

TITLE OF THE INVENTION

ELEVATOR OPERATION DIAGNOSIS DEVICE, ELEVATOR OPERATION
DIAGNOSIS SYSTEM, AND ELEVATOR OPERATION DIAGNOSIS METHOD

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001]

The present invention relates to an elevator operation diagnosis device, an elevator operation diagnosis system, and an elevator operation diagnosis method.

2. Description of the Related Art

[0002]

An elevator is a transportation system for vertical movement in a building and supports smooth movement of users in the building. Particularly in a case where a plurality of elevators are operating, an elevator group control system, which controls the plurality of elevators as a group, realizes efficient operation in consideration of the wait time of users. In recent years, in a group control system, control has been performed to predict an operation locus of an elevator car and further shorten the wait time. However, the operation efficiency of the elevator may be reduced depending on use conditions on the user side.

[0003]

Japanese Patent No. 2846102 discloses a system, which performs operation control of an elevator using a claim from a user relating to operation of an elevator or improvement measures that prevent occurrence of a phenomenon that the operation efficiency of the elevator car is reduced temporarily even if no claim is actually made, with respect to an elevator group control system. The improvement measures described in Japanese Patent No. 2846102 involve those relating to an operation specification of a plurality of elevators as a group, for example, an improvement measure for operating an elevator being at a standstill, and an improvement measure for invalidating a door closing button of an elevator car which is waiting at a starting floor for guests or users to enter the elevator car in order to suppress the elevator car from starting with a small number of guests getting in or being accommodated in the elevator car.

[0004]

In addition, Japanese Patent No. 4739848 discloses a technique for collecting information on elevator users and creating an operation plan. That is, Japanese Patent No. 4739848 discloses an example in which a gate through which a user passes is installed in a passage leading to an elevator hall, and operation control of a group-control elevator, such as allotment express operation, is performed

based on information on the number of people passing through the gate.

[0005]

Further, JP 2007-55700 A discloses a technique for proposing elevator operation restriction information to reliably achieve an energy saving target set by a manager while minimizing deterioration in convenience of an elevator. That is, JP 2007-55700 A discloses an example in which the elevator operation restriction information for energy saving is proposed based on integrated power consumption information through a remote monitoring device and a control center to be confirmable on a customer terminal.

SUMMARY OF THE INVENTION

[0007]

However, the elevator operation control system described in Patent Document 1 is limited to the improvement measures that can be executed by the elevator group management control device. Here, when investigating a cause of the reduction in the elevator operation efficiency occurring in an actual site, causes other than causes due to the system control such as the elevator group management control are found in many cases. For this reason, there is a problem that it is difficult to expect a

large improvement effect with the improvement measure that can be executed by the elevator group management control device. Further, there is a possibility that a plurality of improvement measure candidates are proposed in the technique described in Japanese Patent No. 2846102. In such a case, there is a problem that a building manager does not know which improvement measure is to be appropriately selected.

[0008]

Further, the operation control of the elevator, such as the allotment express operation and flexible express operation, disclosed in Japanese Patent No. 4739848 is the control that limits a destination floor of the elevator, and thus, there is a problem that the degree of freedom of use for a user is reduced so that convenience is impaired. In addition, the implementation cost is high because it is necessary to change a control program and display guidance. Therefore, the technique described in Japanese Patent No. 4739848 is not always a more appropriate improvement measure for an elevator where congestion is a problem, and it is desirable to select and implement an improvement measure from a broader perspective.

[0009]

Further, the technique described in JP 2007-55700 A provides information to the building manager to restrict

the operation of the elevator with the emphasis on energy saving, but is not a technique for improving the operation efficiency of the elevator.

[0010]

In order to solve the above-described problems of the related arts, an object of the invention is to provide an elevator operation diagnosis device, an elevator operation diagnosis system, and an elevator operation diagnosis method capable of proposing an improvement measure to appropriately improve operation efficiency reduction in various methods to a building manager in a situation where elevator operation efficiency reduction occurs such as a situation where a wait time is long and a state of congestion.

[0011]

In order to solve the above problem, for example, the configurations described in the claims are adopted.

Although the present application includes a plurality of means for solving the above problems, as an example thereof, an elevator operation diagnosis device of the invention includes: an operation efficiency reduction phenomenon detection processing unit that collects operation data of an elevator and detects a phenomenon that operation efficiency of the elevator is reduced based on the operation data; and a factor determination processing

unit that determines a factor of the operation efficiency reduction phenomenon.

The elevator operation diagnosis device further includes: an improvement measure selection processing unit that selects one or a plurality of improvement measures based on the operation efficiency reduction phenomenon detected by the operation efficiency reduction phenomenon detection processing unit and the factor determined by the factor determination processing unit; and an improvement measure information output processing unit that outputs the improvement measure selected by the improvement measure selection processing unit.

[0012]

Further, in the elevator operation diagnosis device of the invention, the improvement measure output from the improvement measure information output processing unit includes at least two of a change of operation control of the elevator, notification of information on a way to use or operate the elevator to an elevator user, and a restriction on a use state of the elevator.

[0013]

According to the invention, in a status where the operation efficiency of the elevator is reduced, it is possible to provide the improvement measure capable of appropriately improving the operation efficiency reduction

in various methods based on the operation data of the elevator.

Other objects, configurations, and effects which have not been described above will become apparent from an embodiment to be described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is a functional block diagram illustrating software functions of an entire elevator operation diagnosis system illustrating an embodiment according to the invention;

Figs. 2A to 2C are views illustrating data structures of databases used in the elevator operation diagnosis system illustrating the embodiment according to the invention;

Fig. 3 is a diagram illustrating the hardware configuration of the entire elevator operation diagnosis system according to the embodiment of the invention;

Fig. 4 is a flowchart illustrating the processing of the entire elevator operation diagnosis system according to the embodiment of the invention;

Fig. 5 is a flowchart illustrating an example of a process of evaluating improvement measures in the elevator operation diagnosis system according to the embodiment of

the invention;

Fig. 6 is a view illustrating an example of improvement measure evaluation data in the elevator operation diagnosis system according to the embodiment of the invention;

Fig. 7 is a flowchart illustrating an example of a process of calculating effects of improvement measures in the elevator operation diagnosis system according to the embodiment of the invention;

Fig. 8 is a flowchart illustrating an example of a process of determining recommendation rankings of improvement measures in the elevator operation diagnosis system according to the embodiment of the invention;

Fig. 9 is a flowchart illustrating an example (Part 1) of a process of formulating an implementation plan of improvement measures in the elevator operation diagnosis system according to the embodiment of the invention;

Fig. 10 is a flowchart illustrating an example (Part 2) of the process of formulating the implementation plan of improvement measures in the elevator operation diagnosis system according to the embodiment of the invention;

Fig. 11 is a graph illustrating a change in performance when performing base type control first and specialized type control next among improvement measures in the elevator operation diagnosis system according to the

embodiment of the invention;

Fig. 12 is a view illustrating a display example of operation diagnosis results on a dashboard in the elevator operation diagnosis system according to the embodiment of the invention; and

Fig. 13 is a view illustrating a proposal example of a procedure for implementing improvement measures in the elevator operation diagnosis system according to the embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015]

Hereinafter, an embodiment of the invention will be described with reference to the drawings, but before the description, a basic idea regarding an elevator operation diagnosis system according to the invention will be described.

An object to be achieved by the embodiment of the invention is to improve a phenomenon that operation efficiency of an elevator operating in a building is reduced.

[0016]

Here, the "phenomenon that the operation efficiency is reduced" is a phenomenon that the operation performance of the elevator is in a state of not reaching the

performance desired by a user for some reason. For example, it is possible to consider a state where an average wait time for a user is long in a certain time zone, a state where a user at a hall is unable to ride in an elevator car and is left unloaded, a state where a line of users is formed at the hall due to continuity of such a state, or a state where the elevator is stopped on each floor and a boarding time is long.

[0017]

Such operation efficiency reduction phenomena is sometimes caused by elevator group management control, but it is often difficult to solve the phenomena only by improving a method of the elevator group management control when considering actual cases. A typical example is a case where users are concentrated in an elevator more than the transport capacity of the elevator at the time of congestion such as at the office-going hour or at lunch.

[0018]

In an embodiment of the invention, with respect to the above-described elevator operation efficiency reduction phenomenon, not only an improvement measure by elevator control but also a plurality of types of improvement measures are proposed to a building owner or a building manager, such as a type of improvement measure that notifies a user of appropriate use and a type of

improvement measure that changes a use state (for example, use time) of the user. Then, the building owner or the building manager selects and executes the optimum improvement measure from among the plurality of proposed improvement measures.

In addition, in order to enable the building owner or the building manager to select a more appropriate improvement measure regarding the plurality of different types of improvement measures, the plurality of proposed improvement measures are evaluated based on each evaluation item of an improvement effect, cost, and a change in user action, and such evaluation results are also proposed.

[0019]

In this manner, in the embodiment of the invention, it is possible to select the improvement measure in response to a factor of the operation efficiency reduction phenomenon of the elevator of a corresponding building by combining the improvement measure by the elevator control and the improvement measure by the use method of the user. In addition, the evaluation results of the improvement measures are proposed together with the plurality of improvement measures in the embodiment of the invention. Such a proposal of the evaluation result proposes not only a positive effect such as the improvement effect but also a negative effect accompanying the improvement such as the

implementation cost and the change in user action. As a result, the building owner or the building manager can evaluate the proposed improvement measures in terms of cost-effectiveness, and thus, there is an advantage that an appropriate improvement measure can be selected.

[0020]

As described above, according to the embodiment of the invention, the improvement measures that enable the building owner or the building manager to more appropriately make an improvement with respect to the elevator operation efficiency reduction phenomenon occurring in the target building can be proposed, and as a result, the building owner or the building manager can execute the optimum improvement measure against the elevator operation efficiency reduction phenomenon.

[0021]

The above is the outline of the concept of the elevator operation diagnosis system according to the embodiment of the invention. Hereinafter, the elevator operation diagnosis system according to the embodiment of the invention based on the points of the concept will be described in detail with reference to the drawings.

[0022]

<First Embodiment of Invention>

First, an elevator operation diagnosis system 100,

which is the embodiment of the invention (hereinafter referred to as "the present example"), and an elevator operation diagnosis device 1, which is a main component thereof, will be described in detail with reference to Figs. 1 to 13.

[0023]

<Description of Entire Configuration of Elevator Operation Diagnosis System 100>

Fig. 1 is a functional block diagram illustrating software functions of the elevator operation diagnosis system 100 and the elevator operation diagnosis device 1 of the present example.

A block in the area surrounded by the one-dot chain line in Fig. 1 is the elevator operation diagnosis device 1 of the present example. Hereinafter, the elevator operation diagnosis device 1 surrounded by the one-dot chain line and a block outside the area surrounded by the one-dot chain line will be referred to as the elevator operation diagnosis system 100 of the present example.

[0024]

As illustrated in Fig. 1, the elevator operation diagnosis device 1 of the present example includes: an operation diagnosis implementation determination processing unit 11 that performs determination on implementation of operation diagnosis of an elevator, an operation

data/improvement measure implementation result database 12, an operation efficiency reduction phenomenon detection processing unit 13, a factor determination processing unit 14, a factor and improvement measure database 15, an improvement measure selection processing unit 16, an improvement measure information output processing unit 18, and an improvement measure execution processing unit 19.

[0025]

The elevator operation diagnosis device 1 of the present example further includes a control improvement measure execution processing unit 20, which is a specific execution processing unit configured to execute an improvement measure, an information provision improvement measure execution processing unit 21, and a use state restriction improvement measure execution processing unit 22.

