

Constructing an emergency intelligence system: A multi-level framework

(Full Paper)

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ABSTRACT

The processes and patterns of actors participating in emergency intelligence activities are not transcendental; instead, they are gradually molded in the intelligence activities and their corresponding management activities. The article constructs the emergency intelligence system based on the macro, meso and micro interconnected multiple mutual-construction theory. The research illustrates the constitution relations between the different levels of the emergency intelligence system and the interactions between the elements of the intelligence system. It also focuses on the analysis of the operating mechanism and the multi-level framework of the emergency intelligence system.

Keywords: Intelligence system, constructivism, activity theory, structuration theory, actor structure, multiple mutual-construction

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INTRODUCTION

The modern society is built on the cyber space (John-Green & Watson, 2014), and the popularization of Internet of Things and Internet has enabled every object and every individual to connect to the network and become an information producer. Intelligence is no longer considered to be a mysterious thing (Saavedra, 2015). New changes in intelligence gathering and analysis emerging in this century need to arouse the attention of researchers, and significant changes will take place in the application scenario and operation methods of the future intelligence system. Intelligence services based on large scale and heterogeneous data resources have been applied in areas such as library and information retrieval and international comparative research (Light, Polley, & Boerner, 2014; UK Government, 2016). Facing new business areas, such as emergency management, the existing theoretical paradigm and system design methods are out of step with the openness, globalization and networking of the modern society. Both the academic and industrial circles mostly view the intelligence and intelligence system from the perspective of technology, overemphasizing the supporting factor of information technology, with little consideration of the issues from the angle of the social existing significance of intelligence. Some researchers have noticed that the designers and users of existing intelligence systems pay attention only to the performance characteristics, such as the target detection and the probability of false reporting (Pakhomov, 2010), or the scale and form of information, instead of the final effect of use, which is obviously away from the social reality and the real needs in applications.

The intelligence service oriented to emergency management has important realistic social significance. The emergency management is considered to be the process by which an organization deals with a sudden, major, unpredictable event that threatens to harm the whole organization or the whole society (Aldewereld et al., 2011). Traditional emergency management is organized from a functional perspective and operates according to a hierarchical and centralized structure (Hutchins et al., 2002; Diedrich et al., 2002). The priori roles and processes allocated are passively responsive to changing demands (Bigley & Roberts, 2001; Jobidon, Turcotte, & Aubé, 2017). The intelligence systems and intelligence service processes that serve emergency management are also in this way. With the reinvention of political balance, the development of emerging technologies, and the growth and flow of population, we are entering a new world. Risks are shifting from localization to the dependence of globalization (Topper & Lagadec, 2013), and managers' perceptions of risk shift from uncertainty to ignorance. Modern society has accumulated a great deal of knowledge and experience, but the supporting effect of the intelligence system on emergency management and the results of emergency response have always been unsatisfactory: On the one hand, the existing theories and methods cannot completely solve the complex problems of intelligence supporting for emergency management, as it is not only a technical problem, but more related to epistemology. On the other hand, the literature on information system strategy tends to focus on high-level (meso and macro) process analysis while ignoring organizational practices (Marabelli & Galliers, 2017), and lacks in the theoretical combination at macro, meso and micro levels. We therefore need an effective and systematic perspective and method to research, design and analyze emergency intelligence systems (Foglia, Greppib, & Guida, 2017), and extend their applications to information systems with similar characteristics.

DESIGN AND ANALYSIS OF EMERGENCY INTELLIGENCE SYSTEM

Research Paradigm through Society

The failure of intelligence support model and intelligence service mechanism is only the appearance of the problem, and the basic reason can be found from the intelligence research paradigm. Because of the following three reasons, not only the

problems faced by emergency intelligence service become uncertain, but also the emergency decision-making problems served by intelligence cannot be called certain: 1) the emergence of a large number of unconventional emergencies; 2) emergencies are parts of larger processes, rather than discrete events; 3) from the tight coupling of causality model to mutual influence and interaction. When users cannot definitely cognize problems, environment and their own needs, new research paradigms need to be adopted to adapt to high uncertainty. The structuration theory proposed by Giddens believes that people are social actors with reflexive and agency. As an integral part of society, the organization is no exception. Reflexive and agency link the individuals, organizations and society as a whole, forming a holistic construction oriented by management activities and through society, which becomes the starting point to research emergency intelligence system from the perspective of constructivism.

