# Thinking of Emergency Assistant Decision-Making Based on Digital Standards

Wan Wang [1,a], Rui Yang [2,b], Dehua Guo [3,c], Tingxin Qin [4,d,*]

wangwan@cnis.ac.cn[a], ryang@tsinghua.edu.cn[b], guodh@cnis.ac.cn[c], qintx@ cnis.ac.cn[d]

Department of Public Safety, China National Institute of Standardization, Beijing 100191, China[1,3,4]
School of Safety Science, Tsinghua, Beijing 100084, China[2]

**Abstract.** In response to the problem of low use efficiency related to emergency response standards. This article proposes a technical path that combines the knowledge gram (KG) and the large language model (LLM). Taking the fire of the crude oil storage tank as an example, the application example was explained. It is necessary to further break through the key models and algorithms in each step. The result shows that the technical path can achieve accurate production of auxiliary decisions based on standardized documents.

**Keywords:** Assistance decision; Digital; Standards

## 1 Introduction

In the use of standardized documents in both paper and PDF versions, the issue of low use efficiency during emergency response to emergencies has attracted widespread attention in the industry. In order to solve this problem and improve the use efficiency of documents in emergency situations, it is necessary to digitize standardized documents in the field of emergency management, achieving precise mapping of standardized knowledge and on-site situations of emergencies. Scholars have conducted preliminary basic research on the digital transformation of emergency response standards. The main implementation paths include the analysis and establishment of standard corpora, the construction of knowledge graphs, and the storage of knowledge graphs. [1-2] Firstly, an ontology model framework applicable for emergency response was constructed, mainly including five categories of emergency response subjects, objects, disaster affected entities, normative documents, and emergency supplies. The entities and relationships of each category were clarified, and an emergency response ontology model was constructed. Based on the ontology model, standard knowledge was labeled and annotated to form a corpus. A knowledge graph was constructed through knowledge extraction and the establishment of triples, and the knowledge graph was stored and displayed through Neo4j.

Based on the research on the digital transformation of standards in the above fields, it is hoped that auxiliary decision generation based on standard normative knowledge can be formed through querying or reasoning, maximizing the role of normative documents in emergency response. [1-2] In recent years, with the development of big language modeling technology, it has been widely used in industries [3]. It is currently necessary to understand how to combine standard digital transformation with big language modeling technology in the field of

PMIS 2024, March 15-17, Changsha, People's Republic of China

DOI 10.4108/eai.15-3-2024.2346381

emergency response, and achieve rapid and efficient generation of auxiliary decision-making based on obtaining accurate corpora. Based on the digital transformation path of emergency response standards implemented by previous researchers, a dataset of common elements of emergency management standards was constructed, and the implementation path of rapid decision-making based on standard digital knowledge was explored by combining big language modeling technology.

## 2 Dataset of common elements in emergency management

Datasets are the foundation for building system applications. Based on constructing the ontology model, a dataset of common elements of emergency response standards was tried to be constructed to unify the application of data in various emergency management systems within a relatively wide range with reference to the construction rules of datasets in other fields [4], including corresponding metadata and data elements. As shown in Table 1, the metadata subset includes the identification information subset and the content information subset. The identification information subset specifies the dataset name, dataset identifier, dataset publisher, keywords, dataset language, dataset classification, etc. The content information subset describes the summary and feature data elements of the dataset. Table 2 describes the properties of data elements to unify the expression of data in the system, and specifies the types of data elements and their representation formats.

The metadata and data element attributes of this dataset are combined with the previous ontology model construction, which can be continuously dynamically improved to form a complete corpus for model construction and the integration of auxiliary decision-making systems.

