

## Research Article

### Text-based Research of Early Warning Platform from Food Complaint Texts

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**Abstract:** This study proposes a food complaint text early warning method based on the guidance of ontology and establishes a scientific and reasonable system of early warning, builds and improves the food security early warning platform. All of those make this study play a supplementary role in the research content of food safety regulators. Based on traditional early warning system, this study constructs food safety complaints warning platform model and builds the food domain ontology and expands food complaint document semantics to highlight the implicit semantics and improve the document's semantic accuracy. Through the calculation of similarity of theme characteristic vector and text categorization constructing classifier, make the automatic classification of food complaint documents based on the theme come true for those which are not correctly classified documents for unsupervised clustering, which can be the purpose of food safety alarm. Then, it is possible to use complaints about food safety for rapid and accurate text data processing, make the food safety regulators understand the food safety hidden trouble in time to protect consumers' rights and interests.

**Keywords:** Food safety, text classification, text clustering, text

## INTRODUCTION

Food safety is related to the national health and social stability and many other problems. In recent years, many food safety incidents occur frequently such as Minnie corporate' poisoning, clenbuterol, beef extract and so on (Mu-Hee *et al.*, 2005). All of these draw much attention to improving food safety. The occurrence of food safety problems not only makes our country suffer severe economic losses, but also affect consumer trust in government and even cause threat to social stability and long-term development of the country. Berrueta *et al.* (2007) so how to establish a long-term and effective mechanism of food safety supervision system to ensure the long-term stable food safety regulation is an urgent problem which needs to explore and solve the problem.

Along with the rapid development of Internet and gradually perfect food safety regulatory system, consumer can be involved in the regulation of food safety by complaining via the Internet (Wen *et al.*, 2011). Due to the increase in the number of complaints documents accompanying, the question about how to classify effectively from the vast amounts of complaints, desultorily document to meet the needs of different users for different information comes up.

The traditional document processing system is difficult to realize the semantic expansion and it is hard for the users to find the information they need from large document accurately.

From the perspective of social administration, with "food safety" and "crisis management" as starting points and introducing crisis management in management field to a long-term regulation and emergence response in food safety field, in this study, I used literature research, analytical induction, case study, expert consultation and field survey and so on to detect our deficiencies in food safety crisis management and systematically analyzed food safety related cases home and abroad, then put forward some solutions and suggestions, with the hope to further improve our food safety crisis management (Tao *et al.*, 2004).

We review and analyze domestic case study of Sale milk powder scandal and turbot fish event. Sale milk powder scandal exposed absent governmental regulation and uncoordinated regulators and poor inspection and quality standards system. Likas *et al.* (2013) the scattered success of turbot event highlights the importance of risk analysis. It tells that food safety assessment must be scientific and risk management decisions, while making, must give full consideration to our social and national conditions, risk communication channels should be unified, content easy to understand.

Food, with its essential character to human beings, food safe must be one among the most concerns in our society. Lots of food borne outbreaks and scandals reported in recent years, including melamine added infant formula, Sudan red in KFC, Nestle milk powder with excessive iodine, Haagen-Dazs "black workshop" Christopher and Hinrich (1999) and so on, have caused

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tremendous doubt and reflection on our food safety management mechanism, within which long-term regulatory functions of relevant departments, situation assessment and emergency response capability, media monitoring and control, investigation, popularizing food safety knowledge among common people, adaptability to international food safety standards, communication and many other cross-cutting issues are involved. The objective of this research is to explore how to improve our food safety miss management.

With the development of economy and the improvement of people's filing standard, food safety problem has attracted wide attention from the public. China is a developing country, since the perplexing reasons, China's food safety problems have become increasingly prominent. Starting from the early warning of food safety work, to solve the food safety problem, can the problems before, pay attention to its dynamic, forecast evaluation period, make the necessary tips, take appropriate measures, to prevent the occurrence of food safety problem, this is undoubtedly the most scientific, the most economical, the most effective. So the study of food security early warning mechanism is more important and urgent.

Forewarned is forearmed. For crisis management, prevention is the key.

There is no doubt, because of food safety related to people's vital interests, related to the thousands of households, so the topic has a range of global, continuous time, attitude sensitivity. "What can we eat today?"

