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(54) **PROJECT PROGRESS PREDICTION DEVICE AND PROJECT PROGRESS PREDICTION SYSTEM**

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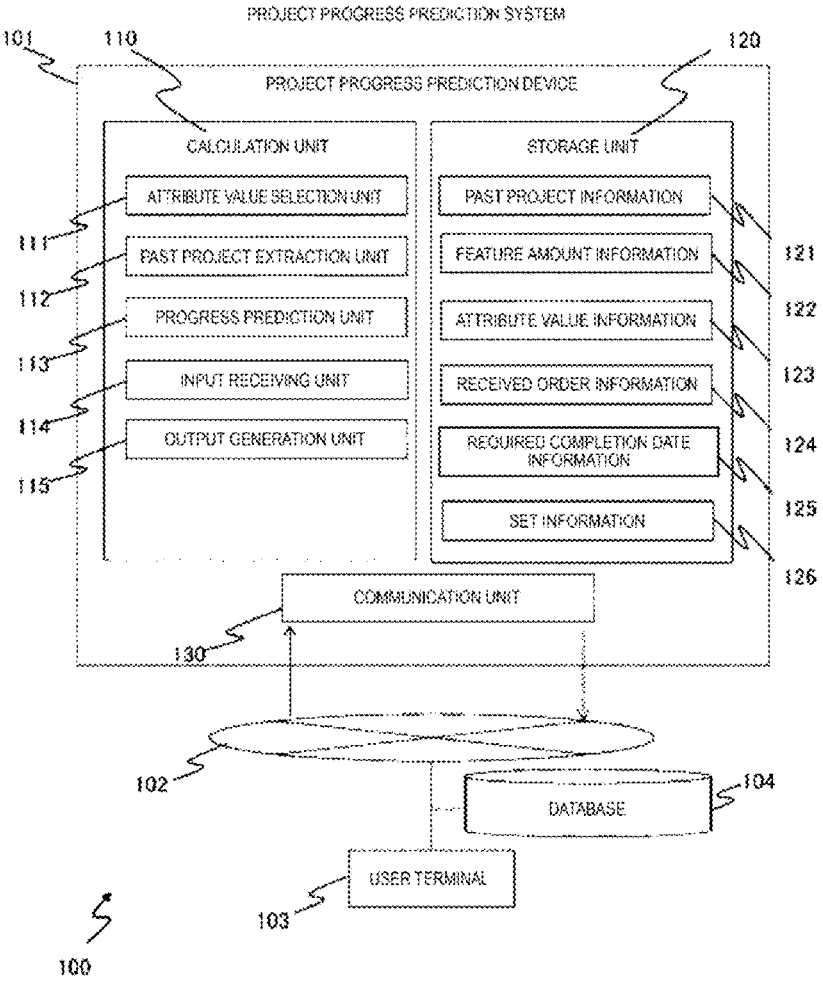
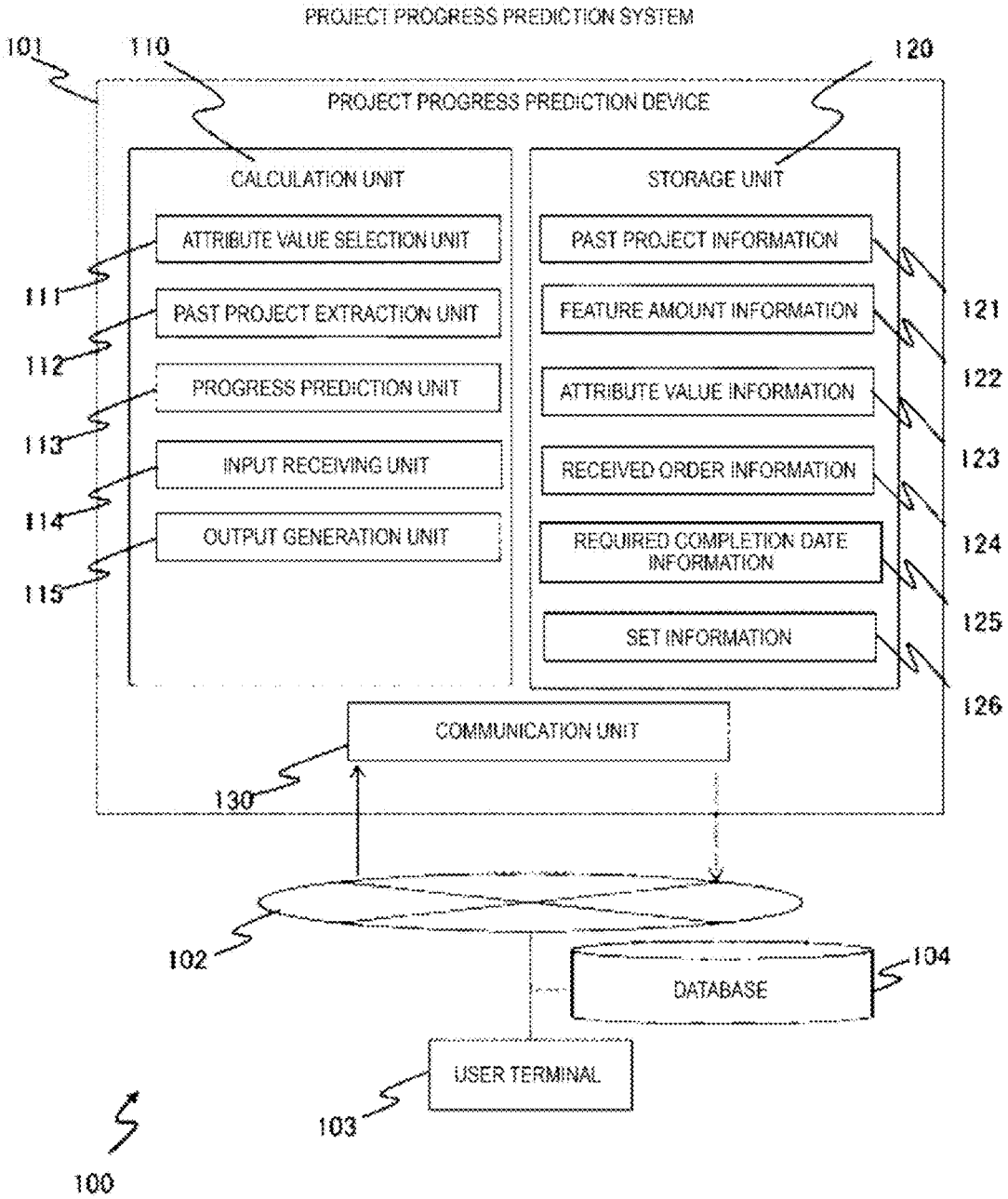
(57) **ABSTRACT**

