

Visual Characteristics Analysis of ‘Public Interest Animation’ for the Promotion of a Safe Society - Focused on a Case Study of Self-Produced Campaign Animation -

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Abstract

This paper explores how visual research in animation applies analogy and metaphor to depict safety theories, particularly through Heinrich’s Domino Theory (1931), Reason’s Swiss Cheese Model(1990), and Rasmussen’s Acci-map approach(1997). These models visually represent accident causation and organizational decision-making, aiding in understanding complex safety concepts. The study also assesses the use of these strategies in designing campaign animations to improve safety awareness, highlighting their role in public interest communications.

Key words: visual research, visualization for safety research, analogy and metaphor, acci-map approach, campaign animation

I. Introduction

From the 1930s to the 1990s, safety science has utilized visualization strategies such as diagrams to elucidate core concepts of theories and models for accident cause analysis (Le Coze and Reiman, 2023). These strategies extended the understanding of accident causation beyond mere human factors to a systemic integration of internal or latent factors with external influences, organizational processes, force dynamics, and decision-making (Swuste, et al., 2023:12-13). This approach transcended the simplistic causal relationships attributed to individual or group errors, instead interpreting human actions and decisions within the broader context of unstable market and capital-centric systems through a social science lens, particularly from the perspective of human factors and cognitive systems engineering. The visual evidence necessary for such analysis is found in safety theories related to Herbert William Heinrich's Domino Model (1931), James Reason's Swiss Cheese Model (1990), and Jens Rasmussen's Acci-map Diagram (1997) (ibid). These visual strategies commonly involve analogy and metaphor, which, along with visual symbols like arrows, illustrate the correlations and causal relationships between accident factors (Gentner, et. al., 2001:199-253). Therefore, this paper explores how analogy and metaphor-based visualization strategies have been employed in significant accident theories and models from a visual research perspective (Gray and Malins, 2004). Furthermore, it investigates how these strategies are reflected and utilized in the production of contemporary motion graphics-style public interest campaign animations. To this end, a self-produced YouTube long-form campaign animation aimed at enhancing safety awareness is designated as a case study to examine its key visual characteristics.

II. Theoretical Discussions

1. Visualization Strategies for Safety Theory-Related Accident Models

Visualization in Safety Theory Accident Models Safety research diagrams, focusing on accident processes and scenarios, illustrate the systemic flow of decision-making, combining organizational internal and external factors (Swuste, et al., 2023:13). They provide a visual basis for analyzing accidents within complex socio-technical systems, extending beyond human factors (Rasmussen, 1997:183-217). Heinrich's Domino Theory, Reason's Swiss Cheese Model, and Rasmussen's Acci-map employ analogy and metaphor to make abstract safety concepts visually comprehensible (Coopmans, et al., 2014). Heinrich's model uses the domino effect to depict accident causation, suggesting that stopping one block can prevent the chain of events leading to an accident (Heinrich, 1931). Reason's model uses Swiss cheese slices to represent defense mechanisms, with holes signifying system flaws that, when aligned, result in accidents (Reason, 1990). Rasmussen's approach analyzes accident causes across system levels, graphically representing the interplay of various factors, including organizational and social influences (Rasmussen, 1997).

These models, through analogy and metaphor, simplify complex safety concepts for broader understanding and recall. Such strategies are vital for safety management and can be applied to educational materials and campaign animations to promote safety awareness (Swuste, et al., 2023:10-13).

2. Visual Characteristics Analysis through a Case Study of Analogy and Metaphor-Based Campaign Animation

Turning diagrams into motion graphics campaign animations makes complex safety theories accessible. Heinrich's Domino Model, for instance, can highlight the sequential nature of accidents through animation (Heinrich, 1931). Reason's Swiss Cheese Model dynamically illustrates systemic vulnerabilities, and Rasmussen's Acci-map simplifies understanding of accidents in socio-technical systems (Rasmussen, 1997).

The study's campaign animation on the Sewol ferry disaster, based on the Acci-map, organizes events across organizations to visualize the intricate causes of the accident. It emphasizes that such disasters stem from complex interactions among organizational players, not just individual errors.