The Adaptive Structuration Theory (Desanctis and Poole, 1994) and the Duality of Technology Theory (Orlikowski, 1992) derived from Structuration theory have been widely used in the field of information technology. Desanctis and Poole combine causality and factors of social constructivism in a common model, to clarify and develop the structural capability of group decision-making interaction process. The focus of research and interpretation is on the process by which organizations incorporate information technology into their work and how they realize and restructure the information technology. The rules, resources and environment used by model are confined by organizational boundary and are deterministic. The practice lens account put forth by Orlikowski is built on the premise that technology structures are emergent and cannot be embodied into the design. While all human practice is embedded in a structured historicity, the intentional part is not structured, but being structured and will be structured. The existing theories have been very effective in analyzing the key success factors of information system projects and studying the adaptive behavior after the technology is adopted, but there are limitations to the research on the parts that are being structured and will be structured. For emergency intelligence system, we need to proceed from the top perspective of society and the bottom perspective of the actors at the same time, to make new exploration in a wider range of multiple mutual-construction relationships, and to pay more attention to being structured and going to be structured.

Hierarchical Model of Emergency Intelligence System

The construction of emergency intelligence system is a continuous process that takes place in the organizational network and social environment, and interacts at different levels. There are multiple elements in the system, they restrict and influence each other at micro, meso and macro level of structures, and together constitute the emergency intelligence system. Research on intelligence system should not only observe and reflect the practice activities of subjects on objects, constructing the system from the whole, but also avoid ignoring the interactions between subjects. It is necessary to analyze the contribution made by the interaction between individuals to the society content and management activities.

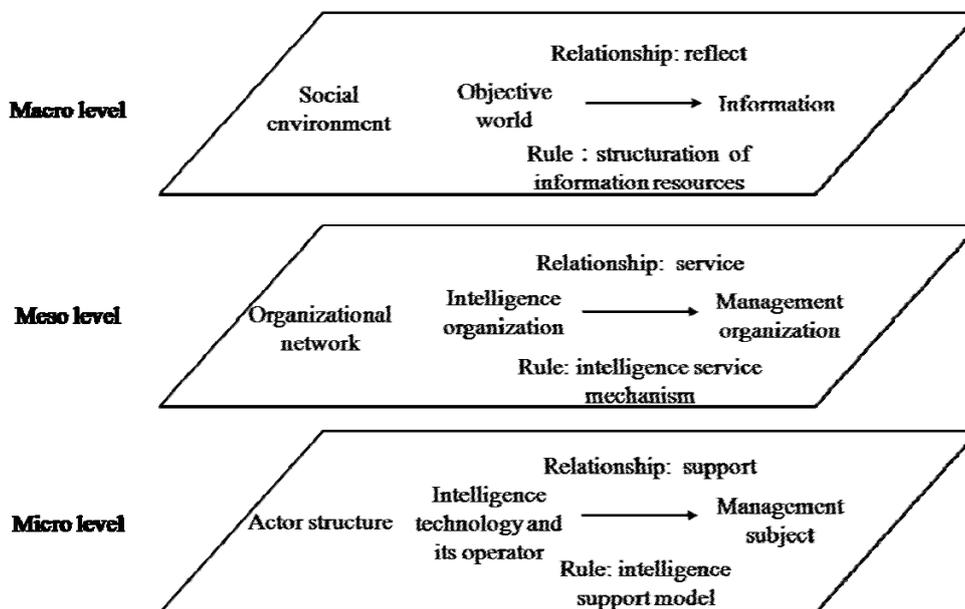


Figure 1: Hierarchical research model of emergency intelligence system

As shown in Figure 1, the elements of emergency intelligence system can be divided into resource elements and rule elements. Resource elements directly involved in the process of intelligence activities include management subject, intelligence technology and its operator, information and intelligence. Rule elements include structuration of information resources, intelligence service mechanism and intelligence support model. In emergency management, the intelligence system does not serve the solidified business process within the management organization; instead, it serves the emergency decision-making and its social consequences. Therefore, we cannot emphasize only the dual mutual-construction relationship between management organization and intelligence technology. There are multiple structures here: the consequences resulted from