To predict a required completion date with high accuracy for each process of a product of which registration information including the delivery date of a project changes frequently. A project progress prediction device includes: a storage unit that stores log information which is a change history of an attribute value of a project and a feature amount of a delivery date including the number of elapsed days for each process; an attribute value selection unit that selects an attribute value having a predetermined correlation with the delivery date of the project using the log information; a past project extraction unit that extracts a completed project having the attribute value similar to that of a prediction target project from the storage unit using the selected attribute value, and estimates a lead time for each of the feature amounts for non-completed processes of the prediction target project using the feature amount of the delivery date of the extracted completed project; and a progress prediction unit that integrates the estimated lead times between the feature amounts and predicts a probability of a required completion date for each process of the prediction target project.



[Fig. 1]

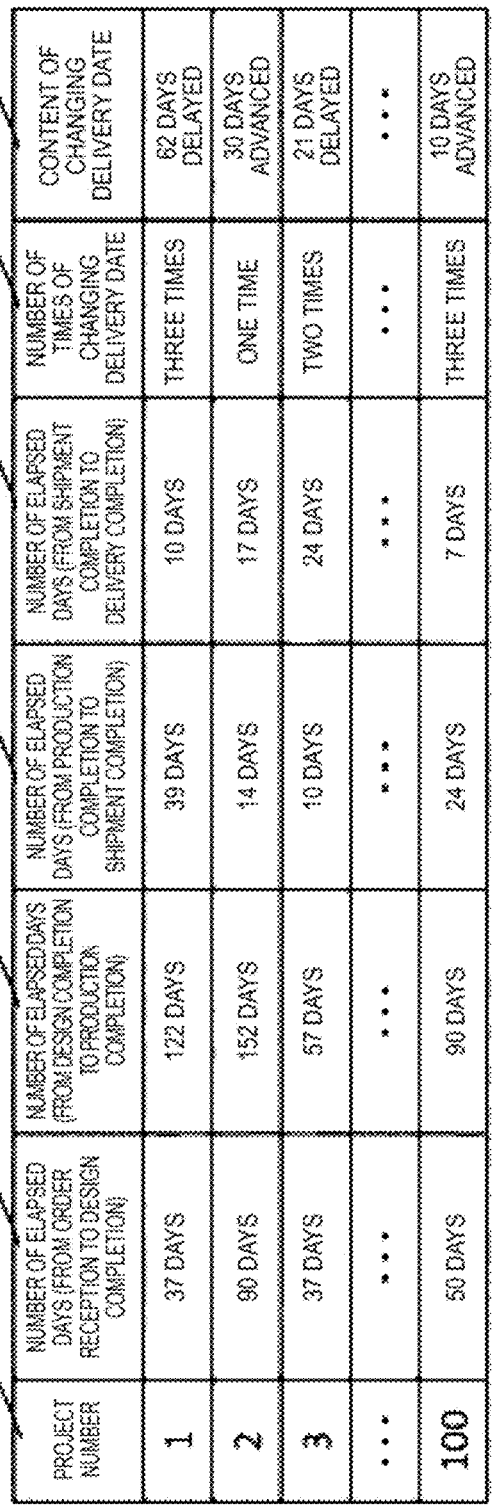

PROJECT PROGRESS PREDICTION SYSTEM
101
110
120
PROJECT PROGRESS PREDICTION DEVICE
CALCULATION UNIT
STORAGE UNIT
ATTRIBUTE VALUE SELECTION UNIT
PAST PROJECT EXTRACTION UNIT
PROGRESS PREDICTION UNIT
INPUT RECEIVING UNIT
OUTPUT GENERATION UNIT
PAST PROJECT INFORMATION
FEATURE AMOUNT INFORMATION
ATTRIBUTE VALUE INFORMATION
RECEIVED ORDER INFORMATION
REQUIRED COMPLETION DATE INFORMATION
SET INFORMATION
111
112
113
114
115
121
122
123
124
125
126
COMMUNICATION UNIT
130
102
104
DATABASE
USER TERMINAL
103
100

[Fig. 2]