From a visual research perspective, the visual characteristics of the AcciMap-based public interest campaign animation can be summarized as follows:

- 1) Analogy for depicting actual events and metaphor for invisible processes, clarifying system structures and relationships.
- 2) Sequential or simultaneous event portrayal to simplify complex information into a coherent narrative.
- 3) Emphasizing key messages with motion and editing to capture audience attention.
- 4) Using audiovisual elements to evoke emotional responses and enhance message empathy.
- 5) Visual consistency, like typography and color, to maintain brand credibility and engage viewers.

III. Issues and Limitations

Public interest campaign animations show potential as vital tools for enhancing safety awareness and preventing

accidents. However, they face limitations and challenges. Firstly, while Acci-map diagrams display complex elements, their visual reproduction and simplification into a coherent narrative can overly simplify complex safety accident theories and models. Secondly, campaign animations must be examined not only visually but also content-wise, necessitating an exploration of semiotics and semantics, as both analogy and metaphor are based on factual information. Thirdly, there is a lack of empirical data to measure the impact and influence of campaign animations, particularly in changing pre-existing safety-related misconceptions and inducing behavioral change, as the process of audience reception, cognitive change, and action is complex.

IV. Conclusions

To This paper has investigated visualization strategies for theories and models analyzing the causes of accidents in safety science. It examined how visual strategies using analogy and metaphor have been applied to Heinrich's Domino Model, Reason's Swiss Cheese Model, and Rasmussen's Acci-map Diagram. Furthermore, a case study explored how these visual representations are applied in the production of public interest campaign animations to enhance safety consciousness. However, when these visualization strategies are applied to campaign animations, they risk oversimplifying complex theories and models and may not fully reflect the intricacies of actual accidents. Additionally, there are limitations in empirically measuring the effectiveness of campaign animations. Therefore, the production and utilization of campaign animations should acknowledge these limitations and consider more sophisticated visualization strategies and content depth. This approach can maximize the potential of campaign animations as effective communication tools for raising safety awareness and preventing accidents.

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Comparative Study on Multi-Level Information Needs of Emergencies Based on "Scenario-Response"

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Abstract

The analysis of emergency information needs is fundamental to emergency information management and serves as a prerequisite and condition for effective emergency management. This study conducts a comparative analysis of the information needs related to natural disasters, accident disasters, public health events, and social safety incidents from the dimensions of information need subjects, stages, and content. Based on the "Scenario-Response" theoretical framework, the study examines the characteristics and roles of information needs at different levels in various scenarios and proposes targeted response strategies. The aim is to provide theoretical support for enhancing the efficiency of emergency management.

Key words: emergency information, information needs, "Scenario-Response"

I. Introduction

Emergency management involves the generation and utilization of information at every stage, with information permeating all emergency management activities. The scientific issues related to the acquisition and analysis of information during emergencies have become critical research areas in China's foundational studies on emergency management (Fan, 2007: 71-76). Rapid, accurate, comprehensive, and timely information acquisition is crucial for addressing unconventional emergencies. Analyzing information needs is a prerequisite for acquiring information; once information needs are clarified, it is possible to standardize information, identify sources, and improve information planning, thereby ensuring the rational utilization and distribution of information resources required for emergencies.

In 1997, Jeffrey S. Klenk, during a disaster management training project supported by the United Nations Office for the Coordination of Humanitarian Affairs, initially defined the concept of emergency information needs. He categorized information needs into three stages: pre-crisis, during the crisis, and post-crisis, elaborating on the entire process from information collection and analysis to information generation. This classification laid the foundation for research on emergency information needs. Subsequent studies further investigated the information needs before and after disasters, emphasizing the differences in information needs at various stages. Research conducted by the United Nations Economic and Social Commission for Asia and the Pacific discussed the general information needs in emergency management, highlighting the importance of information flow. These studies established the basis for categorizing emergency information needs, underscoring the diversity of information needs across different stages and contexts.

