sewerage plant. Operational know-how regarding the state understanding and operation manipulation of the water supply and sewerage plant can be obtained by analyzing the relationship between time-series data of the measured values and the control values. However, in order to perform this analysis, classification information, which is information that patterns of these time-series data were classified, is required to be attached to the time-series data of the measured values and the control values. There has been a problem that the workload of the operator attaching this classification information to the time-series data is high.

[0007] The present invention has been made to solve the above-mentioned problem, and an object thereof is to reduce the workload of an operator to attach classification information necessary for estimating operational know-how of a water supply and sewerage plant to time-series data of measured values and control values.

Means to Solve the Problem

[0008] According to a first aspect of the present invention, there is provided an operational know-how estimation device includes a data acquisition unit configured to acquire target time-series data being time-series data of measured values regarding a state of a water plant and control values regarding operation manipulation, a classification information attachment unit configured to perform pattern classification of the target time-series data of the measured values and the control values, respectively for each section and attach classification information being a result of the pattern classification to the sections of the target time-series data, a know-how estimation unit configured to calculate a conditional probability that the measured values and the control values are simultaneously established for each classification information, and estimate operational know-how representing the control values to be set for the measured values based on the conditional probability, and a display control unit configured to create display information that supports state

understanding or operation manipulation of the water plant based on the operational know-how and cause a display unit to display the display information.

[0008a] According to a second aspect of the present invention, there is provided an operational know-how estimation device comprising: a data acquisition unit configured to acquire target time-series data being time-series data of measured values regarding a state of a plant and control values regarding operation manipulation: a classification information attachment unit is configured to estimate a magnitude attribute representing understanding of an operator of the water plant with respect to a size of a value of the target time-series data of the measured values and the control values, respectively, and attaches the magnitude attribute to a section of the target time-series data as classification information; a know-how estimation unit configured to calculate a conditional probability that the measured values and the control values are simultaneously established for each classification information, and estimate operational know-how representing the control values to be set for the measured values based on the conditional probability; and a display control unit configured to create display information that supports state understanding or operation manipulation of the plant based on the operational know-how and cause a display unit to display the display information.

[0008b] According to a third aspect of the present invention, there is provided an operational know-how estimation device comprising: a data acquisition unit configured to acquire target time-series data being time-series data of measured values regarding a state of a plant and control values regarding operation manipulation; a classification information attachment unit configured to classify the target time-series data for each section by a clustering algorithm and attach classification information being a classification result to the sections of the target time-series data; a know-how estimation unit configured to calculate a conditional probability that the measured values and the

control values are simultaneously established for each classification information, and estimate operational know-how representing the control values to be set for the measured values based on the conditional probability; and a display control unit configured to create display information that supports state understanding or operation manipulation of the plant based on the operational know-how and cause a display unit to display the display information; and an event determination unit configured to detect an event occurrence period used by the operator of the water plant to determine operation manipulation from the time-series data of the measured values, wherein the know-how estimation unit is configured to calculate a conditional probability that the measured values and the control values are simultaneously held for each piece of classification information with the event occurrence period and other periods being distinguished.

[0009] According to a fourth aspect of the present invention, there is provided an operational know-how estimation method includes the steps of acquiring target time-series data being time-series data of measured values regarding a state of a water plant and control values regarding operation manipulation, performing pattern classification of the target time-series data of the measured values and the control values, respectively for each section, attaching classification information being a result of the pattern classification to the sections of the target time-series data, calculating a conditional probability that the measured values and the control values are simultaneously held for each classification information, estimating operational know-how representing the control values to be set for the measured values based on the conditional probability, creating display information that supports state understanding or operation manipulation of the water plant based on the operational know-how, and causing a display unit to display the display information.

Effects of the Invention

[0010] According to the present invention, the classification information necessary for estimating the operational know-how of the water plant is added to the time-series data; therefore, the reduction in the workload of the operator who attaches the classification information to the time-series data is ensured. The objects, features, aspects, and advantages of the present invention will become more apparent from the following detailed description and the accompanying drawings.

Brief Description of Drawings

[0011] [FIG. 1] A block diagram illustrating a configuration of an operational know-how estimation device according to the first embodiment.

CLAIMS

[Claim 1]

An operational know-how estimation device comprising:

a data acquisition unit configured to acquire target time-series data being time-series data of measured values regarding a state of a water plant and control values regarding operation manipulation;

a classification information attachment unit configured to perform pattern classification of the target time-series data of the measured values and the control values, respectively for each section and attach classification information being a result of the pattern classification to the sections of the target time-series data;

a know-how estimation unit configured to calculate a conditional probability that the measured values and the control values are simultaneously established for each classification information, and estimate operational know-how representing the control values to be set for the measured values based on the conditional probability; and

a display control unit configured to create display information that supports state understanding or operation manipulation of the water plant based on the operational know-how and cause a display unit to display the display information.

