Estimating the crisis information coverage model in the internet communities

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Abstract

Purpose – In this study, the process of crisis information communication is viewed as a systems-based concept. An integrated and systematic three-phase model has been constructed to describe the process of crisis information coverage on the internet. By analyzing factors in the three stages that affect the coverage ratio and speed, this study aims to explore the law of information communication in this process and provide useful evidence for crisis managers to make informed decisions.

Design/methodology/approach – A complete information communication model has been constructed including the following three stages: crisis information release, crisis information diffusion and crisis information reception. The effects of important factors and variables in the model have been studied, including the crisis information release quantity, crisis information release mode, crisis information diffusion speed and crisis information obsolescence speed.

Findings – The quantitative analysis shows that crisis information release quantity and diffusion speed are positively correlated with coverage ratio; crisis information obsolescence speed is negatively correlated with coverage ratio; and crisis information release mode affects the speed of coverage but does not affect the final coverage ratio.

Originality/value – Theoretical value: from the perspective of systems thinking, a detailed, systematic and coupled information coverage model has been constructed. Application value: this study finds the most efficient methods to regulate coverage speed and final rate, knowledge of which may play an important role in guiding the practice of crisis communication management.

Keywords Internet, Diffusion, Crisis, Obsolescence, Coverage

Paper type Research paper

1. Introduction

Crisis information communication is one of the most important and difficult parts of crisis management (Wei and Zhao, 2006), as its process is notoriously complex and constantly changing. Crisis information could be any information related to the specific crisis (Wei et al., 2010) and is always disseminated to the public through various channels after a crisis.

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occurs. With the rapid development of the internet and its characteristics of rich content, quick speed, convenient retrieval, timely updating and more interactivity, information communication on the internet has completely changed the way in which the public receives information (Wei et al., 2012). Modern technology can allow each netizen to be a news publisher on the internet with low cost and high efficiency (Wei et al., 2012), especially through the emergence of social media such as microblogs and Twitter. This capability has greatly increased the complexity of information communication after a crisis and has amplified the netizens’ perception of crisis information (Oh et al., 2013; Wei et al., 2012). It is crucial to explore this dynamic process to provide guidance for crisis managers to respond appropriately to crisis events.

Numerous scholars have long recognized that the complexity of highly interdependent processes necessitates a systems approach (Marcus et al., 2010; Roome, 2011). As an important ability to understand the existence and functions of an entity (Assaraf and Orion, 2005; Evagorou et al., 2009), systems thinking has attracted increasing attention in various fields such as education (Vennix, 2005; Saxton et al., 2014), safety science (Underwood and Waterson, 2014) and supply chain management (Stadtler, 2015), and it has been confirmed to be an effective tool to analyze any complex system. Hence, a mature understanding of crisis information communication management requires studies to adopt a perspective of systems thinking that provides a discipline for seeing the whole (Mella, 2009).

Following the lead of this research, this study divides crisis information communication into three stages: crisis information release, diffusion and reception. Each of these is a subsystem involving multiple factors and influencing the other stages, accompanied by a constant change and development. After constructing this integrated crisis information coverage model, patterns of crisis information release, diffusion and reception were analyzed in detail (Figure 1).

We used efficient methods to model these three subsystems. Normal, damped exponential and fluctuating release modes were used to describe the crisis information release stage. The logistic function were used to model crisis information diffusion, and we also added the factor of information obsolescence into the crisis information receiving model.

We also studied significant factors and variables that affect crisis information coverage: the duration of crisis information release, release mode, total quantity of released information, information diffusion capacity in diffusion process, speed of information diffusion, speed of information obsolescence, total quantity of information available to the public on the internet and the public’s daily receiving information capacity.