In terms of analytical frameworks, Xu Ruixia introduced Activity Theory (AT) into the field of emergency management, establishing an AT-based framework for analyzing emergency information needs, providing a new perspective for understanding these needs. The United Nations Inter-Agency Standing

Committee (IASC) Consolidated Appeals Process (CAP) working group developed and explained the Needs Assessment Framework (NAF) model, which serves as a tool for humanitarian coordinators to organize and present information on humanitarian aid requirements. Thomas Tanner focused on the information needs for climate change and disaster risk assessment in Bangladesh, demonstrating an analysis framework for emergency information needs specific to certain regions and environments. These frameworks each offer distinct features, providing analytical tools for emergency information needs in different contexts.

In terms of management models, Lei Zhimei and colleagues have developed a multidimensional analysis model for emergency information. This model systematically and comprehensively analyzes the information needs across different stages, decision-making entities, and decision-making objectives, and the intrinsic relationships between these information needs. Corriveau, Guy M., using structured system analysis and design methods, conducted an information needs analysis for emergency management information systems and proposed a multi-agency emergency management information model to support decision-making. These models contribute to a better understanding and fulfillment of specific communication and information needs in emergency management, thereby effectively coordinating the emergency response among various organizations and institutions.

Existing literature indicates that current research on emergency information needs typically analyzes individual events and lacks comparative studies on the information needs for different types of events. This study, based on the "Scenario-Response" theory, examines the levels of information needs for different types of emergencies from the dimensions of information need subjects, stages, and content. It reveals the characteristics and roles of information needs at different levels in various scenarios and proposes targeted response strategies, providing theoretical support for the rational utilization of emergency information resources and enhancing the efficiency of emergency management.

II. Analysis of Emergency Information Needs for Sudden Incidents

With the development of information technologies such as the internet, the sources of information have become more numerous and the ways of dissemination more diverse. The diversity, complexity, and multiple attributes of information determine that the analysis of emergency information needs is a complex system analysis process. China's "Emergency Response Law" clearly states that sudden incidents refer to events that occur unexpectedly, cause or may cause serious social harm, and require emergency response measures. Sudden incidents can be classified into four categories based on their nature and characteristics: natural disasters, accident disasters, public health incidents, and social security incidents. In the emergency management of unconventional sudden incidents, different emergency subjects have different information needs.

1. Information Needs for Natural Disasters

Natural disasters are characterized by their sudden onset, destructiveness, and unpredictability. The information needs for natural disasters focus on data provided by monitoring and early warning systems, such as meteorological data, to promptly deliver critical information about the location, time, and intensity of the disaster. For example, during the “7·20” heavy rain event in Zhengzhou, Henan in 2021, the meteorological department issued a second red rainstorm warning at 6:00 a.m. on July 20th, but the municipal government only issued an emergency notice around 8:00 a.m. Moreover, this notice did not enforce mandatory measures such as school closures or business suspensions, leading to citizens continuing their daily activities despite the severe weather conditions. This delay and inaccuracy in information dissemination prevented the public from taking timely preventive measures, increasing the risk of casualties. Accurate meteorological warnings and real-time information dissemination play a crucial role in organizing rescue efforts, reducing losses, and facilitating post-disaster recovery. This highlights the importance of information in responding to natural disasters. The classification of information needs for natural disasters is shown in Table 1.

Table 1: Emergency Information Needs for Natural Disasters

Emergency Type	Emergency Subject	Information Needs Content
Natural Disasters	Disaster Victims	Basic Information: Disaster warning information (e.g., typhoon, earthquake, flood), including time, location, intensity, and predicted impact.
		Preparedness Measures: Emergency supplies preparation guide, shelter locations, evacuation routes, family emergency plan.
		Dynamic Information: Real-time disaster information, secondary disaster (e.g., aftershocks, floods) warnings.
		Emergency Measures: Specific avoidance recommendations, emergency contact information, evacuation instructions, shelter information.
		Disaster Assessment: Post-disaster damage assessment, extent of damage, and statistical data of affected areas.
		Recovery Information: Progress of disaster relief, resource distribution, reconstruction plans, psychological support and counseling information.
	Emergency Managers	Risk Assessment: Historical disaster data, identification of potential risk areas, disaster model predictions.
		Warning Systems: Disaster monitoring data (e.g., weather, geological), operational status of early warning systems, public education and drill plans.
		Emergency Plan: Detailed emergency plans, resource lists and deployment plans, emergency drill results.
		Real-time Monitoring: Real-time disaster data (e.g., monitoring station reports, satellite images), dynamic updates of affected areas.
		Resource Allocation: Availability and deployment status of rescue resources (e.g., personnel, equipment, supplies), status and location of rescue teams.
		Coordination Information: Coordination information with other departments and agencies, command center decisions and directives, public feedback and needs assessment.