**Table 1.** Dataset metadata.

| Metadata subset | Metadata item | Metadata value |
|---|---|---|
| Identification information subset | Dataset Name | Dataset of Common Elements for Emergency Response Standards |
| | Dataset identifier | SDSA00.01 |
| | Dataset publisher - Unit name | To be determined |
| | Keyword | Common elements of emergency response standards |
| | Dataset language | Chinese |
| | Dataset Classification - Category Name | Emergency Response - Common Elements of Standards |
| Content information subset | Summary of dataset | In the emergency response standards, common elements of four types of emergencies are covered, including general, response process, and rescue materials. |
| | Dataset feature data elements | Emergency response, prevention and preparation, monitoring and early warning, response and rescue, recovery and reconstruction, etc. |

**Table 2.** Data Element Properties (Example).

| | Data Element Category | Data Element Name | Definition | Data type | Presentation format | Data element allowable value |
|---|---|---|---|---|---|---|
| 1 | Basic universal | Emergency code | A character or set of characters that represents a specific thing (emergency) or concept. | S | N14 | GB/T 35561-2017 Classification and Coding of Emergencies |
| 2 | | Disaster carrier code | A character or set of characters that represents a specific thing (emergency) or concept. | S | N6 | GB/T 32572-2016 Classification and Code of Natural Disaster Carrier |
| 3 | | … | … | … | … | … |
| 4 | | Submission time | The information submission time after an emergency occurs | T | T6 | |
| 5 | Prevention preparation | Risk probability | The measurement of the opportunity for an event to occur, represented by a number between 0 and 1. 0 represents impossible occurrence and 1 represents certain occurrence. | N | N1 | |
| 6 | | … | … | … | … | … |
| 7 | Disposal and rescue | Emergency time | The effective time for the emergency system to response. | DT | DT15 | |
| 8 | | … | … | … | … | … |
| 9 | Recovery and reconstruction | Statistical information on employee injury and death accidents | The statistical information of employee injury accidents refers to the basic data items to be mastered by the labor safety management and supervision departments for statistics, analysis, and prediction of employee injury accidents in this industry. | N | AN..100 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 0 | | … | … | … | … | … |
| 1 | Emergency materials | Quantity of materials | The quantity of various materials required for emergency response | N | N1 | |
| 2 | | … | … | … | … | … |
| 3 | Standardization documents | Classification of standardized files | | S | AN..8 | Laws and regulations, policy documents, contingency plans, and standards, etc. |
| 4 | | … | … | … | … | … |

Description of data type:
S - character type, T - time type, N - numerical type, DT - date time type.
Description of format:
N - The type of value represented in numerical form from "0" to "9".
T - The type of value represented in the hhmmss format specified in GB/T 7408.
DT - The type of value represented in the YYYYMMDDThhmmss format specified in GB/T 7408.
AN - Alphabetic or (and) numeric characters.
Character length: Directly provide the number of character lengths after the data type identifier, such as N4; Provide the maximum number of characters after the data type identifier, such as AN..20

