International Journal of u- and e- Service, Science and Technology
Vol.8, No. 8 (2015), pp.273-284
http://dx.doi.org/10.14257/ijunesst.2015.8.8.28

A Mixed Dispatch Model of Emergency Supplies Based On Two Stages

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Abstract

Gradually increasing frequency of emergencies in recent years leads to great demands for emergency logistics of relief supplies. Existing research of emergency supplies has many features like imperfect dispatch mechanism, inflexible distribution methods and low informatization degree of emergency logistics, which is difficult to meet the uncertainty needs caused by emergencies. Based on this, the current paper proposes a stage planning model of emergency logistics system and supplies dispatch models at two stages and introduces the concept of distributed parallel computing to real-timely optimize distribution indicators and routes of emergency supplies and solve the difficulties of optimization caused when responding to uncertainties. The target stage planning model includes the model at initial stage of disasters and the model at middle stage of disasters and comes up with the idea that economic factor is taken into consideration in the emergency logistics design at middle stage. Supplies dispatch models at two stages include pre-planning and real-time dispatch and use historical information and real-time information to provide the optimal route for vehicles. To check operability of the model, the paper conducts simulation on NetLogo platform and shows good effects.

Keywords: *emergency logistics, supplies dispatch models at two stages, stage planning, route optimization, parallel computing*

1. Introduction

With the gradually growing trends of worldwide natural disasters and public health events, constructing a large-scale quickly-responding emergency logistics system to reduce casualty losses evolves into the focus of governments and researchers. Research on logistics and intelligent logistics has had a long history and has gained fruitful achievements, while research on emergency logistics has only been carried out in recent years. At present, the relevant research on and application of emergency logistics are mainly focused on the following respects: studies on the organizational mechanism of emergency logistics and emergency technology [1, 19]; research on LRP models of emergency logistics [2, 3]; studies on the raising and dispatching of emergency supplies [4, 5] and so on. Logistics dispatch related issue is one of the hot issues in emergency supply studies. Early scholars mainly borrow traditional research ideas on intelligent logistics, which mainly focus on the study of static problems. In recent years, with the rapid development of IOT, Internet, and distributed computing technology, some scholars begin to study the dynamic dispatch aspects of emergency supplies. Logistics dispatch related issue is one of the hot issues in emergency supply studies. Early scholars mainly borrow

ISSN: 2005-4246 IJUNESST

traditional research ideas on intelligent logistics, which mainly focus on the study of static problems. In recent years, with the rapid development of IOT, Internet, and distributed computing technology, some scholars begin to study the dynamic dispatch aspects of emergency supplies. Literature [20] put forward a model integrated supplies distribution and route real-time guidance, conduct gradual second-class division towards large-scale Internet and adopt dynamic parallel computing to realize synchronous parallel computing of large-scale emergency logistics networks. Literature [21] puts forward the use of data mining to find the most optimal route and adopts the method of combining feed-forwards and feedbacks of neural networks to learn road emergencies, calculating the fastest top N routes based on data submitted by data acquisition system. Literature [24] employs improved parallel tabu search algorithm to conduct parallel computing on the issue of dynamic vehicle routes. Above literature deals with the real-time and dynamic aspects of route optimization of emergency logistics and has certain value of reference. However, existing research mainly collects static data and deals with emergency logistics, as such a highly dynamic problem, through static thinking. Thus, it still remains to be improved in emergency response speed and dynamic real-time handling ability.

Furthermore, Zuo Xiaode [17], a Chinese famous scholar, gives a systematic account of the management, system and supply chain of emergency logistics and other aspects, and sums up the following problems existing at least in current emergency logistics rescue: 1) distribution indicators of emergency logistics are not perfect, delivery methods are not flexible and transportation is a big problem; 2) informationization of emergency logistics is low and is difficult to meet the demands of urgent situations. Therefore, it will be of great significance to study parallel dispatch mechanism of targeted emergency logistics with the support of real-time information according to the characteristics of emergency logistics itself.