		Disaster Assessment: Detailed disaster impact reports, statistical data on affected populations and property losses, secondary disaster risk assessment.
		Recovery Plan: Disaster recovery and reconstruction plans, resource allocation schemes, recovery progress reports.
		Experience Summary: Summary reports on disaster response, improvement suggestions for emergency plans, training and drill improvement plans.

2. Information Needs for Accident Disasters

Accident disasters are characterized by their suddenness, severity, and complexity, often causing significant casualties and property damage in a short period. The information needs for such disasters focus on the specific time, location, and cause of the accident, as well as detailed information on the number of casualties and the affected areas. Additionally, it is crucial to quickly obtain information on the allocation of emergency rescue resources, emergency response measures, and environmental impact assessments. This information is vital for a prompt response, effective rescue efforts, and preventing secondary disasters.

For example, during the “8·12” explosion accident at Tianjin Port, the lack of timely and accurate information had a severe negative impact on the rescue efforts. The large quantities and types of hazardous chemicals stored in Ruihai Company's warehouse were not promptly and accurately communicated to the rescue personnel. This led to insufficient understanding of the situation by the initial rescue forces, preventing them from taking effective measures. During the firefighting process, the unknown characteristics of the hazardous chemicals led to the failure to prevent secondary explosions. The classification of information needs for accident disasters is shown in Table 2.

Table 2: Emergency Information Needs for Accident Disasters

Emergency Type	Emergency Subject	Emergency Stage	Information Needs Content
Accident Disasters	Disaster Victims	Pre-emergency	Safety Information: Potential risks and accident prevention measures, safety operating procedures, emergency avoidance guidelines.
			Emergency Preparedness: Emergency supplies preparation guide, family emergency plans, evacuation routes, and safety shelter locations.
		In-emergency	Dynamic Information: Safety warnings and alerts, specific time, location, type of the accident, accident progress, and current safety status on-site.
			Emergency Measures: Specific avoidance recommendations, evacuation instructions, emergency rescue contact information, evacuation routes, and rescue resource distribution points.
		Post-emergency	Accident Assessment: Impact assessment reports, extent of damage and affected areas, statistical data of affected individuals and regions.

			Government Announcements: Official statements and announcements from the government, safety measures, and recovery plans.
			Risk Assessment: Identification of potential accident risks, historical accident data analysis, detailed risk assessment of accident-prone areas.
			Preventive Measures: Safety inspection reports, hidden hazard identification results, storage status of emergency supplies and equipment, emergency drills and training plans.
			Emergency Plan: Detailed emergency response plans, resource allocation plans, emergency command system, and communication mechanisms.
		In-emergency	Real-time Monitoring: Real-time accident data (e.g., surveillance videos, transmitted data), dynamic updates on the accident development.
			Resource Allocation: Status and deployment of rescue resources (e.g., personnel, equipment, supplies), status and movement of rescue teams and progress of deployment.
			Coordination Information: Coordination information with other departments and agencies, decisions and directives from the command center, public feedback, and needs assessment.
		Post-emergency	Accident Investigation: Detailed reports on the causes of the accident, comprehensive impact assessment, statistical data on affected individuals and property losses, secondary disaster risk assessment.
			Recovery Plan: Site cleanup and recovery plans, resource allocation schemes, rescue and reconstruction progress reports.
			Experience Summary: Summary reports on accident handling, improvement suggestions for emergency plans and safety measures, training, and drill improvement plans.