## 3 Technical path for auxiliary decision generation

The efficient generation of emergency response assisted decision-making requires not only the formation of a complete basic corpus, but also the implementation of technical paths. The organic combination of Knowledge Graph (KG) technology and Large Language Model (LLM) technology is currently the most efficient and feasible approach. KG construction is a data mapping based on standardized file knowledge for emergency response, providing accurate knowledge and data information, and representing the source of data information. In recent years, the rise of LLM can quickly form auxiliary decision-making through machine deep learning. However, there are often phenomena where models cannot truly understand language, such as data bias, overfitting, and poor model interpretability [5-7]. In the field of emergency management, accurate and correct decisions cannot be provided, especially the inability to cite sources and sources, which is inconsistent with our expected goals. For example, directly inputting the question "How to deal with combustion and explosion accidents in crude oil storage tanks?" into the big language model provides the following steps, including (1) Alarm and evacuation: The location of the incident should immediately issue a fire alarm signal and ensure the safe evacuation of personnel. Emergency evacuation plans and escape routes should be planned in advance and regularly rehearsed. (2) Notify emergency services: Immediately notify the local fire alarm, emergency services, and relevant departments. Provide detailed accident information, including the location of the incident, the type of accident, and the potential nature of the danger. (3) Use fire extinguishing equipment: If possible, try using appropriate firefighting equipment for initial firefighting, but be sure to ensure your own safety. For oil fires, dry powder fire extinguishers are usually an effective choice. (4) Isolation of hazardous areas: Isolate the accident scene as much as possible to ensure that no unauthorized personnel enter the hazardous area. This can reduce the risk of accidents spreading. (5) Use foam extinguishing system: For large crude oil storage tank fires, usually use a foam fire extinguishing system, which can form a foam layer covering the fire source to prevent the supply of oxygen, to suppress the fire and reduce the temperature of the storage tank: Use water cannons and other means to lower the temperature of nearby storage tanks to reduce the risk of fire spread. (6) Monitor and be ready to respond to progress at any time: Use monitoring equipment to monitor the gas and temperature at the fire scene, as well as the structural condition of the storage tank. Immediately respond to potential fire developments based on monitoring results at any time. (7) Emergency oil leakage handling: A fire may cause damage to the storage tank, leading to oil leakage. Immediately take measures to prevent the spread of leaks and dispose of them. (8) Collaborative Operations: Fire accidents require collaborative operations, not only from the fire department, but also support from other relevant units such as environmental protection and medical care. The entire process is correct, but some steps are not very practical. For example, in Step (3), it is stated to "ensure one's own safety", but it is not clear how to ensure one's own safety; In step (5), it is pointed out that "the applicable foam fire extinguishing system is used", but the specific scenarios are different when using the foam fire extinguishing system, and the specific operation needs more detailed technical support. Data input is required from the knowledge graph to supplement and correct the results (see Fig.1). Based on knowledge graph data input, knowledge retrieval and knowledge inference model construction are carried out to correct and supplement the auxiliary decision-making directly formed by LLM, thus forming a highly operational auxiliary decision-making based on accurate knowledge.

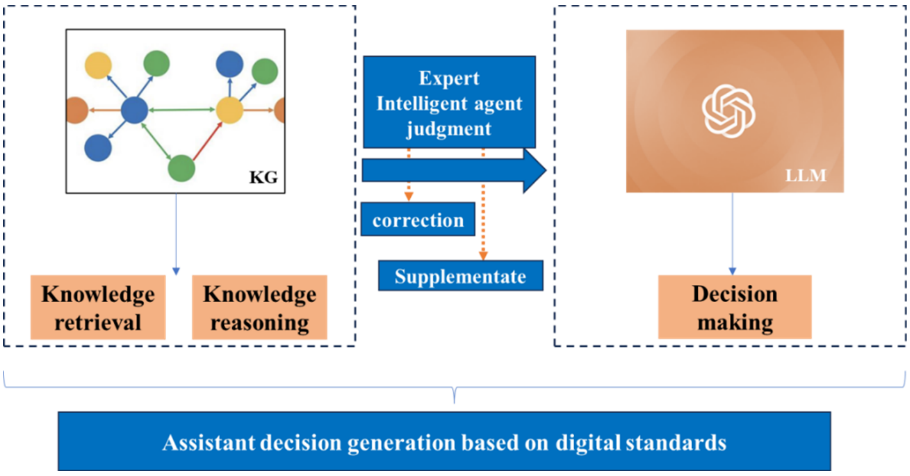


**Fig. 1** Diagram of KG and LLM combination to generate assistant decision-making.

## 4 Application example explanation

Taking the response to hazardous chemical accidents as an example, a path approach combining KG and LLM is adopted to provide auxiliary decision-making (as shown in Fig. 2). For the fire accident caused by the explosion of crude oil storage tank, LLM provided a response plan, including alarm and evacuation, notification of emergency services, isolation of dangerous areas, use of foam fire extinguishing system, lowering the temperature of storage tank and other steps. Where, the use of firefighting equipment requires ensuring personal safety, but it does not specify how to protect personnel. The *Emergency Quick Reference Manual for Commonly Used Hazardous Chemicals* [8] propose how rescue personnel should take personal

