

2014

BioTechnology

An Indian Journal

FULL PAPER

BTAIJ, 10(24), 2014 [14816-14820]

Research of the dangerous chemical's road transport safety management system

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ABSTRACT

Dangerous chemicals plays an irreplaceable important role in the socio-economic development. But for many reasons resulted in severe loss of control, which led to the transport of chemicals has unsafe factors. We have designed a set of complete solutions. The relevant government departments are involved, and the production, purchase, transportation enterprise qualification, license centralized unified management, vehicles, drivers, guards, and relevant documents are to be investigated in the system, verifiable. Loaded, transported, disposed of the three aspects of the implementation of responsible system and mutual supervision. GPS module on the route of the vehicle, the speed of the entire process to monitor, control. Programs include business management, supervision and punishment, real-time monitoring, information sharing, rescue, decision support, and the function of responsibility. Program to further improve road transport safety management level to facilitate the full range of government departments supervision, reduce transportation accidents.

KEYWORDS

Road transport; Management of chemicals; Safety supervision; Emergency relief; Global positioning system.



INTRODUCTION

Dangerous chemicals are special chemicals which have flammable, explosive, toxic, harmful and corrosive characteristics, they play an active role in production development, change of the environment and the improvement of people's daily life, at the same time, because of its inherent chemical hazard, it poses a threat to personnel safety and causes damage to facilities and the environment. With the rapid development of chemical industry and economic construction in China, road transport volume and types of dangerous chemicals also gradually increase over time. In recent years, the occurrence of many leakage accidents of dangerous chemical in the nation has indicates the seriousness of the problem.

The problems that exist in road transport of dangerous chemicals are: insufficient transport capacity, overload and violating transport of toxic chemicals vehicle, and poor management of source of road transport and safety supervision, as well as unsound road transport crisis management mechanism.

The reasons for road transportation safety hazards are very complicated. In terms of enterprises, selling enterprise, using enterprise and transport service provider have chance; psychology, try every means to evade supervision, and pursue the maximum benefits at the expense of public safety. In terms of relevant departments of the government, ineffective government regulation and information sharing are the main problems. From the perspective of regulatory measures of poisonous chemicals road transportation, simple methods and bad effectiveness are the obvious issue. Regulators do not follow working requirements and implement scientific and systematic safety supervision in practice.

The main purposes of safety management system of dangerous chemicals are to improve road transportation safety management of dangerous chemicals and strengthen all-round supervision on transportation vehicles of dangerous chemicals, build an emergency rescue system for road transport accident of dangerous chemicals, improve emergency rescue technology and information support system, establish an effective rapid reaction mechanism, improve the capability of emergency rescue, reduce the loss as much as possible and the possibility of dangerous chemicals accident caused by former one through the use of advanced management methods in the field.

FOREIGN AND DOMESTIC CONDITIONS

In scientific research, at the beginning of 1980s, China began to attach great importance to assessment and control of major hazard source, "the study of significant dangerous source evaluation and macro control technology" was included in key projects of science and technology for "national eighth five-year plan", which offered great technical support for control and evaluation of major hazard source^[1]. In terms of legal system, the State Council issued the "Regulations on the safety administration of dangerous chemical goods" (referred to as no. 87 regulation), but the regulation does not adapt to the development of modern economy and has great limitations^[2]. The issuing and implementation of "Dangerous chemical safety management ordinance" provided a solid legal basis for safety management of dangerous chemicals, It also reflects No. 170 Convention concerning chemicals safety management in the world^[3]. In order to effectively manage dangerous chemicals production enterprises, China began strict safety review on enterprise through safety evaluation and issuing of safe production license, those which do not invest enough in safety or hide hidden danger will be stopped from production and management^[4].

OPERATIONAL ANALYSIS

Overall structure of system

Dangerous chemicals transport involves 3 kinds of enterprises and 8 government departments in dangerous chemical field, all the participants regard dangerous chemicals safety as their first priority in their work, they separately complete their working assignments, mutually guarantee safe production of dangerous chemicals, their business relationships are shown as figure 1.

