LOGISTICS MATERIAL ALLOCATION METHOD, APPARATUS, COMPUTER DEVICE, AND STORAGE MEDIUM

TECHNICAL FIELD

[0001] The present application relates to the field of logistics transportation technologies, and in particular to a logistics material allocation method, apparatus, computer device, and storage medium.

BACKGROUND

[0002] In logistics operations, containers and other logistics material circulate through consolidate and distribute parcel between hubs and various service points. Due to a real-time need for container in hubs and limited space in service points for accommodating containers, manual assistance is required to allocate containers, quickly meet the application needs of hubs for container, and release the space of service points. Existing manual allocation requires additional vehicles for separate material transportation, leading to increased costs.

SUMMARY

[0003] Based on this, it is necessary to address the above technical problems by providing a logistics material allocation method, apparatus, computer device, and storage medium, which can reduce the costs of logistics material allocation.

[0004] In a first aspect, the present application provides a logistics material allocation method, including: acquiring transport point information, consolidation and distribution routes, and historical logistics information corresponding to each transport point in a plurality of transport points within an allocation area; for each transport point, determining available material space of a transport vehicle at the transport point on the consolidation and distribution routes according to the historical logistics information; determining material allocation routes according to the transport point information and the consolidation and distribution routes; determining a material allocation model according to the transport point information, the

historical logistics information, the available material space and the material allocation routes; solving the material allocation model to determine a material allocation scheme.

[0005] In a second aspect, the present application provides a logistics material allocation apparatus, including: information acquisition module, configured to acquiring transport point information, consolidation and distribution routes, and historical logistics information corresponding to each transport point in a plurality of transport points within an allocation area; space analysis module, communicatively connected to the information acquisition module, and configured to determine, for each transport point, available material space of a transport vehicle at the transport point on the consolidation and distribution routes according to the historical logistics information; route planning module, communicatively connected to the information acquisition module and the space analysis module, configured to determine material allocation routes according to the transport point information and the consolidation and distribution routes; scheme planning module, communicatively connected to the information acquisition module, the spatial analysis module, and the route planning module, configured to determine a material allocation model according to the transport point information, the historical logistics information, the available material space, and the material allocation routes; solve the material allocation model to determine a material allocation scheme.

[0006] In a third aspect, the present application also provides a computer device, where computer device includes: one or more processors; memory, and one or more applications, where one or more applications are stored in the memory and configured to be executed by the processor to implement the above logistics material allocation method.

[0007] In a fourth aspect, the present application also provides a computer-readable storage medium, on which a computer program is stored, and the computer program is loaded by a processor to execute steps in the above logistics material allocation method.

[0008] The above logistics material allocation method, apparatus, computer device, and storage medium analyze loading patterns of parcel of each transport point based on the historical logistics information of the each transport point in the allocation area, then analyze the available material space of the transport vehicle in each transport point on each of consolidation and distribution routes, determine the material allocation routes based on the transport point information and the consolidation and distribution routes, and then determine

the material allocation model and solve the material allocation model to determine the material allocation scheme based on the transport point information, the historical logistics information, the available material space and the material allocation routes, thereby reducing the costs of logistics material allocation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] To more clearly illustrate the technical solutions in the embodiments of the present application, the following will briefly introduce the drawings needed in the description of the embodiments. Obviously, the drawings in the following description are only some embodiments of the present application. For those skilled in the art, other drawings can be obtained from these drawings without creative effort.

[0010] Figure 1 is a schematic flowchart of a logistics material allocation method provided by an embodiment of the present application.

[0011] Figure 2 is a schematic flowchart of a determination process of an allocation area provided by an embodiment of the present application.

[0012] Figure 3 is a schematic diagram of a mapping relationship between service points and hubs within an allocation area provided by an embodiment of the present application.

[0013] Figure 4 is a schematic flowchart of a determination process of an available material space provided by an embodiment of the present application.

[0014] Figure 5 is a schematic flowchart of a determination process of material allocation routes and additional vehicle information provided by an embodiment of the present application.

[0015] Figure 6 is a schematic flowchart of a determination process of additional vehicle candidate routes provided by an embodiment of the present application.

[0016] Figure 7 is a schematic flowchart of a determination process of a material allocation model provided by an embodiment of the present application.

[0017] Figure 8 is a schematic flowchart of the step S601 in Figure 7.

[0018] Figure 9 is a schematic flowchart of a logistics material allocation method provided by another embodiment of the present application.

[0019] Figure 10 is a schematic structural diagram of a logistics material allocation apparatus

provided by an embodiment of the present application.

[0020] Figure 11 is a schematic structural diagram of a computer device provided by an embodiment of the present application.

[0021] Figure 12 is a schematic structural diagram of a storage medium provided by an embodiment of the present application.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0022] Referring to Figure 1, the embodiments of the present application provide a logistics material allocation method, the method may include following steps S101~S105.

[0023] S101, acquiring transport point information, consolidation and distribution routes, and historical logistics information corresponding to each transport point in a plurality of transport points within an allocation area.

[0024] Specifically, the transport point is a transit or consolidation location for parcels, including but not limited to a hub and a service point. The transport point information includes at least one of following information: a location of the transport point, a type of the restricted vehicle of the transport point, and a space size of the transport point.

[0025] The consolidation and distribution routes include a consolidation route and a distribution route within the allocation area. The consolidation routes are used to load parcels from transport points onto transport vehicles, and do not unload parcels from the transport vehicles to the transport points. Similarly, the distribution routes are used to unload parcels from the transport vehicles the transport points, and do not load parcels from the transport points onto the transport vehicles. Therefore, on the consolidation and distribution routes, the transport vehicles may have available material space at the transport points for material allocation. The material can be containers used to accommodate parcels. The allocated material may include at least one of following container materials: a logistics material cage, a woven bag, and recyclable parcel packaging material. The historical logistics information refers to parcel transport information and transport vehicle information of each transport point on the consolidation and distribution routes.

[0026] In one embodiment, as shown in Figure 2, before the step S101, the logistics material allocation method also includes: S201, obtaining service points and hubs participating in

allocation in a target area; S202, dividing the service points and the hubs participating in the allocation according to a preset mapping relationship between the service points and the hubs to obtain a plurality of allocation areas.

[0027] Specifically, the embodiment of the present application can be applied to transport points in a target area that has a direct parcel transportation relationship, such as service points and hubs. Parcels of the service points are directly transported to hubs for transit. The hubs distribute the parcels to the service points according to areas to which parcels belong. The preset mapping relationship between the service points and the hubs is a transportation relationship between the service points and the hubs.