Put forward new ideas and initiatives and continuous. Researchers have also gradually from the literature and the necessity of food safety early warning mechanism demonstration significance, more and more inclined to how to set up a food security early warning mechanism, the problem of global concern from the macro to the micro, from the broad field of consciousness to the concrete behavior level. In our Wubei Province, through the "Regulations" of food safety supervision and management the establishment of a long-term mechanism of Wubei province; Wuhan City, supervision: "the Wuhan municipal food safety

risk early of eight warning food safety mechanism" and "Wuhan city food safety supervision mechanism", from the policy level to do a more comprehensive norms and paper.

However, scholars on the reasons of the crisis and crisis early warning theory studies, but the content is less, the construction of crisis early warning mechanism and perfection of relatively small, in the direction of the research is mainly to the impact of the crisis of food safety research and response system, the construction of crisis early warning mechanism and perfection of less. Especially, how to establish a mechanism, build the mechanism, early warning mechanism for a region, a food industry and the regional characteristics and how the specific operation, to use what method research is not enough, plus food safety problems often perplexing, which is often sudden, involving extensive personnel the problem, complicated, involving many departments, sometimes show regional and timeliness, in short trivial complex.

Therefore, it is necessary for us to systematically study and analysis of construction and management, food security early warning system in developed countries and the United States of America and the EU as a reference, urgent therefore the subject research.

Food security early warning system construction and perfection of local adaptation, found hidden in a timely manner, can prevent the occurrence of security incidents from the source, greatly save manpower, material resources, financial resources, both from the economy, or from the social harmony, people's happiness and good health and so on, have a big contribution to society, so the topic is efficient to solve problems.

## METHOD AND TEXT ANALYSIS

We define related concepts, introducing crisis management theories and how to apply these theories to food safety crisis management. Conclusions drawn from studying our food safety crisis management status