3. Information Needs for Public Health Events

Public health events are characterized by their rapid spread, wide impact, and prolonged duration. Their specific information needs include accurate disease surveillance data, case reports, source tracing, and transmission route analysis to promptly implement control measures and curb the spread of the epidemic. For example, during the COVID-19 pandemic, real-time tracking of confirmed cases, close contacts, and the dynamics of epidemic transmission, along with rapid epidemiological investigations and contact tracing, are crucial for controlling the spread of the virus, effectively organizing medical treatment, and formulating prevention policies. Meeting these information needs helps government and health departments make informed decisions and ensure public health safety. The classification of information needs for public health events is shown in Table 3.

Table 3: Emergency Information Needs for Public Health Events

Emergency Type	Emergency Subject	Information Needs Content
Accident Disasters	Disaster Victims	Health Education: Understanding disease prevention knowledge, healthy habits, and hygiene measures. Knowledge of common infectious disease symptoms and prevention methods.
		Vaccination Information: Preventive vaccination details, including locations, times, and precautions.
		Emergency Preparedness: Emergency supplies (e.g., masks, disinfectants, common medications), family emergency plans.
		Dynamic Information: Latest epidemic notifications, including disease transmission routes, high-risk areas.
		Medical Resources: Locations and contact information for medical institutions, testing sites, vaccination information, drug availability, and access to medical services.
		Response Measures: Government-issued preventive measures and guidelines, such as home isolation, social distancing, mask-wearing.
		Psychological Support: Providing psychological counseling and support information to help cope with stress and anxiety.
		Assessment Information: Comprehensive evaluation reports post-epidemic, impact analysis, infection rates, and recovery statistics.
		Recovery Information: Social and economic recovery plans, restoration of medical services and public health infrastructure information.
		Continued Protection: Long-term health management advice, subsequent vaccination, and health monitoring information.
	Emergency Managers	Risk Assessment: Identification of potential public health risks, historical data analysis, high-risk areas and population assessment.
		Monitoring System: Surveillance data and trend analysis of infectious diseases.
		Emergency Plan: Detailed contingency plans and response strategies, prevention measures, and supply preparedness plans, emergency drills, and training plans.
		Real-time Monitoring: Real-time epidemic data (e.g., case reports, suspected cases, treatment data, death statistics, transmission dynamics).
		Resource Allocation: Status and deployment of medical resources (e.g., hospital beds, medical staff), status of protective material distribution and management.
		Coordination Information: Coordination information with health departments, medical institutions, and other agencies, command center decisions, public feedback, and needs assessment.
		Epidemic Investigation: Reports on the causes and transmission mechanisms of the epidemic, detailed impact assessments, statistical analysis of affected populations and economic impacts.
		Recovery Plan: Post-epidemic recovery and reconstruction plans, public health system improvements, resource allocation plans, progress reports on recovery efforts.

		Experience Summary: Summary reports on epidemic response, suggestions for improving emergency plans and preventive measures, training, and drill improvement plans.
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4. Information Needs for Social Safety Incidents

Social safety incidents are characterized by their suddenness, complexity, and significant social impact. Their specific information needs include the exact location, time, and nature of the incident, information on the involved personnel and affected populations, as well as analysis of related background and motives. Additionally, it is crucial to quickly obtain information on the deployment of law enforcement and rescue forces, public safety guidelines, and public opinion management. For example, during the 2021 Capitol Hill riot in the United States, law enforcement agencies failed to timely and accurately share and handle intelligence regarding potential threats, resulting in inadequate preparation of security measures and an inability to effectively prevent and control the riot. Following the incident, information about the causes, participants, and affected scope of the riot was disseminated in a chaotic manner, further exacerbated by misinformation and fake news, which increased social unrest and division. In social safety incidents, timely and accurate information dissemination and transparency not only help control the situation and ensure public safety but also effectively manage public opinion pressure and maintain social stability. The classification of information needs for social safety incidents is shown in Table 4.

Table 4: Emergency Information Needs for Social Safety Incidents

Emergency Type	Emergency Subject	Information Needs Content
Accident Disasters	Disaster Victims	Prevention Knowledge: Learning basic knowledge and skills for preventing social safety incidents, identifying suspicious behavior, and protecting oneself and others.
		Emergency Preparedness: Preparing emergency plans, understanding emergency shelters and evacuation routes, and preparing emergency supplies (e.g., food, water, necessary medications).
		Dynamic Information: Obtaining the latest updates on the incident, including the time, location, nature, and progress of the incident.
		Avoidance Instructions: Getting official safety guidance and instructions, such as evacuation routes and shelter locations.
		Rescue Information: How to get emergency help and rescue services, contact emergency services, and rescue agencies.
		Event Assessment: Understanding the impact of the incident, including specific situations of affected areas and people.
		Recovery Information: Progress of social order restoration, how to get support from government and non-governmental organizations.