[0028] The service points and the hubs participating in the allocation in the target area are obtained, and the hubs consolidate and distribute cargo to the service points, while the service points are governed by different districts. Therefore, firstly, the service points are grouped according to its affiliated district. Considering that the service points in different districts may be consolidated and distributed cargo by a same hub, therefore, as shown in Figure 3, if there are service points in different districts mapped to a same hub, the districts are merged into a same group. This ensures that material transfer networks of groups do not interfere with each other and that the material transfer networks within each group are connected. Each group is an allocation area, and each allocation area contains only one hub.

[0029] S102, for each transport point, determining available material space of a transport vehicle at the transport point on the consolidation and distribution routes according to the historical logistics information.

[0030] Specifically, the historical logistics information refers to parcel transport information and transport vehicle information of each transport point on the consolidation and distribution routes. The parcel transport information includes but is not limited to parcel loading and unloading volume. Loading conditions of each transport point on consolidation and distribution routes have obvious periodicity, so the available material space corresponding to each transport point on the consolidation and distribution routes can be determined through the historical logistics information. The available material space is used to allocate and transfer logistics material. Different parcels and different logistics materials occupy different volumes, so a unified unit volume size can be used as a standard for measuring transport vehicle space for

statistical calculations.

[0031] In one embodiment, the historical logistics information includes parcel transport information and transport vehicle information, as shown in Figure 4, step S102 includes: S301, determining historical parcel loading and unloading volume of the transport point on the consolidation and distribution routes according to the parcel transport information; S302, determining the available material space of the transport vehicle at the transport point on the consolidation and distribution routes according to the historical parcel loading and unloading volume and the transport vehicles information.

[0032] Specifically, the parcel loading and unloading volume includes loading volume and unloading volume, the consolidation routes are used to load parcels of the transport points, and the distribution routes are used to unload parcels to the transport points. The loading volume of the consolidation route in each transport point and the unloading volume of the distribution route in each transport point is determined based on the parcel transport information. The historical parcel loading and unloading volume of each transport point in consolidation and distribution routes is determined through statistical analysis of multiple times of the loading volume or the unloading volume of a same route in a same transport point. Each route in the consolidation and distribution routes periodically follows a same route for consolidated and distributed cargo, so the same route is a route that periodically passes same transport points in a same order in the consolidation and distribution routes.

[0033] Loading space (transport vehicle loading volume) of transport vehicles used by the consolidation and distribution routes is determined based on the transport vehicle information. The available material space of a transport vehicle in the transport points on the consolidation and distribution routes is determined combine with the historical parcel loading and unloading volume of the transport point on the consolidation and distribution routes. The available material space of the transport vehicle at the transport point on the consolidation and distribution routes is: loading volume of the transport vehicle - (cumulative loading quantity of stopping nodes on the consolidation and distribution routes - cumulative unloading quantity of stopping nodes on the consolidation and distribution routes). For example, a starting point of the consolidation routes can be a hub, the transport vehicle may have no loading volume when departing from the starting point of the consolidation routes, and as it passes through service

points for loading, available space of the transport vehicle is occupied.

[0034] S103, determining material allocation routes according to the transport point information and the consolidation and distribution routes.

[0035] Specifically, on the distribution route, parcels on transport vehicles is gradually unloaded to the transport points, and available material space of the transport vehicle gradually increases. On the consolidation route, the transport vehicles depart from the hub empty, also with sufficient available material space. Therefore, the consolidation and distribution routes can be used as the material allocation routes, and while the transport vehicles on the consolidation and distribution routes are in consolidating and distributing cargo, the available material space can be used to allocate material, thus effectively utilizing the available space of the transport vehicles on the existing consolidation and distribution routes, that is, remaining space except parcels of the transport vehicles on the consolidation and distribution routes is used to allocate logistics material, reducing costs.

[0036] In addition, the transport capacity of the existing optional consolidation and distribution routes may not meet the timely allocation demand of logistics material, and transport capacity of additional vehicles is needed to transport logistics material. Therefore, an additional vehicle candidate route can be determined as an additional material allocation route based on the transport point information, that is, the material allocation routes include the consolidation and distribution routes and the additional vehicles candidate route. It should be noted that the additional vehicle candidate routes are only used for allocating logistics material and not for loading parcel.

[0037] In one embodiment, the transport point information includes restricted vehicle information of the transport point and coordinate information of the transport point. As shown in Figure 5, step S103 includes: S401, enumerating an additional vehicle multi-stop route for each transport point in the plurality of transport points in a case that transport capacity of the consolidation and distribution routes is less than or equal to transport capacity of material allocation demand; S402, obtaining a total transportation distance and an origin-to-destination distance of the additional vehicle multi-stop route according to the coordinate information in the transport point information; S403, filtering a plurality of additional vehicle multi-stop routes corresponding to the plurality of transport points to obtain the additional vehicle

candidate route according to the total transportation distance and the origin-to-destination distance. In an exemplary embodiment, the logistics material allocation method further includes: S404, determining additional vehicle information of the additional vehicle candidate route according to the restricted vehicle information in the transport point information.

[0038] In some exemplary embodiments, the transport capacity of the consolidation and distribution routes can be determined based on the available space of the transport vehicles. The transport capacity of material allocation demand can be preset, for example, it can be determined based on available material space of transport vehicles at the transport point on the consolidation and distribution routes.

[0039] Specifically, the number of transport points contained in each allocation area is limited, so the additional vehicle multi-stop routes for each transport point can be enumerated. The number and order of the transport points passed through by the additional vehicle multi-stop routes can be restricted based on an actual situation of the allocation area, or there can be no restrictions at all.

[0040] The total transportation distance and the origin-to-destination distance of each additional vehicle multi-stop route are obtained. The total transportation distance is a sum of distances between the transport points passed through by an additional vehicle multi-stop route. For example, if an additional vehicle multi-stop route is from transport point A to B to C to D, then the origin-to-destination distance is a distance between A and D, and the total transportation distance is a sum of distances between A and B, B and C, and C and D.

[0041] The multiple additional vehicle multi-stop routes are filtered based on the total transportation distance and the origin-to-destination distance to obtain the additional vehicle candidate routes. The transport point information includes restricted vehicle information of the transport points, so additional vehicle information of the additional vehicle candidate routes can be determined based on the transport point information. The additional vehicle information is information of transport vehicles of the additional vehicle candidate routes, including but not limited to information such as at least one of vehicle type and loadable space.

[0042] In addition, for the additional vehicle candidate routes determined in this embodiment, the more the quantity, the higher the cost. Therefore, the cost of additional vehicle candidate routes needs to be accounted. If the transport point information does not contain the cost

information of passage between any two transport points, then remove the additional vehicle candidate routes containing those two transport points, and then calculation of distance and filtering of routes are performed on the remaining additional vehicle candidate routes.