[0026]

When receiving a request signal for execution of operation diagnosis from a dashboard information processing device 2 to be described later, the operation diagnosis implementation determination processing unit 11 determines whether to implement the operation diagnosis of the elevator based on operation data of the elevator from the operation data/improvement measure implementation result database 12.

[0027]

The operation data/improvement measure implementation result database 12 illustrated in Fig. 1 includes an operation data database 121 illustrated in Fig. 2A and an improvement measure implementation result database 122 illustrated in Fig. 2B.

The operation data database 121 illustrated in Fig. 2A stores operation data of an elevator of each building collected via a communication network. These pieces of operation data are collected from an elevator group control device 4 and an elevator control device 5 of each building via the communication network. As a matter of course, operation data for each unit of each elevator is collected in the case of group management control in which a plurality of elevators are controlled as a group.

[0028]

As illustrated in Fig. 2A, the operation data database 121 stores operation data classified by a building name, an elevator bank name, and a date.

As the operation data, data such as a boarding floor and the number of passengers and a deboarding floor and the number of passengers (not illustrated) are stored in addition to elevator car position data of each unit, hall call data, and elevator car call data associated with the time. These pieces of operation data are used to calculate

an operation state index for an elevator of a corresponding building and an index relating to an operation efficiency reduction phenomenon.

[0029]

The improvement measure implementation result database 122 illustrated in Fig. 2B stores data on implementation results of improvement measures implemented in the past. That is, when the improvement measures have already been implemented in the elevators of the respective buildings, the content thereof, implementation dates, history of changes in operation states before and after implementation, and the like are recorded. In the example illustrated in Fig. 2B, pieces of data, such as a start date, an end date, a type of an improvement measure, the improvement measure, performance indices before and after implementation of the improvement measure, and implementation cost, are recorded. These pieces of data are used as actual record data to calculate evaluation values and the like when selecting an improvement measure for a new building.

[0030]

When the description is given returning to Fig. 1 again, the operation efficiency reduction phenomenon detection processing unit 13 detects the operation efficiency reduction phenomenon using operation data of a

target elevator in a case where the operation diagnosis implementation determination processing unit 11 has performed the determination on the implementation of the operation diagnosis. Here, the operation efficiency reduction phenomenon refers to a phenomenon that the operation performance of an elevator is lower than a desired level, and may be rephrased as an operation performance deterioration phenomenon in that sense.

Examples thereof may include (1) a state where an average wait time or an average hall call duration is long, (2) a state where an average boarding time is long, (3) a state where there are many leftovers, (4) a state where a line is generated at the hall, and (5) a status where many people are already in an arriving elevator car so that the other people cannot get in in many cases, and the like.

[0031]

Among these examples, a particularly important operation efficiency reduction phenomenon is a phenomenon that the state where the average wait time is long occurs. A long wait time for an elevator may mean that a tenant of the building is less satisfied with the building.

Therefore, it is necessary for the building owner or the building manager to implement an appropriate improvement measure from the viewpoint of satisfaction of the tenant.

[0032]

The factor determination processing unit 14 is supplied with an output of the operation efficiency reduction phenomenon detection processing unit 13 and an improvement measure relating to a factor causing an operation efficiency reduction phenomenon from the factor and improvement measure database 15. The factor determination processing unit 14 performs a process of determining a factor of the operation efficiency reduction phenomenon based on these two pieces of input information.

[0033]

Fig. 2C illustrates a data structure accumulated in the factor and improvement measure database 15.

As illustrated in Fig. 2C, the factor and improvement measure database 15 records an operation efficiency reduction phenomenon, a factor, an improvement measure type, and an improvement measure in association with each other.

That is, the factor and improvement measure database 15 records the detected operation efficiency deterioration phenomenon, the factor linked to this operation efficiency reduction phenomenon, the improvement measure type linked to the determined factor, and the specific improvement measure.

[0034]

The number of factor candidates for each operation

efficiency reduction phenomenon is not necessarily one, but there are often a plurality of factors. In addition, the number of improvement measure candidates for each factor candidate is not necessarily one, but there are often a plurality of improvement measures. Fig. 2C illustrates these in association with each other in a table format. The factor determination processing unit 14 refers to the factor and improvement measure database 15, and thus, can appropriately select the factor for the operation efficiency reduction phenomenon occurring in the elevator of the building and the improvement measure.

[0035]

The factor determination processing unit 14 implements factor determination by inference using the "if-then rule" or the like from information which is a feature of the operation efficiency reduction phenomenon analyzed from the operation data, for example. Alternatively, the factor determination processing unit 14 can also classify a feature value extracted from the operation data when the operation efficiency reduction phenomenon occurs to determine a cause of the operation efficiency reduction.

[0036]

For example, for an operation efficiency reduction phenomenon that the average wait time at the office-going hour is long, a state where the number of users of an

elevator at the office-going hour is close to or equal to or larger than a limit of the facility capacity (transport capacity) of the elevator is exemplified as the factor of the operation efficiency reduction. In addition to the above state, it is also possible to consider a state where a boarding rate decreases even during the congestion because elevator users do not get in an elevator car. If the boarding rate is low, the actual number of passengers (people to be carried) transported by the elevator does not increase so that the elevator users may be left unloaded to increase the wait time. As described above, not only an issue of elevator control but also factors such as the use state or the operation method of the elevator by the elevator users are included in the determination on the factor of the operation efficiency reduction phenomenon in the elevator operation diagnosis system 100 of the present example.

[0037]

The improvement measure selection processing unit 16 is an essential part of the elevator operation diagnosis system of the present example, and performs a process of selecting a more appropriate improvement measure candidate from a group of improvement measures extracted from a wide variety of viewpoints in response to the factors of the operation efficiency reduction. The improvement measure

selection processing unit 16 is connected with a factor determination processing unit 14, an operation data/improvement measure implementation result database 12, the factor and improvement measure database 15, and an elevator operation simulator 17.

[0038]

As illustrated in Fig. 1, the improvement measure selection processing unit 16 includes: an improvement measure candidate extraction processing unit 161, an improvement measure candidate effect calculation processing unit 162, an evaluation value calculation processing unit 163, an evaluation score and recommendation ranking processing unit 164, and an implementation plan formulation processing unit 165.

Hereinafter, processing of each unit provided in the improvement measure selection processing unit 16 will be described in detail with reference to Fig. 1.

[0039]

First, the improvement measure candidate extraction processing unit 161 performs a process of extracting an improvement measure candidate in response to a factor of operation efficiency reduction based on the factor determined by the factor determination processing unit 14 and the factor and improvement measure information related thereto from the factor and improvement measure database

15. In the extraction of the improvement measure candidate, an improvement measure suitable for the factor is extracted from the factor determined by the factor determination processing unit 14 and contrast data between the factors and the improvement measures accumulated in the factor and improvement measure database 15.

[0040]

As described in Fig. 2C, various factors causing operation efficiency reduction for many cases of multiple elevators in the past, a plurality of types of improvement measures for the factors, and the improvement measures thereof are accumulated in the factor and improvement measure database 15. Specifically, a group of the following three types of improvement measures are accumulated. That is,

(1) a type of a control change or new addition of group management control or operation control;

(2) a type of information provision to an elevator user on how to appropriately use or operate an elevator; and

(3) a type of a restriction on a use state (for example, restriction on a use time) for a tenant company and/or a building owner occupying the building.

[0041]

A plurality of improvement measures belonging to

each type are assigned to the above types (1) to (3). Although details will be described later with reference to Fig. 6, for example, in the case of the type (2) of information provision on how to appropriately use or operate the elevator, included are improvement measures such as provision information on a congestion status for a rush-hour zone or the like and provision of information to guide an elevator user to avoid movement in a down direction using the elevator in the rush-hour zone.

[0042]

In this manner, the improvement measure candidate extraction processing unit 161 selects an improvement measure candidate corresponding to a factor input from the factor determination processing unit 14 by rule-based inference such as the "if-then rule" or with reference to the database (table) of improvement measure implementation results illustrated in Fig. 2B for the factor determined by the factor determination processing unit 14 from the above-described group of three types of improvement measures. This rule of "if-then format" is, for example, a rule in which a factor and an improvement measure are associated with each other, and enables selection of an improvement measure corresponding to a factor if the factor is identified.

Note that it is also possible to select the

improvement measure candidate for the factor input from the factor determination processing unit 14 based on a method such as machine learning that focuses on the relationship between an improvement measure implemented in the past and a determined factor.

[0043]

Note that there are basically a plurality of improvement measure candidates to be selected here, and the number of types of improvement measures is also one or plural as described above. Here, if functions of the above-described group of three types of improvement measures are classified from the viewpoint of "control", the change or addition of control is "elevator operation control", the information provision on a way to use or operate is "indirect control of an action or operation of a user", and the restriction on the use state is "direct control of user action". When the improvement measures are divided into the three types of categories as illustrated in the present example, both the operation of the elevator and the action or operation of the user can be appropriately adjusted. In other words, it is possible to appropriately improve the operation efficiency reduction phenomenon occurring in the elevator simultaneously using the plurality of improvement measures.

[0044]

Next, the improvement measure candidate effect calculation processing unit 162 performs a process of calculating the respective effects for a plurality of improvement measure candidates. In this effect calculation process, how much effect an improvement measure has before and after implementation of the improvement measure is calculated for each selected improvement measure candidate.

That is, it is necessary to first illustrate how much desired effect each of the improvement measures can obtain in order for the building owner or the building manager to select the appropriate improvement measure from among the plurality of improvement measure candidates. Therefore, the improvement measure candidate effect calculation processing unit 162 quantitatively or roughly calculates and evaluates the effects of the respective improvement measure candidates in this process of calculating the effects of the improvement measure candidates.

[0045]

This calculation of the improvement effect is performed using the elevator operation simulator 17. That is, the elevator operation simulator 17 refers to operation conditions such as facility specifications of an elevator and traffic flow to set an input condition of the elevator operation simulator 17 so as to match an actual condition

of the operating elevator. Here, the facility specifications of the elevator collectively refer to a target building, the number of floors, an elevator speed, a passenger capacity, the number of elevators, a distance, an elevator model, a group management model, and the like.

Since a simulation of an elevator operation is implemented by a program of the elevator operation simulator 17 set as described above, it is possible to calculate the improvement effects of the respective improvement measure candidates.

[0046]

Further, data close to conditions of the target building and elevator may be selected from the actual record data of the same improvement measure in other buildings and other elevators to perform estimation calculation based on the result. Here, the data accumulated in the factor and improvement measure database 15 is used as the actual record data of the improvement measure. Details of the improvement measure effect calculation process described here will be described with reference to the flowchart in Fig. 7.

[0047]

Next, the evaluation value calculation processing unit 163 considers the improvement effect, which is the result of the improvement measure candidate effect

calculation processing unit 162, and performs a process of calculating an evaluation value for each improvement measure. That is, the evaluation value calculation processing unit 163 calculates the evaluation value for each evaluation item indicating which improvement measure is superior in which item for each of the selected improvement measure candidates. Here, three items, for example, (1) the magnitude of an improvement effect obtained by an improvement measure, (2) the magnitude of the implementation cost of the improvement measure, and (3) the magnitude of a change in user action by the improvement measure are selected as the evaluation item.

It is possible to consider a case where these evaluation values are evaluated at levels, such as five levels, a case where the evaluation values are evaluated numerically by continuous values, and the like, and the case of the evaluation at levels will be described as an example.