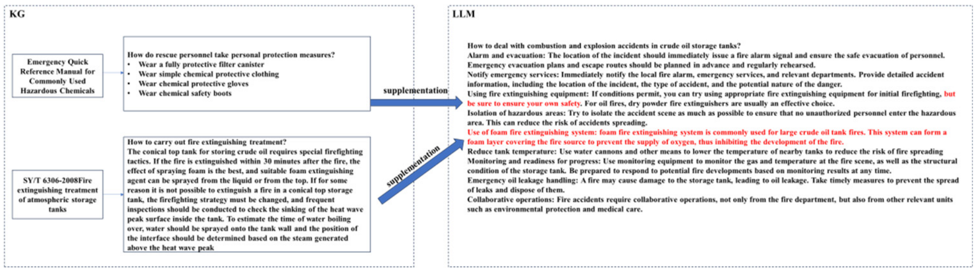


**Fig. 2** Assistant decisions of the fire caused by the exploration of crude the oil storage tank.

protection measures, including wearing fully protective gas canisters, wearing simple chemical protective clothing, wearing chemical protective gloves, and wearing chemical safety boots. This knowledge supplement is provided for the auxiliary decision-making proposed by LLM. Similarly, the auxiliary decision-making provided by LLM is only a general description in the process of using the foam fire extinguishing system. Usually use foam extinguishers to block oxygen, but the cone top tanks storing crude oil need special fire-fighting tactics. The detailed method is involved in the industry standard *Fire Suppression Treatment of Atmospheric Tanks* (SY/T 6306-2008) [9]. Through the search of knowledge in the knowledge map, it can be added to the auxiliary decision-making, and it can accurately correct special situations, and further demonstrate standardized documents from which knowledge comes.

## 5 Conclusions

Based on constructing the basic corpus of standardized emergency documents, the combination of knowledge graph construction technology and large language models is an effective technical path to achieve highly efficient auxiliary decision-making based on standardized documents. It can solve the problems of poor implementation effectiveness and low use efficiency of standards in emergency situations. However, the specific implementation of the technological path still needs to further break through the construction of models and algorithms in each link, and connect various technical details.

**Fund Project.** The work is supported by National Key R&D Program of China (Grant No. 2021YFF0600400).

## References

[1] You Weijia, Meng Yunzhu, Yang Yuexiang, et al. Research on the Construction and Application of Knowledge Graph Based on Emergency Response Standards [J]. Intelligence Theory and Practice, 2023,46 (11): 164-173. DOI: 10.16353/j.cnki.1000-7490.2023.11.021

[2] Yang Yuexiang, Liu Wenling, Lin Ruiting, et al. Research on an automatic identification method for emergency elements in sudden events [J]. Library Forum
[3] Zhao W X, Zhou K, Li J, et al. A survey of large language models[J]. arXiv preprint arXiv:2303.18223, 2023.
[4] WS/T 370-2022, Standard for Compilation of Basic Datasets of Health Information [S]. Beijing: China Standard Publishing House, 2022
[5] Jonathan K. Best practices for implementing ChatGPT, large language models, and artificial intelligence in qualitative and survey-based research [J]. JAAD International, 2024, 14 22-23.
[6] Gaël M L, Balázs K, T M H, et al. Uncovering the semantics of concepts using GPT-4. [J]. Proceedings of the National Academy of Sciences of the United States of America, 2023, 120 (49): e2309350120-e2309350120.
[7] W G L. LLMs are not ready for editorial work. [J]. Nature human behaviour, 2023, 7 (11): 1814-1815.
[8] Sun Wanfu, Guo Xiuyun, Zhai Liangyun. Emergency Quick Reference Manual for Common Hazardous Chemicals (Third Edition) [M]. Beijing: China Petrochemical Press, 2018
[9] SY/T 6306-2008, Fire extinguishing treatment for atmospheric storage tanks [S] Beijing: China Standard Publishing House, 2008 Health Chinese Center for Diease Control and Prevention. Healthy China Operation (2019-2030) [EB/OL]. [2021-07-06]. http://www.chinanutri.cn/fgbz/fgbzfggf/202006/t20200622_217455.html.)