[0043] In one embodiment, as shown in Figure 6, step S403 includes: S501, determining a target additional vehicle multi-stop route with a shortest total transportation distance as a candidate route if at least two target additional vehicle multi-stop routes in the plurality of additional vehicle multi-stop routes pass through same transport points; S502, determining a route detour ratio according to a total transportation distance and an origin-to-destination distance of the candidate route, wherein the route detour ratio is used to characterize a degree of detour of the candidate route; S503, determining the candidate route as the additional vehicle candidate route in a case that the route detour ratio is less than or equal to a preset detour ratio threshold.

[0044] Specifically, if at least two target additional vehicle multi-stop routes pass through the same transport points, that is, if multiple routes of the additional vehicle candidate routes pass through the same transport points but in different orders, for example, target additional vehicle multi-stop route 1 is from transport point A to B to C, and target additional vehicle multi-stop route 2 is from transport point A to C to B, then the target additional vehicle multi-stop route with the shortest total transportation distance is determined as the candidate route, that is, all the candidate routes do not completely pass through the same transport points.

[0045] The route detour ratio can be used to characterize a degree of detour of the candidate route. The route detour ratio of a candidate route can be determined based on a product of a total transportation distance and an origin-to-destination distance of the candidate route, or based on a ratio between the total transportation distance and the origin-to-destination distance of the candidate route. The candidate route with the route detour ratio less than or equal to the preset detour ratio threshold is determined as the additional vehicle candidate routes. The smaller the route detour ratio, the lower the degree of detour of the corresponding candidate route, that is, among all the candidate routes, the routes with the lower degree of detour are preferentially selected as the additional vehicle candidate routes.

[0046] S104, determining a material allocation model according to the transport point information, the historical logistics information, the available material space and the material

allocation routes.

[0047] Specifically, the material allocation model includes an objective function and constraints, and the constraints are determined based on the transport point information, the historical logistics information, the available material space and the material allocation routes. The constraints include but is not limited to at least one of inventory constraint of logistics material of transport points and constraint of available space of transport vehicles on the material allocation routes. The objective function is a multi-objective model, which comprehensively considers multiple parameters in the constraints to minimize a total cost, thereby an optimal solution is obtained.

[0048] In one embodiment, the material allocation model includes the objective function and the constraints, the constraints include a shortage constraint, a surplus constraint, and a loading and unloading volume constraint of material of each transport point, the transport point information further includes inventory information of the transport point. In an exemplary embodiment, as shown in Figure 7, step S104 includes: S601, determining the shortage constraint of material shortage quantity, the surplus constraint of material surplus quantity, and the loading and unloading volume constraint of material loading and unloading volume for each transport point on the material allocation routes according to the inventory information in the transport point information, the historical logistics information, the additional vehicle information and the available material space; S602, determining times of loading and unloading material according to the material loading and unloading volume; S603, determining an additional vehicle route cost of the additional vehicle candidate route according to the additional vehicle information and the coordinate information in the transport point information; S604, determining the objective function according to the material shortage quantity, the material surplus quantity, the material loading and unloading times, the additional vehicle route cost and preset weight coefficients.

[0049] Specifically, the constraints include the shortage constraint, the surplus constraint, and the loading and unloading volume constraint of material of each transport point, and the transport point information includes the inventory information of logistics material of each transport point. The inventory information includes minimum allowable inventory and maximum allowable inventory, where for some transport point, parcels and logistics materials

may be placed outdoors during the day, so the maximum allowable inventory is divided into daytime maximum allowable inventory and nighttime maximum allowable inventory. Since real-time inventory of material of each transport point has certain fluctuations, and space of the transport point has certain adjustability, it is not possible to completely limit the real-time inventory of material of each transport point between the minimum allowable inventory and the maximum allowable inventory. However, considering a limited adjustment capability of the transport point, it is necessary to impose the shortage constraint on the difference between the minimum allowable inventory of the transport points and the real-time inventory of material, that is, material shortage quantity, and the impose surplus constraint on the difference between the real-time inventory of material of each transport point and the maximum allowable inventory, that is, material surplus quantity.

[0050] The loading and unloading volume constraint is a constraint of material loading and unloading volume, at the transport points, of each material allocation route. Material loading and unloading times is determined based on the material loading and unloading volume, at the transport points, of each material allocation route. The transport point information may further include coordinate information of the transport points, and additional vehicle route cost of each additional vehicle candidate route is determined based on the additional vehicle information and the coordinate information of the transport point information. The additional vehicle route cost of each additional vehicle candidate route is determined based on a distance between the transport points and a relevant information set of matched transport vehicles. In an exemplary embodiment, the transport point information may include the inventory information of the transport point, the coordinate information of the transport point, and the additional vehicle information.

[0051] The minimum allowable inventory and the maximum allowable inventory of each transport point are set based on an actual situation of each of the transport point. The larger the material shortage quantity is, the more likely the transport point is to lack material, and the larger the material surplus quantity is, the more idle material and wasted transport point storage space there are. Similarly, the higher the material loading and unloading times and the additional vehicle route cost are, the more resources are wasted, so the objective function is determined based on the material shortage quantity, the material surplus quantity, the material

loading and unloading times and the additional vehicle route cost, and the optimal solution is determined based on that the objective function is minimum. In addition, the material shortage quantity, material surplus quantity, the material loading and unloading times and the additional vehicle route cost have preset weight coefficients, respectively, and these parameters can be weighted according to the weight coefficients. These objectives (the material shortage quantity, the material surplus quantity, the material loading and unloading times and the additional vehicle route cost) are conflicting, so when making decisions based on the multi-objective model (the objective function), it is necessary to balance by setting the coefficients of the objectives. The weight coefficients can be set based on actual planning needs for the objectives, and this embodiment does not impose specific limitations.

[0052] In one embodiment, the constraints further include inventory constraint of material of each transport point, as shown in Figure 8, step S601 includes: S701, determining the loading and unloading volume constraint of the material loading and unloading volume for each transport point on the material allocation routes according to total material loading and unloading volume, the additional vehicle information and the available material space of all transport points on the material allocation routes; S702, determining the inventory constraints of the material inventory of the transport point of the material allocation routes according to the material loading and unloading volume and the historical parcel loading and unloading volume; S703, determining maximum allowable inventory and minimum allowable inventory of the transport point on the material allocation routes according to the inventory information in the transport point information; S704, determining the shortage constraint according to the minimum allowable inventory and the material inventory; S705, determining the surplus constraint according to the maximum allowable inventory and the material inventory.

[0053] Specifically, the available material space of a transport vehicle in an initial transport point on additional vehicle candidate routes is determined based on the additional vehicle information. The loading and unloading volume constraint includes two types, one is that cumulative material loading and unloading volume of each transport point and previous transport points of the material allocation route does not exceed the available material space of the transport vehicle of the material allocation routes at the initial transport point. The other type is that total material loading and unloading volume of all transport points of the material

allocation routes is 0, that is, the material allocation route allocate logistics material between the transport points, and after a route is executed, there is no logistics material placed on the transport vehicle.