intelligence – decision-making – management activities have an impact on the social environment, and in turn affect the intelligence and decision-making itself. The resource elements such as management subject, intelligence technology and its operator, information and intelligence cannot be piled up as intelligence system itself. There are multiple mutual-construction relationships between the actor structure, organizational network and social environment in the emergency intelligence system. Research on the emergency intelligence system needs to start from the intermediate elements between people and society, especially the rules elements that bridge other elements together.

Rule Elements of Emergency Intelligence System

Structuration of information resources

Information is one of the resource elements of emergency intelligence system, and the structuration of information resources is the rule element that bridges social environment and intelligence technology. Management subject hopes that through the planning and preparation of information resources, the information boundary and the information itself will be determined or approached to a definite form. However, this desire is facing the dual challenges of the complexity of social environment and the richness and complexity of the information it brings: In the context of the complexity of social environment, information and its sources have heterogeneous and complex characteristics, and information resources have become an open system that lacks overall consistency and is difficult to manage and plan. Because 1) information utilization is dependent on the structure of information resources; 2) faced with different services, the effectiveness of information resources structure is different; 3) the structure of information resources is dynamically changing, so it is only when the specific management activities and corresponding intelligence activities are carried out that the structuration of information resources can be temporarily established. The structuration of information resources is the depiction and construction of space slices of a social environment corresponding to a specific business at a certain time in the future, so as to adapt to the ability of the actor and promote the achievement of management objectives. With respect to emergency management, only when emergency decision-making and emergency response occur, in the determined activity space and time segment, the management subject, management content and organizational network can be confirmed, the structuration of information resources can be established, and the value of information can be reflected. This is a temporary organizational activity, not a fixed and pre-set digital activity, and its ultimate goal is to support decision-making rather than to stack data.

Intelligence service mechanism

The operation of emergency intelligence system originates from the structuration of information resources oriented to emergency management, and ends in the intelligence service for the decision-making subjects. The construction of emergency information system is a construction with the intelligence users and application environment as the center, instead of one with intelligence technology as the center. Viewed in the angle of intelligence users, the three sectors respectively formed in the political and state area, market economy area and citizen society area, i.e. the power organizations represented by governmental agencies, the market organizations represented by profit-seeking enterprises and social organizations represented by public welfare non-governmental organizations, form the framework foundation for emergency management operation jointly with residents in cities and rural areas, and jointly participate in management in the forms of permanent or temporary, formal or informal networks. The intelligence demands occurring in emergency management activities are characterized by diversification and correlation, including not only the diversified demands of management subjects of different types on intelligence contents and forms, but also the coordinated demands for intelligence by managers with associated or conflicting interests in the management of the same emergency, as well as the coordinated demands for intelligence in associated or potentially associated emergencies. Therefore, the emergency intelligence system needs to provide service to administrators in a complex and heterogeneous environment with fuzzy boundaries, and the intelligence service mechanism for emergency management needs to adapt to such situations, to promote the mutual collaboration of various parts and adapt to the rapidly changing social environment. When the new intelligence service mechanism is in operation, the space-time structure of the distribution of information resources changes in a beneficial way, and information resources will produce the agglomeration effect oriented to emergency management.