The remainder of this article is organized as follows: Section 2 provides the literature review. Section 3 describes the crisis information coverage model. Section 4 analyzes the factors that influence the crisis information coverage ratio. Section 5 gives the implications, and Section 6 concludes the paper.
2. Literature review

Effective crisis information communication is important for handling a crisis event because timely and accurate information can not only meet the public’s rapidly increasing demand for information (Zavyalova et al., 2012) but also reduce the public’s risk perception and guard against their overreaction to the crisis itself (Wei et al., 2014). According to the protective action decision model (PADM) by Lindell and Perry (1992, 2004), the information derived from messages transmitted by social sources such as governmental authorities, news media and peers through communication channels to people at risk, plays a very important role in the evolution of these people’s perceptions (Lindell and Perry, 2012). The main goal of crisis information communication management is to facilitate compliance with protective measures and foster psychological resilience (Keselman et al., 2005). Therefore, it is critical for crisis managers to understand the dissemination rules on crisis information to ensure effective crisis communication (Yao et al., 2006). Information coverage to the public is the goal of information communication (Shannon and Weaver, 1949), but most previous studies on crisis information coverage focused on only the transmission of information in the media rather than among the public. Our study aims to compensate for the lack of research in this aspect.

3. Crisis information coverage model based on systems thinking

3.1 Three-stage crisis information coverage model

The communication of crisis information, a complete process, includes information release, diffusion through various channels and interaction between releasers and receivers. According to the Shannon and Weaver’s (1949) information communication theories, information transmission aims to deliver information to the target audience. Therefore, studying the crisis information coverage ratio is defined as the proportion of those who received crisis information.

In the existing research, information release and diffusion have not been strictly differentiated and defined. Some studies overlooked the information release process and only proposed some information spreading models from different perspectives, such as logistic model and SIR model (Wei et al., 2012; Kawachia et al., 2008). And information release and diffusion were not distinguished. In this study, we posit that crisis information communication is a systems-based concept and crisis information release or diffusion process cannot be considered as an independent part. The crisis information communication process is divided into three mutually coupled stages: crisis information release, diffusion and reception. These three stages comprise the complete process of crisis information communication and coverage.

3.2 Crisis information release model

Previous studies have verified the applicability and rationality of three release modes: normal distribution, damped exponential distribution and fluctuation can be used to describe most of the crisis information release modes (Wei et al., 2009).

Based on these three release modes, the quantity of crisis information released every day after the crisis event happened is described as a function that includes time, release modes and other factors. The function is presented as follows:

\[ N_i = f(i, length, mode, suminfo) \]  

Here, \( i \) represents the number of days after the crisis, \( length \) represents the duration of crisis information release, \( mode \) represents the crisis information release mode (normal, damped or fluctuating) and \( suminfo \) represents the total quantity of crisis information release. This function can be used to describe the information release of any crisis event.
3.3 Crisis information diffusion model
In early 1992, Egghe and Rao (1992) pointed out that the research information indicates S-shaped growth for the fields of sciences and the humanities. Combined with SIR model, the diffusion of crisis information on the internet can be considered to present S-shaped growth.

To describe the diffusion model of crisis information, the logistic function can be used, and its usability on crisis information diffusion has been verified (Wei et al., 2012). The function is used to describe the total quantity of crisis information that is presented and the daily growth of crisis information. That can be expressed as follows:

\[
M_j = \frac{S}{1 + ce^{-jr}}, \quad c = \frac{S - M_0}{M_0}
\]

The daily growth of crisis information can be expressed as:

\[
D_j = M_j - M_{j-1} = \frac{S}{1 + ce^{-jr}} - \frac{S}{1 + ce^{-r(j-1)}}, \quad c = \frac{S - M_0}{M_0}
\]

In equation (2) and (3), \(S\) represents the extent of diffusion, that is, the maximum diffusion quantity of one piece of crisis information; \(r\) represents the increase ratio of the crisis information quantity; \(j\) represents the number of days after the crisis information release; and \(M_0\) represents the scale of the crisis information in the initial state, which is considered as 1 in this study.