This paper is a study of the model of emergency supplies' real time dispatch from the aspect of emergency logistics management. Mainly based on history data and real-time traffic information, this paper gives out the dispatch strategy of integrating pre-planning and real-time dispatch, optimizes distribution index and delivery routes and comes up with emergency logistics' parallel real time dispatch system, so as to provide multiple optimized routes, which are reliable and time-saving, for vehicles on road. In order to examine the result of this system, this paper utilizes the simulation tool NetLogo of Northwestern University to do simulation verification. The results show that the parallel real-time dispatch system developed in the paper has a good performance in real-time dispatch and can meet the initial demands of urgent supplies in disaster areas.

2. Emergency Supplies Dispatch Modeling

2.1. Problem Statement

Under the background of natural disaster, based on emergency logistics theory, VPR theory 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 dispatch 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.

2.2. Stage Planning of Problem

When natural disasters occur, supply demands and real traffic condition and other factors are uncertain. If proper schemes can be proposed aimed at real-time factors to deliver emergency supplies at the first moment, the scope of disaster areas will be controlled and economic loss will be prevented to some degree. Thus, most of current studies focus on the timeliness of emergency logistics, but neglecting its economical efficiency. However, this paper focuses on grading the timeliness and economical efficiency of emergency logistics on the basis of disaster characteristics and its law of development. At the same time, this paper constructs two phases optimized models for emergency logistics: initial disaster model and middle disaster model.

2.2.1. Initial Disaster Model: Initial disaster model is used in the initial period of disaster and aims at minimizing the transportation time of emergency supplies. This phase designs a scheme combined pre-planning and real-time dispatch to optimize delivery plan and vehicle delivery routes, the information flow of these two is as shown in Figure 1.

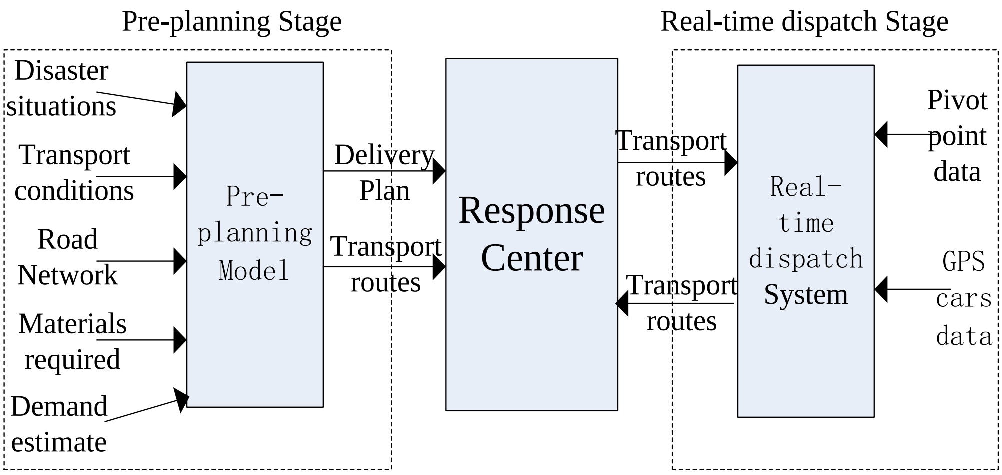

Figure 1. Information Flow Combining Pre-planning and Real-time Dispatch

The pre-planning refers to the emergency planning in disaster-prone regions before disaster occurring, as such proper scheme can be proposed at the first moment of the disaster. When disaster occurs, firstly we could fuzzy cluster [18] the disaster area and determine each disaster group's urgent degree for supplies, according to five indexes, such as the extent of building damage, location to the heart of disaster area, the density of population, survival rate and vulnerable groups rate in survivals, forming supplies demanding urgent levels for each disaster areas. Meanwhile, based on the situation of the disaster and some related history information, all supplies should be classified regarding to demanding time fence, mainly divided into urgently-needed supplies and non-urgently-needed supplies. As in Table 1, as for convenient system dispatching, the time window of urgently-needed supplies has been set as 0, while the time window of non-urgently-needed supplies has been set as 1, and the supplies demanding levels and delivery method are as shown in Table 1. Since urgently-needed supplies are of higher rank, they should be delivered by timely delivery route, while for non-urgently-needed supplies, they should be delivered in fixed time and with fixed quantity. At last, delivery plan has been formed regarding to supplies demanding urgent levels, supplies demanding rank and transportation conditions.