[0054] The constraints also include the inventory constraint of material of each transport point. The inventory constraint is a real-time inventory constraint of material of each transport point. The inventory constraint of material inventory of each transport point on each material allocation route is determined based on the material loading and unloading volume and historical parcel loading and unloading volume of each transport point on each material allocation route, that is, material inventory of a certain transport point on a certain material allocation route is material inventory of a previous material allocation route passed through the transport point minus the material loading and unloading volume and the historical parcel loading and unloading volume. It should be noted that initial inventory of logistics material of each transport point is determined based on time when the model of this embodiment starts to be applied, and the logistics material of each transport point flows mutually, so the initial inventory of logistics material of each the transport point is different when the model starts to be applied at different times.

[0055] The maximum allowable inventory and the minimum allowable inventory of each transport point on each material allocation route is determined based on the transport point information, the and minimum allowable inventory and the maximum allowable inventory of each transport point are set based on an actual situation of each transport point, and this embodiment does not impose specific limitations.

[0056] The shortage constraint is determined based on the minimum allowable inventory and the material inventory of each transport point on each the material allocation route, that is, the sum of the material inventory and the material shortage quantity is greater than or equal to the minimum allowable inventory.

[0057] The surplus constraint is determined based on the maximum allowable inventory and the material inventory of each transport point on each material allocation route, that is, the difference between the material inventory and the material surplus quantity is less than or equal to the maximum allowable inventory.

[0058] S105, solving, the material allocation model to determine a material allocation scheme.

[0059] Specifically, the objective function in the material allocation model is weighted sum of the material shortage quantity, the material surplus quantity, the material loading and unloading times and the additional vehicle route cost, that is, each objective has the weight coefficient for balance, and a minimum value of the objective function is solved based on the constraints in the material allocation model.

[0060] The embodiments of the present application fully consider the remaining space of parcel transport vehicles used to consolidate and distribute cargo, and at the same time the economical additional vehicle candidate routes for each allocation area are built. The material allocation scheme is planed based on the optional consolidation and distribution routes and built the additional vehicle candidate routes. Goals of reasonable resource allocation and reducing transportation costs and operational difficulty are achieved.

[0061] Referring to Figure 9, the embodiments of the present application provide a logistics material allocation method, the method includes following steps:

[0062] S1. Processing site data: transport points participating in allocation is filtered, allocation areas are divided according to district to which the transport points belong, and establish a material allocation network for each of the allocation areas.

[0063] S1.1. Inputting site data.

[0064] S1.1.1. Setting safety inventory (the minimum allowable inventory): different from general goods, in the transport points, containers (logistics material) flow in with parcel or flow out with parcel, and the setting safety inventory is mainly to balance a difference between outflow and inflow. In this solution, the safety inventory of each of hubs/service points is configured by the hub/service point.

[0065] S1.1.2. Counting initial inventory: initial inventory of containers of each hub/service point Ji = storage number of containers after a last shift of a previous day of each hub/service point + distribution cages arriving at the hub/service point before a calculation start time of the material allocation model at the day - consolidation cages arriving at the hub/service point before the calculation start time of the material allocation model at the day. This value is calculated by a system and entered to the material allocation model.

[0066] S1.1.3. The maximum daytime storage capacity (the maximum allowable inventory): a limit of containers that can be stored during the day by each hub/service point. This value is

configured by the hub/service point.

[0067] S1.1.4. The maximum nighttime storage capacity (the maximum allowable inventory): A limit of containers that can be stored at night by each hub/service point. This value is configured by the hub/service point.

[0068] S1.2. Dividing the allocation areas.

[0069] The hubs and service points participated in the allocation are filtered, as shown in Figure 3, the hubs consolidate and distribute cargo to each of the service points, while each of the service points is governed by different districts. Therefore, firstly, the service points are grouped according to its affiliated district, considering that the service points in different districts may be consolidated and distributed cargo by a same hub, so if there are service points in different districts mapped to a same hub, the districts are merged into a same group. This ensures that material allocation network of each group do not interfere with each other and that material transfer networks within each group are connected.

[0070] S2. Processing routes data: the consolidation and distribution routes are filtered, the material space of each transport point is calculated; and transport capacity of additional vehicles is constructed and filtered, the material allocation routes are determined. The material allocation routes include the consolidation and distribution routes and the additional vehicle candidate routes.

[0071] S2.1. Filtering the consolidation and distribution routes with complete routes within the allocation area

[0072] S2.2. Predicting the available material space of each transport point on the consolidation and distribution routes

[0073] Data analysis shows that loading situations of the routes at each of the hubs and the service points have obvious periodicity, so the historical parcel loading and unloading volume of the consolidation and distribution routes at each of the transport points can be used to calculate available material space of the transport vehicles at each of the transport points on the consolidation and distribution routes. The available material space of the transport vehicles at the transport point on the consolidation and distribution routes is determined according to a difference between loading amount of the transport vehicles and a second intermediate difference, the second intermediate difference is determined according to a difference between

cumulative loading amount of the transport vehicles at stopping nodes at the consolidation and distribution routes and cumulative unloading amount of the transport vehicles at stopping nodes at the consolidation and distribution routes. For example, the available material space of the transport vehicles in each of the transport points on the consolidation and distribution routes is: loading amount of the transport vehicle - (cumulative loading amount of the transport vehicle at stopping nodes on the consolidation and distribution routes - cumulative unloading amount of the transport vehicle at stopping nodes on the consolidation and distribution routes).

[0074] 1) Calculating the available material space of a transport vehicle in each transport point on the consolidation routes.

[0075] The consolidation routes start from the hubs, with no loading amount at the transport vehicle when starting, and as it passes through sites for loading, the available space is occupied.

[0076] 2) Calculating the available material space of transport vehicle in each transport point on the distribution routes.

[0077] Starting points of the distribution routes may be hub, taking a distribution route passing through transport point A-B-C as an example, the transport vehicles starts fully loaded from the transport point A, the full load amount is 8, unloads 5 at the transport point B, unloads 3 at the transport point C, then the remaining available material space of transport vehicle are A: 8-(8-0)=0, B: 8-(8-5)=5, 8-(8-(5+3))=8.

[0078] S2.3. filtering the additional vehicle candidate routes.

[0079] When transport capacity of the optional consolidation and distribution routes cannot meet demand of transporting containers back to hubs in time, transport capacity of additional vehicles needs to be added to transport containers, in order to meet a goal of cost saving, transport capacity of the additional vehicles can be connected in series with multiple service points. The process of determining the candidate routes for connecting the transport capacity of the additional vehicles can include the following steps:

[0080] brute-force enumerating the additional vehicle multi-stop routes of each of the transport points within the allocation area;

[0081] removing the additional vehicle multi-stop routes with missing cost information;

[0082] among the remaining additional vehicle multi-stop routes, selecting a route with the shortest total transportation distance that passes through same transport points as the candidate

route;

[0083] calculating the route detour ratio for each candidate route, that is, the product of sum of the segment distances (the total transportation distance) and direct distance from the start to the end of the candidate routes (the origin-to-destination distance), and determine the candidate routes with a detour ratio less than or equal to a preset detour ratio threshold as the additional vehicle candidate routes;

[0084] determining optional vehicle types (the additional vehicle information) for transport capacity of the additional vehicle based on vehicle type restrictions at the loading and unloading gates of the sites passed sequentially by the additional vehicles (the transport point information).