After a crisis, varying quantities of crisis information are released every day, and each piece of crisis information will achieve a certain amount of diffusion. The aggregation of these diffusion amounts is the total quantity of all the crisis information about the crisis.

According to the crisis information release and diffusion models, the total diffusion quantity of a crisis event’s information (\(T_k\)) at time \(t\) is described as follows:

\[
T_k = \sum_{j=t}^{k} \sum_{i=1}^{k} N_iD_j
\]

3.4 Crisis information reception model
The ultimate receptor of crisis information is the public. Thus, the final result of crisis information communication can be measured by the coverage ratio of the public that is informed of the crisis after the diffusion. However, in this transformation, two core factors should be considered: availability of information itself and the capacity of the public to receive information.

For availability of information, we mainly focused on network information obsolescence. In recent years, with the development of research on Webometrics, network information obsolescence has become a hot topic (Markwell and Brooks, 2003; Bugeja and Dimitrova, 2006). Network information obsolescence describes the accessibility of academic journal citation or network information. After a certain time, a greater proportion of inaccessible Web pages usually means faster aging of information. In the research on literature and network information obsolescence, the methods that scholars use are consistent, and they often measure the speed of information obsolescence by introducing “half-life”, “cited half-life” and “price index”. Internet information has a strong timeliness; thus, its life cycle and half-life are short (Bugeja and Dimitrova, 2006). The half-life of internet news and microblogs are shorter than four and two days, respectively (Ju, 2010).

In this study, we considered information obsolescence and used an information failure factor \(\alpha\) to measure it. The factor denotes to what extent the crisis information disseminated
on the internet will be submerged by new information as time goes on. At the initial time, \( \alpha = 1 \), and as time progresses, the factor will gradually tend to become 0. This change should follow Belnap’s (1958) negative exponential function model, \( \alpha(t) = be^{-at} \), and in this work, it is reasonable to assume the coefficient \( b \) is equal to 1. After considering the influence of information obsolescence, the \( T_k \) in equation (4) should be revised to \( T_k' \), denoting the quantity of information that the public can receive at day \( k \):

\[
T_k' = \sum_{j=i}^{k} \sum_{i=1}^{k} N_i D_j \alpha_{k-j}
\]

(5)

Meanwhile, other high-profile events may also be reported on the internet, and although a certain quantity of information reaches \( T_k' \), not all the information can be eventually received by the public. The probability of the public receiving information that is only about the crisis event can be expressed as:

\[
R_k = \frac{T_k'}{total}
\]

(6)

where \( total \) is the total quantity of internet information available to the public that day.

Another important factor influencing crisis information coverage among the public is their information reception capacity. The quantity of information that any member of the public can receive and absorb in a day is also limited because of limited time and energy. We assume that the public’s daily information reception capacity is \( m \). Thus, the probability that the public receives the crisis event information at day \( k \) can be expressed as:

\[
p_k = 1 - (1 - R_k)^m = 1 - \left( 1 - \frac{T_k'}{total} \right)^m
\]

(7)

Based on the assumption that the public is homogeneous, the probability of the public receiving the crisis event information at day \( k \) can also be viewed as the coverage ratio of the crisis event information among the public. After the evaluation function of the daily information coverage ratio is constructed, the daily total coverage ratio is also identified. We hypothesize that the processes of crisis information that cover the public every day are independent of each other. Thus, the total coverage ratio of crisis event information at day \( n \) can be expressed as \( C_n \):

\[
c_n = 1 - \prod_{k=1}^{n} (1 - p_k) = 1 - \prod_{k=1}^{n} \left( 1 - \frac{T_k'}{total} \right)^m = 1 - \prod_{k=1}^{n} \left( 1 - \sum_{i=1}^{k} \sum_{j=i}^{k} N_i D_j \alpha_{k-j} \right)^m
\]

\[
N_i = f(i, \text{length}, \text{mode}, \text{suminfo})
\]

\[
D_j = \begin{cases} 
S & j = i \\
\frac{1}{1 + (S - 1)e^{-r(j-i)}} - \frac{S}{1 + (S - 1)e^{-r(j-i-1)}} & j > i 
\end{cases}
\]

\[
\alpha_{k-j} = e^{-a(k-j)}
\]