Intelligence support model

The activity of intelligence supporting decision-making is a two-way interactive process. This two-way feedback mechanism is called reflexivity. Reflexivity infuses each other with uncertainty, leading to the possibility that management behavior may produce unpredictable results. The ultimate deadlock in modern society consists in the gulf between knowledge and decision-making: no one really knows the consequences of the overall situation -- but we still have to make a decision. Decision-making is fallible, and even all contrived construction may be flawed. Reflectivity and fallibility are not the only source of uncertainty, but when we exclude technical conditions, they become the most important source of uncertainty in emergencies. The construction of emergency intelligence system needs to consider the factors of reflectivity and fallibility: 1) using fallibility and reflectivity to mitigate the impact of uncertainty; 2) using continuous and high-frequency decision-making to support the emergency decision-making in the context of fallibility; 3) adopting widely distributed sensing systems that support heterogeneous network to support emergency decision-making in the context of reflectivity.

Multi-level Analysis of Emergency Intelligence System

Jones and Karsten (2008) pointed out that researchers need to shift from the traditional focus on phenomena associated with information systems at the individual, group, and organizational levels to a wider range of research. As mentioned earlier, the relevant conceptual framework of emergency intelligence system includes multiple levels of close interconnection and

interaction: actor structure, organizational network and social environment. With reference to the viewpoint of Pozzebbon (2012), we place the multilevel framework within a constructivist tradition, and view the research of emergency intelligence system as procedural and inherently multilevel. There are many factors at each level, and there are interactions between factors within each level and among different levels of factors, which in turn influence the behavior of actors.

Morgeson and Hofmann (1999) have suggested identifying and integrating the unity between different levels with the functional similarity: a structure theorized as multi-level has function of equivalent relation at each level, therefore functions with similar structure (but different in structure) can be constructed as a wider network structure. But obviously, the multi-level framework of emergency intelligence system is not a multi-level structure with consistent functionality, and it even has no consistent directionality, that is, there is no hierarchical feature of decomposing from high to low or converging from low to high between levels, and it is multiple mutual-constructed, rather than being constructed in a single direction from society – organization – actors. In this framework, it is not always possible to find consistent relations between independent variables and dependent variables at different levels, and it is also difficult to seek for determined relation between different variables across levels. The multi-level analysis of emergency intelligence system is not for researchers of organization science to consider the method of construction at a higher level of analysis, instead, it provides for interdisciplinary researchers a holistic perspective to observe the mutual-construction relationship between social environment, organizational network and actors structure, as well as the mechanism and process of their joint action on the emergency management.