[0085] In addition, the additional vehicle route cost of each of the additional vehicle candidate routes is calculated based on the cost information in the transport point information. Departure time for each of the additional vehicle candidate routes is determined based on departure time of service points in the transport point information, and the additional vehicle candidate routes are associated with the transport points.

[0086] S3. Constructing and solving the material allocation model. The material allocation model includes objective functions and constraints.

[0087] S3.1. Refining decision variables: the key elements to solve the problem is to determine the material loading and unloading volume $e_{i,j}$ of a transport vehicle at each transport point j on each material allocation route i. This variable is an integer, when the variable is positive, it indicates that the transport vehicle loads logistics material at the transport point j on the material allocation route i, and when the variable is negative, it indicates that transport vehicle unloads logistics material at the transport point j on the material allocation route i. All space of the transport vehicle on each material allocation route is released after a series of loading and unloading operations from an origin to a destination, the corresponding loading and unloading volume constraint is: $\sum_{i,j\in J_i} e_{i,j} = 0, \quad \forall i \in I$. I is a set of the material allocation routes.

[0088] S3.2. Constructing state transition constraint (the inventory constraint): to ensure that

the real-time material inventory at each site does not exceed the maximum allowable inventory and is not less than the minimum allowable inventory, variable $s_{i,j}$ representing the material inventory of the transport point j after the transport vehicle corresponding to the material allocation route i passes is added, and the inventory constraint is added for the material inventory of each transport point. The material inventory of a transport point j in the multiple transport points passing through an i-th material allocation route is determined according to a difference between a first intermediate difference and material loading and unloading volume, at the transport point j, of the i-th material allocation route, and the first intermediate difference is determined according to a difference between material inventory of the transport point j after passing through a (i-1)-th material allocation route and the number of container converted from loading and unloading parcel amount of the i-th material allocation route at the transport point j. For example, the material inventory $s_{i,j}$ of the transport point j after passing through the i-th material allocation route = the material inventory $s_{i-1,\ j}$ of the transport point j after passing through the i-1th material allocation route - the number of container $u_{i,j}$ converted from the loading and unloading parcel quantity at the transport point j on the i-th material allocation route - the material loading and unloading volume $e_{i,j}$, at the transport point j, of the i-th material allocation route, the corresponding inventory constraint is: $s_{i,j} = s_{i-1,\ j} - u_{i,j} - e_{i,j}, \quad \forall j \in J$, J is a set of the transport points in the allocation area. When the i-th material allocation route is the additional vehicle candidate routes, since the additional vehicle candidate routes are only used for allocating logistics material and does not perform parcel transportation, the number of containers converted from the loading and unloading parcel quantity, at the transport point j, of the i-th material allocation route is 0.

[0089] S3.3. Constructing a relationship between route allocation and site gap (the shortage constraint): firstly, a positive integer variable $gap_{i,j}$ is set to represent a real-time gap value (the material shortage) of transport point j before the transport vehicles corresponding to the i-th material allocation route passes; secondly, control that the sum of the material inventory $s_{i,j}$ of the transport point j after the transport vehicles corresponding to the i-th material allocation

route which passes through transport point j leaves and the material shortage $gap_{i,j}$ must be greater than or equal to the minimum allowable inventory $s_j \min$ of the transport point j. The corresponding shortage constraint is: $s_{i,j} + gap_{i,j} >= s_j \min$， $\forall i \in I$， $\forall j \in J$. Specifically, the material shortage of the transport point j before the transport vehicle corresponding to the i-th material allocation route passes = the minimum allowable inventory - the material inventory of the transport point j before the transport vehicle passes. The material inventory of transport point j after the transport vehicle leaves + the material shortage of the transport point j before the transport vehicle passes = the material inventory of transport point j after the transport vehicle leaves + the minimum allowable inventory - the material inventory of the transport point j before the transport vehicle passes >= the minimum allowable inventory. In other words, the material inventory of the transport point j after the transport vehicle leaves - the material inventory of the transport point j before the transport vehicle passes >= 0, which means that when there is a shortage of material in the inventory, the amount of material unloaded by the transport vehicle must be greater than or equal to 0.

[0090] S3.4. Constructing a relationship between route allocation and site maximum storage capacity (the surplus constraint): firstly, a positive integer variable $sur_{i,j}$ is set to represent the value (the material surplus) of the transport point j exceeding the site maximum storage capacity before the transport vehicle corresponding to the i-th material allocation route passes; secondly, the difference between the material inventory $s_{i,j}$ of the transport point j after the transport vehicle corresponding to the i-th material allocation route which passes through the transport point j leaves the transport point j and the material surplus $sur_{i,j}$ is controlled to be less than or equal to the maximum allowable inventory $s_j \max$ of the transport point j, the corresponding surplus constraint is: $s_{i,j} - sur_{i,j} \le s_j \max$， $\forall i \in I$， $\forall j \in J$. Specifically, the material surplus of the transport point j before the transport vehicle corresponding to the i-th material allocation route passes = the material inventory of the transport point j before the transport vehicle passes – the maximum allowable inventory. The material inventory of the transport point j after the transport vehicle leaves – the material

surplus of the transport point j before the transport vehicle passes = the material inventory of the transport point j after the transport vehicle leaves - the material inventory of the transport point j before the transport vehicle passes + the maximum allowable inventory <= the maximum allowable inventory. In other words, the inventory of material after the transport vehicle leaves - the inventory of material before the transport vehicle passes <= 0, which means that when there is a surplus of material in the inventory, the amount of material unloaded by the transport vehicle must be less than or equal to 0.

[0091] S3.5. Constructing a relationship between route allocation and remaining space of the transport capacity (the loading and unloading volume constraint): The available material space of the transport vehicle at the transport point j on the i-th material allocation route is $emp_{i,j}$. For the consolidation and distribution routes in the material allocation routes, the available material space is an available material space obtained from the analysis of the historical logistics information; for the additional vehicle candidate routes, the available material space is loading capacity of the transport vehicles. The sum of the loading and unloading volume of material corresponding to the transport points after the transport point j corresponding to the i-th material allocation route (the cumulative loading and unloading volume of material) must be less than the available material space of the transport vehicle corresponding to the i-th material allocation route at the transport point j, and the corresponding the loading and unloading volume constraint is: $\sum_{i,j} e_{i,j} \le emp_{i,j}, \forall i \in I, \forall j \in J_i$.