(8)

4. Analysis of influencing factors

According to the crisis information coverage model above, the following factors may influence crisis information coverage: duration of crisis information release (\( \text{length} \)), release
mode \((\text{模式})\), total quantity of releasing information \((\text{suminfo})\), information diffusion capacity in the diffusion process \((S)\), speed of information diffusion \((r)\), speed of information obsolescence \((\alpha)\), total quantity of information available to the public on the internet \((\text{total})\) and public’s daily receiving information capacity \((m)\).

### 4.1 Sample case for the crisis information coverage model

To use this crisis information coverage model, we need to set reasonable hypotheses and parameters of the three variables of the modes, including information release \((\text{length}, \text{mode}, \text{and suminfo})\), information diffusion \((S, r)\) and information reception \((\alpha, \text{total} \text{and } m)\).

In our sample case, the crisis event information release model was set as the normal distribution release mode. In this sample case, the quantity of crisis information from Day 0 to Day 10 was set as follows: 10, 20, 55, 135, 180, 200, 180, 135, 55, 20 and 10. The total quantity of information released was set as \(\text{suminfo} = 1,000\).

According to research about constructing crisis information coverage models, the diffusion mode of crisis information can be measured by the logistic model. In our crisis information coverage model, we do not consider the difference of the speed of information diffusion, and we deem that the focus problem of information around the same event is very close and that different pieces of crisis information have similar diffusion rules. Using these assumptions about the diffusion characteristics, we set the parameters of our diffusion model to \(S = 1,000\), \(r = 4\).

Related research showed that the half-life of Web news is usually between one and four days. Owing to the strong timeliness of crisis information, we conclude that the aging speed of such information and Web information should be in the same order of magnitude. Thus, the half-life of Web crisis information can be set to five days and Belnap’s (1958) negative exponential function model can be accordingly expressed as \(\alpha(t) = e^{-\alpha t}\), \(\alpha = 0.15\). Based on this formula, we can measure the crisis information failure factor \(\alpha\). The total information on the internet that the public can receive will be expressed as \(\text{total} = 100000000000 \left(10^{11}\right)\), and the daily information capacity of the public is standardized to \(m = 100\). Put simply, we assume that, in any one day, the public can absorb only one billionth \((10^{-9})\) of the internet information available.

The coverage ratio of crisis information has an S-shaped growth form. The daily release quantity gradually grows at the beginning of the communication, but the coverage ratio grows slowly owing to the limited public in contact with such information. After the daily release quantity of crisis information reaches a peak, the growth of the coverage ratio starts to accelerate because of diffusion by the public. At the end of the crisis information release, the growth speed of the coverage ratio will also slow down, and the coverage ratio will become gradually stable. In this case, the coverage ratio stabilized on the 30th day after the event occurred and reached 6.596 per cent on the 50th day.

### 4.2 Influence of each crisis information release model variable on the information coverage ratio

At the crisis information release stage, the duration \((\text{length})\), mode \((\text{mode})\) and total quantity of the crisis information release \((\text{suminfo})\) all have an influence on the crisis information coverage ratio.

In our sample cases, the release duration \((\text{length})\) is shortened to five days and extended to 20 days, but the mode \((\text{mode})\) and total quantity of information release \((\text{suminfo})\) remain unchanged. We then compared the results of the three cases. Figure 2(a) shows that we find that the information coverage ratio with a duration of five days is always higher than that with a duration of ten days, and it is also higher than that with a duration of 20 days. For the
Figure 2. Influence of each crisis information release model variables on the information coverage ratio.

