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Research Article

Research on the Food Safety Information Management System based on the Data Flow Technology

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Abstract: Food is the paramount necessity of the people. Food is the material foundation of human survival and food safety is the most basic insurance. Food safety crisis management mechanism of local government has an important significance on deepening the theoretical research of food safety crisis management perfecting the food safety management function and management mechanism. This study conducted a deep research on the food security issues from public management crisis management theory, institutional economics and other theories; and based on the food security crisis management it carried a research on mechanism in order to put forward feasible policies and suggestions on food safety problem for local government. The food safety information management system based on data flow technology is also constructed in this study.

Keywords: Agent-oriented, data flow technology, evaluation system, food safety, information, information management system

INTRODUCTION

In recent years, the increasing food safety incidents not only cause serious damage to health and life safety of consumers, also have significant effects on economic and social development. Therefore, the government's regulation of food safety is increasing and enterprises also pay more and more attention to food safety management of supply chain to control food safety risk and achieve sustainable development. However, food supply chain management does not work efficiently, which is difficult to achieve dual optimization goal of food safety and earnings.

There are a series of links and a lot of related hazards from food from production to consumption (Xu, 2005). Any elements of the hazards are likely to lead to serious food safety incident. According to food safety management system, link and monitor the whole process information of food chain from production to consumption is considered a viable program to achieve food "from farm to table" quality and safety management. Food safety traceability system, which makes the core idea of food safety management come true, has an important significance to the achievement of food safety management (Redmond and Griffith, 2004).

The food safety informatization supervision has been recognized as one of highly effective and flexible food safety management models in the world (Yapp and Fairman, 2006). The model, consisting of food information traceability system, food safety credit system, food safety expert inquiry system, database system, food safety monitoring, alarming and quick responding system, is characterized by a clear division of responsibilities among supervision departments, closely related management processes, food safety risks analyzing and controlling, open and transparent food safety information and so on. It is an advanced management model that worth referring to and learning from since it has realized a thorough supervision on food safety (Baiman *et al*., 2000). Since it has realized effective thorough supervision on food safety, it is an advanced management model that worth referring to and learning from (Darby and Karni, 1973). Therefore, this work is seeking for an idea for developing food safety informatization management in China by considering Chinese characteristics as well as basing on an analysis on food safety management system (Ehiri *et al*., 1995). Finally, specific suggestions on constructing and improving the food safety informatization management system of China are proposed (Wang, 2004).

The model of food safety traceability chain is constructed in this work. Study and establish the food safety traceability chain hierarchical model based on the analysis of food chain and analyzes the granularity, integrity and key identification about the food traceability chain. Build the fault tree of the food traceability chain and propose the structure function. Solve the fault tree for minimum cut set using the method of qualitative analysis and calculate the probability of occurrence in a fault tree using the quantitative analysis method. Figure out the structural importance, probability importance and key importance

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of food traceability chain fault tree by means of the quantitative analysis method (Wang and Zhao, 2008).

The logic model of food safety traceability system and analysis the function, aim, executive object is also put forward. Design the framework of the food safety traceability system, the structure of multiple platform traceability. Present the key steps of establish the traceability system for organization; and introduce the process of setting up food safety traceability system take the navel orange as example based on the angle of view of the food chain.

This study conducted a deep research on the food security issues from public management crisis management theory, institutional economics and other theories; and based on the food security crisis management it carried a research on mechanism in order to put forward feasible policies and suggestions on food safety problem for local government. The food safety information management system based on data flow technology is also constructed in this study.

MATERIALS AND METHODS

Introduction and implication: What is "informatization"? It has different definitions to scholars all over the world as different perspectives will result in different descriptions and definitions on "informatization". After analyzing and integrating definitions of "informatization" by scholars, the author has chosen a definition of "informatization" that best meets food safety management informatization requirements, that is, informatization refers to a process of creating organize preparatory, social economy and science technology with best conditions for meeting informational requirements from citizens, state organs, institutions and social organizations and realizing their rights and interests through organizing and using information resources (Schwagele, 2005).