		Psychological Support: Information on psychological counseling services, helping affected individuals cope with trauma.
	Emergency Managers	Risk Assessment: Conducting potential risk assessments for social safety, analyzing historical data, high-risk areas, and populations.
		Monitoring System: Establishing and maintaining surveillance and early warning systems for social safety, continuous monitoring of social order dynamics.
		Emergency Plan: Formulating detailed emergency plans, including strategies and resource allocation plans for different types of social safety incidents, conducting regular drills and training.
		Real-time Monitoring: Real-time acquisition of data and dynamic information on the incident, including surveillance videos, field reports, and public feedback.
		Resource Allocation: Adjusting and deploying necessary resources (e.g., police force, medical staff, equipment) to ensure effective response.
		Coordination Information: Coordination information with other departments, ensuring unified command and coordination, public feedback and needs assessment.
		Event Investigation: Conducting in-depth investigations of the incident, compiling detailed incident reports, evaluating the overall impact of the incident.
		Recovery Plan: Formulating and implementing social order recovery plans, allocating and managing resources, ensuring support for affected areas.
		Summary and Improvement: Summarizing experiences from the incident response, improving emergency plans and preventive measures, organizing training and drills, enhancing the capabilities and preparedness of emergency managers.

III. Comparative Analysis of Information Needs Levels for Emergencies Based on the "Scenario-Response"

Modern emergency management needs to handle various unconventional emergencies, which are difficult to predict and have evident complexity and potential secondary disasters. In such cases, the traditional "prediction-response" model often fails. In recent years, scholars have gradually introduced the scenario concept into emergency management for emergencies, and based on scenario dependency, they have developed the "Scenario-Response" theoretical system (Cosgrave, 1996: 28-35; Kowalski-Trakofler, Vaught, & Scharf, 2003: 278-289). This theoretical system generates emergency decision-making plans in real-time based on the constantly changing scenarios during the occurrence and development of events, thereby effectively reducing the uncertainty in the emergency response process. Therefore, using the "Scenario-Response" model to categorize the levels of information needs for emergencies not only meets the governments needs for emergency management but also effectively enhances the publics emergency response capabilities, minimizing the losses caused by emergencies.

The destructiveness of emergencies and the uncertainty of their progression determine the diversity of information needs scenarios. Categorizing information needs scenarios based on multiple dimensions enables decision-makers to identify different levels of information requirements according to the characteristics of each scenario, thereby adopting

corresponding resource supply strategies. To enhance the effectiveness of emergency information, this paper compares the levels of information needs for different types of emergencies from three dimensions: subject , temporal , and nature. The overall framework is shown in Figure 1.

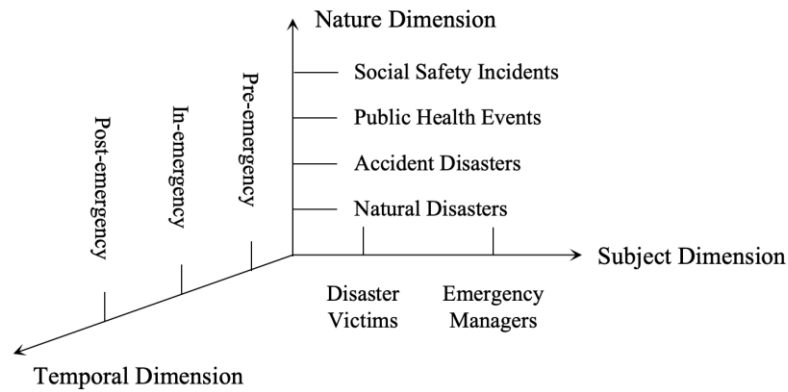


Figure 1: Overall Framework for Comparative Analysis of Emergency Information Needs

1. Comparative Analysis Based on the Subject Dimension

In the subject dimension, this study categorizes the information needs subjects into emergency managers and disaster victims. The stakeholder theory emphasizes that organizations should consider the needs and interests of all parties affected by their actions in decision-making and management processes. The roles and responsibilities of emergency managers and disaster victims differ in sudden incidents, resulting in varying information needs and usage purposes. Emergency managers require comprehensive and timely information for scientific decision-making and command dispatch, while disaster victims need specific and practical information to ensure their safety and restore normal life.