Table 1. Materials Demand Level and Dispatch Methods

	Demanding time	Time Window	delivery method
Urgently-needed supplies	within half a working day	[0]	Timely delivery
Non-urgently-needed supplies	more half a working day	[1]	Dispatch timely and quantitatively

Besides, the best route should be found according to current road network and transportation condition, and if road degree is more than 3, then the pitch point of each road (like T road, crossroads, and so on)should be set as pivot point. Real time collecting system should be installed at every pivot point and is ready to provide basic data for real time dispatch system; according to real time road condition, the real time dispatch system will adjust vehicle delivery plan. This paper will create a principle-subordinate structure's real time dynamic distributed dispatch system, ensuring all vehicles could arrive each distribution point in time. The system collects real-time data of GPS cars and route pivot points, thus being able to integrate local and global real-time road condition to predict remaining routes. In addition, this system uses premier dispatch task in respect of task dispatch and assigns related task to processing subsystem individually to handle with priority level, but for the tasks in the same level, they should be handled parallelly and simultaneously.

2.2.2. Mid-term Disaster Model: Middle model is used in the phase when disaster has been initially stabilized. At this time, the demand of disaster area is generally stable, so delivery route can refer to optimization route in initial period. Therefore, on the premise of satisfying supplies transportation time, this phase could infuse economical factor. The exact specification is to classify all supplies according to demanding time fence, and divide emergency supplies into urgently-needed and non-urgently-needed supplies. As for higher ranking emergency supplies, the strategy of neglecting logistics cost should be taken, while for lower ranking emergency supplies, the strategy of calculating logistics cost should be taken. This flexible management is in favor of reducing economical loss in emergency logistics. Specifically, constraint conditions should be taken in respect of higher ranking supplies; for higher ranking emergency supplies (for example: medicines and so on), only real time factor should be taken into consideration (target is the model in planing phase); for the demand of lower ranking emergency supplies or non-urgently-needed supplies (such as food, water and supplies in fixed supply time) economical factors, like cost, should be calculated in condition of in-time delivery.

2.3. Problem Formalization

On the basis of above hypothesis, mathematics model is built as shown in Figure 2, distributing supplies from the set supply center i (i=1,2,...,I)to each distribution point j(j=1,2,...,J), the supply 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.

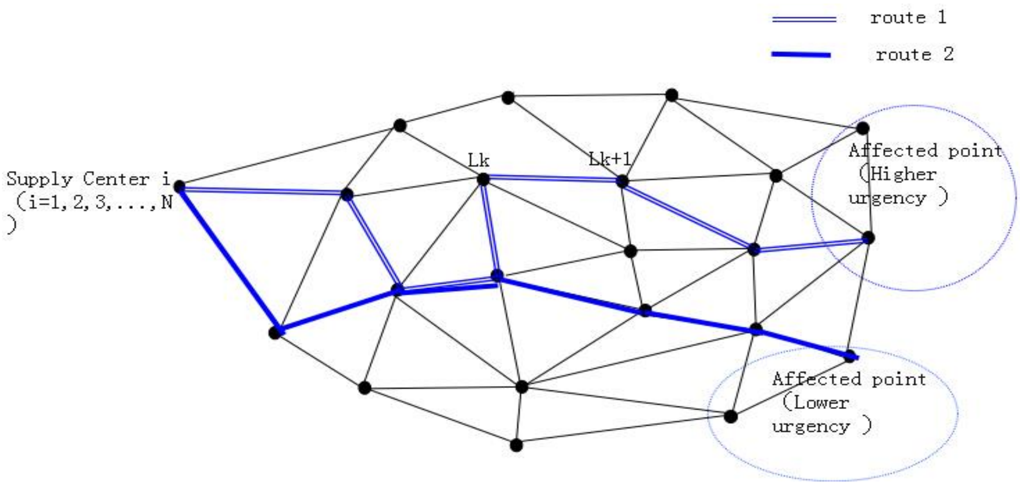

Figure 2. Problem Model

The important variables in question are defined as follows:

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

2) Q_i : the capacity of material supplying center i, where $i \in I$ and Q_i is assumed to be large;

3) 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

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

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

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

$$Path_{ij} = \left(i, L_1, L_2, ..., L_R, L_{R+1}, .., L_K, j\right) \quad (R=1,2,...,K);$$

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

$$\overrightarrow{SEC}_{L_R L_{R+1}} = \left\langle \bar{V}_{L_R L_{R+1}},\ Pos_{L_R},\ Pos_{L_{R+1}}, \bar{\sigma}_{L_R L_{R+1}} \right\rangle$$

where $\bar{V}_{L_R L_{R+1}}$ is the inherent average speed per hour of the road section (L_R, L_{R+1}) and Pos_{L_R} 、 $Pos_{L_{R+1}}$ is the starting location of the road section (L_R, L_{R+1}) ; $\bar{\sigma}_{L_R L_{R+1}}$ is the real-time congestion coefficient on the road section (L_R, L_{R+1}) ;

7) $\bar{\sigma}_m$,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:

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

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

$V_m < \bar{V} L_R L_{R+1}$, $0 < \bar{\sigma} m < 1$.

9) T_{ij}^{m} is the delivery time of the vehicle m from the supply center i to distribution points j, which includes the supplies' loading and unloading time and the transportation time. Δd is assumed as the needed time of unit supplies' loading in supply center and unloading in distribution points. T $t_{ij}^{m} = normT_{ij}^{m} + (1-\bar{\sigma} ij) congT_{ij}^{m}$ he transportation time of the vehicle m is decided by real-time road condition,whose formula is , where $normT_{ij}^{m}$ is the time the vehicle m needs from the supply center i to the disaster area j,and $congT_{ij}^{m}$ is the average extra delivery time because of traffic jam $t_{ij}^{m} = normT_{ij}^{m} + (1-\bar{\sigma} ij) congT_{ij}^{m}$ and the repair of interrupted road. $normT_{ij}^{m}$ is a constant computed according to the physical distance of the route and specified average speed per hour. $congT_{ij}^{m}$ is a function and can be assumed as a continuous random variable. According to the concept of arrival time interval of queuing theory in opsearch[10], its distribution can be assumed to be exponential, that is, density function $f\left(t^{1}{}_{ijm}\right) = \lambda_{ijm} e^{-\lambda_{ijm} t}$ (t>0). Then the average extra time is . $congT_{ij}^{m} = 1/\lambda_{ij}^{m}$ Thus, the delivery time of the vehicle m is

$$T_{ij}^{m} = t_{ij}^{m} + \Delta dR_{ij}^{m} = normT_{ij}^{m} + (1 - \bar{\sigma}_{ij}) congT_{ij}^{m} + \Delta dR_{ij}^{m} ;$$

10) $X_{ij}^{m} = \begin{cases} 1, \text{the vehicle m is sent off from the supply center } \boldsymbol{i} \text{ to the disaster area } \boldsymbol{j} \\ 0, \text{others} \end{cases}$

11) $W^{m}{}_{ij}$ refers to the increased cost resulting from road damagement when vehicle m set out from i supply point to j disaster point, for example: maintenance cost and so on.

12) $C^{m}{}_{ij}$ refers to transportation cost when vehicle m sets out from supply i to disaster j.

2.4. Objective Function

2.4.1. Initial Disaster Model of Objective Function : The minimum of emergency supplies' delivery time is the initial model of objective function. Based on above definitions, the objective function of initial disaster period is presented as follows:

$$minE_1 = \sum_{i \in I} \sum_{j \in J} \sum_{m \in M} X_{ij}^{m} \left[normT_{ij}^{m} + (1 - \bar{\sigma}_{ij}) congT_{ij}^{m} + \Delta dR_{ij}^{m} \right]$$

(1)

The objective function (1) shows that when traffic jam and even interruption are taken into consideration, the total delivery time is minimalized and the delivery time of the objective function comprises two parts: ' loading and unloading time;

2.4.2. Middle Disaster Model of Objective Function: Regarding of the high level emergency of emergency supplies, the logistics activity cost cannot be taken into consideration at the stage. But for the lower level emergency, the logistics activity cost should be included, see the following middle model of objective function:

①Take the high level emergency of supplies as single object, the objective function is (1);

②Take the low level emergency of supplies as multiple object. In addition to satisfying the formula (1), the economic factors also should be taken into consideration:

$$\min E_2 = \sum_{i\in I}\sum_{j\in J}(1-\bar{\sigma}_{ij})W^m{}_{ij} + \sum_{i\in I}\sum_{j\in J}\sum_{m\in M}R_{ij}^m C^m{}_{ij} \tag{2}$$

Formula (2) is delivery supplies cost, including extra cost caused by road damage and transportation cost.

2.5. Constraint Condition

Constraint condition is as below:

$$\sum_{i\in I}\sum_{j\in J}\sum_{m\in M}\mathbf{R}_{ij}^m \le \sum_{i\in I}\mathbf{Q}_i \tag{3}$$

$$\sum_{m\in M}\mathbf{B}_m \le \sum_{m\in M}\mathbf{R}_{ij}^m\mathbf{X}_{ij}^m \tag{4}$$

$$X_{ij}^m R_{ij}^m = X_{ij}^m B_m \tag{5}$$

$$normT_{ij}^m + \Delta\mathbf{d}\boldsymbol{R}_{ij}^m \le \boldsymbol{E}_m \tag{6}$$

$$E_m - \varepsilon \le T_m \le E_m + \varepsilon \qquad (0 \le \varepsilon \prec 1) \tag{7}$$

Formula (3) ensures that all supplies in the supply center are sufficient, that is, the demands of disaster area can be satisfied; formula (4)guarantees that the carrying capacity of all vehicles in supply center can meet demands; formula (5) suggests freight volume of trucks starting from the supply center is their carrying capacity, they start when they are full loaded; Formula (6) and (7) are time constraints: (6) indicates that under normal condition, the delivery time of the vehicle m from the supply center i to the disaster area j is within expected time; and(7) shows that the actual arrival time is within soft time window of expected time.

3. Real-time Scheduling Mechanism Design and System Analysis

3.1. Real-time 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.

Moreover, in order to improve the real-time processing ability to real-time scheduling system, this paper make the parallel processing to big date caused by large-scale emergency based on the Hadoop ideas. In short, the combination of preliminary planning and real-time scheduling system will improve the rationality and effectiveness of the allocation of resources, and will make the most timely response to the emergency things and the effects if secondary disasters, and will solve informationization of emergency logistics, inflexible dispatching way, transportation problems and other problems of the emergency logistics management.

3.2 Real-time Scheduling System Analysis

Regarding of real-time scheduling based on pre-planning and scheduling supplies, in the pre-planning stage, we can use existing research results [20], real-time scheduling system that has the ability to response timely is the key in scheduling model. Below is the design analysis to the overall level framework and scheduling steps of the system. Its whole framework is expressed as Figure 3.

1) The data-collecting system adopts distributed data-handling scheme to store and check data. Distributed data are distributed on several servers and all GPS cars are grouped according to destinations (disaster areas). Each group communicates with the corresponding database server and vehicles regularly submit real-time data package, mainly including the location Pos_m at time t, the speed V_m at time t, the total driven time Tm and travelled miles d_m and so on. Data-acquiring devices are placed at the pivot points of road network. A is returned regularly, which includes destination (distribution points) j, traffic flow flow (x) , needed time Em and four fields of the next node. Each pivot point will send updated information to vehicles only when the routing Table changes.

2) Business logic level. The main objectives of data preprocessing are to integrate all real-time information through Web services; to form a vehicle-united task list with prior dispatch based on supply level; to group data according to vehicle unit; to provide prerequisites for dispatch center assigning tasks. Dispatching center seeks a local optimum and global optimal comprehensive solution for vehicles according to real-time traffic condition. The center' task dispatch will use Yahoo's Hadoop Capacity Scheduler. That is, it is to divide real-time dispatch system resources into several task queues and to assign each queue certain number of dispatching task nodes to deal with the related dispatching tasks. Each task queue internally forms a dispatching emergency level based on vehicles' emergency dispatching coefficient. It conducts prior dispatch according to emergency level (FIFO by default). Tasks with high emergency levels will be dispatched first. The completed tasks will be not allowed to pre-empt. Tasks with higher emergency level will be dispatched only when the task is finished.