Upon that, the "informatization" in food safety informatization management model is regarded in this work as having dual concepts-"management" and "service". The "informatization" in food safety management is not only a technical concept, but also contains informatization on management philosophy and method. Firstly, it is on information resource-informatization requires a quantity accumulation on information resource and a guarantee on quality, as well as a consistency between quantity and quality; not only a focus on collection and accumulation of information quantity, but also screening, analyzing and integrating information so as to make information support decisions effectively. Secondly, on information technology, it requires to popularize Internet and communication technology and realize artificial intellectualization of information system. Thirdly, it is informatization on management foundation-requiring to formulate information-related laws and regulations, creating an information disclosing and sharing system, promoting information broadcasting standardization, developing information concepts and information consciousness among the public and so on (Roberto, 2006).

Basic model and framework: The food safety management system of European Union is consisting of four parts: Firstly, tracking and recording the food supplying chain and processing chain and creating profiles and a traceability system; secondly, creating a food safety credit system and adhering to open and transparent information; third, creating a powerful expert inquiry system and databases to provide powerful support for the government to make decisions; finally, creating a food safety crisis emergent response system by basing on modern advanced Internet technology and communication technology. As to specific measures, European Union has began to apply EAN UCC tracking system for all beef products in all countries of European Union at the beginning of the 21st century. And in 2000, EU parliament and EU council co-formulated the 2000/1760E/C decree Traceability of Beef, which is a unified beef product traceability system that covers European Union and its major member countries. By recognizing, marking with codes, recoiling with profiles, tracking and monitoring all beef products in a unified way, the system can trace detailed information of every segment from beef product production to sales, as well as sources of every beef product, to guarantee their safety.

As a result of adhering to open and transparent food information by European Union, the European Food Safety Authority would publish all latest food-related information in time. Consumer representatives and related organizations are allowed to attend meetings held by the management council and invited to participate in some activities organized by the authority. As to management on food labels, European Union area has formulated strict regulations that explicitly require that the content of food labels should be accurate and reliable, provide real and comprehensive information related to the labeled food and guarantee information on labels are standard and unambiguous so that consumers will not be misled or cheated by labels. In as early as the late of 1970s, European Community (the predecessor of EU) has issued Directive of Food Labeling Statement and Advertisement Regulations. According to the directive, labels on food packages should contain clear and accurate content on the project and standards instead of misleading or cheating content or content out of nothing. In 1990s, to further improve the management on food labels, European Union issued a more comprehensive and standard management rule-Directive on Nutrition Labeling for Foodstuffs. In addition to universal general management rules, the

directive also contains special management rules for specific food (called as special instruction), such as rules on labels on genetically modified food, feed, organic food and others. According to the directive, certain types of food that used to have safety problems should be marked with specific labels.

Integrating effective information resource to support decision-making and establishing a food safety expert inquiry institution and database system: As to constructing a food safety expert inquiry system, European Food Safety Authority has set up a Scientific Steering Committee and eight special science groups consisting of members that have gone through professional assessments and strict screening and of certain academic authority. The Scientific Steering Committee is responsible for overall coordination on food safety problems while the eight scientific groups have definite responsibilities and duties respectively though they are generally working on monographic studies and scientific evaluations on food safety with a view to provide scientific and technical support for European Food Safety Authority to make decisions through providing information and data. If EU Commission wants to come up with certain legislative suggestion on food safety, it should communicate with the committee and science groups for suggestions. From that we can know that legislation on food safety in European Union is based on scientific guidance and featured by certain scientific and a sound and powerful expert database support. In addition, in special periods when food safety crises happen, scientists that are responsible for food safety in European Union countries should be responsible for one special institution-Food Safety Crisis Handling Group. As an institution for dealing with food safety crises, the group will be provided with as many data support and technical guidance as possible by the committee and science groups when food crises happened so that the handling group can deal with food safety crises more scientifically and quickly.