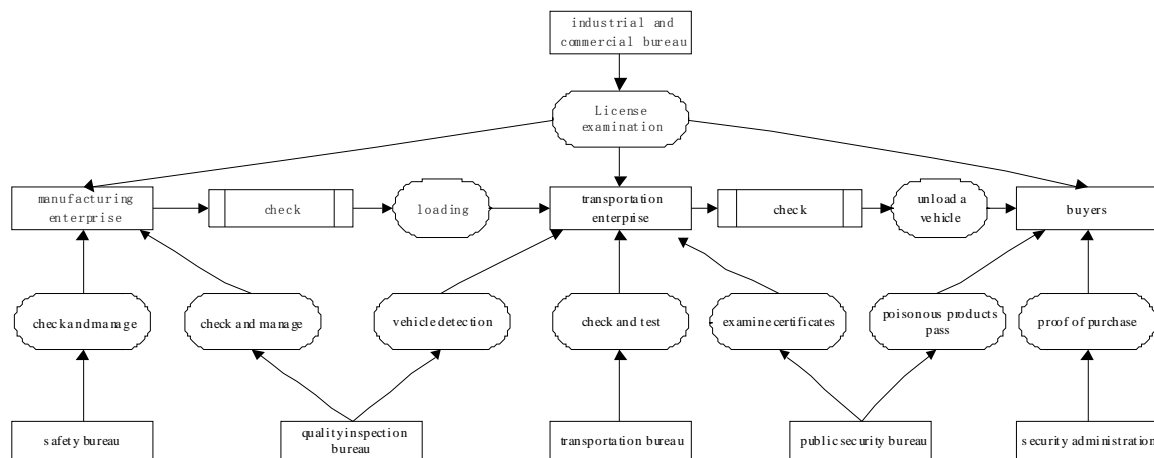


FIGURE1: The business relationship between the departments

In their mutual relationships, dangerous chemicals production, transportation and purchase are the most important parts, which are the also the main problems that need to be resolved urgently in the field.

Purchasing enterprises

Before loading of highly toxic chemicals, carry out field and online investigation on qualification of purchasing enterprises, transportation service provider, transport vehicle, drivers and supercargos, safety warning signs, "Highly Toxic Chemicals Purchase Proof", "Road Transportation Pass of Highly Toxic Chemicals", at the same time inspect and record conditions of transport vehicle to ensure their accordance with relevant provisions^[5].

Dangerous chemicals use enterprise

In addition to carrying out field and online investigation on qualification of dangerous chemicals purchasing enterprises, transportation service providers, transport vehicle, drivers and supercargos, safety warning signs, "Highly Toxic Chemicals Purchase Proof", "Road Transportation Pass of Highly Toxic Chemicals" before loading highly toxic chemicals, it is also of great importance to conduct whether any supercharge loading exists, if any problem is found, reporting to department of safety supervision is required. If no problem is found, do check online signature of related responsible persons. After unloading dangerous goods, responsible persons need to check volume, weight and sales data of unloaded highly toxic chemicals, any arbitrary unloading and sales behavior on the road are not allowed. If no problem is found during the inspection process, then recording inspection data and carrying out online signing are needed.

Dangerous chemicals transportation enterprise

It is necessary to record types, quantity, transport route and conditions of dangerous goods selling and using enterprises in detail, according to one car-one recording mode, with "Road Transportation Pass of Highly Toxic Chemicals" as the index.

Dangerous chemicals-related government departments

Safety supervision department: online review of various qualifications of dangerous goods production, use and storage enterprises, recording of these organizations' violating or even illegal behaviors with the use of regulatory penalties subsystem.

Traffic police department: field examination and online verification of "Purchase Receipt of Highly Toxic Chemicals" or "Purchase Permit of Toxic Chemicals", road transport business license of transporter, vehicle transport permit, vehicle transport permit, driving license of vehicle, ID cards and qualification certificate of drivers and supercargos, transport vehicle special mark and safety sign, transport route, delivery schedule and planned transport weight that are provided by applying enterprises.

Transport department: training and appraisal on legal representative, driver, supercargo of transport unit, issuing of qualification certificate, recording of training content, appraisal results, qualification certificate information, invigilator and certificate issuing personnel in the system for inquiry.

Quality supervision departments: Carrying out regular inspection on chemicals tank and recording information about inspection and responsible person of inspection in the system.

Department of industry and commerce: registration of hazardous chemicals production, management, storage and transport companies, and providing business license according to "Administrative Licensing Law of the people's Republic of China", supervision of dangerous chemicals business activities as well as prohibiting any unlicensed and illegal business behavior.

Environmental protection, health, fire control department: environmental protection evaluation on dangerous chemicals production, storage and transportation; Establishing and improving the mechanism of environmental protection rescue and the mechanism of the injured relief; Establishing an accident rescue experts database and a wounded experts database.