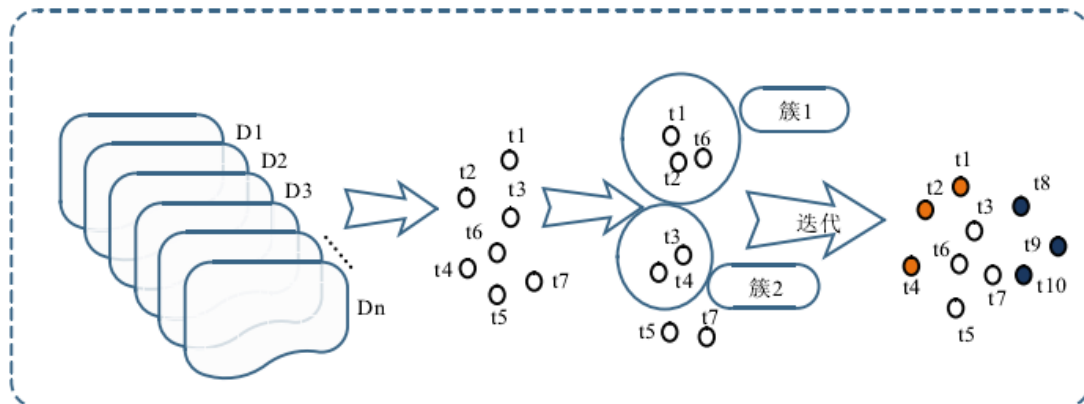


Fig. 1: K-means algorithm

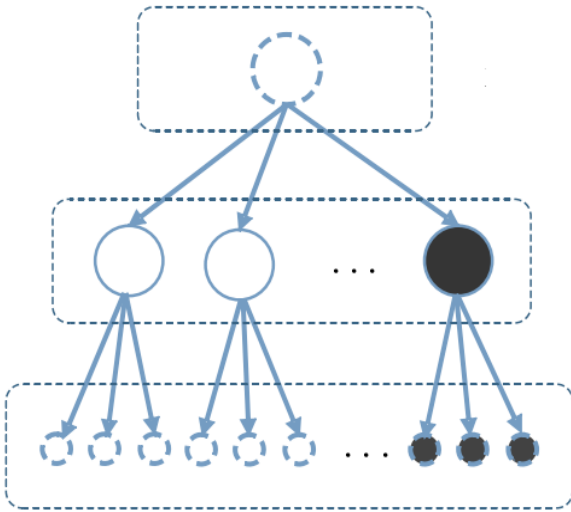


Fig. 2: Topology architecture

quo are as below: a crisis response system from national to local levels has basically formed, including major food safety emergency headquarters from nation to local wide, daily management institutions and experts Advisory Committee, (Fig. 1) but our segmented regulation pattern may still offset these efforts. China has initially formed emergency reporting and information disclosure systems, but has not yet formed an independent investigation mechanism or forecasting and early warning mechanism, plus, emergency plans need to be more operable and pragmatic. Legislation and law enforcement are being improved gradually, but food safety standards and food safety testing need strengthening, together with prevention and tracing technology; risk communication gains more and more attention though, still remains a weak point.

This is about food safety management in United States. The U.S. food safety management system is based on a robust and flexible federal and local legal system and highly industrial discipline. Federal, state and local departments complement each other; co-manage food safety in the United States, with open and transparent information, clear and full accountability, risk-based food safety analytical methods and early warning system, efficient food safety monitoring systems, orderly food borne outbreak investigation system as well as food recall system. To better deal with the emerging challenges in the field of food safety, the United States also makes significant change of its food safety regulatory system, including enacting Food and Drug Administration Food Safety Modernization Act, (Fig. 2) initiating Federal Food Safety Working Group as coordination centre responsible directly to the President.

We review "the tainted spinach events" and "Salmonella contaminated peanut butter event" in the

US. In dealing with the poisoned spinach, the US set us a good example of its emergency early warning mechanism characterized by unified management, territorial-based and hierarchical response, meanwhile provides us reference of reducing food safety risks and effectively responding to food safety crises, including regulating production standards, encouraging regional marketing agreement, (Food security law of the People's Republic of China, 2009) enhancing the study of food safety standards, improving traceability system, well monitoring and control the mass media. Salmonella contamination peanut butter event, on the other hand, highlights the importance of a strict food recall system and food production safety management.

### SUGGESTION

We present some suggestions to improve China's food safety crisis system. First of all, overall leadership in food safety coordination should be management strengthened; non-governmental organizations should play a more important role. Second, early crisis warning mechanism should be built through diverse channels (including real-time monitoring of domestic and foreign media, researching professional literature, detecting the potential risk in advance, analyzing historical data of early warning system, identifying risk variation, information sharing among different regulators, introducing third-party accreditation, risk sourcing from lists of restricted import, improving reward systems, etc.); the quality of practitioners need to be improved, morally and technologically; establish post evaluation mechanism; play the role of food safety expert database in a real sense. Zhang and Liu (2008) finally, strengthen risk communication skills; establish a unified nationwide food certification traceability system covering the whole process from farm to table; strict punitive system a sounding food recall system and relevant operating system (Fig. 3).

**Methods:** With the development of economy and the improvement of people's filing standard, food safety problem has attracted wide attention from the public. China is a developing country, since the perplexing reasons, China's food safety problems have become increasingly prominent. Starting from the early warning of food safety work, to solve the food safety problem, can the problems before, pay attention to its dynamic, forecast evaluation period, make the necessary tips, take appropriate measures, to prevent the occurrence of food safety problem, this is undoubtedly the most scientific, the most economical, the most effective. So the study of food security early warning mechanism is more important and urgent. Eq. (1):

$$S : \{x_1, x_2, \dots, x_D\} \rightarrow F : \{y_1, y_2, \dots, y_d\} \quad (1)$$

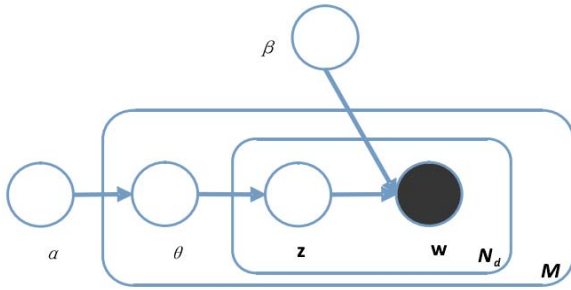


Fig. 3: LDA model

Forewarned is forearmed. For crisis management, prevention is the key. Eq. (2):