European Union has a food safety database that covers the whole European Union system and contains EU food safety-related policies, as well as a regulation database and a food ingredient database. Data and information from the database is helpful to researchers for analyzing and studying the influence of various foods on human health and to food manufacturers for getting more information on food ingredient so as to develop new products and make food labels that are in accordance with laws and regulations. Meanwhile, the public can search for detailed information in food monitoring reports of previous years on websites of FVO and other management institutions.

Using advanced telecommunication technologies to establish a food safety monitoring, warning and quick responding system: In as early as 1970s, European countries have established a Rapid Alarm System for Food and Feed (RASFF). As a huge food rapid alarm and emergency system, RASFF covers European Food Safety Authority (EFSA), European Food Management Committee and member countries of European Union. When food safety problems that may endanger human health have appeared in member countries of EU or third party countries, RASFF will be started up immediately to inform all EU countries about the problems so as to prevent unqualified foods from entering those countries. In addition, EU countries can advise EU Commission to start the alarm system when discovering there is a food safety crisis in certain area. The commission of RASFF will confirm the information immediately and inform EU countries about the crisis if it has been verified as true (Anderson, 2001).

Track the food supplying chain make food information traceable; and processing chain and record them in details; create a traceability system to realize an open create profiles to and transparent procedure that goes "from farmland to dining tables" so that foods bought by consumers can be guaranteed as safe. In specific, food information traceability system is a complete and closed procedure: Tracking, recording and filing every segment of foods from production; creating a detailed and continuous information flow; tracking and recording every segment from production to final consumption to facilitate tracking. Such management method is helpful for confirming every segment of food production, as well as their sources and usages. In addition, it can track inspected products quickly and accurately while monitoring and analyzing the influence of food on human being and environment timely and accurately.

By referring to the food traceability model of European Union, this study has established a bidirectional information flow model for food information tracking in China (Fig. 1). In the tracking system, food information flow is moving in both positive and negative directions; food information has been profiled since production and later segments are also profiled in sequence; the profile information will form an information flow that moves in positive direction and backtrack in negative direction to form a bidirectional flow model. The advantages of the bidirectional information flow are: real-time tracking on product usages; sending information to downstream segments quickly and accurately and releasing alarming information when a problem is identified in previous segments so as to call back all unqualified food in time; a realization of tracking when a safety problem has appeared in the next segment so as to identify the segment where the problem has appeared quickly and accurately.