(a) The information release duration influence on coverage ratio
(b) The information release modes influence on coverage ratio
(c) The total quantity of information release influence on coverage ratio
(d) The multiple of the total quantity of the crisis information release
final coverage ratio after the observation period (the 50th day), the results of the three cases are 6.967, 6.596 and 6.347 per cent.

To study the influence of the crisis information release mode (mode), three release modes are selected for comparison. In addition to the sample case of the normal distribution release mode, we also constructed a case of damped exponential distribution release mode and adopted ten randomly generated cases of fluctuating release mode. In the contrast of the 12 cases, the duration (length), total quantity of the information release (suminfo) and other hypotheses are all fixed, so the only difference exists in the release mode. Figure 2(b) shows the result of calculating the information coverage ratio.

We can find that the crisis information coverage ratio for the fluctuating release mode is always lower than that for the damped exponential distribution release mode, whereas the crisis information coverage ratio for the fluctuating mode is lower than that for the damped exponential mode not only in the initial stage but also in the later stage of the communication. Some results using the fluctuating mode exceed those for the damped exponential mode. To explore the relationship between the total quantity of the crisis information release (suminfo) and coverage ratio, this section chose five cases for comparison, and the crisis information release mode (mode) of the five cases is the same (i.e. the normal mode).

However, the total quantity of the crisis information release (suminfo) in each case is different, and is 1/10, 1/2, 1, 2 and 10 times the total amount (1,000); all other variables are the same. From the results of the coverage ratio change, as shown in Figure 2(c), we find that the different total quantity of the crisis information release (suminfo) has a minimal influence on the shape of the coverage ratio curve, and the five curves are all S-shaped; the only difference exists in the level of the coverage ratio that eventually reached a steady state. After an observation period of 50 days, the crisis information coverage ratios of the five cases account for 0.725, 3.379, 6.596, 12.714 and 49.237 per cent. Obviously, under the same crisis information release mode (mode), with the increase of the total quantity of the crisis information release (suminfo), the coverage ratio of the crisis event will also increase, which can be easily derived from the crisis information coverage model. Figure 2(d) shows the relationship between the different total quantities of the crisis information release (represented by the different multiples of the total quantity of the crisis information release) and eventually, the crisis information coverage ratio. We find that increasing the total quantity of the crisis information release (suminfo) can indeed improve the crisis information coverage ratio.

Even in the situation in which the total quantity of crisis information release is very high, the crisis information coverage ratio can be enhanced to 100 per cent. Thus, when the total quantity scale of the crisis information release is small, increasing the total quantity of the crisis information release can significantly improve the coverage ratio. However, with the increase of the total quantity scale of the crisis information release, improvement in the effectiveness of the coverage ratio will continuously decrease through an increase in the total quantity of the crisis information release.

4.3 Influence of each crisis information diffusion model variable on information coverage ratio
According to the crisis information coverage model, the maximum diffusion quantity of one piece of information (S) and information diffusion speed (r) can influence information coverage ratio in the crisis information diffusion stage. To study these influences, we adopt a similar method as was used in the former section. Then, we explore the influence of the two factors by using the five cases.

To study the influence of maximum diffusion quantity of one piece of information (S), we chose five cases in which S is set to 1/10, 1/2, 1, 2 and 10 times the original sample case. Figure 3(a) shows the information coverage ratio for the five cases. For the different
Figure 3. Influence of each crisis information diffusion model variable on the information coverage ratio.
diffusion quantities of one piece of information, the curves of the crisis information coverage ratio retain the original tendency, but the crisis information coverage speed is significantly different. Thus, the faster the diffusion speed, the faster the crisis information coverage speed. Figure 3(b) shows the relationship between the maximum diffusion quantity of one piece of information and the final coverage ratio. We find that if the information diffusion quantity is large enough, the final coverage ratio can reach 100 per cent.