$$g(x) = wx + b \tag{2}$$

There is no doubt, because of food safety related to people's vital interests, related to the thousands of households, so the topic has a range of global, continuous time, attitude sensitivity. "What can we eat today?" Eq. (3):

$$\xi_i = y_i(wx_i + b) \xi_i \geq 0, \forall i \tag{3}$$

Put forward new ideas and initiatives and continuous. Researchers have also gradually from the literature and the necessity of food safety early warning mechanism demonstration significance, more and more inclined to how to set up a food security early warning mechanism, Tao *et al.* (2004) the problem of global concern from the macro to the micro, from the broad field of consciousness to the concrete behavior level. In our Hebei Province, through the "Regulations" of food safety supervision and management the establishment of a long-term mechanism of Hebei province; Shijiazhuang City, supervision: "the of eight warning food safety Shijiazhuang municipal food safety risk early mechanism" "Shijiazhuang city food safety supervision mechanism", from the policy level to do a more comprehensive norms and paper. Eq. (4):

$$\xi_i = \frac{1}{\|w\|} |g(x_i)| \tag{4}$$

However, scholars on the reasons of the crisis and crisis early warning theory studies, but the content is less, the construction of crisis early warning mechanism and perfection of relatively small, in the direction of the research is mainly to the impact of the crisis of food safety research and response system, the construction of crisis early warning mechanism and perfection of less. Eq. (5):

$$y(x_i, c_j) = \begin{cases} 1 & x_i \in c_j \\ 0 & x_i \notin c_j \end{cases} \tag{5}$$

Especially, how to establish a mechanism, build the mechanism, early warning mechanism for a region, a food industry and the regional characteristics and how the specific operation, to use what method research is not enough, plus food safety problems often perplexing, which is often sudden, involving extensive personnel the problem, complicated, involving many departments, sometimes show regional and timeliness, in short trivial complex. Eq. (6)-(8):

$$score(x, c_j) = \arg \max_{j=1}^m \sum_{i=1}^k sim(d, x_i) y(x_i, c_j) \tag{6}$$

$$P(C_i | d) = \frac{P(d | C_i) P(C_i)}{P(d)} \tag{7}$$

$$P(C_i) = \frac{N_i}{N} \tag{8}$$

According to the characteristics of food safety crisis in our country, the early warning mechanism of food safety crisis should include the countrywide food supervision and examination system, information collection and analysis system, forecast, prevention and control system. Firstly, a comprehensive food safety supervision and examination mechanism should be constructed by a central authority which can organize and coordinate all relevant departments to act as a core and to form a network. Secondly, a food safety information center should be established, whose main task is to collect, analyze, classify and assess the information database. Thirdly, the task of food safety crisis forecasting should be executed by expert analysis system and must be promptly notified to the public. Lastly, effective intervention measures must strengthen to prevent, eliminate or ease a food safety crisis. Eq. (9)-(11):

$$P(d | C_i) = \prod_{k=1}^m P(t_k | C_i) \tag{9}$$

$$C_{NB} = \prod_{k=1}^m P(t_k | C_i) P(C_i) \tag{10}$$

$$d_{avg}(c_i, c_j) = \frac{1}{n_i n_j} \sum_{p \in c_i} \sum_{p \in c_j} |p_{ik} - p_{jk}| \tag{11}$$

The early warning system also needs the supports of proper organization system, legal regulations and standard systems. It should be formed from central government to local ones and laws of food safety crisis management as well as standard systems of food safety are also urgently needed. Eq. (12)-(15):

$$d(c_i, c_j) = \sum_{k=1}^n |m_{ik} - m_{jk}| \tag{12}$$

$$d(c_i, c_j) = [\sum (p_{ik} - p_{jk})^n]^{\frac{1}{n}} \tag{13}$$

$$d(c_i, c_j) = \max_{1 \leq k \leq p} |p_{ik} - p_{jk}| \tag{14}$$

$$p(w_i) = \sum_{j=1}^T P(w_i | z_i = j) P(z_i = j) \tag{15}$$

From the perspective of Public Management, the frequently accrued food security incidents have very important association with the confusion of food security regulatory secularism and lack of the early-warning mechanisms. This article will introduce the theory of the early-warning to the study of food security crises, to strengthen supervision of food quality and security, to create a dynamic, efficient, integrate food security early-warning theory and nip it in the bug. Eq. (16)/(17):