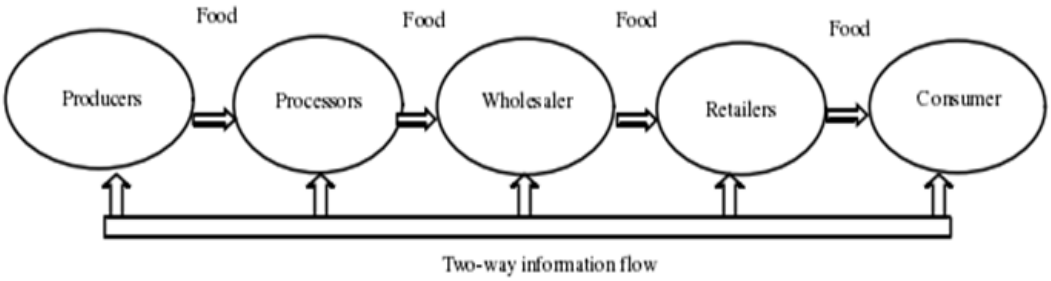

Fig. 1: Logistics and information flow of food traceability system

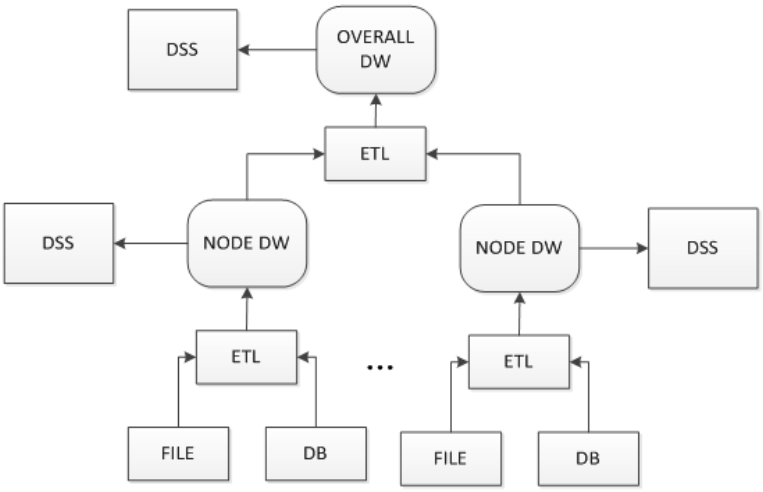

Fig. 2: The architecture of the information data flow system

The architecture of the information system based on data flow: In information grid, there will be many databases or files store the history data. The data often includes: traffic information, business information, etc. Many departments will need to analyze its own data in the nodes, so we can design some node flow. The node flow will extract its data from the online transaction database or file. The overall data flow will extract data from every node flow by ETL tools. The ETL tools are used in data flow to extract and transform data from data source. The architecture of the information grid data flow system is given in Fig. 2.

In Group Company or large organization, there will be many departments inside of their organization. These departments often locate in different place of the world each department will need to construct their own data flow called node flow. The overall department will need to realize the entire information of the Group Company or organization, so they need to construct the overall data flow. With the node flow, using DSS the direct department will analyze its data for decision; the overall department will analyze the overall information data for the overall decision.

Data marts are usually smaller and focus on a particular subject or department. Some data marts, called department data marts, are subsets of larger data flows. Each data mart is used for a direct analysis, for instance; selling analysis, product analysis, etc. Compare with the node flow, the data marts and the node flow are two different concepts.

The node flow can contain some data marts and the overall data flow contains some data marts too. They are all subject oriented. They maybe contain the same subject. But in fact, the node flow's data marts contain the node information and the overall data marts contain the overall information. The node flow usually is not subject oriented. For example, the node department is a sub company named company A, which is a sub company of a group company. So the node flow stores the sub company's information, the overall data flow store many sub company's information. The company A is a computer mainboard factory. This factory has a department of selling. So the company A's data flow is a node flow of the overall group company. The company A's dataflow will at least contains two data marts: selling oriented and product oriented. The data marts will also contain in the overall group's data flow. It is the difference and relation of the data marts and node data flow.

Using distributed data flow, we can analyze the node data and overall database. This strategy can reduce the cost of development and maintenance. In a group company, if we only construct an overall data flow to satisfy all the needs of each department, the

management will be very complicated. It seems impossible for the overall department to extract data directly from the distributed departments' on-line transaction database or file. So, we must develop distributed data warehouse to realize these needs. Hence, in information grid, we need to develop the distributed decision support system to analyze the distributed data.

The overall DSS can be disposed on the overall data flow. As discussed in the front of this study, the overall data flow can extract data from the node flow using ETL tools. The overall data flow will contain the entirely data of all node flows. In the overall DSS, the data are from all node flows. So the overall data flow will lie a problem; how to reorganize the overall flow. To resolve this problem, we can do the follow steps; First, analyze the node flow and pick-up the public information; Second, redesign the model of the overall data flow; Third, extract data from the node flow or node data sources last, design and code the DSS analysis model After designing and loading the overall DSS, we can use ETL tools to extract data from the nodes.

The data structure in data flow is established based on the business system data structure. The data transformation in the system not only completes the simple task of converting the data format for the aims of untying the data format, but also integrates semantic differences between the two business systems, such as time characteristic and summary characteristic. The system should redefine data name, type, description and relationship including: unifying data type, adjusting data length and increasing time attribute.

Unifying data type: The same data with different data types must be unified as the same type. For example, as far as the date field is concerned, a system is defined as the date data, in other systems, it is defined as character data and at last it should be unified as a character data.