Adopting the similar research method to study the influence of information diffusion speed, the $r$ in the five cases was set to $1/10, 1/2, 1, 2$ and $10$ times of the sample case. Figure 3(c) shows the corresponding information coverage ratio, and Figure 3(d) presents the relationship between the final coverage ratio and the information diffusion speed ($r$). Increasing the crisis information diffusion speed can indeed improve the coverage ratio, but after the crisis diffusion speed reaches a certain degree, the final coverage ratio also reaches a limit (in this case, the limit value is 6.596 per cent), and increasing the diffusion speed does not make sense because of the absence of growth of the coverage ratio. Thus, in this case, we should consider other measures to increase the crisis information coverage ratio.

4.4 Influence of each crisis information reception model variable on the information coverage ratio

According to the crisis information coverage model, the information obsolescence speed or information failure factor ($\alpha$), the total quantity of information that the public can receive on the Internet ($total$), and the public’s daily information reception capacity ($m$) can influence information coverage ratio in the information reception stage.

We can study the influence of information obsolescence on the coverage ratio by controlling $\alpha$, as shown in Figure 4(a) and 4(b). We find that information obsolescence speed ($\alpha$) has a negative influence on coverage ratio, and a slowdown of information obsolescence can result in an increase of coverage ratio. However, this increase has a certain limit because even if the obsolescence speed was reduced to 0, the coverage ratio in the observation period would not reach 100 per cent. Meanwhile, the increase of obsolescence speed has also led to a decline of the coverage ratio, but it did not drop to 0. A form of convex function is present; no simple linear relationship exists between the obsolescence speed and final coverage ratio.

As Figure 4(a) and 4(b) shows, the greater the total quantity of Web information received by the public ($total$), the smaller the coverage ratio is. The large amount of receivable Web information will distract the public’s attention, which will lead to the transfer of public focus and finally result in a drop in the coverage ratio. After the quantity of the Internet information increases to a certain degree, the information coverage ratio of such an event will tend to become 0. On the contrary, if the total Web information were reduced to contain only the information of the crisis event, the final coverage ratio would reach 100 per cent.

Considering the public’s daily information reception capacity, we propose that the more daily information received by the public, the greater the coverage ratio will be. As Figure 4(a) and 4(b) shows, we find that the public’s information capacity has a significant influence on the coverage ratio; with diminishing public information capacity, the coverage ratio will approach 0, but when the public information capacity is large enough, the coverage ratio will tend to become 100 per cent.

5. Implication

5.1 Control strategy of crisis information management

The objective of crisis information management is to regulate information coverage. This is done by specifically regulating the coverage rate to make the information cover the most people or reducing the time to pass crisis information to more people as quickly as possible.
Figure 4. Influence of each crisis information reception model variable on the information coverage ratio.
The most efficient method to increase the final coverage ratio is increasing the crisis information release quantity. Decreasing the crisis information obsolescence speed, crisis information diffusion speed and release mode is a poor choice because of the limited effects. To decrease the final coverage ratio, the order of adjustment is as follows: decreasing crisis information release quantity > accelerating crisis information obsolescence speed > decreasing crisis information diffusion speed = adjusting crisis information release mode.

To improve the increasing speed of crisis information coverage ratio, the first choice is to adjust the crisis information release quantity, the second is to adjust crisis information obsolescence speed (in the middle and late periods of communication) and release mode (in a prior period) and the last is to adjust the crisis information diffusion speed. In addition, the appendices summarize positive and negative regulation and control measures for the factors that can be controlled.

5.2 Methods of crisis information management
Based on the above findings, this study reveals specific methods of crisis information management from four aspects: total amount, release model, diffusion model and obsolescence speed of crisis information. For each of these methods, the regulation direction can be either positive or negative.