$$p(w | d) = \sum_{j=1}^T \varphi_w^j \cdot \theta_j^d \tag{16}$$

$$I(\alpha | \beta) = \sum_{i=1}^M \log p(d_i | \alpha, \beta) \tag{17}$$

The food safety practices in the United States, European Union, Japan, Denmark and other developed countries and regions were analyzed from two dimensions, namely the regulatory systems and legislations (policies, laws and technical standards). The comparison indicated that it would be necessary to integrate the responsibility divisions of the food safety regulatory bodies in our country, according to the natural process of food production, food processing, food circulation and food consumption and the specialized capacities of different supervision bodies. It should that it was ideal to put the whole supervision of most of the single product under one department. At the same time, we should learn advanced experience from developed countries and regions and establish highly effective and scientific food safety rules, technological regulations and standards that are in line with international practices, thus to meet the need of the internationalized supervision of food safety and to construct a safeguard for food safety through perfect supervision system. Eq. (18):

$$P(w, z) = P(w | z) P(z) \tag{18}$$

Under the guiding principles of public administration theory and economic theory and other related theories, given to the practice of establishing and improving the China's socialist market economic system, this dissertation, based on the current status of

China's food safety regulation and the experiences in developed nations and regions, using theoretical and empirical analysis methods, qualitative and quantitative analysis approaches, systematically explored the mechanism and patterns of and approaches for food safety supervision in accordance with the principles of systems engineering and the logical structure of system constituents developed countries and regions, foreign experience and practices based on the use of and theoretical analysis, qualitative analysis and quantitative analysis methods, in accordance with the systems engineering principles, based on the constituent elements of the regulatory system. The dissertation is divided into 10 chapters according to the logical relations and structures. Eq. (19)/(20):

$$P(w | z) = \left( \frac{\Gamma(W\beta)}{\Gamma(\beta)^W} \right)^T \prod_{j=1}^T \frac{\Gamma(n_j^w + \beta)}{\Gamma(n_j + W\beta)} \tag{19}$$

$$\frac{1}{P(w | T)} = \frac{1}{M} \sum_{m=1}^M \frac{1}{P(w | z^{(m)})} \tag{20}$$

Food products have the features of credence goods. Being a kind of public goods, there exist externalities, information asymmetries in food supply, so market failure is quite common.

To address the market failure in food safety, the fundamental solution lies in the governmental regulation the "visible hand", to offset the limitations of market mechanism. However, years of regulatory practices show that the effect of government regulation is not satisfactory; the malfunctioning of governmental regulation is still plaguing the whole society. Theoretically, the fundamental reason for government failure is that we still do not have a profound understanding of the food safety supervision mechanism; all these are the important issues concerning food safety and need to be clarified. The understanding to connotation and extension of food safety concept has not reached unanimity, the decision mechanism of food safety is not yet clear and have not the ways and means to construction cheap and efficient regulation mechanisms, especially on how to create conditions suited to China's regulatory system less. Therefore, the study of China's food safety monitoring system has great theoretical and practical significance:

$$\begin{aligned} w_i | z_i, \phi_{z_i} &\sim \text{Discrete}(\phi^{(z_i)}) \\ \phi &\sim \text{Dirichlet}(\beta) \\ z_i | \theta^{(d_i)} &\sim \text{Discrete}(\phi^{(d_i)}) \\ \theta &\sim \text{Dirichlet}(\alpha) \end{aligned} \tag{21}$$

As mentioned earlier, China's specific national conditions based on, food safety issues have become increasingly prominent, for us such a large developing country, but also in a period of rapid economic growth, industrialization degree increasing, the rapid development of food processing enterprises and the excessive emphasis on economic benefits and neglect of safety, or at the expense of the cost of safety chase profit and so on, the food security early warning mechanism we brook no delay. Therefore, it is necessary for us to systematically study and analysis of construction and management, food security early warning system in developed countries and the United

States of America and the EU as a reference, urgent therefore the subject research.

