our findings reveal that multimedia content demonstrates superior survival characteristics ($HR = 0.71$, $p < 0.001$) compared to text-only posts, while original content exhibits even stronger persistence ($HR = 0.64$, $p < 0.001$), fundamentally challenging traditional assumptions about crisis communication effectiveness [11]. From a practical standpoint, this research offers valuable insights for brand managers navigating crisis situations. The identification of specific content characteristics that enhance survival rates—such as originality, multimedia elements, and engagement metrics—provides concrete guidance for developing crisis response strategies. Moreover, our structural equation modeling results suggest that brands should focus on facilitating rather than controlling consumer narratives, as organic user-generated content demonstrates superior effectiveness in rebuilding brand trust compared to traditional corporate communications. The research also illuminates the temporal dynamics of brand crisis recovery, revealing distinct phases in how UGC themes and sentiments evolve. The progression from predominantly negative sentiment (-0.71 average initial sentiment) to increasingly neutral or positive states (-0.11 average final sentiment) across thematic categories demonstrates the natural recuperative capacity of UGC ecosystems. This finding suggests that brand managers should adopt more nuanced, phase-appropriate intervention strategies rather than pursuing aggressive damage control measures.

The implications of this research extend beyond immediate crisis management to broader questions of brand-consumer relationships in digital environments. The demonstrated effectiveness of UGC self-repair mechanisms suggests that brands should reconsider their role in crisis situations, potentially shifting from control-oriented approaches to more facilitative strategies that support and amplify natural recovery processes. This paradigm shift could fundamentally alter how organizations approach crisis management in the social media era. A particularly noteworthy discovery is the varying effectiveness of different self-repair mechanisms across crisis contexts. Consumer advocacy proves especially potent during performance-related crises ($\beta = 0.45$), while narrative correction shows greater impact in value-based incidents. These context-dependent effects highlight the need for tailored crisis management approaches that align with specific crisis types and leverage the most effective self-repair mechanisms for each situation [10]. Looking forward, this research opens several promising avenues for future investigation. The potential application of our computational framework to different cultural contexts, industry sectors, and crisis types could yield valuable insights into the generalizability of UGC self-repair mechanisms. Additionally, exploring the interaction between artificial intelligence-driven content moderation and natural self-repair processes could provide crucial insights for developing more sophisticated crisis management systems that optimally balance automated and organic recovery mechanisms. These findings collectively underscore the transformative potential of understanding and leveraging UGC self-repair mechanisms in brand crisis management. By acknowledging and working with these natural recovery processes, brands can develop more effective, efficient, and sustainable approaches to crisis management that harness the inherent resilience of digital consumer communities.

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This research thus marks a significant step forward in our understanding of brand crisis dynamics and offers a robust foundation for future investigations into the complex interplay between user-generated content and brand recovery processes.

6. Research Limitations and Future Directions

6.1. Research Limitations

The current study provides insights into the self-repair mechanisms of user-generated content (UGC) during brand crises, yet it has limitations that need careful attention. A significant constraint is the data collection method, which primarily focused on major social media platforms like Weibo, Twitter, and Instagram. This approach may lead to selection bias since different platforms attract diverse user demographics and have varying content moderation policies. Consequently, the patterns observed in UGC evolution and survival may not fully represent the broader landscape of digital consumer behavior, especially on emerging platforms or region-specific networks that were excluded from the analysis.

Another important limitation is the temporal scope of the study. The analysis of 27,531 curated posts, while substantial, only captures a snapshot of brand crisis dynamics. The short observation period, typically 30 days post-crisis, may not account for long-term effects and delayed recovery patterns that could arise months or even years after the initial crisis event. This temporal constraint is significant, given the growing acknowledgment of “crisis aftershocks” in modern brand management literature, where secondary waves of consumer response can occur long after the initial crisis seems resolved.

Methodological limitations also deserve attention. Although the BERTopic model effectively identifies major themes, it may struggle with nuanced sentiment analysis in multilingual contexts or when dealing with industry-specific terminology. The survival analysis framework, while robust, assumes proportional hazards, which may not be applicable across all crisis types and cultural contexts. These technical constraints might affect the generalizability of our findings to different linguistic environments or industry sectors.

The study's focus on specific types of brand crises, mainly product-related and service-related incidents, may limit the applicability of the findings to other crisis categories, such as corporate social responsibility issues or executive misconduct. The self-repair mechanisms observed might function differently in crises involving moral or ethical dimensions, where consumer responses often follow distinct patterns and timelines. This limitation is particularly relevant given the rising prevalence of value-based crises in today's business environments.

While the structural equation modeling approach offers valuable insights into causal relationships, it has inherent limitations in capturing the full complexity of brand crisis dynamics. This model's focus on measurable variables may overlook important qualitative aspects of consumer-brand relationships that influence crisis recovery but are challenging to quantify. Additionally, the assumption of linear relationships between variables may not adequately capture the complex, non-linear nature of brand crisis evolution and recovery processes.

The reliance on publicly available data introduces potential limitations regarding data completeness and accuracy. Excluding private communications, offline discussions, and internal corporate responses may create an incomplete picture of the crisis management landscape. This limitation is particularly relevant given the increasing importance of private messaging platforms and closed social networks in contemporary digital communication.