[0048]

First, the evaluation value relating to the magnitude of the improvement effect obtained by the improvement measure in (1) is converted into an evaluation value at a level among the five levels, for example, based on the magnitude of the effect calculated in the process of calculating the effects of the improvement measure

candidates. In addition, the evaluation value of "the magnitude of the implementation cost of the improvement measure" in (2) is an evaluation value on a monetary basis when implementing the improvement measure. Examples of the cost for implementation of the improvement measure include cost for modifying a program of group management control, additional cost for an information display device, and cost of labor in a case where guidance by a person is required, and the like. The evaluation value for "the magnitude of the change in user action" in (3) is obtained by evaluating the total amount of actions of all users that change due to the implementation of the improvement measure. This can be evaluated, for example, by Formula (1).

[0049]

[Formula 1]

Magnitude of change in user action =

Number of affected users x amount of action change
per user caused by improvement measure

[0050]

For example, it is possible to consider a case where a change of an office-going hour is proposed to users (tenant companies) on some floors as an improvement measure in order to suppress the concentration of the number of users in the rush-hour zone. In such a case, the amount of action change can be evaluated based on the number of

people affected by the improvement measure and the amount of changed time. In addition, for example, it is possible to consider a case of proposing an improvement measure for control that restricts the use of a specific floor in order to suppress the use during a time zone such as the office-going hour. In this case as well, the improvement measure can be evaluated in the same manner using the use restriction as the change amount.

[0051]

In addition, there is a case where operation on only even floors or odd floors is proposed, for example, as an improvement measure to suppress the number of floors as the stop floor. In this case, the change in user action is movement using stairs from the stop floor to a floor where the elevator does not stop. The magnitude of this change in user action can also be evaluated by the above Formula (1).

[0052]

Here, the amount of change in action per user can be expressed as the evaluation value by quantifying the amount of change in use time, the amount of change in the amount of movement between floors (including a restriction on movement), and the amount of change in the operating method. Although units of the use time, the amount of movement between floors, and the amount of change in the

operating method are different, it is possible to handle these values in a unified manner by using a conversion coefficient (a kind of weighting coefficient) based on the degree of burden on a user.

[0053]

When the relationship among the three evaluation items of (1) the magnitude of the improvement effect, (2) the magnitude of the implementation cost of the improvement measure, and (3) the magnitude of the change in user action are summarized, the "magnitude of the improvement effect" represents the effect, and the "magnitude of the implementation cost of the improvement measure" and the "magnitude of the change in user action" represent the cost. That is, the "magnitude of the change in user action" is an index as cost of the burden on the user side. As a result, it is possible to evaluate the cost-effectiveness or cost performance of the improvement measure candidates by the three evaluation items.

[0054]

As already described, the three types of candidate improvement measures associated with the factors of the operation efficiency reduction include the "type of information provision on how to appropriately use or operate the elevator". This type of improvement measure is an improvement measure that encourages a voluntary action

change from the provided information rather than forcing a compulsory action change of a user, and thus, is preferably adjusted such that the magnitude of the action change is smaller or no change is required.

[0055]

When the evaluation value calculation process performed by the evaluation value calculation processing unit 163 is completed, the evaluation score and recommendation ranking processing unit 164 performs a process of performing evaluation score calculation and recommendation ranking based on the evaluation value calculated by the evaluation value calculation processing unit 163. In the evaluation score and recommendation ranking process, the evaluation score and recommendation ranking processing unit 164 sets evaluation scores from the evaluation values of the three items calculated for each of improvement measure candidates, and ranks the improvement measure candidates based on the evaluation scores. Here, the evaluation score is a score set based on the sum of weightings of the evaluation values of the three items or a predetermined rule from states of the evaluation values of the three items.

[0056]

Note that the recommendation ranking may be performed directly from the evaluation values of the three

items without setting new evaluation scores from the evaluation values obtained by the evaluation value calculation processing unit 163. This recommendation ranking indicates a ranking of an improvement measure candidate to be recommended to the building owner or the building manager. As a matter of course, the ranking is set from an improvement measure with a higher evaluation score or evaluation value.

[0057]

The recommendation rankings given by the evaluation score and recommendation ranking processing unit 164 are basically set in the order of being cost-effective, but may have variations, such as emphasis on the cost and emphasis on the effect, depending on a request from the building owner or the building manager. Such variations can be reflected by weighting of the three evaluation items or a rule for setting the recommendation ranking. As will be described later, the evaluation scores quantifying the recommendation ranking and the degree of recommendation enables the building owner or the building manager to select an appropriate improvement measure using common criteria even for a plurality of improvement measure candidates selected from various types.

[0058]

Next, the implementation plan formulation processing

unit 165 performs a process of formulating an implementation plan including an implementation order. This implementation plan does not propose for implementation of only one improvement measure from among improvement measure candidates, but a proposal for implementation of a plurality of improvement measures at the same time, a proposal for a process with a set order of implementation of a plurality of improvement measures, or the like is formulated.

Here, in the case of proposing the process with the set order of implementation, an implementation plan is established in which, for example, an improvement measure, which is easy to implement with no cost and no change in user action is first implemented, and, if the result illustrates a little improvement or no improvement, a more effective improvement measure is implemented next.

[0059]

As the building manager, it is easy to implement an improvement measure that is inexpensive and has no burden on a user first, and thus, it is preferable to apply an implementation procedure in which such an improvement measure is implemented first and then the next improvement measure is implemented in consideration of the effect. That is, it is conceivable to implement the improvement measures in the ascending order of the implementation cost

or in the ascending order of the change in user action among the above-described three evaluation items.

[0060]

The implementation plan formulation processing unit 165 first formulates the improvement measure of the control change, which is easy to implement and requires low implementation cost and a small impact on a user, in consideration of the above-described three types of improvement measures. Next, the improvement measure of the information provision that requires low implementation cost and entrusts a user to take a voluntary action is formulated. If the effect does not increase even after then, it is preferable to formulate an implementation plan that implements a control change or addition of new control, which requires high implementation cost, or a restriction on a user's use state of the elevator, for example, staggered work hours, staggered lunch hours, and the like.

[0061]

It is effective to propose the implementation plan in which the improvement measures are taken in this order to the building owner or the building manager in advance as the implementation plan according to the status and factors of the operation efficiency reduction. That is, it is desirable that the implementation plan formulation

processing unit 165 set the implementation order in response to features of the selected improvement measure candidates and propose the set implementation order as the implementation plan (implementation process).

[0062]

As a result, the building owner or the building manager can select not single-shot but planned and continuous improvement measures and implement an appropriate measure for the operation efficiency reduction phenomenon occurring in the target building. Note that the implementation plan (implementation process) will be described more specifically with reference to Fig. 13.

[0063]

The respective functions and processing of the improvement measure selection processing unit 16, which is the main component of the elevator operation diagnosis device 1 of the present example, has been described above. Features thereof are summarized again as below.

- The group of three types of improvement measures to be applied for the elevator and the user is provided in order to propose and execute a wide variety of improvement measures including the elevator control and a plurality of improvement measures are selected from among the plurality of types of improvement measures (the improvement measure candidate extraction process).

- The improvement measures are evaluated by the evaluation items of (1) the improvement effect, (2) the implementation cost, and (3) the user action change from the viewpoint of cost-effectiveness in order to evaluate how good each candidate improvement measure is for the various types of improvement measures (the evaluation value calculation process).

[0064]

- The evaluation scores for the respective candidate improvement measures are calculated based on the above evaluation items such that the building owner or the building manager can select an appropriate improvement measure, and the recommendation rankings are set (the evaluation score and recommendation ranking process).

- The implementation order based on the evaluation is set in advance, and the plurality of improvement measures are executed in the order, that is, the improvement measures are executed in a process according to the order (an implementation plan formulation process).

[0065]

With the improvement measure selection process of the improvement measure selection processing unit 16 described above, it is possible to propose the appropriate improvement measure in response to the operation efficiency reduction phenomenon occurring in the target building or

elevator and the factor thereof to the building owner or the building manager. As a result, the building owner or the building manager can select a more suitable improvement measure from among the improvement measure candidates.

Note that a more detailed processing procedure of the implementation plan formulation processing unit 165 will be described later based on flowcharts of Figs. 9 and 10.

[0066]

Next, the improvement measure implementation plan formulated by the implementation plan formulation processing unit 165 of the improvement measure selection processing unit 16 is supplied to the improvement measure information output processing unit 18. The improvement measure information output processing unit 18 outputs additional information, such as the improvement measure selected by the improvement measure selection processing unit 16 and the recommendation ranking, to be proposed to the building owner or the building manager. An output destination of the information from the improvement measure information output processing unit 18 is the dashboard information processing device 2.

[0067]

The dashboard information processing device 2 is connected to a mobile information terminal such as a

smartphone, an information terminal device, such as a personal computer and a tablet terminal, an information processing device, and the like via a communication network such as the Internet, and can receive information content from these types of information terminal devices via the Internet.

That is, the dashboard information processing device 2 is connected to an information processing terminal device 3 of the building owner or the building manager via the network, and provides the information on the improvement measure output from the improvement measure information output processing unit 18 and the information content on a result of operation diagnosis to the building owner or the building manager.

[0068]

Further, the dashboard information processing device 2 can bidirectionally communicate with the elevator operation diagnosis device 1 and the building manager information processing terminal device 3. With this mechanism, the building owner or the building manager can receive a dashboard (information content) relating to the operation diagnosis from the dashboard information processing device 2, and receive the information such as the operation efficiency reduction phenomenon and the factor thereof, the proposed improvement measure based on

the diagnosis, the evaluation score thereof, and the recommendation ranking.

[0069]

The improvement measure candidates proposed by the improvement measure information output processing unit 18 to the dashboard information processing device 2 are browsed by the building owner or the building manager through the building manager information processing terminal device 3. Then, the building owner or the building manager determines an improvement measure to be implemented from among the browsed improvement measure candidates, and sends the determined improvement measure to the improvement measure execution processing unit 19 via the dashboard information processing device 2.

[0070]

The improvement measure execution processing unit 19 performs a process of executing the improvement measure determined by the building owner or the building manager.

The improvement measure execution processing unit 19 executes this execution process according to a category group of the improvement measures divided into the three types. This type-based execution process is also a technique which is a feature of the elevator operation diagnosis device 1 of the present example, and will be divided into types (A) to (C) for description.

[0071]

(A) A type of an improvement measure of a change or new addition of group management control/operation control

In the case of an improvement measure classified into the type (A), the control improvement measure execution processing unit 20 sets a specific control change or newly added detailed specifications such as a control parameter. Instruction data to execute the specifications of the type (A) is transmitted to the elevator group control device 4 and/or the elevator control device 5. In response to the result, the elevator group control device 4 and/or the elevator control device 5 executes the improvement measure determined by a building owner or a building manager.

[0072]

(B) A type of an improvement measure of provision of information on a way to use or operate an elevator

In the case of an improvement measure classified as the type (B), the information provision improvement measure execution processing unit 21 creates information data to be provided to a user, and distributes the information to various information display devices such as an information display device 6 in an elevator car, an information display device 7 at a hall, a digital signage device 8 installed on a floor (story) of a building, and a personal mobile

information terminal device 9. Each of the devices 6 to 9 receiving the distribution result provides the elevator user with desired information on the improvement measure determined by the building owner or the building manager.

[0073]

As the user changes a method of using an elevator in view of the information provided from the information provision improvement measure execution processing unit 21, the operation efficiency reduction phenomenon in the elevator is improved. For example, it is possible to consider a case where there are a lot of demands for the elevator to move in the down direction even during a rush-hour congestion time zone when the elevator mainly moves in an up direction from a lobby floor, so that the operation efficiency is reduced. In such a case, as an improvement measure for the operation efficiency reduction, it is conceivable to provide the information requesting suppression on the use of the elevator in the down direction during the rush-hour congestion time zone to the information display device 6 in the elevator car and the information display device 7 at the hall. As a result, if the elevator users refer to this information to decrease the use of the elevator in the down direction during the rush-hour congestion zone, the operation efficiency reduction of the elevator is improved.