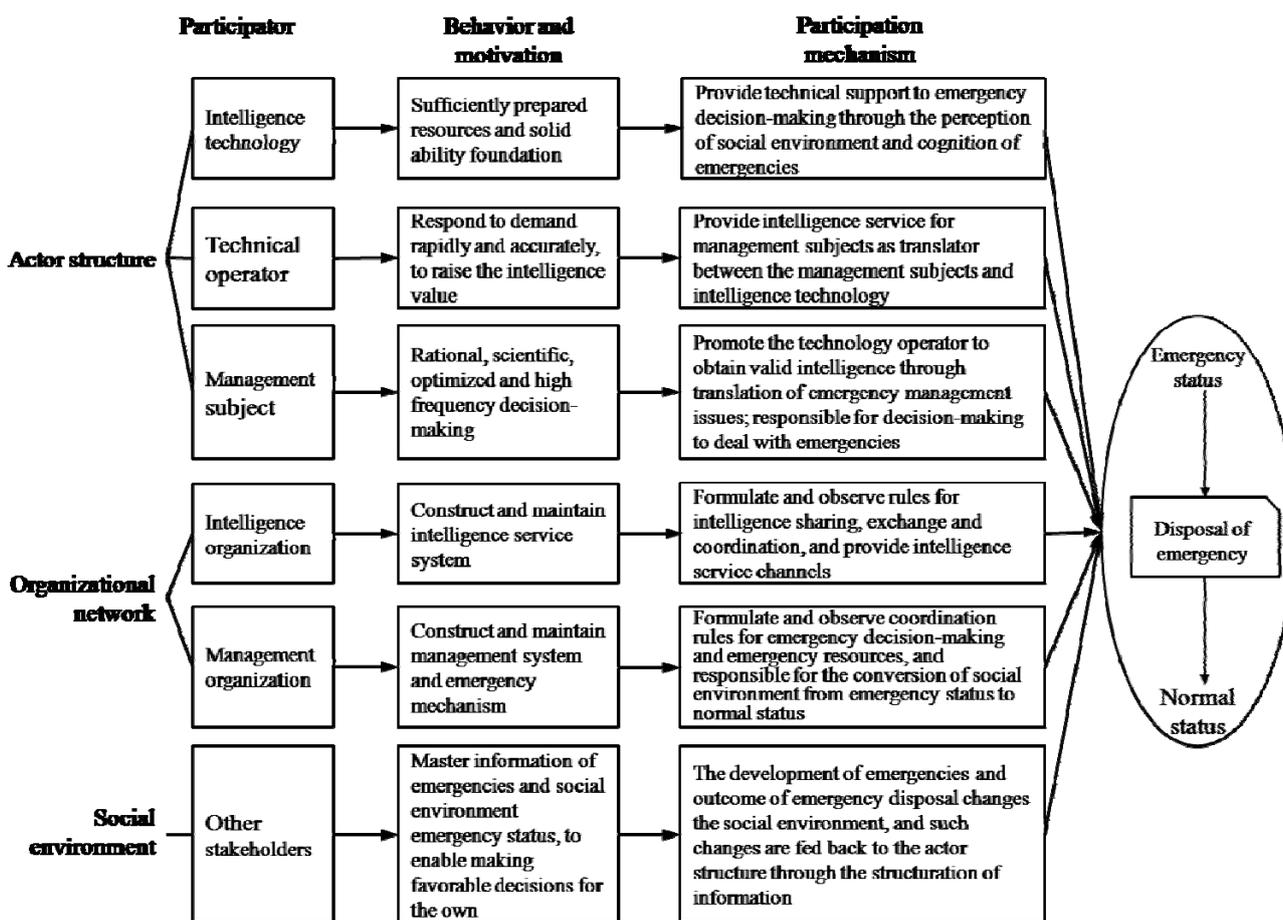


Figure 4: Mechanism of emergency intelligence system acting on the response of emergencies

CONCLUSIONS

When the human society becomes more and more abundant and developed, a variety of suspense is produced for the prospect of the world. People cannot predict the future accurately, and can only use scenario simulation and conceptions to imagine various possibilities of the future. This has forced the emergency managers to depend more and more on the experience, models and data involuntarily. However, in a modern society full of reflexivity, we are unable to understand at present and hard to judge in the future the future-oriented risks triggered by the management behavior resulted from emergency decision-making, so the traditional intelligence research paradigm has limitation in new social environment and emergency management activities.

This research is conceptual and theoretical. Starting from the perspective of constructivism, the theories, concepts as well as the new parts of different disciplines are integrated into a multidimensional framework to solve the theoretical problems in the

construction of emergency intelligence system. This theoretical framework and research paradigm can also be extended to apply to intelligence systems with similar characteristics. This article analyzes the challenges faced by emergency intelligence system and provides a holistic perspective on the construction of emergency management intelligence system. It closely integrates the macro (social environment), meso (organizational network) and micro (actor structure) levels of theories, explains the constitution relations between different levels and interactions between the intelligence system elements (resource elements and rules elements), and focuses on the analysis of operational mechanism and multiple mutual-construction relationships of emergency intelligence system. The emergency intelligence system is resource elements and constitution relations embedded into the social environment and organizational network, rather than a simple technical system: the management subjects, intelligence technology and its operator form a mutual-construction relationship at the micro level; the management subjects, intelligence technology and its operator, information resources and organizational network form a mutual-construction relationship at the meso level; the actor structure, organizational network and social environment form a mutual-construction relationship at the macro level. When we re-understand and construct emergency intelligence system using the research paradigm through society, the intelligence and intelligence system will become the foundation support and core assets of emergency management.

ACKNOWLEDGMENT

This work is partially supported by grant 16ZDA046 of the National Social Science Foundation, China.

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