[Claim 2]

An operational know-how estimation device comprising:

a data acquisition unit configured to acquire target time-series data being time-series data of measured values regarding a state of a plant and control values regarding operation manipulation:

a classification information attachment unit configured to estimate a magnitude attribute representing understanding of an operator of the water plant with respect to a

size of a value of the target time-series data of the measured values and the control values, respectively, and attaches the magnitude attribute to a section of the target time-series data as classification information;

a know-how estimation unit configured to calculate a conditional probability that the measured values and the control values are simultaneously established for each classification information, and estimate operational know-how representing the control values to be set for the measured values based on the conditional probability; and

a display control unit configured to create display information that supports state understanding or operation manipulation of the plant based on the operational know-how and cause a display unit to display the display information.

[Claim 3]

An operational know-how estimation device comprising:

a data acquisition unit configured to acquire target time-series data being time-series data of measured values regarding a state of a plant and control values regarding operation manipulation;

a classification information attachment unit configured to classify the target time-series data for each section by a clustering algorithm and attach classification information being a classification result to the sections of the target time-series data;

a know-how estimation unit configured to calculate a conditional probability that the measured values and the control values are simultaneously established for each classification information, and estimate operational know-how representing the control values to be set for the measured values based on the conditional probability; and

a display control unit configured to create display information that supports state understanding or operation manipulation of the plant based on the operational know-how

and cause a display unit to display the display information; and

an event determination unit configured to detect an event occurrence period used by the operator of the water plant to determine operation manipulation from the time-series data of the measured values, wherein

the know-how estimation unit is configured to calculate a conditional probability that the measured values and the control values are simultaneously held for each piece of classification information with the event occurrence period and other periods being distinguished.

[Claim 4]

The operational know-how estimation device according to claim 3, wherein

the event determination unit is configured to detect the event occurrence period based on a change pattern of an extreme value in the time-series data of the measured values.

[Claim 5]

The operational know-how estimation device according to claim 3, wherein

the event determination unit is configured to detect the event occurrence period based on a time interval of an extreme value in the time-series data of the measured values.

[Claim 6]

The operational know-how estimation device according to any one of claims 3 to 5, further comprising:

an input unit configured to receive input from a user;

a know-how re-estimation unit configured to re-estimate the operational know-how, wherein

the know-how estimation unit is configured to determine that the time-series data of the measured values is response operation unknown data when the time-series data of the control values in the event occurrence period determined from the time-series data of the measured values does not exist,

the input unit is configured to receive the time-series data of the control values in the event occurrence period in the response operation unknown data as response operation data from the user, and

the know-how re-estimation unit is configured to re-estimate the operational know-how based on the response operation unknown data and the response operation data.

[Claim 7]

The operational know-how estimation device according to claim 6, wherein

the know-how estimation unit is configured to determine that the time-series data of the measured values and the time-series data of the control values as operation basis lacking data when a mutual information amount between the time-series data of the measured values and the time-series data of the control values is equal to or less than a predetermined threshold value,

the input unit is configured to receive attribute information regarding a period of the operation basis lacking data as operation basis data from the user, and

the know-how re-estimation unit is configured to re-estimate the operational know-how based on the operation basis lacking data and the operation basis data.

[Claim 8]

The operational know-how estimation device according to claim 2, wherein

the classification information attachment unit is configured to attach the classification information to the section of the target time-series data according to an attribute attachment constraint which is a constraint regarding a section length of the target time-series data to which one piece of classification information is attached.

[Claim 9]

The operational know-how estimation device according to any one of claims 3 to 6, further comprising

an event detection sensitivity recording unit configured to record event detection sensitivity that defines a degree of matching of a feature amount in the time-series data of the measured values for detecting the event occurrence period in the event determination unit, and

the event determination unit is configured to detect the event occurrence period based on the event detection sensitivity.

[Claim 10]

An operational know-how estimation method comprising the steps of:

acquiring target time-series data being time-series data of measured values regarding a state of a water plant and control values regarding operation manipulation;

performing pattern classification of the target time-series data of the measured values and the control values, respectively for each section;

attaching classification information being a result of the pattern classification to the sections of the target time-series data;

calculating a conditional probability that the measured values and the control values are simultaneously held for each classification information;

estimating operational know-how representing the control values to be set for the measured values based on the conditional probability;

creating display information that supports state understanding or operation manipulation of the water plant based on the operational know-how; and

causing a display unit to display the display information.

[Claim 11]

The operational know-how estimation device according to claim 8, wherein,

when a plurality of pieces of classification information are estimated in a section of the target time-series data, which is restricted that one piece of classification information is supposed to be attached thereto by the attribute attachment constraint, the classification information attachment unit is configured to attach classification information that integrates the plurality of the pieces of classification information to the section of the target time-series data.