Emergency materials scheduling in the context of Internet+

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Abstract

Population, resources, environment, public health and other social conflicts with the social development have become increasingly prominent, resulting in a variety of public safety emergencies worldwide have occurred to the social, economic and other serious damage and impact. Emergence's degree of harm, risk coefficient was significantly higher compared to the previous. China is in a peak time of public emergencies. Emergency relief material dispatching is the key link to disaster prevention and reduction. In this paper, the research based on status of emergencies at home and abroad to introduce the characteristics of emergency logistics in emergencies, structure and materials scheduling problems, sum up the results of studies in recent years, including models and algorithms., which presents emergency and emergency material dispatching research, and puts forward the corresponding improving direction.

Keywords

Internet+; Emergencies; Emergency materials; Material scheduling model.

1. Introduction

Emergency logistics is to point to in response to the serious natural disasters, sudden public health events, the public security events and military conflicts and other emergencies and the demand for goods and materials, personnel, funds for emergency guarantee a special logistics, activity. Emergency logistics and general logistics, by fluid, carrier, flow, flow elements, such as with utility and space utility, time character. Most cases of emergency logistics through the logistics efficiency to achieve its logistics efficiency, and ordinary logistics emphasis on efficiency and emphasis on benefits. What is the context of internet+? Prime minister Ke qiang li, At 12th National People's Congress three times meeting on March 5, 2015, was put forward for the first time in the government work report "Internet +" plan of action. "Internet +" represents a new economic form, which make full use of the internet in the allocation of production factors and optimization and integration, incorporates the depth of the innovation of the Internet in economic society in various fields, promote the real economy innovation and productivity, the formation of a wider range of internet-based facility and realize the economic development of tools for new form. The Internet of Things is a novel paradigm that connects the pervasive presence around us of a variety of things or objects to the Internet by using wired technologies to reach desired goals. Since the concept of the Internet of Things was introduced in 2005, we see the deployment of a new generation of networked smart objects with communication, sensory and action capabilities for numerous applications, mainly in global supply chain management, environment monitoring and other non-stress environments. This paper introduces the Internet of Things technology for use in the emergency management community.

2. Backgrouds

Since the 1990s, along with social networking, cloud computing, networking and the emergence of Internet+ age gradually come. Gradually increase security awareness, social attention to major emergencies rising. From the early years of the "SARS", snowstorm, to the earthquake in recent years, Tianjin Port explosion, these large-scale emergencies heavy economic losses, affected a wide range of affected people and more, so traditional methods cannot be shipped emergency supplies chips supplies to meet the needs of the disaster area. In addition, major incidents also have information uncertainty, time-critical and other characteristics, so mining useful information from massive data, and then converted into useful knowledge, emergency decision applied to large-scale emergencies become the current mainstream trend. For emergency supplies effectively play its due role in the rescue, to protect the supply and demand of emergency supplies, it is necessary to have an accurate transport of emergency supplies chips process, comprehensive, scientific understanding, to ensure efficient transport of emergency supplies chips to reduce the incidents of and property losses caused by life.

As early as 1976, Balachandran in the study of radioactive hazardous materials transportation think we should leave the emergency point nearest supply point to participate in an emergency, the establishment of a transport optimization model[1]; Minner based on dynamic multi-objective model, and before and after the fire, the study of emergency supplies configuration , raise transportation issues[2]; Van Wassenhove dynamic programming model, and in the case of different relief tasks resource Allocation[3]; Meller studied a location as emergency supplies based on genetic algorithm method[4]. These studies can be summarized as static and dynamic research studies, targeted, but for major emergency supplies logistics still need further discussion. Although the literature to establish the mathematical model can be used in a variety of natural disasters, but also due to the lack of understanding of major emergencies, the use of a narrow range, the algorithm cannot be applied given the logistics and other major emergencies.

3. Features

Considering the information required for supporting three sequential and distinct rhythms in emergency response operations: mobilization rhythm, preliminary situation assessment rhythm, and intervention rhythm, the paper proposes a modified task-technology fit approach that is used to investigate how the Internet of thing technology can be incorporated into the three rhythms and enhance emergency response operations. The findings from our research support our two hypotheses: H1: Internet of thing technology fits the identified information requirements; and H2: Internet of Things technology provides added value to emergency response operations in terms of obtaining efficient cooperation, accurate situational awareness, and complete visibility of resources.