FUNCTIONALDESIGN

Business management

Business management is the core content of this paper, at the same time, businesses of production, use and transport companies, safety supervision, public security, transport, quality supervision, industry and commerce, environmental protection, health department and others are integrated in a platform. Data of all production and management activities are stored in a database. Main businesses are divided into the following three aspects:

(1). Management of basic information about production and using companies, and all required certificates; Management of information on daily inspection of corporate management, pre-arranged plan, risk source monitoring. Information on details of loading and unloading in production activities need to be recorded, and reporting is required in case of any violation behavior.

(2). Transport enterprises need to manage their basic information, all kinds of emergency plans, transportation license, information about drivers and supercargos, as well as their vehicles. Information about all production and operating activities need recording, all relevant vehicles shall be equipped with GPS positioning systems and relevant safety equipments.

(3). Main functions of relevant government departments include emergency plan management, management of all types of certificates, license approval and supervision of business activities, real-time monitoring and punishment management of vehicle. All departments cooperate with each other so as to ensure safe production. In order to ensure safe production of companies and government departments' effective supervision, the system has 7 models, namely, business management, regulatory penalty, real-time monitoring, emergency rescue, accountability, decision support and information sharing, according to analysis of business needs of all departments.

Real-time monitoring of vehicle

Through the installation of GPS monitoring platform on transport vehicle, government departments can realize real-time monitoring of dangerous chemicals vehicles in a certain region, and carry out inspection according to information on transport time, route and speed from database. In case of any illegal vehicle, the system can automatically alarm and display information on vehicle owner, driver and supercargo, then management person in control center can contact driver, supercargo according to the information for correcting the illegal behavior, all illegal information can be automatically transferred to the system's database, relevant departments can carry out punishment according to violations fact recorded in the system.

In addition, in order to effectively avoid dangerous chemicals vehicle entering crowded area, motor vehicle plate automatic identification system can be installed in intersection of prohibited area and connected with real-time monitoring platform. All existing dangerous goods transport vehicles are in blacklist, once any of them enters the forbidden area, automatic alarm occurs, at the same time, information on goods, vehicle owner, drivers and supercargo is displayed, personnel in monitoring center can contact illegal vehicle for correcting behavior. If auxiliary light source is provided, 24 hours monitoring can be realized in forbidden area. Work mode of GPS monitoring system is shown as figure 2.

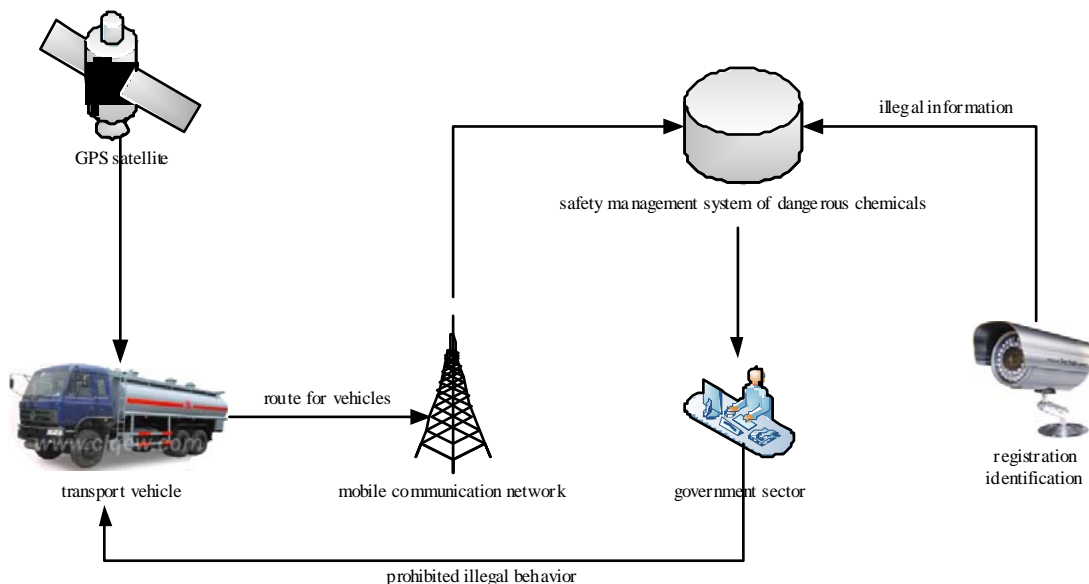


FIGURE2: The monitor and control system of GPS

Supervision punishment

Despite type of enterprises, if necessary certificates are not available, timely reporting needs to be done through the system. Safety supervision, public security, transportation, quality supervision, industry and commerce departments can verify and handle relevant issues according to reported information in this system and give handling results. In case of any irregularity, punishment may be given to enterprises or responsible persons.