### RESULTS AND DISCUSSION

The crisis of food safety threatens people's health seriously, blemishes the government's credit and even influences the society's stabilization and the national security. From the perspective of public administration, that the food safety crisis occurs frequently in our country is possibly caused by the chaos of food safety supervision and management as well as the lack of early warning (Fig. 4).

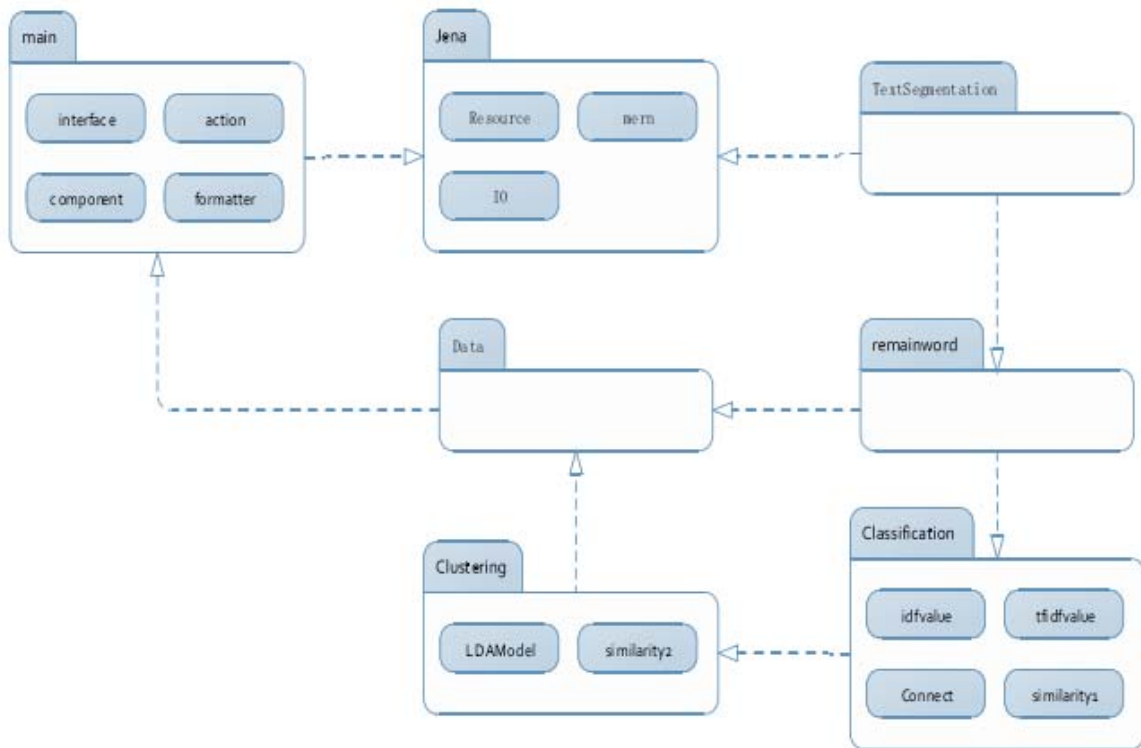


Fig. 4: Early warning platform

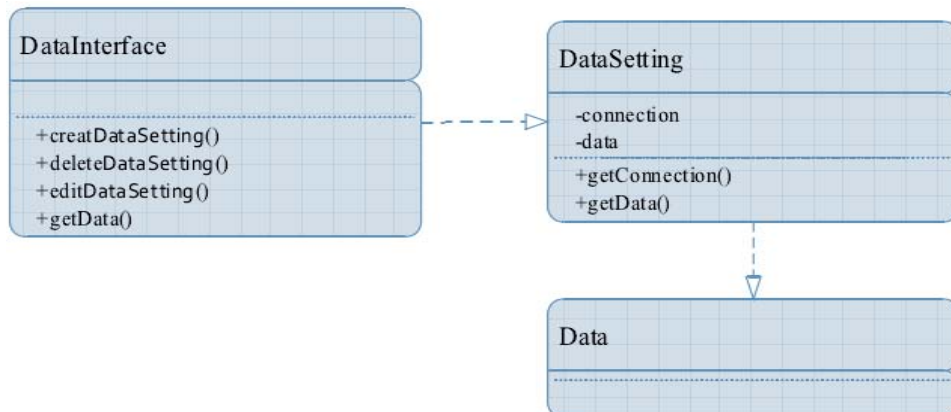


Fig. 5: Data layer

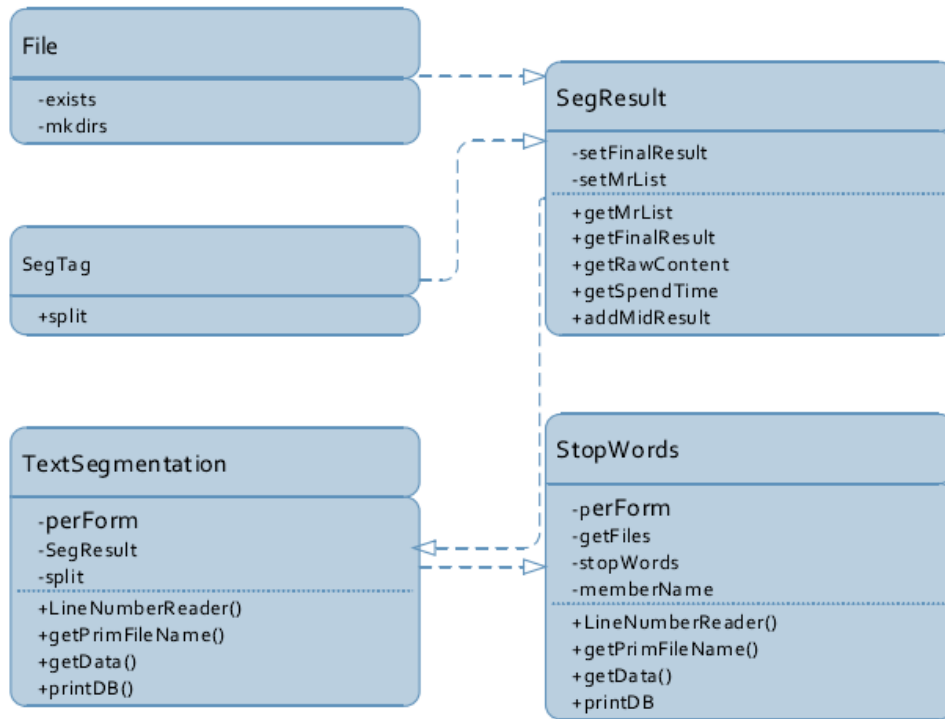


Fig. 6: Text handle

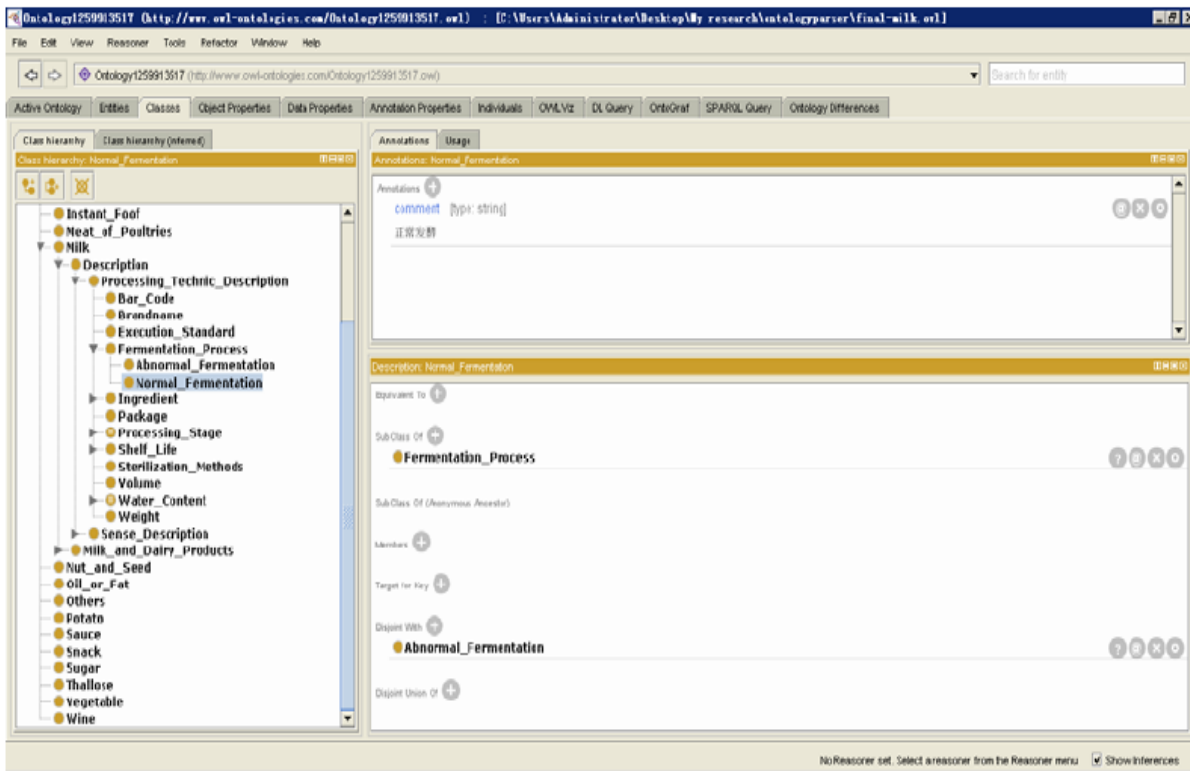


Fig. 7: Frame

Food security early warning system construction and perfection of local adaptation, found hidden in a timely manner, can prevent the occurrence of security

incidents from the source, greatly save manpower, material resources, financial resources, both from the economy, or from the social harmony, people's

happiness and good health and so on, have a big contribution to society, so the topic is efficient to solve problems (Fig. 5 and 6).