Table 5: “Scenario-Response” Model of Emergency Information Needs for Different Subject

Subject Dimension	Level of Information Needs	Information Supply Strategy
Disaster Victims	Basic Information Needs	Provide timely and accurate basic information about the event, including the location, time, nature, and safety guidelines.
	Emergency Information Needs	Disseminate emergency evacuation, survival, and rescue information through various channels (e.g., SMS, broadcasts, social media).
	Recovery Guidance Needs	Provide post-disaster reconstruction, psychological support, health protection guidance, helping victims gradually restore normal life.
	Information Interaction Needs	Establish hotlines, online Q&A platforms, and other interactive channels to address victims concerns and collect feedback.

Emergency Managers	Monitoring Information Needs	Real-time monitoring systems providing dynamic data, such as disaster development status, changes in affected areas, and environmental monitoring data.
	Resource Allocation Needs	Real-time updates and sharing of resource status through information systems, including the allocation and usage of materials, equipment, and personnel.
	Decision Support Needs	Provide comprehensive and accurate analysis reports and predictive models to assist decision-makers in formulating effective emergency strategies.
	Information Coordination Needs	Establish a unified information release and coordination platform to ensure information sharing and cooperation among emergency managers at all levels.

In emergencies, the needs of disaster victims mainly focus on basic information, emergency information, recovery guidance, and information interaction levels, emphasizing the timeliness, accuracy, and operability of information to ensure their safety and gradual return to normal life. Emergency managers, on the other hand, focus on monitoring information, resource allocation, decision support, and information coordination, emphasizing comprehensive and accurate data analysis and information sharing to ensure the efficiency and coordination of emergency responses. Disaster victims are more concerned with specific action guidance and interactive feedback, whereas emergency managers need comprehensive data and analysis support to formulate and implement effective emergency strategies.

2. Comparative Analysis Based on Temporal Dimension

In the temporal dimension, this article primarily discusses the full cycle of emergency management, which includes managing prevention, preparation, response, and recovery for sudden incidents. This involves pre-incident prevention, actions during the incident, and post-incident handling. After the 9/11 incident, the U.S. Department of Homeland Security divided emergency management into five stages: preparation, prevention, protection, response, and recovery. Some scholars believe that emergency management stages include preparation, prevention, mitigation, response, recovery, and learning. This article, considering the information needs during sudden incidents, divides the time dimension into three phases: pre-emergency, in-emergency, and post-emergency. Different temporal dimensions have varying resource needs.

Table 6: “Scenario-Response” Model of Emergency Information Needs for Different Temporal

Temporal Dimension	Level of Information Needs	Information Supply Strategy
Pre-emergency	Warning Information Needs	Utilize modern information technologies such as big data to establish efficient monitoring and warning systems, collect and analyze relevant data in real-time, and issue early warnings.

	Emergency Preparedness Needs	Develop and regularly update emergency plans, ensure the readiness of supplies and personnel, and conduct mock drills.
	Training and Education Needs	Organize regular training and education activities to raise public awareness and preparedness for emergencies.
In-emergency	Dynamic Information Needs	Utilize various channels to update and share real-time disaster information, ensuring accurate and timely information dissemination to all emergency stakeholders.
	Emergency Response Needs	Quickly mobilize emergency resources and coordinate effective emergency response and rescue operations through the command system.
	Safety Assurance Needs	Provide safety guidance information to ensure the safety of affected individuals and rescue personnel, preventing secondary incidents.
Post-emergency	Disaster Assessment Needs	Organize expert teams to conduct in-depth post-disaster assessments, collect and analyze relevant data, and compile comprehensive incident evaluation reports.
	Recovery and Reconstruction Needs	Publish recovery and reconstruction plans, provide necessary support and guidance to help affected areas quickly restore normal life.
	Summary and Improvement Needs	Summarize emergency management experiences, improve emergency plans and systems, and enhance overall capabilities for responding to future incidents.