[0092] S3.6. Constructing an objective function: allocation objectives are comprehensively considered to meet basic requirements of real-time availability of containers and storage capacity of containers not exceeding the available space, and then, with an aim of low cost, the transportation needs of the sites for containers are prioritized to be met by capacity of the consolidated and distributed cargo. The mathematical expression can be seen in the objective function: $Z_{\min} = \sum_{i\in I, j\in J} w_1 gap_{i,j} + \sum_{i\in I, j\in J} w_2 sur_{i,j} + \sum_{i\in I} w_3 x_i \cos t + \sum_{i\in I, j\in J} w_4 d_{i,j}$.

$x_i \cos t$ is additional vehicle route cost of the i-th material allocation route, $d_{i,j}$ is material loading and unloading times of the i-th material allocation route at the transport point j, and the

material loading and unloading times $d_{i,j}$ is an absolute value of the material loading and unloading volume $e_{i,j}$ of the material allocation routes i at transport point j. When the i-th material allocation route is an existing consolidation and distribution route, $x_i \cos t$ is 0 or other preset route costs.

[0093] S3.7. Adjusting weight coefficients of the objectives: the transportation network has diverse needs. When establishing models for material allocation problems in different scenarios, scenario-specific needs should be included in multi-objective model as evaluation criteria. Based on the material allocation multi-objective model of real-time routes, the main objectives are: w_1 : material shortage quantity weight; w_2 : material surplus quantity weight; w_3 : additional vehicle route cost weight; w_4 : material loading and unloading times weight. These objectives are conflicting, so when the multi-objective model makes decisions, it needs to combine business to determine how to balance the weights of these objectives.

[0094] S3.8. Solving the material allocation model: the above integer plan problem model can be solved by a solver, or heuristic algorithms such as genetic algorithm, ant colony algorithm (Ant Colony Algorithm, ACA), tabu search, and simulated annealing can be used for the solving.

[0095] S4. Processing model result.

[0096] The material loading and unloading volume $e_{i,j}$ at the transport point j on the material allocation route i is obtained by the solving, that is, the material transfer scheme that the material allocation route i needs to execute at the transport point j.

[0097] The embodiments of the present application can be applied to the distribution and allocation planning of container logistics material such as cages, woven bags, and parcel packaging recycling. Based on route shipping rules, hubs and service points are divided into districts, and each district can be modeled and solved separately for the allocation plan. Additional vehicle multi-stop schemes of the districts are constructed. Based on constructed the additional vehicle multi-stop scheme of each group and the remaining space of each segment of the consolidation and distribution routes, an allocation scheme is generated to make full use of vehicle resources and reduce allocation costs. Real-time inventory changes of each

site and each service point are considered, the storage space of service points are timely released, the real-time needs of container for hubs are met, and the route allocation costs are comprehensively considered to perform multi-objective optimization and obtain a comprehensive solution.

[0098] As shown in Figure 10, the embodiments of the present application provides a logistics material allocation apparatus 900, including: information acquisition module 910, configured to acquire transport point information, consolidation and distribution routes and historical logistics information corresponding to each transport point in a plurality of transport points within an allocation area; space analysis module 920, communicatively connected to the information acquisition module 910, configured to determine, for each transport point, available material space of a transport vehicle at the transport point on the consolidation and distribution routes according to the historical logistics information; route planning module 930, communicatively connected to the information acquisition module 910 and the space analysis module 920, configured to determine material allocation routes according to the transport point information and the consolidation and distribution routes; scheme planning module 940, communicatively connected to the information acquisition module 910, the space analysis module 920 and the route planning module 930, configured to determine a material allocation model according to the transport point information, the historical logistics information, the available material space and the material allocation routes; solve the material allocation model to determine a material allocation scheme.

[0099] In some embodiments of the present application, the historical logistics information includes parcel transport information and transport vehicle information, the space analysis module 920 is configured to: determine historical parcel loading and unloading volume of the transport point on the consolidation and distribution routes according to the parcel transport information; determine the available material space of the transport vehicle at the transport point on the consolidation and distribution routes according to the historical parcel loading and unloading volume and the transport vehicle information.

[0100] In some embodiments of the present application, the material allocation routes include the consolidation and distribution routes and the additional vehicle candidate routes, and the transport point information includes the restricted vehicle information of the transport point

and the coordinate information of the transport point. The route planning module 930 is configured to: enumerate an additional vehicle multi-stop route for each transport point in the plurality of transport points in a case that transport capacity of the consolidation and distribution routes is less than or equal to transport capacity of material allocation demand; obtain a total transportation distance and an origin-to-destination distance of the additional vehicle multi-stop route according to the coordinate information in the transport point information; filter a plurality of additional vehicle multi-stop routes corresponding to the plurality of transport points to obtain the additional vehicle candidate route according to the total transportation distance and the origin-to-destination distance. The route planning module 930 is also configured to determine additional vehicle information of the additional vehicle candidate routes according to the restricted vehicle information in the transport point information.

[0101] In some embodiments of the present application, the route planning module 930 is configured to: determine a target additional vehicle multi-stop route with a shortest total transportation distance as a candidate route if at least two the target additional vehicle multi-stop routes in the plurality of additional vehicle multi-stop routes pass through same transport points; determine a route detour ratio according to a total transportation distance and an origin-to-destination distance of the candidate route, where the route detour ratio is used to characterize a degree of detour of the candidate route; determine the candidate route as the additional vehicle candidate route in a case that the route detour ratio is less than or equal to a preset detour ratio threshold.

[0102] In some embodiments of the present application, the route detour ratio is determined based on a product of the total transportation distance and the origin-to-destination distance of the candidate route.

[0103] In some embodiments of the present application, the material allocation model includes the objective function and the constraints, the constraints include a shortage constraint, a surplus constraint, and a loading and unloading volume constraint of material of each transport point, the transport point information further includes inventory information of the transport point. The scheme planning module 940 is configured to: determine the shortage constraint of material shortage quantity, the surplus constraint of material surplus quantity, and

the loading and unloading volume constraint of material loading and unloading volume for each transport point on the material allocation routes according to the inventory information in the transport point information, the historical logistics information, the additional vehicle information and the available material space; determine times of loading and unloading material according to the material loading and unloading volume; determine an additional vehicle route cost of the additional vehicle candidate route according to the additional vehicle information and the coordinate information in the transport point information; determine the objective function according to the material shortage quantity, the material surplus quantity, the material loading and unloading times, the additional vehicle route cost, and preset weight coefficients.