3) Data analysis is to organize, analyze and compare the results of dispatching tasks. The system mainly compares and analyzes the responding time of real-time dispatch system and timely arrival rate of vehicles in detail.

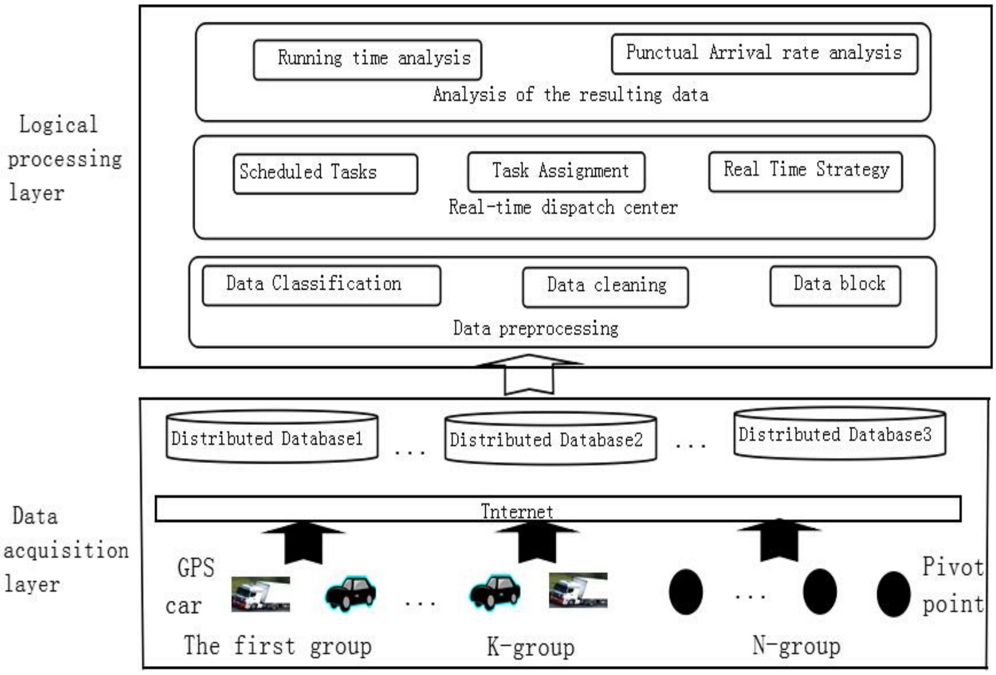

Figure 3. The Framework of Real-time Dispatch System

Real-time dispatching steps:

1) According to the prior levels of emergency supplies in pre-planning, the vehicles are also divided into different prior levels correspondingly. The time window of vehicles carrying urgent supplies is 0 and the time window of vehicles carrying non-urgent supplies is 1 . Vehicles with the same time window have the same priority.
2) Computing the real-time congestion coefficient $\overline{\sigma}_m$ of on-way vehicles m（m=1,2,3,...,M) at the road section $(L_R,\ L_{R+1})$ according to their priority level. The computing formula is as follows:

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

3) Form urgent levels of vehicle dispatch. Form dispatch urgent levels according to real-time time error ratio TM（m）of vehicle m. Its computational formula is:

$$\text{urgen（m）} = TM(m) = \alpha \frac{E_{ij}^{m} - T_{ij}^{m}}{E_{ij}^{m}}$$

Among it, $-1 \prec \alpha < 0$。 Form an urgent level list of dispatch task of all vehicles according to urgent coefficient urgen（m ） from large to small.

4) If emergencies cause traffic jam and interruption of the e point at the route, if e is an original road network node at that time, e is a real node. Or it is taken as a virtual one and is added into forbidding searching Table S. All nodes in S are urgent rescue points. The pseudo-code is expressed as:

$$S = S \cup e$$

5) Checking whether the flow volume flow（x）of routing Table at all pivot points x is 0. The node x whose flow volume is 0 is added into imminent prediction nodes set F, or the next step is conducted.
6) According to emergent levels of vehicle dispatch, it chooses the next node for corresponding temporary emergent rescue point e in turn. Extract the secondary nodes LR（R=1,2, 3,...,K） that are directly connected to the temporary emergent rescue point

e and have one node interval with it from set S. If $L_R \notin F$, LR is included into set A of next candidate codes.