Danger rescue

After receiving any alarm from dangerous chemicals vehicle, police personnel in command center confirm conditions of vehicle, driver and supercargo, starting point and destination, transport route, features of dangerous chemicals, rescue and protection requirements with the use of system information sharing platform, instructing officers who are on duty to take corresponding measures and informing transporting and using enterprises about information provided by the system, as well as alarming emergency rescue center in the city.

In addition to reporting to city government in a timely manner, emergency rescue center in the city shall also obtain dangerous chemicals accident emergency rescue plan, information from protection expert database, health rescue medical expert database, and inform relevant personnel for comprehensive starting of emergency rescue work. After a preliminary estimate, rescue response time is 5-20 minutes, and 30-60 minutes are needed for comprehensive rescue operation, and with smooth, timely and accurate flow of information, and effective implementation of field protection and rescue measures, accident caused by former one can be effectively avoided.

Responsibility investigation

For loading and unloading of all dangerous chemicals vehicles, issuing of related certificate and safety personnel appraisal, names of relevant responsible person need to be signed, in this way, corresponding responsible person can be found in case of any accident.

As for safety, traffic, quality supervision, public security and other departments concerned, the system has established a safety supervision chain in which responsibilities and responsible person are clear, at the same time, personnel in each department are required to fulfill their duties according to relevant rules and regulations. With this platform, relevant government departments restrain and supervise each other; when any accident resulting for ineffective supervision and negligence, dereliction occur, corresponding responsible person is subject to punishment.

Decision support

With stored information in the system, relevant users are provided with comprehensive data analysis functions, which mainly include statistical analysis on distribution, nature and economic type of enterprises, statistical information on filling, transportation and unloading, transport time and route of dangerous chemicals, as well as characteristics of illegal behavior, all of these information offer support for the government's scientific decision-making.

SYSTEMIMPLEMENTATION

At present, main design patterns of software development can be divided into 2 types: C/S mode and B/S mode. Although nowadays C/S model is still applied in some areas, in the internet age, C/S mode tends to show more and more shortcomings, which are shown as follows:

1) Low efficiency. Because client is directly connected to server, partial system resources of server is used for connection with client. Then when a lot of data is requested, the limited system resources of server will be used for connection with client, thus being unable to respond to data request in a timely manner. The excessive data request can cause rapid decline of overall operation efficiency of the system, and even its complete collapse.

2) Poor reliability. In the C/S structure, client application directly deal with database server, thus client has sufficient authority of accessing database, this means the existence of big danger.

3) Difficult maintenance and poor portability of program. Since application logic is encapsulated in the client application, centralized control and management of it is impossible. All clients need to be updated once application encounters any change. Distribution work of client application is tedious and unacceptable. And this is not realistic for distribution characteristics of the system in this paper.

This system is used in near 1000 clients, what is more, most of them are chemicals production and transportation enterprises, and the obvious features are wide distribution and poor computing ability, if using C/S mode, system installation and maintenance are almost out of the question. Considering the actual situation in the field, B/S mode is adopted in the development process of this system.

B/S access model is adopted in this system, with two servers used in the whole system. A network card of WEB server is connected to the internet, while another network card is connected to database server, thus reducing the possibility of database server being attacked and increasing its safety level. The two servers are equipped with database, WWW service is configured, and hot backup is realized between them. Role change can be realized manually at any time, system operation can be restored in the shortest period of time when any unexpected breakdown takes place. All users can access the system through Internet access, in addition to that, there is no time and geographical constraints.

SUMMARY

In this paper, various problems are studied through the analysis of current dangerous chemicals transportation, at the same time, some solutions are proposed. And the author determines to develop dangerous chemicals safe transportation management system which is based on B/S mode with the use of .Net, Oracle and GPS technologies. The GPS real-time monitoring module makes the supervision of transport links in which the occurrence of problems are most likely possible; Government supervision punishment module facilitates the effective constraint and standardization of corporate behavior; while, decision support module offers sufficient data for the government departments' comprehensive and good understanding of dangerous chemicals production

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