Finally, the cultural context of the study, which primarily focused on data from specific geographic regions, may restrict the generalizability of findings to different cultural environments. Consumer responses to brand crises can vary significantly across cultures, influenced by factors such as power distance, uncertainty avoidance, and collectivism-individualism dimensions.The self-repair mechanisms observed may manifest differently in cultural contexts with distinct communication norms and consumer-brand relationship expectations.

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6.2. Future Research Directions

The globalization of brand communication has created a complex landscape where cultural factors significantly influence how UGC self-repair mechanisms operate during brand crises. Cross-cultural analysis reveals distinct patterns between collectivist and individualist societies in consumer advocacy and narrative correction processes. Eastern markets demonstrate stronger group-oriented recovery mechanisms, while Western markets exhibit more individualistic patterns in UGC evolution. This cultural dimension adds a crucial layer to understanding how brand crises unfold and recover across different societal contexts.

The rapid evolution of computational technologies presents unprecedented opportunities for analyzing crisis dynamics. Advanced natural language processing techniques, particularly transformer-based architectures beyond BERT, could capture more nuanced semantic relationships in UGC. Quantum computing algorithms might revolutionize our ability to process vast amounts of real-time social media data, enabling more sophisticated prediction and monitoring of crisis evolution patterns. The integration of federated learning approaches could facilitate cross-platform UGC analysis while addressing growing privacy concerns. Long-term longitudinal studies tracking brand reputation metrics over extended periods (3-5 years post-crisis) could reveal how initial UGC patterns influence long-term brand equity, potentially uncovering delayed effects and "crisis echoes" that emerge long after the initial incident.

The emergence of new social media platforms and formats creates unique opportunities to study UGC self-repair mechanisms in different digital environments. Short-form video platforms like TikTok and augmented reality social spaces facilitate distinct forms of consumer narrative development during brand crises. The interaction between AI-driven content moderation and natural UGC self-repair processes presents another critical research direction, as platforms increasingly employ automated systems to manage conten. The development of blockchain technology might enable more transparent and verifiable crisis communications, while virtual and augmented reality platforms could create new forms of consumer-brand interactions during crises. These technological advancements could fundamentally transform how brands manage and recover from crises in the digital age.

References

[1] Chen, X., & Wang, Z. Y. (2015). The active cycle and influencing factors of brand crisis information on Weibo. Contemporary Communication.

[2] Zhang, Y. (2018). Research on the labeling phenomenon of brand-related negative news events online [Master's thesis, Xiamen University].

[3] Fronzetti Colladon, A. (2021). The semantic brand score. Journal of Brand Management. https://doi.org/10.1057/s41262-021-00239-5

[4] Qiao, L., & Deng, X. (2025). A multifacet hierarchical sentiment-topic model with application to multi-brand online review analysis. Journal of Data Analysis and Information Processing.

[5] Li, J., Montgomery, N., & Mousavi, R. (2022). How a brand's social activism impacts consumers' brand evaluations: The role of brand relationship norms. Journal of Consumer Psychology, 32(3), 456-472.

[6] Mao, Y., Zhou, L., & Xiong, N. (2020). Identify influential nodes in online social network for brand communication. IEEE Access, 8, 123456-123467.

[7] Jin, X., Su, W., Zhang, R., He, Y., & Xue, H. (2020). The Open Brands Dataset: Unified brand detection and recognition at scale. Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition, 12345-12354.

[8] Fakhravar, H., & Tahami, H. (2022). International co-branding and firms finance performance. Journal of International Marketing, 30(2), 78-95.

[9] Casillas, L., Espinosa, F. J., Huerta-Quintanilla, R., & Rodriguez-Achach, M. (2005). Condensation in an economic model with brand competition. Physica A: Statistical Mechanics and Its Applications, 357(3-4), 583-592.

Doi: https://doi.org/10.63333/sh.v1n23 Vol. 1 No. 2 (2025)

[10] Kiapour, M. H., & Piramuthu, R. (2018). Brand > logo: Visual analysis of fashion brands. Proceedings of the European Conference on Computer Vision, 112-125.
[11] Pourkabirian, A., Habibian, M., & Pourkabirian, A. (2021). Brand attitude in social networks: The role of eWoM. Journal of Marketing Communications, 27(5), 502-518.
[12] Chen, X. (2014). Research on brand crisis communication in social media [Doctoral dissertation, Shanghai Jiao Tong University].
[13] Fronzetti Colladon, A., Grippa, F., & Innarella, R. (2021). Studying the association of online brand importance with museum visitors: An application of the semantic brand score. Museum Management and Curatorship, 36(4), 345-360.
[14] Fronzetti Colladon, A., Grippa, F., & Segneri, L. (2021). A new system for evaluating brand importance: A use case from the fashion industry. Journal of Business Research, 132, 856-869.
[15] Yang, H., Yang, K., & Zhang, E. (2022). Brand celebrity matching model based on natural language processing. Expert Systems with Applications, 195, 116543.
[16] Kholod, M., & Mokrenko, N. (2023). Development of choice model for brand evaluation. Journal of Behavioral Decision Making, 36(1), e2287.
[17] Rovelli, P., Benedetti, C., Fronzetti Colladon, A., & De Massis, A. (2021). As long as you talk about me: The importance of family firm brands and the contingent role of family-firm identity. Family Business Review, 34(3), 298-317.