The Internet can provide such features as interactivity, two-way communications, and multimedia information on demand. One of its advantages is that a great deal of information can be made widely available. Access to these data can be either restricted (e.g., by password use) or open to any Internet user. The potential for dispensing information is enormous. There is also excellent potential for contacting other persons, either individually (as in e-mail) or in groups, for on-line discussions. An important 'aspect of the Internet is that it can provide information one-way, without permitting direct inquiries from those receiving the information. This could be an advantage for public information personnel and others responsible for information dissemination during disasters, in that they could provide information without simultaneously having to deal with a flood of direct inquiries from the media or the public. On the other hand, the Internet does have some drawbacks. A major drawback at present is limited access. This is more of a problem world-wide than it is in the United States at present; by some estimates, about 30%of people in the United States have some form of Internet access, and this percentage is rising rapidly. To communicate or receive communications on the Internet requires literacy, knowledge of the language or languages in use, capability of using computers and software, and access to both a computer and the Internet. Also, relevant portions of the Internet must be operational: both clients and servers need to be up and not overloaded. All the communications systems that we use in emergency response, including networks, can be fragile and technically vulnerable. To compare technical vulnerabilities of the Internet with those of other communications systems, such as television, radio, telephone, cellular telephones, facsimile machines, and so on, is well beyond the scope of this paper. In crisis situations, you need redundancy; that can be accomplished by having access to many different communication channels during and after an emergency.

4. Features

4.1 Opportunities and Challenges

Emergency response information systems should support first responders by enhancing their situational awareness which will lead to better decision-making[6,8].

As a communication system and an information repository, a strategic tool and a populist medium, the Internet can influence many aspects of emergency management. Fortunately, the Internet has publicly revealed its strengths and weaknesses. For emergency managers, the challenge is now to maximize the strengths and minimize the weaknesses of the Internet, to find ways to engage the technology for disaster preparedness and relief while learning to manage the new risks of a world online. Like any other significant variable, the Internet must be addressed as part of the disaster plan. Internet preparedness is needed.

4.2 Problem Statement

Under the background of natural disaster, based on emergency logistics theory, VPR theory[6-8] and analysis of existing research results, this paper do real-time optimization for distribution and transport routes of emergency supplies according to the disaster development characteristics by combined with the actual road network structure. It assumes that there are I supply centers and M vehicles available. The particular car m (m =1,2,3...,M) is only reserved for a fixed supply center i (i =1,2,3， ...,I). J affected points need initial rescue. Suppose that the relevant historical data, network structure and disaster situation etc., are known condition. The following assumptions are made:

(1) The affected area is large and the road condition is complicated and dynamic.

(2) The number and location of material supplying points are fixed, emergency supplies are sufficient and the delivery power is strong.

(3) There are emergency logistics dispatching information centers and material supplying points in the area. Information on vehicle operation and others can be transported to dispatch centers real-timely.

(4) Given the shortest path and its time between any two nodes of network. On the premise of minimizing material dispatching time, the optimization goal of the problem is to reduce the overall operation cost of emergency logistics as much as possible.

4.3 Data sources

Research data includes detecting signals of various sensors (such as many aspects of the land, weather, traffic monitoring signal), field observation images, video, satellite captured images, remote sensing images, live sound, digital, real-time reporting, etc.

4.4 Problem Formalization

On the basis of above hypothesis, mathematics model is built as shown in Figure 1[5], distributing supplies from the set supply center i (i=1,2,...,I)to each distribution point j(j=1,2,...,J), the research data includes detecting signals of various sensors (such as many aspects of the land, weather, traffic monitoring signal), field observation images, video, satellite captured images, remote sensing images, live sound, digital, real-time reporting, etc. .ply center firstly choose the best route to distribute according to pre-planning scheme, then the pre-planning phase produces delivery plan and initial optimal route for each disaster point, as is shown in route 1 and route 2, and deliver as delivery plan and route 1, route 2. If suddenly road has been cut off on route (L_R, L_{R+1}). Then the real time dispatch system should Figure out dispatch route for the vehicles on this road quickly. Notably, the dispatch rank of all vehicles on route 1 is higher than what is on route 2.

The important variables in question are defined as follows:

E_{ij}^{m}: time variable,m ∈ M, expected time of expected vehicle, m' arrival in distribution points;

Q_i : the capacity of material supplying center i, where i ∈ I and Q_i is assumed to be large;

R_{ij} is the number of supplies distributed from the supply center i to distribution points j and R_{ij}^m refers to the traffic volume during the time of the m vehicle moving from distribution center i to the disaster area j, where