First, to improve the information transparency, the government and other information authorities in the crisis can constantly update the information of the crisis progress through the official website and social media to increase the public understanding of the crisis event. In addition to information release about the crisis progress, rumors should be controlled to avoid misleading the public. For example, the Rob salt affair after the Fukushima nuclear leak resulted from the internet rumor that iodized salt is an antidote for radiation, misinformation which should be monitored by the government and clarified in a timely way.

Second, regulation of the crisis information release is challenging for crisis managers. Aside from some special sorts of crises (e.g. mine accidents, nuclear leaks) in which the government can cordon off the area and publish information uniformly, in most crises, the various stakeholders (i.e. affected groups, news media, the government and so on), will publish different crisis information. In the face of this complex information environment, crisis managers should choose the right release model carefully.

Third, whether it is manmade or a random event, the sphere of influence and loss level of the crisis will affect the dissemination rate of crisis information. To improve the dissemination speed, the form of crisis information should be taken seriously, such as the development of more attractive information for the crisis information: giving accurate and detailed description of the events in the crisis information and adding pictures, audio, video and other forms of multimedia. However, the dissemination speed and coverage ratio of rumors should be controlled strictly and the rumors that have been discovered should be quickly identified so the public can find the refutation of the false information when they see the information for the first time.

Lastly, although there is no direct and intuitive measure of crisis information obsolescence speed, crisis managers can regulate crisis information obsolescence speed through specific methods. Some crisis information will affect the reputation of the government, enterprises and individuals, and so these stakeholders have a stronger desire to accelerate the obsolescence process. The methods to do so can be considered from two aspects. On the one hand, the crisis information should be deleted or hidden over time, such as through the deletion of relevant news reports or related microblogging, and withdrawing the relevant news information from the main page of news website. On the other hand, crisis managers can release an abundance of other information to dilute the primary information
by adopting information ocean tactics. Public focus can be transferred and the difficulty of capturing this information will be increased.

6. Conclusion
Considering the entire process of information communication using the systems thinking perspective, this study developed a crisis information coverage model in three stages: information release, information diffusion and information reception. The crisis information coverage ratio was chosen as an indicator of the crisis information communication result.

The role of four factors (i.e. total amount, release model, diffusion model and obsolescence speed of crisis information) is analyzed in the three stages of the crisis information coverage model. Using the simulation case method, we set a sample case, adjusted the parameters of factors separately, and found the variation trend of the coverage accordingly.

In the crisis information release stage, keeping the total quantity of the crisis information release unchanged and reducing the duration of crisis information release can effectively improve the speed of the coverage ratio, but it has a minimal influence on the final coverage ratio. Moreover, the coverage ratio under the normal distribution release mode is always lower than that under the damped exponential distribution release mode. The coverage ratio under the fluctuating crisis information release mode is lower than that under the damped exponential mode only in the initial stage of dissemination but can surpass it at the end stage of dissemination, and the influence of release mode on the final coverage ratio is still limited. In addition, increasing the total quantity of the crisis information release can significantly enhance the coverage ratio, even enough to reach 100 per cent.

In the crisis information diffusion stage, both the maximum diffusion quantity of one piece of information and information diffusion speed have a positive influence on the coverage ratio, but only when the maximum diffusion quantity of one piece of information is large enough can the coverage ratio be enhanced to nearly 100 per cent. In contrast, the influence of information diffusion speed on the final coverage ratio is very limited.

In the crisis receiving stage, both the information obsolescence speed and the total quantity of Web information that the public can receive have a negative influence on the coverage ratio, whereas the public's daily information reception capacity has a positive influence on the coverage ratio. However, the increase or decrease in information obsolescence speed cannot enhance the coverage ratio to 100 per cent or reduce it to 0 during the observation period. Thus, from the perspective of influence degree, the latter two factors may play more important roles.

Although this study focuses on the study of mathematical models, finds useful conclusions and results in meaningful management guidance by the study of mathematical models, it lacks related empirical research. That is the main limitation of this study and future study should focus attention on internet media and verify the law of crisis information release, diffusion and reception with empirical evidence.

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