[0074]

(C) A type of an improvement measure of a restriction on a use state for a tenant company and a building owner

In the case of the improvement measure classified into the type (C), the use state restriction improvement measure execution processing unit 22 determines a specific use state restriction content. Then, the use state restriction improvement measure execution processing unit 22 transmits the use state restriction content to a building tenant information processing terminal device 10 and the building manager information processing terminal device 3.

[0075]

On the basis of this information, the tenant company occupying the building or the building manager implements a measure to restrict the use state of the elevator. For example, specific examples of the use state restriction include a restriction on office-going hours (working start time) to disperse elevator use time, a restriction on lunch hours (lunch break time), a restriction on office-leaving hours (working end time), and the like. In addition, it is also possible to consider a restriction on available floors during congestion such as the office-going hour.

[0076]

For example, it is possible to consider a case where a tenant occupies the 7th, 8th, 9th, and 10th floors, and a state where the elevator stops at each of the floors at the office-going hour is formed so that the operation efficiency is reduced. In such a case, information can be provided in the form of proposing an improvement measure to restrict an available floor at the office-going hour, such as a restriction on the available stop floors to the 8th and 10th floors, to the tenant.

As described above, to switch an instruction destination (output destination) for execution of the improvement measures in response to the types of improvement measures illustrated in (A) to (C) is also an important technique of the elevator operation diagnosis system 100 of the present example. As a result, the building owner or the building manager can execute an appropriate improvement measure in response to the types (A) to (C) of improvement measures.

[0077]

As described above, with the elevator operation diagnosis system 100 of the present example illustrated in Fig. 1, a more appropriate improvement measure can be proposed to the building owner or the building manager in response to the elevator operation efficiency reduction phenomenon occurring in the target building, and further,

it is possible to implement such an improvement measure by an appropriate execution means.

[0078]

<Description of Hardware Configuration of Entire Elevator Operation Diagnosis System of Present Example>

Fig. 3 is a diagram illustrating the hardware configuration of the entire system including the elevator operation diagnosis system 100 of the present example.

As illustrated in Fig. 3, the hardware configuration of the elevator operation diagnosis system 100 of the present example is roughly divided into three systems: (1) an elevator remote control system, (2) a group control elevator system, and (3) a building control system. The elevator operation diagnosis device 1 described in Fig. 1 is positioned in the elevator remote control system.

[0079]

Hereinafter, configurations and specific operations of the above three systems will be described.

(1) Elevator remote control system

The elevator remote control system is a system that controls an elevator operating in a target building, and also has a role of connecting the elevator side and a building control side by a communication means.

An elevator remote monitoring system 31 constituting this system includes the elevator operation diagnosis

device 1 and the dashboard information processing device 2 described in Fig. 1 as the main components thereof.

[0080]

The elevator remote monitoring system 31 is a system that monitors a state via a communication network in order to safely, reliably, smoothly, and efficiently operate a large number of buildings to be monitored, and a large number of elevators operating in the buildings.

Configurations having the main functions among them include the dashboard information processing device 2 exchanging information with the building owner and the building manager, and the elevator operation diagnosis device 1.

[0081]

Since the elevator operation diagnosis device 1 and the dashboard information processing device 2 have already been described in Fig. 1, the detailed description thereof will be omitted.

As described in Fig. 1, the elevator operation diagnosis device 1 diagnoses an operation state of each elevator from the operation data of multiple elevators obtained by remote monitoring, and improves the operation efficiency if there occurs operation efficiency reduction. The dashboard information processing device 2 proposes a maintenance status of an elevator, an operation state of the elevator, a status of a diagnostic result, and further,

implements the proposal of the improvement measure to the building owner or the building manager.

[0082]

(2) Group control elevator system

The group control elevator system is a system that directly controls elevators of a target building. Hereinafter, group-controlled elevators in which a plurality of elevators are collectively controlled as a group will be described as an example. Elevator group control devices 41 and 42 (the same as the elevator group control device 4 in Fig. 1) of the target building execute control of the elevator group to be controlled. Elevator control devices 51 and 52 (the same as elevator control device 5 in Fig. 1) are provided for each unit and control the operating motions of elevators.

[0083]

That is, an elevator car No. 1 511 is controlled by the elevator control device 51, and an elevator car M 521 is controlled by the elevator control device 52. The elevator car Not. 1 511 is provided with an elevator car call registration device 512, a load sensor 513 that measures the load inside the elevator car, and an elevator car information display device 61 installed in the elevator car. The load sensor 513 measures the weight of the number of passengers in the elevator car, and estimates the number

of boarding people and the number of debording people at each stop floor from a change in the weight.

[0084]

Note that an image sensor (not illustrated) may be provided in the elevator car 511 together with the load sensor 513 to measure the number of people. The elevator car call registration device 512 is a device that allows a user to register a destination floor, and can estimate the number of people in the elevator car 511 together with destination floor information and the load sensor 513. The information display device 61 in the elevator car is, for example, a display device in the elevator car 511, and corresponds to the information display device 6 in the elevator car illustrated in Fig. 1. Image information and voice information are output to the information display device 61 in the elevator car from the information provision improvement measure execution processing unit 21 illustrated in Fig. 1. That is, the information display device 61 in the elevator car is used in the improvement measure type of information provision on how to appropriately use or operate the elevator which has already been described.

The elevator car No. M 521 is also provided with an elevator car call registration device 522, a load sensor 523, and an information display device 62 in the elevator

car, and the operation thereof is the same as that of the elevator car No. 1 511, and thus, will not be described.

[0085]

Next, the hall side of the elevator will be described. At an elevator hall 81 on the first floor, a hall call registration device 811 and an information display device 71 at the hall are installed. The hall call registration device 811 is a device that allows a user to input a destination direction at the hall, and the information display device 71 at the hall is a device that displays and outputs information on a display or the like at the hall. The information display device 71 at the hall corresponds to an information display device 7 at a hall described in Fig. 1, and image information and voice information are output from the information provision improvement measure execution processing unit 21 illustrated in Fig. 1 similarly to the information display device 61 in the elevator car. The information display device 71 at the hall is also used as the improvement measure type of information provision on how to appropriately use or operate the elevator.

[0086]

Similarly, a hall call registration device 821 and an information display device 72 at the hall are installed for an elevator hall 82 on the N-th floor, and the

operation thereof is the same as that of the elevator hall 81 on the first floor, and thus, will not be described.

Other elevator group control devices 42 operating in the same building or other buildings have the same functions and configurations as the elevator group control device 41, and thus, the description thereof will be omitted.

[0087]

(3) Building control system

The building control system is a system that controls the entire building, such as a building facility, and tenant companies or users occupying the building, in terms of hardware and software. The building control system includes the building manager information processing terminal device 3, the building tenant information processing terminal device 10, the digital signage device 8 installed on the floor of the building, the mobile information terminal device 9 of the elevator user, and a communication network 32 connecting these devices by communication. Here, the building manager information processing terminal device 3, the building tenant information processing terminal device 10, the digital signage device 8 installed on the floor of the building, and the mobile information terminal device 9 of the elevator user are the same as those described with

reference to Fig. 1, and thus, will be denoted by the same reference signs, and the description thereof will be omitted.

[0088]

The information processing terminal device, the information terminal, the elevator operation diagnosis device 1, and the dashboard information processing device 2 are connected via the communication network 32 so as to be capable of exchanging data and information with each other. With this configuration, an operation diagnosis result in the elevator operation diagnosis device 1 is sent to the dashboard information processing device 2, and an improvement measure, which is the operation diagnosis result, is proposed to a building owner and/or a building manager.

The building owner and/or the building manager transmits information on the improvement measure for a selected elevator operation to the elevator operation diagnosis device 1 via the dashboard information processing device 2. As a result, an instruction is issued from the elevator operation diagnosis device 1 side to the group control elevator system to take a measure to implement the improvement measure.

[0089]

Note that roles of the digital signage device 8

installed on the floor of the building and the mobile information terminal device 9 of the elevator user will be supplementarily described. The digital signage device 8 and the mobile information terminal device 9 of the elevator user also play the same role as the information display device in the elevator car or at the hall. That is, when an improvement measure belonging to the improvement measure type of information provision on how to appropriately use or operate the elevator is implemented, the information is provided to the digital signage device 8 and the mobile information terminal device 9 of the user so that the user of the elevator can refer to the information to improve the elevator use.

[0090]

In addition, in the case of an improvement measure belonging to the type of the restriction on the elevator use state for the tenant company or a building owner, the tenant company needs to announce the restriction on the use state to the user if the tenant company implements the improvement measure. For this reason, the tenant company can promptly notify the user of the information on the use restriction by providing the information using the digital signage device 8, the mobile information terminal device 9 of the elevator user, the information display devices 61 and 62 in the elevator car, and the information display

devices 71 and 72 at the hall.

[0091]

<Flow of Processing of Entire Elevator Operation Diagnosis System of Present Example>

Fig. 4 is a flowchart illustrating the flow of the processing of the entire system including the elevator operation diagnosis device 1 of the present example. The flowchart of Fig. 4 illustrates the content already described in the functional block of Fig. 1 as its operation procedure, and the content of the flowchart of Fig. 4 will be described hereinafter in correspondence with the processing of Fig. 1.

[0092]

First, the operation diagnosis implementation determination processing unit 11 determines whether there is a request for implementation of elevator operation diagnosis (S1). Here, the operation diagnosis implementation request is issued by a building owner or a building manager via the dashboard information processing device 2.

[0093]

If there is the operation diagnosis implementation request in Step S1 (YES in S1), operation data of a target elevator is input to execute the operation diagnosis (S2). Here, the operation data/improvement measure implementation

result database 12 of Fig. 1 is read and input. If there is no operation diagnosis implementation request in Step S1 (NO in S1), the processing is ended.

[0094]

Next, the operation efficiency reduction phenomenon detection processing unit 13 executes a process of detecting an operation efficiency reduction phenomenon using the input operation data (S3). Here, the operation efficiency reduction phenomenon refers to a case where the operation performance of the elevator is lower than the required performance as described above, and specific examples thereof include (1) a long average wait time (or average hall call duration), (2) a high occurrence rate of a long wait time, (3) a long average boarding time, (4) occurrence of a lot of unloaded people, (5) occurrence of a waiting line for an elevator car, and (6) frequent occurrence of a status where a lot of people are already in an arriving elevator car to prevent other people from getting in.

[0095]

The operation efficiency reduction phenomenon detection processing unit 13 determines whether the operation efficiency reduction phenomenon has been detected in the elevator to be diagnosed as a result of the operation efficiency reduction phenomenon detection process

(S4). If the operation efficiency reduction phenomenon has been detected in Step S4 (YES in S4), the factor determination processing unit 14 determines a factor of the detected operation efficiency reduction phenomenon (S5). For example, as factors of the operation efficiency reduction phenomenon that the average wait time is long, it is possible to consider a factor that the number of elevator users during the time zone is extremely large, a factor that there are many people using the elevator on many floors of the building so that there are many hall calls and stops, and a factor that there are a lot of stops due to elevator car calls (destination floor calls) since many people board the elevator car in the office-going hour.

[0096]

As data relating to the factor, the data accumulated in the factor and improvement measure database 15 of Fig. 1 is referred to. Data relating to factors of the operation efficiency reduction phenomena in many buildings and many elevators is accumulated in the factor and improvement measure database 15. When the factor is determined, the improvement measure selection processing unit 16 selects an improvement measure candidate based on the determined factor (S6).