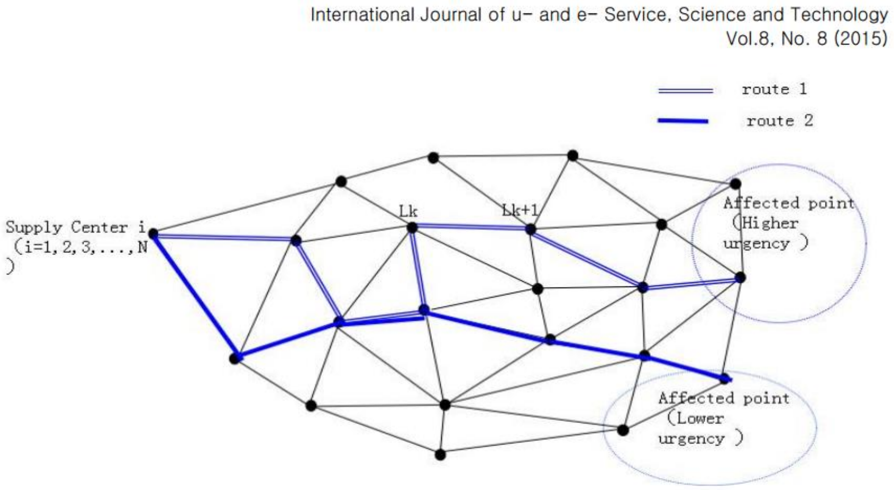

Fig. 1 Problem Model

$$R_{ij} = \sum_{m=1}^{M} R_{ij}^m \ (i \in I, j \in J, m \in M)\,;$$

B_m (m=1,2,3,...,M) is the upper limit of carrying capacity of the m vehicle;

The route from the supply center i to distribution points j is

$$Path_{ij} = (i, L_1, L_2, \ldots, L_R, L_{R+1}, \ldots, L_K, j\,)_{(R=1,2,\ldots K)};$$

A certain road section $(L_R, L_{R+1})$of the route is

$\overrightarrow{SEC}_{L_R L_{R+1}} = (\bar{V}_{L_R L_{R+1}}, Pos_{L_R}, Pos_{L_{R+1}}, \bar{\sigma}_{L_R L_{R+1}})$

$\bar{\sigma}_m$, which equals, $\bar{\sigma}_{L_R L_{R+1}}$the real-time congestion coefficient of the m vehicle(m=1,2,3,...,M)on the road. The computational formula is:

$$\bar{\sigma}_m = \bar{\sigma}_{L_R L_{R+1}} = \frac{\min\ (\ V_m, \bar{V}_{L_R L_{R+1}}\ )}{\bar{V}_{L_R L_{R+1}}}$$

V_m is the real-time speed of the vehicle m. When $V_m = 0, \bar{\sigma}_m = 0$; when $V_m \geq \bar{V}_{L_R L_{R+1}}, \bar{\sigma}_m = 1$; and when $V_m < \bar{V}_{L_R L_{R+1}}, 0 < \bar{\sigma}_m < 1$.

5. Real-time materials Scheduling Mechanism Design

Emergency logistics is a special logistics that time requires above all else, and the scheduling strategy is the key factor to realize the emergency logistics on time. Because when natural disasters (such as earthquake, explosion, etc.,) occur, they will bring some certain influence to the road to disaster area and roads damaged even interrupt, at the same time, if medicine, tents, water and other supplies can reach the disaster area according to the disaster area need timely and accurately, it will reduce the frequency of occurrence of secondary disasters to a certain extent and control the further spread of the affected scope. For material dispatching in the disaster areas, most of the existing research is to use historical date to dispatch goods statically, but lacks response capability when emergency things occur. So, in order to improve the rationality of material dispatching and real-time response ability, this paper adopts the combination of advance planning and real-time scheduling strategy for the emergency supplies scheduling. By combining with the existing research results, Preliminary planning stage processes historical information, disaster area situation and other data, to form the priority of emergency degree for goods and every disaster area, to estimate the material demands and goods quantity, and at the stage it is concluded that the distribution plan and initial optimal route.

While, in order to strengthen the timely processing ability of demanded supplies, this paper adds the real-time scheduling system on the basis of preliminary planning. The system can collect real-time network local data and make real-time prediction to global network structure. Thus the system can adjust the optimal route in road vehicle timely by combining with the historical data, the local and global network real-time information.

6. Conclusion

To summarize, Emergency logistics is different from normal logistics, it has the characteristics of sudden, uncertainty, the weak economy and timeliness. This paper studies the material scheduling model of emergency supplies on the basis of the four characteristics and makes the following conclusion. Pre-planning analyzes historical data and disaster situation, and forms rational dispatching plan according to the priority of goods and disasters emergency degree, also forms initial optimal route according to transportation condition and network information. But real-time scheduling system can be used into the timely response to emergency and the prediction to the dynamic network framework on the basis of real-time and historical data. The prediction of dynamic network framework here mainly predicts the of various road sections. Using real-time scheduling system can improve the timeliness and accuracy of material dispatching.

Internet+ is not only a major change on the technology and tools, but also the productivity of information technology revolution, which allows us to leap more accurate allocation of resources, and thus more practical and efficient, changing the traditional emergency decision fundamentally mechanism, from the traditional to obtain as much information in a limited amount of time and decision-making into a large number of simultaneous influx of information and data to sort, analyze and find out the relationship between decision-making.

In summary, based on the scheduling problem under Internet + state of emergency supplies, experts and scholars at home and abroad has been considerable research, targeted, but because of the uncertainty of emergencies, time constraints and other characteristics, emergency supplies scheduling lack of comprehensive, scientific understanding of the system, the use of a limited range, which, after expecting to have more experts and scholars into the research, it was found or the creation of wider application models and algorithms to solve emergency supplies scheduling problem.

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