[0104] In some embodiments of the present application, the constraints also include an inventory constraint of material of each transport point. The scheme planning module 940 is configured to: determine the loading and unloading volume constraint of the material loading and unloading volume for each transport point on the material allocation routes according to total material loading and unloading volume, the additional vehicle information, and the available material space of all transport points on the material allocation routes; determine the inventory constraints of the material inventory of the transport point of the material allocation routes according to the material loading and unloading volume and the historical parcel loading and unloading volume; determine maximum allowable inventory and minimum allowable inventory of the transport point on the material allocation routes according to the inventory information in the transport point information; determine the shortage constraint according to the minimum allowable inventory and the material inventory; determine the surplus constraint according to the maximum allowable inventory and the material inventory.

[0105] In some embodiments of the present application, the material inventory of a transport point j in the plurality of transport points passing through an i-th material allocation route is determined according to a difference between a first intermediate difference and material loading and unloading volume of the i-th material allocation route at the transport point j, the first intermediate difference is determined according to a difference between material inventory of the transport point j after passing through an (i-1)-th material allocation route and the number of container converted from loading and unloading parcel amount of the i-th material allocation

route at the transport point j.

[0106] In some embodiments of the present application, when the i-th material allocation route is the additional vehicle candidate routes, the number of containers converted from the loading and unloading parcel amount of the i-th material allocation route at the transport point j is 0.

[0107] In some embodiments of the present application, the plurality of transport points include hubs and service points, before the acquiring the transport point information, the consolidation and distribution routes and the historical logistics information corresponding to each transport point in the plurality of transport points within the allocation area. The information acquisition module 910 is also configured to: obtain service points and hubs participating in allocation in a target area; divide the service points and the hubs participating in the allocation according to a preset mapping relationship between the service points and the hubs to obtain a plurality of allocation areas.

[0108] In some embodiments of the present application, the available material space of the transport vehicles at the transport point on the consolidation and distribution routes is determined according to a difference between loading amount of the transport vehicle and a second intermediate difference, the second intermediate difference is determined according to a difference between cumulative loading amount of the transport vehicle at stopping nodes on the consolidation and distribution routes and cumulative unloading amount of the transport vehicles at stopping nodes on the consolidation and distribution routes.

[0109] In the above embodiments, the descriptions of each embodiment have their own emphasis, and parts not detailed in a certain embodiment can refer to relevant descriptions of other embodiments.

[0110] For example, the computer device shown in Figure 11 may execute step S101 through the information acquisition module 910 in the logistics material allocation apparatus 900 shown in Figure 10. The computer device may execute step S102 through the space analysis module 920. The computer device may execute step S103 through the route planning module 930. The computer device may execute step S104 and step S105 through the scheme planning module 940. The computer device includes a processor, a memory, and a network interface connected through a system bus. Among them, the processor of the computer device is configured to

provide computing and control capabilities. The memory of the computer device includes non-volatile storage medium and internal memory. The non-volatile storage medium stores operating system and computer program. The internal memory may also store computer program. The internal memory provides an environment for operation of the operating system and computer program in the non-volatile storage medium. The network interface of the computer device is configured to communicate with external computer device through a network connection. The computer program is executed by the processor to implement a logistics material allocation method.

[0111] Those skilled in the art can understand that the structure shown in Figure 11 is only a block diagram of part of the structure related to the solution of the present application, and does not constitute a limitation on the computer device to which the solution of the present application is applied. The specific computer device may include more or fewer components than those shown in the figure, or combine some components, or have different component arrangements.

[0112] In some embodiments of the present application, a computer device is provided, including one or more processors; memory; and one or more applications, where the one or more applications are stored in the memory and configured to be executed by the processor to perform the steps of the above logistics material allocation method. The steps of logistics material allocation method here may be the steps in the logistics material allocation method of the above various embodiments.

[0113] In some embodiments of the present application, a computer-readable storage medium 1200 is provided, as shown in Figure 12, the computer-readable storage medium 1200 stores a computer program 1210, the computer program is loaded by a processor, causing the processor to perform the steps of the above logistics material allocation method. The steps of logistics material allocation method here can be the steps in the logistics material allocation method of the above various embodiments. In addition, the computer-readable storage medium shown in Figure 12 is only one embodiment of a computer-readable storage medium, and its structure is not limiting. The embodiments of the present application do not specifically limit the structure of the computer-readable storage medium.

[0114] Those of ordinary skill in the art can understand that all or part of the processes in the

methods of the above embodiments can be completed by a computer program instructing related hardware. The computer program can be stored in a non-volatile computer-readable storage medium, and when the computer program is executed, it can include the processes of the embodiments of the above methods. Any reference to memory, storage, database, or other media used in the various embodiments provided in the present application may include at least one of non-volatile and volatile memory. Non-volatile memory may include read-only memory (Read-Only Memory, ROM), magnetic tape, floppy disk, flash memory, or optical memory, and the like. The volatile memory may include random access memory (Random Access Memory, RAM) or external cache memory. By way of illustration and not limitation, RAM may be in various forms, such as static random access memory (Static Random Access Memory, SRAM) or dynamic random access memory (Dynamic Random Access Memory, DRAM), and the like.

[0115] The technical features of the above embodiments can be combined arbitrarily. For the sake of brevity, not all possible combinations of the technical features in the above embodiments are described. However, as long as there is no contradiction in the combination of these technical features, it should be considered as the scope recorded in this specification.

[0116] The above provides a detailed introduction to a logistics material allocation method, device, computer device, and storage medium provided by the embodiments of the present application. Specific examples are used in this article to explain the principles and implementation methods of the present application. The description of the above embodiments is only used to help understand the method and core ideas of the present application; at the same time, for those skilled in the art, according to the ideas of the present application, there will be changes in specific embodiment and application scope. In summary, the content of the present specification should not be understood as a limitation to the present application.

CLAIMS

What is claimed is:

1.A logistics material allocation method, comprising:

acquiring transport point information, consolidation and distribution routes, and historical logistics information corresponding to each transport point in a plurality of transport points within an allocation area;

for each transport point, determining available material space of a transport vehicle at the transport point on the consolidation and distribution routes according to the historical logistics information;

determining material allocation routes according to the transport point information and the consolidation and distribution routes;

determining a material allocation model according to the transport point information, the historical logistics information, the available material space and the material allocation routes;

solving the material allocation model to determine a material allocation scheme.

2. The logistics material allocation method according to claim 1, wherein the historical logistics information comprises parcel transport information and transport vehicle information, and the determining the available material space of the transport vehicle at the transport point on the consolidation and distribution routes according to the historical logistics information comprises:

determining historical parcel loading and unloading volume of the transport point on the consolidation and distribution routes according to the parcel transport information;

determining the available material space of the transport vehicle at the transport point on the consolidation and distribution routes according to the historical parcel loading and unloading volume and the transport vehicle information.