If the operation efficiency reduction phenomenon has

not been detected in Step S4 (NO in S4), the processing is ended.

[0097]

First, the improvement measure candidate extraction processing unit 161 of the improvement measure selection processing unit 16 selects an improvement measure candidate based on the factor determined in Step S6. The improvement measure selected by the improvement measure candidate extraction processing unit 161 is selected from the categories of the following three types of improvement measures as already described.

That is, the three types are (1) the change or addition of operation control, (2) the notification of information on the way to use or operate an elevator to the user, and (3) the restriction on the use state of the elevator (for example, the restriction on the use time).

The improvement measures belonging to these three types are accumulated in the factor and improvement measure database 15 of Fig. 1 in association with the factors. Since a large number of improvement measures implemented in the past are stored in the factor and improvement measure database 15, it is possible to select an improvement measure having an actual record and high reliability as a candidate.

[0098]

Next, the improvement measure candidate effect calculation processing unit 162 of the improvement measure selection processing unit 16 calculates an effect of each improvement measure candidate. Subsequently, the evaluation value calculation processing unit 163 calculates an evaluation value for the selected improvement measure candidate (S7).

As described above, this evaluation value of the improvement measure is calculated based on (1) the magnitude of the improvement effect, (2) the magnitude of implementation cost of the improvement measure, and (3) the magnitude of the change in user action. These three items correspond to the effect and cost of cost-effectiveness, and it is possible to suitably evaluate the selected improvement measure candidate from the viewpoint of cost-effectiveness by using the evaluation values of these three items.

[0099]

When the evaluation values of the above three items are calculated for each improvement measure candidate, the evaluation score and recommendation ranking processing unit 164 of the improvement measure selection processing unit 16 performs calculation of the evaluation score based on this evaluation value and recommendation ranking of each improvement measure candidate based on the evaluation value

and evaluation score. Subsequently, the implementation plan formulation processing unit 165 formulates an implementation plan that defines an implementation order and the like (S8).

[0100]

Since these processes have already been described in Fig. 1, details thereof will be omitted, but the evaluation score and recommendation ranking processing unit 164 sets the evaluation score corresponding to the total score of the improvement measure based on the calculated evaluation values of the respective items, for each of the selected improvement measure candidates. Then, the recommendation ranking is performed in order of which improvement measures can be recommended more based on this evaluation score. Here, the evaluation score is a score obtained by evaluating a weighted evaluation value depending on which of the three items of the evaluation values is evaluated as important. As already described with reference to Fig. 1, the implementation plan formulated by the implementation plan formulation processing unit 165 is not a plan to implement an improvement measure in a single shot, but is an implementation plan that formulates a process of implementing a plurality of improvement measures in a timely manner.

[0101]

For example, it is possible to consider an implementation process in which an improvement measure requiring a low cost and small burden on the user (action change) is immediately implemented first, and then, an improvement measure, which can be expected to be highly effective even if some cost is required, is implemented next, and this implementation process becomes the implementation plan formulated by the implementation plan formulation processing unit 165. This point will be described in detail with reference to Fig. 13.

[0102]

If the evaluation value for each item, the evaluation score serving as the overall evaluation value, the recommendation ranking, and the implementation plan (implementation process) have been set for the selected improvement measure candidate, these pieces of information are displayed on the dashboard information processing device 2 as the operation diagnosis result together with the operation efficiency reduction phenomenon, the factor, and the like by the improvement measure information output processing unit 18 of Fig. 1 (S9). This operation diagnosis result (information content) displayed on the dashboard information processing device 2 is provided as information to the building owner or the building manager via the building manager information processing terminal

device 3 in Fig. 1.

[0103]

The building owner or the building manager refers to the information on the operation diagnosis result and selects and determines which improvement measure to implement (S10). The improvement measure determined by this building owner or the building manager is transmitted to the improvement measure execution processing unit 19 of the elevator operation diagnosis device 1 via the building manager information processing terminal device 3 and the dashboard information processing device 2 of Fig. 1.

The improvement measure execution processing unit 19 performs a process of executing the received improvement measure, and supplies the processing result to any of the control improvement measure execution processing unit 20, which implements the execution process according to a type on the three types of improvement measures, the information provision improvement measure execution processing unit 21 of the information provision, or the use state improvement measure execution processing unit 22 as already described to implement the selected improvement measure (S11).

The above is the processing flow of the entire elevator operation diagnosis system 100 of the present example.

[0104]

<Processing Procedure Relating to Evaluation of Improvement Measure>

Fig. 5 is a flowchart illustrating an example of a process of evaluating improvement measures in the elevator operation diagnosis device 1 of the present example. The flowchart of Fig. 5 is given to describe processing from the improvement measure candidate extraction processing unit 161 to the implementation plan formulation processing unit 165 described in Fig. 1, that is, a procedure from the improvement measure candidate extraction to the improvement effect calculation process, the improvement measure evaluation value calculation process, the evaluation score and recommendation ranking process, and the implementation plan (implementation order) formulation process in more detail.

[0105]

First, the improvement measure candidate extraction processing unit 161 of the improvement measure selection processing unit 16 selects improvement measures in response to determined factors based on the factor and improvement measure database 15 in which the factors and the improvement measures are associated with each other using a rule such as an if-then format (S12). Here, the rule such as the if-then format is, for example, a rule in which factors and improvement measures are associated with each

other. If a factor can be identified by using this rule, it is possible to select an improvement measure corresponding to the identified factor.

[0106]

When improvement measure candidates are selected in Step S12, first, the improvement measure candidate effect calculation processing unit 162 calculates the magnitude of an improvement effect with respect to an operation efficiency reduction phenomenon (S13). For this purpose, first, the improvement effect is calculated by a simulation, and then, the improvement effect is calculated based on actual record data of the same improvement measure in other elevators. For example, if there is the operation efficiency reduction phenomenon that the average wait time is long, a reduction effect is quantified by a wait time reduction ratio, a reduction rate, or the like obtained by comparing the average wait time before and after implementation of the improvement measure. In this quantification, for example, an improvement effect that the average wait time is reduced by 20% before and after the implementation of the improvement measures is calculated.

[0107]

Here, the evaluation value calculation processing unit 163 converts a numerical value of the improvement effect into an evaluation value with level values, for

example, at five levels as already described with reference to Fig. 1. For example, the evaluation value is converted into 5 if the operation efficiency reduction phenomenon is reduced by 30%, and the evaluation value is converted into 4 if the operation efficiency reduction phenomenon is reduced by 20%. This evaluation value is set to a level value in a predetermined range or a normalized value so as to facilitate comparison with evaluation values of other items. A specific example of the evaluation value of the improvement measure will be described again with reference to Fig. 6.

[0108]

First, the evaluation value calculation processing unit 163 calculates an evaluation value for cost (financial cost) required to implement an improvement measure, which corresponds to the cost of cost-effectiveness of the improvement measure (S14). This evaluation value is calculated by any of the following methods (1) to (3).

(1) Refer to a data table that describes cost for each improvement measure.

(2) Calculate cost for an improvement measure using a formula (for example, a formula that converts the amount of a program to be changed into cost).

(3) Calculate cost based on actual record data of cost for the same improvement measure implemented in other

elevators.

[0109]

Furthermore, the evaluation value calculation processing unit 163 also evaluates a change in user action caused by implementation of an improvement measure, which is not financial cost, from the viewpoint of cost. This is calculated as an evaluation value corresponding to the magnitude of the change in user action that occurs when the improvement measure is implemented (S15). For example, the evaluation value calculation processing unit 163 performs calculation such that the evaluation value is "4", "3", and "2" when the office-going hour is changed by 5 minutes, 10 minutes, and 30 minutes, respectively.

Since the change in action relating to the use of the elevator, such as the change of the office-going hour, is a burden (demerit) to the user, the evaluation value is estimated as a kind of cost. In the present example, the evaluation value of the cost is set such that the evaluation value decrease as the cost increases. This aims to make the evaluation value of the effect correspond to the evaluation value of the cost.

[0110]

Next, the evaluation value calculation processing unit 163 calculates an evaluation value corresponding to the magnitude of the change in user action (S15).The

evaluation value corresponding to the magnitude of this change in user action is also calculated by any of the following methods (1) to (3) similarly to the calculation of the evaluation value for the financial cost required for implementation of the improvement measure described above.

(1) Refer to a conversion table that converts an action change amount into an evaluation value

(2) Calculation by a calculation formula to obtain an evaluation value from the action change amount

(3) Calculate the magnitude of action change and an evaluation value thereof based on actual record data of the action change amount for the same improvement measure implemented in other elevators

However, it is by no means easy to predict a change in user action caused by implementation of the improvement measure.

In such a case, it is effective to make an estimation using the actual record data based on similar past improvement measures as illustrated in (3) above.

[0111]

If the evaluation values for the improvement effect, cost, and user action change are calculated for each improvement measure candidate in Steps S14 to S15, the evaluation score and recommendation ranking processing unit 164 of the improvement measure selection processing unit 16

calculates an evaluation score corresponding to the total evaluation points by a calculation rule from each evaluation value or a weighted sum of the evaluation values next (S16).

Here, as the rule to calculate the evaluation score from each evaluation value, it is possible to consider, for example, a rule that an improvement measure with low cost is prioritized to give a good evaluation score, or a rule that an improvement measure that causes a small change in user action is emphasized to give a good evaluation score. [0112]

If the evaluation score is calculated in Step S16, the evaluation score and recommendation ranking processing unit 164 sets the recommendation rankings of the improvement measures based on the magnitude of the evaluation score or the rule for each evaluation value (S17).

Finally, the implementation plan formulation processing unit 165 of the improvement measure selection processing unit 16 formulates the implementation order of the improvement measures, that is, the implementation plan, based on the respective evaluation values, the evaluation scores, and the recommendation rankings (S18).

Here, the recommendation rankings are used to display the evaluation scores of the plurality of

improvement measures in descending order for the building owner or the building manager so as to enable the building owner or the building manager to easily select an improvement measure. The building owner or the building manager selects the improvement measure to be implemented in the target building according to this recommendation ranking.

[0113]

<Example of Improvement Measure Evaluation Data>

Fig. 6 is a view illustrating an example of improvement measure evaluation data in the elevator operation diagnosis system 100 of the present example. In Fig. 6, five fields of an improvement measure type (A1), an improvement measure (A2), an evaluation value (A3), an evaluation score (A4), and a recommendation ranking (A5) are provided.

The data illustrated in Fig. 6 includes data held by the elevator operation diagnosis device 1 as internal data and data displayed and output by the dashboard information processing device 2 as a part of a diagnosis result.

[0114]

Hereinafter, the content of Fig. 6 will be described in more detail. First, in the field (A1) of the improvement measure type, the improvement measures are classified into the three types as described above. That

is, the three types are: (1) the change or addition of control, (2) the provision of information on use or the operation method, and (3) the restriction on the use state.

In the field (A2) of the improvement measure, the improvement measure candidates selected to improve the operation efficiency reduction phenomenon are illustrated to be divided into the types of the improvement measures. [0115]

For example, when the improvement measure type is (1) the change or addition of control, an improvement measure of calling all elevators to the lobby floor in the rush-hour zone and an improvement measure of allotment express operation in the rush-hour zone (also called sectoring operation) are selected as candidates.

If the improvement measure type is (2) the provision of information on the use or operation method, improvement measures such as provision of congestion status information in the rush-hour zone and provision of information on suppression of the elevator use in the down direction in the rush-hour zone are selected.

When the improvement measure type is (3) the restriction on the use state, an improvement measure of implementing staggered work hours is selected as a candidate.