This article attempts through to the basic theory of food security early warning mechanism, in contrast to the developed countries food security early warning mechanism experience and practice, have developed national food security early warning work inspiration for us, for we compared with the developed countries in the presence of food security early warning work gap, deficiencies and shortcomings, research on early warning of food safety in China enlightenment and reference, so as to find the measures and methods suited to our actual conditions (Fig. 7).

### CONCLUSION

Food safety early-warning measures and methods proposed in this study mainly in the following aspects: strengthening the propaganda, set up and improve the legal system, strengthen the cooperation between departments, the establishment of long-term mechanism, working play the fine management and establishment of traceability system, improve risk monitoring, media role. This study also analyzed the Shijiazhuang city food safety alert status and put forward the improvement measures and suggestions are feasible.

### ACKNOWLEDGMENT

This study is supported by Zhejiang Provincial Key Research Base of Management Science and Engineering and Zhejiang Industrial Development Policy Key Research Centre of Philosophy and Social Science of Zhejiang Province (SIPM1105).

### REFERENCES

- Berrueta, L.A., R.M. Alonso-Salces and K. Heberger, 2007. Supervised pattern recognition in food analysis. *J. Chromatogr. A*, 1158(1): 196-214.
- Christopher, D.M. and S. Hinrich, 1999. *Foundations of Statistical Natural Language Processing*. The MIT Press, Cambridge, ISBN: 0262133601, pp: 680.
- Food Security Law of the People's Republic of China, 2009. Part Ten by Law, Article Ninety-nine, 11(6): 29-38. (In Chinese)
- Likas, A., N. Vlassis and J. Verbeek, 2013. The global k-means clustering algorithm. *Pattern Recogn.*, 36(2): 451-461.
- Mu-Hee, S., L. Soo-Yeon, K. Dong-Jin and L. Sang-Jo, 2005. Automatic classification of web pages based on the concept of domain ontology. *Proceeding of the 12th Asia-Pacific Software Engineering Conference (APSEC)*. Asia-Pacific, 15: 645-651.
- Tao, L., M. Sheng and O. Mitsunori, 2004. Document clustering via adaptive subspace iteration. *Proceeding of the 27th Annual International ACM Conference on Research and Development in Information Retrieval (SIGIR'04)*, pp: 218-225.
- Wen, L., M. Duoqian and W. Weili, 2011. Two level hierarchical combination method for text classification. *Expert Syst. Appl.*, 38(3): 2030-2039.
- Zhang, J.B. and X.M. Liu, 2008. The current situation and application of risk assessment methods on food additives. *China Food Addit.*, 18: 46-51. (In Chinese)