Adjusting data length: If the same data own the inconsistent length, it should be adjusted for the unified length. If dealing with data's structure has the same structure with that of the data flow, data flow can load the data. After the data are loaded into the data flow, all records are ensured to be related to other table records and verify each record in the fact table related to the record in the dimension table which is used by fact tables. All of these validations could be realized by the referential integrity between dimension tables and fact tables.

RESULTS AND DISCUSSION

The realization of food safety credit module based on open food information: Upon a reference to the experience of opening food information of European Union, measures to construct a food safety credit system in China include:

- Applying advanced communication technology to establish a quick and accurate information communicating and reporting system to speed up information broadcasting and improve the accuracy.

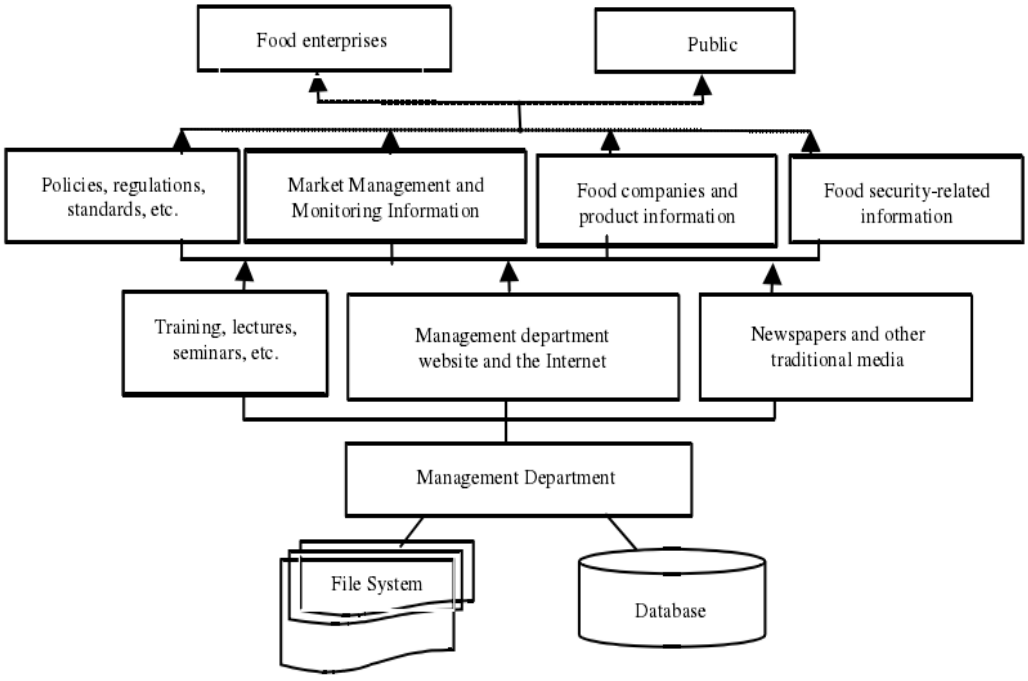

Fig. 3: Food safety information releasing and disclosing system

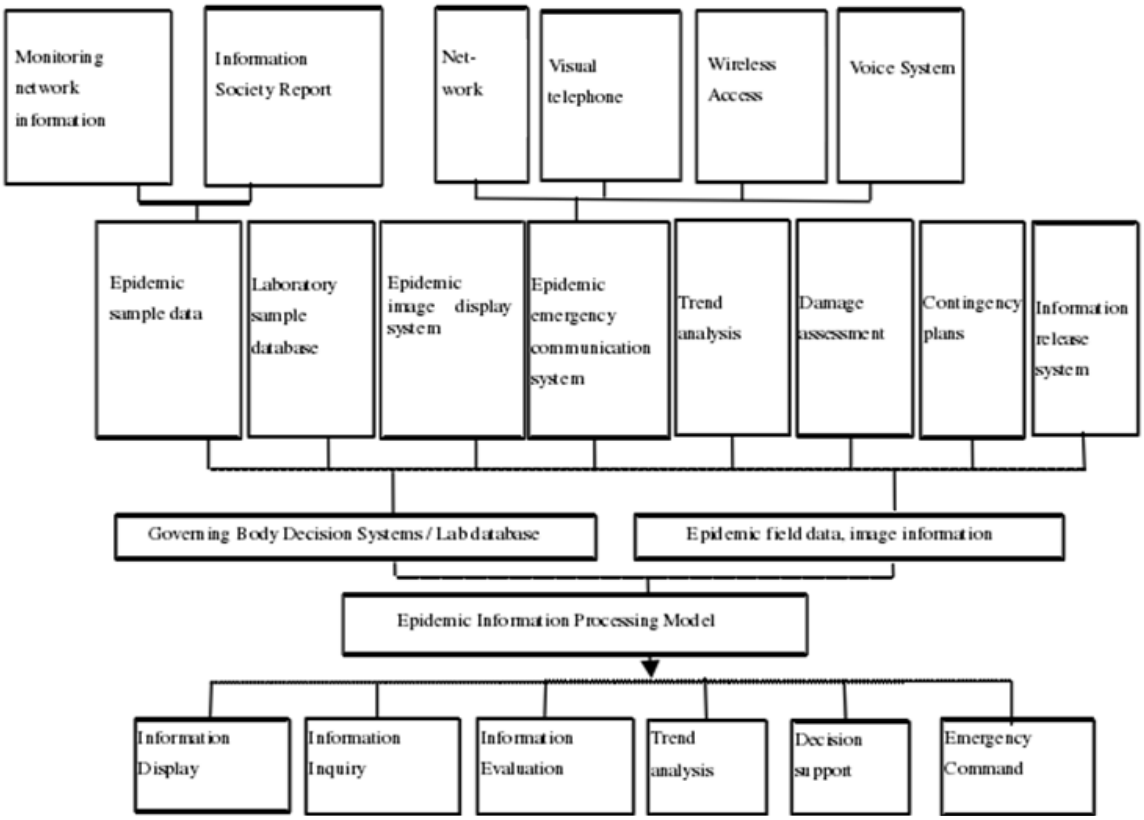

Fig. 4: Model of food safety emergency reaction system in China

- Governmental management departments should play a role of safeguarding information publication and take necessary measures to rectify information island, blocked information transmission and unbalance information acceptance. In addition, the management departments should provide related information services, as well as latest laws, regulations, policies, standards and other related information, for related enterprises and the public through various channels for free; finally, the departments should establish and release credit records on all enterprises, which is shown in the following Fig. 3.
- Establishing information release regulations and standards for related industries formulating access systems for various industries and supervising their enforcement.