3. The logistics material allocation method according to claim 2, wherein the material allocation routes comprise the consolidation and distribution routes and an additional vehicle candidate route, the transport point information comprises restricted vehicle information of the transport point and coordinate information of the transport point, and the determining the material allocation routes according to the transport point information and the consolidation and distribution routes comprises:

enumerating an additional vehicle multi-stop route for each transport point in the plurality of transport points in a case that transport capacity of the consolidation and distribution routes is less than or equal to transport capacity of material allocation demand;

obtaining a total transportation distance and an origin-to-destination distance of the additional vehicle multi-stop route according to the coordinate information in the transport point information;

filtering a plurality of additional vehicle multi-stop routes corresponding to the plurality of transport points to obtain the additional vehicle candidate route according to the total transportation distance and the origin-to-destination distance,

wherein, the logistics material allocation method further comprises:

determining additional vehicle information of the additional vehicle candidate route according to the restricted vehicle information in the transport point information.

4. The logistics material allocation method according to claim 3, wherein the filtering the plurality of additional vehicle multi-stop routes corresponding to the plurality of transport points to obtain the additional vehicle candidate route according to the total transportation distance and the origin-to-destination distance comprises:

determining a target additional vehicle multi-stop route with a shortest total transportation distance as a candidate route if at least two target additional vehicle multi-stop routes in the plurality of additional vehicle multi-stop routes pass through same transport points;

determining a route detour ratio according to a total transportation distance and an origin-to-destination distance of the candidate route, wherein the route detour ratio is used to characterize a degree of detour of the candidate route;

determining the candidate route as the additional vehicle candidate route in a case that the route detour ratio is less than or equal to a preset detour ratio threshold.

5. The logistics material allocation method according to claim 4, wherein the route detour ratio is determined according to a product of the total transportation distance and the origin-to-destination distance of the candidate route.

6. The logistics material allocation method according to any one of claims 3 to 5, wherein the material allocation model comprises an objective function and constraints, the constraints comprise a shortage constraint, a surplus constraint, and a loading and unloading volume

constraint of material of each transport point in the plurality of transport points, the transport point information further comprises inventory information of the transport point, and the determining the material allocation model according to the transport point information, the historical logistics information, the available material space and the material allocation routes comprises:

determining the shortage constraint of material shortage quantity, the surplus constraint of material surplus quantity, and the loading and unloading volume constraint of material loading and unloading volume for each transport point on the material allocation routes according to the inventory information in the transport point information, the historical logistics information, the additional vehicle information and the available material space;

determining times of loading and unloading material according to the material loading and unloading volume;

determining an additional vehicle route cost of the additional vehicle candidate route according to the additional vehicle information and the coordinate information in the transport point information;

determining the objective function according to the material shortage quantity, the material surplus quantity, the material loading and unloading times, the additional vehicle route cost and preset weight coefficients.

7. The logistics material allocation method according to claim 6, wherein the constraints further comprises inventory constraint of the material of the transport point, and the determining the shortage constraint of the material shortage quantity, the surplus constraint of the material surplus quantity, and the loading and unloading volume constraint of the material loading and unloading volume for each transport point on the material allocation routes according to the inventory information in the transport point information, the historical logistics information, the additional vehicle information and the available material space comprises:

determining the loading and unloading volume constraint of the material loading and unloading volume for each transport point on the material allocation routes according to total material loading and unloading volume, the additional vehicle information and the available material space of all transport points on the material allocation routes;

determining the inventory constraints of the material inventory of the transport point of

the material allocation routes according to the material loading and unloading volume and the historical parcel loading and unloading volume;

determining maximum allowable inventory and minimum allowable inventory of the transport point on the material allocation routes according to the inventory information in the transport point information;

determining the shortage constraint according to the minimum allowable inventory and the material inventory;

determining the surplus constraint according to the maximum allowable inventory and the material inventory.

8. The logistics material allocation method according to claim 7, wherein material inventory of a transport point j in the plurality of transport points passing through an i-th material allocation route is determined according to a difference between a first intermediate difference and material loading and unloading volume of the i-th material allocation route at the transport point j, the first intermediate difference is determined according to a difference between material inventory of the transport point j passing through an (i-1)-th material allocation route and the number of container converted from loading and unloading parcel amount of the i-th material allocation route at the transport point j.

9. The logistics material allocation method according to claim 8, wherein when the i-th material allocation route is the additional vehicle candidate route, the number of containers converted from the loading and unloading parcel amount of the i-th material allocation route at the transport point j is 0.

10. The logistics material allocation method according to any one of claims 1 to 9, wherein the plurality of transport points comprise hubs and service points, before the acquiring the transport point information, the consolidation and distribution routes, and the historical logistics information corresponding to each transport point in the plurality of transport points within the allocation area, the logistics material allocation method further comprises:

obtaining service points and hubs participating in allocation in a target area;

dividing the service points and the hubs participating in the allocation according to a preset mapping relationship between the service points and the hubs to obtain a plurality of allocation areas.

11. The logistics material allocation method according to any one of claims 1 to 10, wherein the available material space of the transport vehicle at the transport point on the consolidation and distribution routes is determined according to a difference between loading amount of the transport vehicle and a second intermediate difference, the second intermediate difference is determined according to a difference between cumulative loading amount of the transport vehicle at stopping nodes on the consolidation and distribution routes and cumulative unloading amount of the transport vehicle at stopping nodes on the consolidation and distribution routes.

12.A logistics material allocation apparatus, comprising:

information acquisition module, configured to acquire transport point information, consolidation and distribution routes, and historical logistics information corresponding to each transport point in a plurality of transport points within an allocation area;

space analysis module, communicatively connected to the information acquisition module, and configured to determine, for each transport point, available material space of a transport vehicle at the transport point on the consolidation and distribution routes according to the historical logistics information;

route planning module, communicatively connected to the information acquisition module and the space analysis module, configured to determine material allocation routes according to the transport point information and the consolidation and distribution routes;

scheme planning module, communicatively connected to the information acquisition module, the space analysis module, and the route planning module, configured to determine a material allocation model according to the transport point information, the historical logistics information, the available material space, and the material allocation routes; solve the material allocation model to determine a material allocation scheme.

13. The logistics material allocation apparatus according to claim 12, wherein the historical logistics information comprises parcel transport information and transport vehicle information, the space analysis module is configured to:

determining historical parcel loading and unloading volume of the transport point on the consolidation and distribution routes according to the parcel transport information;

determining the available material space of the transport vehicles at the transport point on

the consolidation and distribution routes according to the historical parcel loading and unloading volume and the transport vehicle information.

14. A computer device, wherein the computer device comprises:

one or more processors;

memory; and one or more applications, wherein the one or more applications are stored in the memory and configured to be executed by the processor to implement the logistics material allocation method according to any one of claims 1 to 11.

15. A computer-readable storage medium, on which a computer program is stored, wherein the computer program is loaded by a processor to execute steps in the logistics material allocation method according to any one of claims 1 to 11.