[0116]

The field (A3) of the evaluation value illustrates a value of the evaluation value for each selected improvement measure candidate. Here, as described above, the evaluation value is evaluated in the state of being divided into three items, that is, the improvement effect, the cost at the time of implementation, and the action change of the user at the time of implementation, from the viewpoint of cost-effectiveness. Here, the evaluation value is evaluated at five levels from 1 to 5. That is, a higher evaluation value indicates better evaluation for the improvement measure. Note that the five-level evaluation value is merely an example, and it is also conceivable to change an evaluation value into a normalized value in the range of 0 to 1 or to express the evaluation value by a score of 0 to 100, in addition to the present example.

[0117]

In either case, it is important to unify areas (value ranges) taken by the evaluation values in order to facilitate comparison between the improvement measures. Further, areas (value ranges) taken by values are unified to facilitate comparison similarly for each evaluation value item. In addition, a weight corresponding to the priority and importance is provided for each evaluation value item.

[0118]

In the example of Fig. 6, the evaluation value is set by qualitatively coarse weighting, such as large, medium, and small, but the evaluation value may be digitized by a weighting coefficient or the like. In the present example, weights are set to give more emphasis on cost of the cost-effectiveness. That is, regarding the weights of the respective items of the evaluation values, the improvement effect is "medium", and the cost and action change are "large". Note that this weight is used at the time of setting the value of the evaluation score corresponding to the comprehensive evaluation and the recommendation ranking of improvement measure.

[0119]

The field (A4) of the evaluation score illustrates the evaluation score calculated based on the evaluation value and the weight of each improvement measure candidate. This evaluation score is also a value at five levels from 1 to 5. In the present example, since the weights of the cost and the action change are large, the improvement measures for which these evaluation values are high have a good evaluation score. Specifically, the improvement measure of the type of the change or addition of control and the improvement measure of calling all the elevators to the lobby floor in the rush-hour zone have the highest (best) evaluation score "4".

[0120]

The improvement measure of this evaluation score "4" is an improvement measure that is easy to introduce since a program change of elevator control is relatively small and only the operation of the elevator changes without requiring the change of the user action. Therefore, the improvement measure of the type of the change or addition of control is often used even in the actual elevator field in cases of operation efficiency reduction phenomena such as long wait time.

The provision of information on the congestion status in the rush-hour zone, which is an improvement measure belonging to the type of the provision of information on the use or operation method, also requires relatively low cost and small change in user action, and thus, shows a moderately good result with the evaluation score "3". Here, the improvement measure of providing the information to the user does not forcefully change the action of the user, but encourages the voluntary change by the provision of information, and thus, the evaluation value of the action change is "3", which is a relatively small value.

[0121]

The field (A5) of the recommendation ranking illustrates recommendation rankings of improvement measures

set according to the evaluation scores or the respective evaluation value items. The field indicates that the improvement measures are recommended in this order to the building owner or the building manager.

[0122]

Since the improvement measure evaluation data illustrated in Fig. 6 is used as above, a more appropriate improvement measure can be proposed from the elevator operation diagnosis device 1 side from the viewpoint of the building owner or the building manager, for the operation efficiency reduction phenomenon that occurs in the target building and elevator. As a result, the building owner or the building manager can select an appropriate improvement measure and implement the selected improvement measure in the elevator.

[0123]

<Processing Procedure for Calculation of Effect of Improvement Measure>

Fig. 7 is a flowchart illustrating an example of calculation of effects of improvement measures in the elevator operation diagnosis device 1 of the present example. This effect calculation process is a flowchart illustrating an evaluation value calculation process corresponding to the magnitude of an improvement measure against an operation efficiency reduction phenomenon in the

improvement measure evaluation process of Fig. 5 in detail

In the improvement measure effect calculation process illustrated in Fig. 7, the improvement effect calculation process is performed according to the three types of improvement measures described above.

[0124]

Hereinafter, the process of calculating the evaluation value corresponding to the magnitude of the improvement measure against the operation efficiency reduction phenomenon will be described in detail with reference to the flowchart of Fig. 7.

The entire processing surrounded by a rectangle of the one-dot chain line illustrated here is the processing corresponding to Step S13 in Fig. 5.

First, it is determined whether a type of improvement measure selected in Step S12 of Fig. 5 is the type of the change or addition of control (S131).

[0125]

If the improvement measure is the type of the change or addition of control in Step S131 (YES in S131), a simulation before and after implementation of the improvement measure that simulates the change or addition of control is performed to calculate an improvement effect thereof (S132).

In addition, cases of other elevators that have

implemented the same improvement measure of the control change or control addition are retrieved, and an effect in this case is calculated based on improvement effects thereof (S133).

In this manner, the improvement effect can be calculated when the improvement measure is the improvement measure belonging to the type of the change or addition of control.

[0126]

If the improvement measure is not the type of the change or addition of control in Step S131 (NO in S131), it is determined whether a type of the improvement measure selected next is the type of provision of information on the use method or operation method (S134).

If the improvement measure is the type of provision of information on the use method or operation method in Step S134 (YES in S134), an effect of the improvement is calculated by performing a simulation before and after the implementation of the improvement measure that simulates the improvement of the use method or operation method of the user by providing the information (S135).

[0127]

Furthermore, cases in other elevators that have implemented the same improvement measure of the provision of information on the use method or operation method are

retrieved to calculate an effect of this case based on improvement effects in the other cases (S136). In this manner, it is possible to calculate the effect before and after the implementation of the improvement measure in the case of the type of provision of information on the use method or operation method.

[0128]

If the improvement measure is not the type of provision of information on the use method or operation method in Step S134 (NO in S134), finally, an improvement effect is calculated by performing simulation calculation before and after implementation of the improvement measure that simulates the improvement measure of the type of the restriction on the use state of the user (S137).

Furthermore, cases in other elevators that have implemented the same improvement measure of the type of the restriction on the use state of the user are retrieved, and an effect of this case is calculated based on improvement effects in the other cases (S138). In this manner, it is possible to calculate the effect before and after the implementation even for the improvement measure of the type of the restriction on the use state of the user.

[0129]

As described above, it is possible to estimate the improvement effect with higher accuracy by calculating the

improvement effect in two ways, that is, the simulation and the implementation cases of the other elevators for the three types of improvement measures. Although not described in the flowchart of Fig. 7, the improvement effect may be calculated from both the simulation and the implementation cases of the other elevators, or may be calculated from either one. If the improvement effect can be calculated from both, it is also possible to take an average of both. In addition, a result of the simulation may be used if there are few implementation cases of other elevators, and both the simulation and the cases may be combined to calculate the improvement effect if the number of implementation cases of other elevators increases.

[0130]

<Processing Procedure to Determine Recommendation Ranking of Improvement Measure>

Fig. 8 is a flowchart illustrating an example of a process of determining recommendation rankings of improvement measures in the elevator operation diagnosis device 1 of the present example. This process illustrates details of a process relating to the "calculation of the evaluation score of the improvement measure based on the calculated evaluation value, the recommendation ranking, and the implementation plan formulation" in Step S8 of the flowchart of Fig. 4. That is, the processing is performed

by the evaluation score and recommendation ranking processing unit 164 and the implementation plan formulation processing unit 165 of the improvement measure selection processing unit 16 of Fig. 1.

In the process illustrated in Fig. 8, the recommendation rankings are determined for the selected improvement measure candidates by utilizing the evaluation values of the three items illustrated in Step S7 of Fig. 4 calculated from the viewpoint of cost-effectiveness.

[0131]

Hereinafter, a procedure of the process relating to "the calculation of the evaluation score of the improvement measure based on the calculated evaluation value, the recommendation ranking, and the implementation plan formulation" will be described in detail with reference to the flowchart of Fig. 8.

In Step S7, each evaluation value for the improvement measure is calculated. In this Step S7, the evaluation values of the improvement measure are calculated for the respective items of the magnitude of the improvement effect, the magnitude of the implementation cost of the improvement measure, and the magnitude of the change in user action as already described.

[0132]

The evaluation score and recommendation ranking

processing unit 164 of the improvement measure selection processing unit 16 illustrated in Fig. 1 implements a series of processes to set the recommendation rankings of the improvement measures based on the evaluation value calculated in Step S7 (S8).

Although the description has been given so far assuming two cases, that is, the case of setting the recommendation ranking of improvement measure based on the evaluation score that is the overall score and the case of setting the recommendation ranking of improvement measure based on the evaluation values of the three items in the description of Figs. 1 and 4, the processing of Step S8 illustrated here adopts a method of setting a ranking rule according to the importance or priority of the evaluation values of the three items and setting the recommendation ranking. Even when the evaluation values of the three items are converted into the evaluation score as the total score, the same recommendation ranking as the recommendation ranking according to the importance or priority of the evaluation values of the three items can be obtained if a method of conversion is set according to the following concept.

[0133]

Hereinafter, a specific process of determining the recommendation ranking based on the evaluation values of

the three items will be described with reference to Fig. 8. In the example illustrated here, the recommendation ranking is set by prioritizing one with lower implementation cost and a smaller change in user action from the viewpoint of cost-effectiveness.

First, an improvement measure for which (1) an evaluation value of implementation cost is zero, (2) an evaluation value of an improvement effect is high, and (3) a change in user action is small is selected as the first recommendation ranking (S81). This is based on the policy that an improvement measure which requires no implementation cost, has a small impact on the user, and can be implemented immediately is implemented with top priority.

[0134]

Next, a provisional recommendation ranking is set from improvement measures having (1) low cost, (2) a high effect, and (3) a small change in user action (S82). This ranking is set in the priority order of (1), (2), and (3) above. Here, an improvement measure whose cost is not zero but small and has a higher improvement effect instead is selected as the improvement measure with next priority.

[0135]

Subsequently, an improvement measure requiring a particularly large amount of change in user action, for

example, an improvement measure requiring action changes of 100 or more users, is adjusted to have a lower recommendation ranking (S83). In other words, it is difficult to implement the improvement measure that requires the action changes of a large number of users, and thus, the implementation priority needs to be lowered. This is because it is desirable for the building owner or the building manager to avoid increasing the burden on the users.

[0136]

Further, when the type of the improvement measure is the improvement measure belonging to the provision of information on the use method or operation method to the user, correction is performed to raise the recommendation ranking thereof (S84). To raise the recommendation ranking of the improvement measure of the type of information provision to the user is effective as an approach to the user side for the improvement, and the provision of information, rather than compulsory, may encourage the voluntary improvement of the use method or operation method.

[0137]

Another reason of raising the recommendation ranking of the improvement measure of the type of information provision to the user is that the information display

device (display) in the elevator car, the information display device at the hall, the digital signage device installed on the lobby floor of the building, and a personal mobile terminal device, such as a smartphone, can be used as a device to provide the information to provide an environment where it is possible to easily and smoothly provide information to the user.

Finally, the final recommendation ranking is set based on the corrected provisional recommendation ranking (S85). This final recommendation ranking is proposed to the building owner or the building manager as the recommendation rankings of improvement measures by operation diagnosis.

[0138]

As described above, for various types of improvement measures that are not limited to the change of the elevator operation control, the evaluation values of the three items corresponding to cost-effectiveness are utilized by the process of determining the recommendation rankings of improvement measures, so that it is possible to set the appropriate recommendation rankings of improvement measures. As a result, the building owner or the building manager can select and implement a more appropriate improvement measure for the target building, and it is possible to smoothly improve the operation efficiency

reduction phenomenon of the elevator.

[0139]

<Processing Procedure to Create Implementation Plan>

Fig. 9 is a flowchart of the process of formulating the implementation plan for the improvement measures, which is performed by the implementation plan formulation processing unit 165 illustrated in Fig. 1.