From the food safety informatization management system of European Union, we can discover that tracking, monitoring and alarming food supplying chains and food borne diseases upon modern information technology so as to react to safety risks quickly and undertake emergency management is a very critical. It is necessary to establish a sound food safety emergency reaction information system. Upon that, this work has constructed a model of food safety emergency reaction system in China which is shown in Fig. 4.

CONCLUSION

This study conducted a deep research mainly based on the food security issues from public management crisis management theory, institutional economics and other theories; and based on the food security crisis management it carried a research on mechanism in order to put forward feasible policies and suggestions on food safety problem for local government. The food safety information management system based on data flow technology is also constructed in this study.

By analyzing and referring to food safety informatization management model of European Union, this work has explored an idea on practicing food safety informatization management in China. The analytic demonstration in this work has proved that it is possible to introduce the idea of informatization management into food safety management of China. In the final idea exploration, this work has teased out and analyzed the several modules of food safety informatization management of European Union to get a regular idea to be applied in China and come up with corresponding operational thoughts for every module. In spite of that, specific operational methods and technologies, as well as empirical analyses undertaken by combining specific cases, are not mentioned in the study since it is a study on idea. Meanwhile, qualitative analysis is a major analysis method applied in this study though a lot of quantitative analyses required for food safety

management are not mentioned. Therefore, the author will focus on the two points to further push and perfect the study content in later studies.

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