In emergencies, the pre-event stage focuses on warning information, emergency preparedness, and training and education, emphasizing prevention and preparation to ensure readiness before the event occurs. The in-emergency concentrates on dynamic information, emergency response, and safety assurance, emphasizing real-time updates and rapid reactions to ensure effective emergency handling and rescue operations. The post-emergency information needs mainly include disaster assessment, recovery and reconstruction, and summary improvements, focusing on evaluating the events impact, formulating recovery plans, and improving the emergency management system.

3. Comparative Analysis Based on Nature Dimension

Different nature of emergencies have distinct focuses regarding information needs. The information needs for natural disasters include disaster warnings, rescue operations, and post-disaster recovery, emphasizing the release of warnings and real-time rescue information. Accident disasters focus on accident details, emergency response, and accident investigation, prioritizing specific details of the accident and the emergency response. Public health events concentrate on epidemic information, preventive measures, and treatment plans, with an emphasis on the timely release of epidemic dynamics and preventive measures. Social safety incidents focus on incident details, on-site control, and incident investigation, emphasizing detailed information about the incident and on-site safety management. All types of events require timely and accurate information support to enhance the efficiency and effectiveness of emergency responses, but

specific needs vary according to the nature of emergencies.

Table 7: “Scenario-Response” Model of Emergency Information Needs for Different Nature

Nature Dimension	Level of Information Needs	Information Supply Strategy
Natural Disasters	Disaster Warning Needs	Establish efficient warning systems, promptly issue meteorological and earthquake warnings.
	Rescue Operation Needs	Issue rescue information through various channels and coordinate the deployment of rescue resources.
	Post-Disaster Recovery Needs	Provide post-disaster reconstruction plans and guidance information, assisting affected areas in recovery.
Accident Disasters	Accident Information Needs	Quickly acquire and convey detailed information on the time, location, cause, and affected areas of the accident.
	Emergency Response Needs	Timely dispatch emergency response measures and safety guidelines, coordinate emergency resources.
	Accident Investigation Needs	Provide detailed accident investigation reports, analyze causes and responsibilities, and offer improvement suggestions.
Public Health Events	Epidemic Information Needs	Timely publish epidemic development dynamics, including confirmed cases, transmission routes, and other key information.
	Preventive Measures Needs	Timely release government preventive measures and health guidelines, enhancing public preventive awareness.
	Treatment Information Needs	Provide information on treatment plans, medical resource allocation, and patient status.
Social Safety Incidents	Incident Information Needs	Publish detailed information about the event, including involved individuals, impact scope, and nature of the event.
	On-site Control Needs	Provide information on on-site safety status and response measures, ensuring public safety during and after the event.
	Incident Investigation Needs	Publish progress and results of incident investigations, analyze background and causes, and propose preventive measures.

IV. Conclusions

In the emergency management of sudden incidents, the uncertainty of event evolution causes different emergency subjects to face different problems at various stages, leading to diverse information needs. This paper systematically and comprehensively analyzes the information needs and their intrinsic relationships from three different dimensions: event

type, emergency stage, and emergency subject. It explores the common information needs during emergencies, providing a foundation and basis for analyzing information needs and integrating information resources in unconventional emergencies.

However, this study has some limitations in practical application. Firstly, the analysis in this paper is primarily based on existing literature and theoretical frameworks, lacking field research and data validation. Future research should incorporate real cases and data to further validate and refine the analytical models. Secondly, this paper mainly focuses on the information needs in emergency management of sudden incidents, without deeply exploring the effectiveness of information supply and transmission. Future research should further investigate how to improve the efficiency and accuracy of emergency information transmission.

Therefore, future research should strengthen empirical studies, validate theoretical models through specific cases and data analysis, and continuously improve the analytical framework and methods for emergency information needs. This will provide a more solid theoretical and practical foundation for enhancing the scientific and effective emergency management.

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