As described above, the implementation plan formulation processing unit 165 of Fig. 1 does not propose implementation of only one improvement measure from among the improvement measure candidates but formulates the implementation plan by the process that sets the order of implementation. The plurality of improvement measures are implemented in an appropriate order according to an appropriate process, thereby aiming to implement an improvement process with a higher improvement effect or a fewer side effect.

[0140]

Hereinafter, the flow of the process in Fig. 9 will be described. In the implementation plan formulation process illustrated in Fig. 9, when selected improvement measures include the type of the information provision and the type of the change or addition of control or the type of the restriction on the use state, the improvement measure of the type of the information provision is

implemented first, and then, the improvement measures of the type of the information provision and the type of the control change or addition or the type of the restriction on the use state are implemented.

[0141]

First, the improvement measure selection processing unit 16 selects an improvement measure corresponding to the factor determined by the factor determination processing unit 14 in Fig. 1 (S91). Here, the selected improvement measure is generally a group of a plurality of improvement measures.

Next, it is determined whether the improvement measures (group) include two or more types among the type of the control change or addition, the type of the information provision, and the type of the restriction on the use state (S92). If it is determined that there are two or more types in Step S92 (YES in S92), subsequently, it is determined whether there is an improvement measure (group) belonging to the type of the information provision on the use method or operation method (S93). If it is determined that two or more types do not exist in Step S92 (NO in S92), the processing is ended.

[0142]

If it is determined that the improvement measures (group) include an improvement measure belonging to the

type of the information provision on the use method or operation method in Step S93 (YES in S93), a plan in which the improvement measure belonging to the type of the information provision is implemented first is set for the implementation plan that sets the procedure for implementing the improvement measures (S94).

If it is determined that the improvement measures (group) do not include an improvement measure that belongs to the type of the information provision on the use method or operation method in Step S93 (NO in S93), the processing is ended.

[0143]

Subsequently, it is determined whether the improvement measures (group) include an improvement measure belonging to the type of the control change or addition or the type of the restriction on the use state (S95). If it is determined that there is the improvement measure belonging to the type of the control change or addition or the type of the restriction on the use state in Step S95 (YES in S95), the improvement measure implementation plan is set to a plan in which the improvement measure belonging to the type of the control change or addition or the restriction on the use state is implemented next (S96). If it is determined that there is no improvement measure belonging to the type of the control change or addition or

the type of the restriction on the use state in Step S95 (NO in S95), the processing is ended.

[0144]

In the implementation plan formulation process illustrated in Fig. 9, the improvement measure of the type of the information provision is implemented first, and then, the improvement measures of the type of the control change or addition or the type of the restriction on the use state are implemented. As a result, it is possible to mitigate the side effect (negative effect) caused by suddenly implementing the improvement measures of the type of the control change or addition and the type of the restriction on the use state.

[0145]

For example, there may be a case where hall call buttons are used unnecessarily or unfavorably by pressing a general call button and a wheelchair call button at the same time to cause reduction in operation efficiency of an elevator unit for wheelchairs.

In such a case, a measure to share the general call button and the wheelchair call button is taken in some cases by the control of the elevator control device 5. However, such a sudden measure is likely to be inconvenient for a user who is actually using the wheelchair call. Therefore, it is desirable to first implement improvement

measures to provide information on a proper use method or operation method for the wheelchair call button from the improvement measures of the type of information provision on the use method or operation method. By taking such a measure, it is possible to reduce the unnecessary use or unfavorable use such as pressing the general call button and the wheelchair call button at the same time.

[0146]

Even if such a measure is taken, the wheelchair call can be used as usual, which does not cause inconvenience to the user using the wheelchair call. However, there is a case where the unnecessary use or unfavorable use such as pressing the general call button and the wheelchair call button at the same time does not decrease so much even if the above improvement measure is implemented, and thus, it is conceivable to make the general call button and the wheelchair call button shared unavoidably. When following such an order, it is possible to suppress the occurrence of the side effect caused by the improvement measure of the control that is forcibly implemented.

[0147]

Similar to Fig. 9, Fig. 10 also illustrates a flowchart of the process of formulating the implementation plan of the improvement measure implemented by the implementation plan formulation processing unit 165

illustrated in Fig. 1. The example of Fig. 10 proposes an improvement measure to be implemented next in consideration of synergy with a previously implemented improvement measure, which is different from the example of Fig. 9.

[0148]

Hereinafter, the flow of processing will be described with reference to the flowchart of Fig. 10. In the implementation plan formulation process illustrated in Fig. 10, when selected improvement measures include a plurality of improvement measures of the type of the control change or addition, a base-type improvement measure that has a wide range of applications and a low risk of side effects is implemented first, and a specialized-type improvement measure having a specific operation efficiency reduction phenomenon as a target is implemented next.

[0149]

First, improvement measures corresponding to a determined factor are selected (S101). Next, it is determined whether there are the plurality of improvement measures of the type of the control change or addition for the selected improvement measures (S102).

If it is determined that the selected improvement measures include the plurality of improvement measures of the type of the control change or addition in Step S102 (YES in S102), the implementation plan formulation

processing unit 165 subsequently determines whether there are two types of a base type and a specialized type with respect to the plurality of improvement measures of the type of the control change or addition (S103).

If it is determined that there are the two types of the base type and the specialized type with respect to the improvement measures of the type of the control change or addition in Step S103 (YES in S103), the implementation plan formulation processing unit 165 formulates the implementation plan as a plan in which the base-type improvement measure is implemented first and the specialized-type improvement measure is implemented next (S104), and the processing is ended.

[0150]

Here, the improvement measures of the base type and specialized type of the type of the control change or addition will be described. The base-type improvement measure is an improvement measure that has a wide range of applications and a low risk of side effects.

For example, there is an improvement measure that changes allocation to an elevator unit with a shorter predicted arrival time if there is the elevator unit with the shorter predicted arrival time when it is determined that a predicted arrival time of an assigned elevator unit to a hall is a long. In other words, the base-type

improvement measure is the improvement measure to change the allocation when the arrival time is predicted to be long.

[0151]

The other specialized-type improvement measure is, for example, an improvement measure specialized for up-peak in the rush hour. This specialized-type improvement measure has a specified application target, and thus, is highly effective for the application target, but is likely to be ineffective or cause a worse effect for other targets, so that appropriate implementation is required. An example of the specialized-type improvement measure is, for example, allotment express operation (also called sectoring operation) in the rush-hour zone.

[0152]

To implement the base-type improvement measure first and implement the specialized-type improvement measure next if YES in Step S103 means to execute the base type, which has a wide range of applications and a low risk, to confirm a desired effect, and then, implement the next specialized-type improvement measure. In other words, if the desired effect is obtained with the base type, it is unnecessary to implement the specialized-type improvement measure while determining as "good" as it is. Further, there is a purpose to further enhance the effect of the improvement

measure by implementing the specialized-type improvement measure only when it is difficult to obtain the desired effect by the base-type improvement measure.

[0153]

If it is determined that the selected improvement measures do not include the plurality of improvement measures of the type of the control change or addition in Step S102 (NO in S102) and it is determined that the improvement measures of the type of the control change or addition do not include the two types of the base type and the specialized type in Step S103, that is, there is only one type of the improvement measures (NO in S103), the processing is ended.

[0154]

Fig. 11 is a graph illustrating a mode of an improvement effect when an improvement measure is implemented twice in total by implementing an improvement measure by the base-type control first and an improvement measure by the specialized-type control second according to the flowchart of the implementation plan formulation process illustrated in Fig. 10.

In the graph illustrated in Fig. 11, the horizontal axis represents a period (for example, a scale of several weeks to several months), and the vertical axis represents a performance index relating to the operation efficiency.

[0155]

Hereinafter, the meaning of Fig. 11 will be described from left to right of the period on the horizontal axis. First, a state before improvement is formed at the beginning of the period (on the leftmost side), and the performance for the operation efficiency is low. Thereafter, the operation diagnosis is implemented to sequentially implement the improvement measures according to the improvement measure implementation plan illustrated in the flowchart of the implementation plan formulation process in Fig. 10.

First, the base-type improvement measure of the type of the control change or addition is implemented so that the performance is improved by making the improvement for the operation efficiency reduction phenomenon. However, the performance has not yet reached a preferable performance line. Therefore, the specialized-type improvement measure of the type of the control change or addition is implemented second. As a result, the effect of the performance is further accumulated to reach the preferable performance line.

As described above, it is possible to implement the improvement while accumulating the effects as illustrated in Fig. 11 by implementing the improvement measures in the proper order while suppressing the risk to the effect

according to the flowchart of the implementation plan formulation process illustrated in Fig. 11.

[0156]

<Display Example of Operation Diagnosis Result on Dashboard>

Fig. 12 is a display example of operation diagnosis results on a dashboard used in the elevator operation diagnosis device 1 of the present example. This display content is output to the building manager information processing terminal device 3 via the proposed improvement measure information output processing unit 18 and the dashboard information processing device 2 described in Fig. 1.

[0157]

The display content illustrated in Fig. 12 proposes an operation efficiency reduction phenomenon that has occurred, a factor thereof, and improvement measure candidates based on the factor, to the elevator of the target building. Furthermore, in Fig. 12, recommendation rankings for the improvement measures, evaluation values of the improvement measures evaluated from the viewpoint of cost-effectiveness and an evaluation score as the total point of the evaluation values are proposed together so as to enable the building owner or the building manager to easily select an appropriate improvement measure.

[0158]

Hereinafter, details of the display content of the operation diagnosis result illustrated in Fig. 12 will be described. First, a display screen (B1) of the elevator operation diagnosis result is output to and displayed on the building manager information processing terminal device 3 via the dashboard information processing device 2 described in Fig. 1.

Here, the dashboard is a tool that analyzes and visualizes a key performance index (KPI) of a company or an organization with collected related data, and an operation state of the elevator, which is one of the main facilities of the building, and the KPI relating to the operation state are visualized and displayed on this dashboard. The content of the display screen displayed on this dashboard is created by the dashboard information processing device 2, and can be browsed by the building manager information processing terminal device 3 via a communication network such as the Internet.

[0159]

On the display screen (B1) of the elevator operation diagnosis result, a result (B2) of the detected operation efficiency reduction phenomenon is first displayed for the building to be diagnosed. In the present example, the result that "the average wait time is long in the rush-hour

zone" is displayed as the detected operation efficiency reduction phenomenon. In addition, the display screen (B1) also displays a determination result (B3) of the factor of the operation efficiency reduction phenomenon. In the present example, "there are many elevator users in the rush-hour zone" is displayed as the factor. In this manner, the phenomenon that is a problem in the target building and the factor are displayed as results of the elevator operation diagnosis first, so that the status can be clearly shown to the building owner or the building manager.

[0160]

Next, an improvement measure, which is to be desirably implemented in the building and the target elevator, is proposed based on the operation efficiency reduction phenomenon and the factor thereof, and this improvement measure becomes a list (B4) of improvement measures proposed to the building manager.

In the list (B4) of the improvement measures, the improvement measures are proposed in the order of the recommendation rankings (B5) already described. Furthermore, the list (B4) is provided with a field of an improvement measure candidate name (B6), a field of each of the improvement measure evaluation results (B7), and a field of an answer point (B8) where the building owner or

the building manager selects which improvement measure to implement based on such information.

[0161]

Here, in the field of each of the improvement measure evaluation results (B7), data of the evaluation score as the overall evaluation value and the evaluation values of the respective items of the effect, the cost, and the user action change are proposed. Furthermore, the field of the answer point (B8) where the building owner or the building manager selects which improvement measure to implement is provided with an implementation determination selection button (B9) so that the building owner or the building manager can select a necessary improvement measure by pressing this implementation determination selection button (B9).