7) Measure the trafficability of each road section. According to the urgent level of vehicle dispatch, evaluate comprehensively travel time of e to next candidate node Lk successively. Integrate real-time vehicle information and real-time pivot point information. Here congestion coefficient is penalty coefficient of trafficability of road section, that is, the comprehensive time evaluation of vehicle m at e to road section LR is:

$$T^{m}_{eL_R} = normT^{m}_{eL_R} + (1 - \overline{\sigma}_{eL_R})congT^{m}_{eL_R}$$

Among it, $normT^{m}_{eL_R}$ is the estimated travel time under normal situation at the road section. Its value is related to the physical distance of road section and the average speed per hour. $congT^{m}_{eL_R}$ is the estra journey time associated with real-time road condition.

8) Taking all nodes e in S as the starting node, all nodes in A as the terminal node, and $T^{m}_{eL_R}$ as the weight of each side construct a temporary directed graph. Use Dijkstra algorithm to find the shortest route in the directed graph and order routes according to the weight value from small to large.

9) The shortest terminal points next node LR (like L1, L7, L10, L4) in step 8 are added into forbidding searching Table S, participate in computation as temporary original points and predicate the trafficability of them to appointed disaster point j . The flow volume of the route n is the smallest value of each pivot point Xi （i=1,2,...,K） . Give explanations by referring to Figure 4.

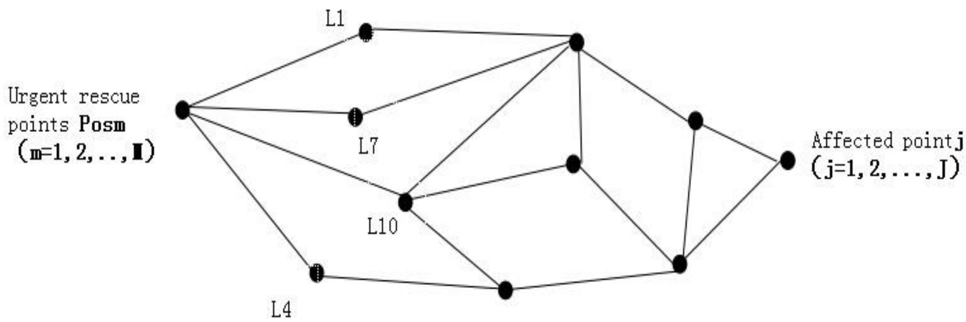

Figure 4. Examples of Real-time Route Map

10) Predicate the trafficability of each route according to the flow volume of each pivot point on all routes and order the traffic volume from large to small.

11) Combine the results of step 8 and step 9 and select the top three optimal routes for vehicles to choose.

12) Repeat step 1-6 till the delivery of emergent supplies within limited time is guaranteed, that is, $|E^{m}_{ij} - T^{m}_{ij}| \le \varepsilon, (\varepsilon \text{ is a positive number near } 0)$

13) Backup each route to the database and provide reference for next batch of vehicles.

4. Conclusions

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. First, in order to realize the efficiency of the emergency logistics and improve its weak economy, this paper makes phased plan to emergency object, namely initial disasters model and middle disasters model. Initial disasters model only takes efficiency into consideration, but middle disasters model adds economy. This structure can meet the disaster relief work the first time, but also reduce the cost of logistics activities from a certain extent. Second, regarding of the sudden and uncertainty of emergency logistics, this paper adopts the combination of pre-planning and real-time scheduling system to improve the timeliness and flexibility of the dispatching of emergency supplies. 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 trafficability of various road sections. Using real-time scheduling system can improve the timeliness and accuracy of material dispatching. In the last, based on above model, we make a preliminary simulation by adopting NetLogo platform. The experimental results show these models have operability, and real-time scheduling system has response ability. The next step is to improve the response speed of the system.

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