The improvement measure information selected here is transmitted to the improvement measure execution processing unit 19 of Fig. 1, and the improvement measure execution processing unit 19 executes the selected improvement measure.

[0162]

The building owner or the building manager can easily grasp the operation efficiency reduction phenomenon, which is a problem in the building and elevator to be subjected to elevator diagnosis, and the factor thereof,

and further, an appropriate improvement measure using the display screen illustrated in Fig. 12. In addition, the list of improvement measures enables the building owner or the building manager to select an appropriate improvement measure based on a clear determination criterion based on the evaluation value of cost-effectiveness.

[0163]

<Procedure for Implementing Improvement Measure>

Fig. 13 illustrates an example of a display screen that proposes a procedure for implementing improvement measures in the elevator operation diagnosis device 1 of the present example. The improvement measure implementation procedure proposed here represents a procedure of implementing a plurality of improvement measures in a process according to a specific implementation order, instead of performing the improvement measures in a single shot.

For example, an improvement measure that can be implemented immediately and requires low cost and a small change in user action is implemented first. Then, after confirming a status of the result, an improvement measure which requires some cost but is more effective is implemented next in this procedure. The implementation procedure is formulated by the implementation plan formulation processing unit 165 in the improvement measure

selection processing unit 16 of Fig. 1.

[0164]

Hereinafter, a proposal example of the improvement measure implementation procedure will be described with reference to Fig. 13. Fig. 13 is a display screen (C1) in the case of proposing the improvement measure implementation procedure. This display screen (C1) is one of the menus of the display screen of the dashboard that proposes the operation diagnosis results described above. The display screen (C1) illustrated in Fig. 13 is a proposal screen that is displayed in parallel with the proposal of improvement measure candidates when proposing the improvement measures. Here, the display screen proposes a process of implementing a plurality of improvement measures in order, in addition to the implementation of the improvement measures in a single shot.

[0165]

In the example of Fig. 13, a three-step implementation procedure of implementation steps 1, 2, and 3 is illustrated. A proposal for an improvement measure of implementation step 1 is "call all elevators to the lobby floor in the rush-hour zone" (C2). An implementation item of implementation step 1 to be executed first is an improvement measure which requires relatively low

implementation cost and has a small impact on an action change of a user, that is, the action of the user. This type of improvement measure belongs to the change of control, and can be expected to produce some effects.

[0166]

If the improvement measure of implementation step 1 is implemented and no effect is visible in X months (for example, two months) after the implementation, an improvement measure of the next implementation step 2 is executed. Here, "provide congestion status information in the rush-hour zone" (C3) is performed for the user. As illustrated in the evaluation results of the improvement measures illustrated in Fig. 6, this improvement measure is an improvement measure which requires relative low cost and small action change, and is expected to have higher effects than the improvement measure at implementation step 1. Therefore, even if the improvement measure of implementation step 1 has a small effect, it can be expected that the operation efficiency reduction phenomenon that has occurred will be improved by the implementation of implementation step 2.

[0167]

When there is no effect in X months (for example, two months) after the implementation even after implementing the improvement measures of implementation

step 2, an improvement measure which requires high cost and a large action change of the user, but has a large expected effect, is implemented as an implementation item in implementation step 3. The improvement measure of this implementation step 3 is "implementation of staggered work hours (change an office-going hour on a higher floor)" (C4) or "allotment express operation in the rush-hour zone" (C6). The implementation of staggered work hours (C4) is an improvement measure that has a large action change of the user but is highly effective, and the allotment express operation in the rush-hour zone (C5) is an improvement measure that requires high implementation cost but is highly effective. The improvement measure is selected depending on whether the building owner or the building manager allows the improvement measure (C4) or (C5).

[0168]

Since the implementation procedure is illustrated using the plurality of improvement measures illustrated in Fig. 13 as one of the proposals of the improvement measures as above, the building owner or the building manager can quickly implement an improvement measure first in response to the operation efficiency reduction phenomenon occurring in the target building and elevator. Then, the building owner or the building manager can further see the effect of the implementation and sequentially implement a more

effective improvement measure.

Since the cost-effective improvement measures are implemented based on the implementation order of improvement measures planned in advance, the building owner or the building manager can suppress the risk of cost-effectiveness. Furthermore, it becomes possible to implement more reliable improvement in terms of cost-effectiveness, which is different from the single-shot implementation of the improvement measures.

[0169]

Although the elevator operation diagnosis device and the elevator operation diagnosis system 100 as one embodiment of the invention have been described as above, some or all of the above-described configurations, functions, processing units, and the like can be also realized by hardware by being designed with an integrated circuit, for example. Further, the above-described respective configurations, functions, and the like can be realized by software by the processor executing a program for realizing the respective functions. Information such as programs, tables, and files that realize the respective functions can be installed in a recording device such as a memory, a hard disk, and a solid state drive (SSD), or a recording medium such as an IC card, an SD card, and a DVD.

[0170]

Further, only a control line and an information line considered to be necessary for the description have been illustrated, and all control lines and information lines required for a product are not illustrated. It may be considered that most of the configurations are practically connected to each other.

[0171]

Incidentally, the above-described embodiment has been described in detail in order to describe the invention in an easily understandable manner, and is not necessarily limited to one including the entire configuration that has been described above. Addition, deletion, or substitution of other configurations can be made with respect to some configurations of the embodiment.

That is, the invention is not limited to the embodiment disclosed in the specification or the drawings, and, of course, includes other application examples and modifications that do not depart from the content described in the claims.

What is claimed is:

1. An elevator operation diagnosis device comprising:

an operation efficiency reduction phenomenon detection processing unit that collects operation data of an elevator and detects an operation efficiency reduction phenomenon of the elevator based on the operation data;

a factor determination processing unit that determines a factor of the operation efficiency reduction phenomenon;

an improvement measure selection processing unit that selects one or a plurality of improvement measures based on the operation efficiency reduction phenomenon detected by the operation efficiency reduction phenomenon detection processing unit and the factor determined by the factor determination processing unit; and

an improvement measure information output processing unit that outputs the improvement measure selected by the improvement measure selection processing unit,

wherein the improvement measure includes at least two of a change of operation control of the elevator, notification of information on a way to use and/or operate the elevator to a user of the elevator, and a restriction on a use state of the elevator.

2. The elevator operation diagnosis device according to claim 1, wherein

the improvement measure selection processing unit calculates evaluation values respectively for a magnitude of an improvement effect of the improvement measure, cost required for implementation of the improvement measure, a magnitude of a change of an action of the elevator user caused by implementation of the improvement measure, and an evaluation score for the improvement measure is calculated by an added value or a weighted addition value of each of the evaluation values.

3. The elevator operation diagnosis device according to claim 2, wherein

the improvement measure selection processing unit sets a priority for the selected improvement measure based on the calculated evaluation score for the improvement measure, and

the improvement measure information output processing unit outputs the selected improvement measure according to a ranking of the improvement measure selected by the improvement measure selection processing unit.

4. The elevator operation diagnosis device according to claim 2 or 3, further comprising

a database that records a factor of the elevator operation efficiency reduction phenomenon and improvement

measures previously implemented in other elevators,

wherein the improvement measure selection processing unit estimates a magnitude of the improvement effect of the selected improvement measure based on the calculated evaluation score, and estimates a magnitude of an effect based on actual record data of an improvement effect obtained by implementation in the other elevator when a similar improvement measure has been implemented in the other elevator recorded in the database.

5. The elevator operation diagnosis device according to claim 2 or 3, wherein

the improvement measure selection processing unit evaluates an improvement measure such that an evaluation score of the improvement measure increases as a cost required for implementation of the selected improvement measure decreases.

6. The elevator operation diagnosis device according to claim 2 or 3, wherein

the improvement measure selection processing unit evaluates an improvement measure such that an evaluation score of the improvement measure decreases as a change of an action of a user caused by implementation of the selected improvement measure increases.

7. The elevator operation diagnosis device according to claim 2 or 3, wherein

the improvement measure selection processing unit evaluates improvement measures such that an improvement measure belonging to the notification of the information on the way to use and/or operate the elevator by implementation of the selected improvement measure has a higher evaluation score than the other improvement measures.

8. The elevator operation diagnosis device according to claim 1, further comprising

an implementation plan formulation processing unit that sets an implementation plan to sequentially implement the improvement measures,

wherein the implementation plan formulation processing unit formulates the implementation plan having an order in which an improvement measure belonging to the notification of the information on the way to use or operate the elevator is implemented first, and an improvement measure regarding the change of operation control of the elevator or the restriction on the use state of the elevator, or regarding a change of an action schedule of the user of the elevator is implemented next.

9. The elevator operation diagnosis device according to claim 1, further comprising

an implementation plan formulation processing unit that sets an implementation plan to sequentially implement

the improvement measures,

wherein the implementation plan formulation processing unit formulates the implementation plan having an order in which a base-type improvement measure is implemented first and a specialized type improvement measure is implemented next for improvement measures belonging to the change of the operation control of the elevator.

10. The elevator operation diagnosis device according to claim 1, further comprising

an improvement measure execution processing unit that allows a building owner or a building manager to determine an improvement measure to be implemented,

wherein the improvement measure execution processing unit notifies an external elevator control device to implement a change of control when the determined improvement measure belongs to the change of the operation control of the elevator, notifies an information output device present in an elevator car and/or a hall of the elevator of information relating to the improvement measure when the determined improvement measure belongs to the notification of the information on the way to use and/or operate the elevator, and notifies an information processing device of a tenant of a building where the elevator has been installed of the information on the

restriction on the use state when the determined improvement measure is the restriction on the use state.

11. An elevator operation diagnosis system comprising:

an elevator control device that controls operation of one or a plurality of elevators;

a dashboard information processing device that outputs information on elevator operation diagnosis; and

an elevator operation diagnosis device that performs the elevator operation diagnosis and proposes improvement measures to a building owner or a building manager when finding a phenomenon that elevator operation efficiency is reduced,

wherein the elevator operation diagnosis device comprises

an operation efficiency reduction phenomenon detection processing unit that collects elevator operation data from the elevator control device and detects the phenomenon that the elevator operation efficiency is deteriorated based on the operation data,

a factor determination processing unit that determines a factor of the operation efficiency reduction phenomenon,

an improvement measure selection processing unit that selects one or a plurality of improvement measures

based on the operation efficiency reduction phenomenon detected by the operation efficiency reduction phenomenon detection processing unit and the factor determined by the factor determination processing unit, and

a selected improvement measure output unit that outputs the improvement measure selected by the improvement measure selection processing unit, and

the improvement measure includes at least two types of a change of operation control of the elevator, notification of information on a way to use and/or operate the elevator to an elevator user, and a restriction on a use state of the elevator.

12. An elevator operation diagnosis method comprising:

an improvement measure candidate extraction process of providing a group of a plurality of types of improvement measures to be applied for an elevator and a user in order to propose and execute a wide variety of improvement measures including elevator control and selecting a plurality of improvement measures from among the plurality of types of improvement measures;

an evaluation value calculation process of evaluating the improvement measures by evaluation items including an improvement effect, implementation cost, and an action change of the user from a viewpoint of cost-

effectiveness in order to evaluate how good each improvement measure candidate is for the a plurality of types of improvement measures; and

an evaluation score and a recommendation ranking process of calculating an evaluation score of each improvement measure candidate based on the evaluation items so as to enable a building owner or a building manager to select an appropriate improvement measure, and setting recommendation rankings.