1211 PROJECT NUMBER	1212 CUSTOMER NAME	1213 TYPE OF INDUSTRY	1214 DELIVERY AREA	1215 CONTRACT AMOUNT	1216 PRODUCT TYPE	1217 DELIVERY DATE	1218 PROGRESS STATUS	1219 UPDATE DATE
1	CUSTOMER1	FINANCE	CHINA	10M YEN	A	'15/7/30	ORDER RECEPTION COMPLETED	'15/2/24
1	CUSTOMER1	FINANCE	CHINA	10M YEN	A	'15/8/30	ORDER RECEPTION COMPLETED	'15/3/2
1	CUSTOMER1	FINANCE	CHINA	10M YEN	A	'15/8/30	DESIGN COMPLETED	'15/4/2
1	CUSTOMER1	FINANCE	CHINA	10M YEN	A	'15/9/5	DESIGN COMPLETED	'15/6/2
1	CUSTOMER1	FINANCE	CHINA	10M YEN	A	'15/9/5	PRODUCTION COMPLETED	'15/8/2
1	CUSTOMER1	FINANCE	CHINA	10M YEN	A	'15/9/30	PRODUCTION COMPLETED	'15/8/10
1	CUSTOMER1	FINANCE	CHINA	10M YEN	A	'15/9/30	DELIVERY COMPLETED	'15/9/10
1	CUSTOMER1	FINANCE	CHINA	10M YEN	A	'15/9/30	SHIPMENT COMPLETED	'15/9/20
2	CUSTOMER2	GOVERNMENT AGENCY	AMERICA	70M YEN	B	'15/12/30	ORDER RECEPTION COMPLETED	'15/2/1
2	CUSTOMER2	GOVERNMENT AGENCY	AMERICA	70M YEN	B	'15/11/30	ORDER RECEPTION COMPLETED	'15/4/2
2	CUSTOMER2	GOVERNMENT AGENCY	AMERICA	70M YEN	B	'15/11/30	DESIGN COMPLETED	'15/5/2
2	CUSTOMER2	GOVERNMENT AGENCY	AMERICA	70M YEN	B	'15/11/30	PRODUCTION COMPLETED	'15/10/1
2	CUSTOMER2	GOVERNMENT AGENCY	AMERICA	70M YEN	B	'15/11/30	DELIVERY COMPLETED	'15/10/15
2	CUSTOMER2	GOVERNMENT AGENCY	AMERICA	70M YEN	B	'15/11/30	SHIPMENT COMPLETED	'17/11/1
3	CUSTOMER3	MEDICALCARE	BRITAIN	50M YEN	C	'16/3/10	ORDER RECEPTION COMPLETED	'15/11/18
3	CUSTOMER3	MEDICALCARE	BRITAIN	50M YEN	C	'16/3/10	DESIGN COMPLETED	'15/12/25
3	CUSTOMER3	MEDICALCARE	BRITAIN	50M YEN	C	'16/3/30	DESIGN COMPLETED	'15/1/5
3	CUSTOMER3	MEDICALCARE	BRITAIN	50M YEN	C	'16/3/31	PRODUCTION COMPLETED	'16/2/20
3	CUSTOMER3	MEDICALCARE	BRITAIN	50M YEN	C	'16/3/31	DELIVERY COMPLETED	'16/3/1
3	CUSTOMER3	MEDICALCARE	BRITAIN	50M YEN	C	'16/3/31	SHIPMENT COMPLETED	'16/3/25
...	...	...	...	...	...	...	...	...

PAST PROJECT INFORMATION 121

[Fig. 3]

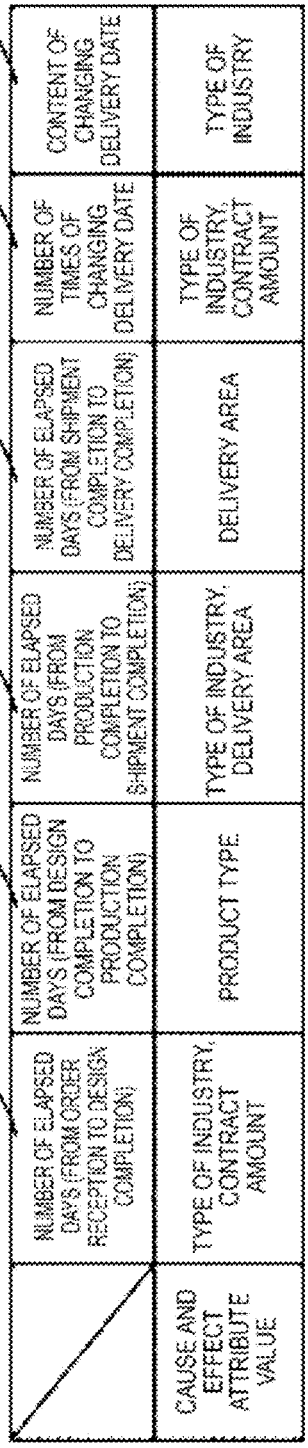


PROJECT NUMBER	NUMBER OF ELAPSED DAYS (FROM ORDER RECEPTION TO DESIGN COMPLETION)	NUMBER OF ELAPSED DAYS (FROM DESIGN COMPLETION TO PRODUCTION COMPLETION)	NUMBER OF ELAPSED DAYS (FROM PRODUCTION COMPLETION TO SHIPMENT COMPLETION)	NUMBER OF ELAPSED DAYS (FROM SHIPMENT COMPLETION TO DELIVERY COMPLETION)	NUMBER OF TIMES OF CHANGING DELIVERY DATE	CONTENT OF CHANGING DELIVERY DATE
1	37 DAYS	122 DAYS	39 DAYS	10 DAYS	THREE TIMES	62 DAYS DELAYED
2	90 DAYS	152 DAYS	14 DAYS	17 DAYS	ONE TIME	30 DAYS ADVANCED
3	37 DAYS	57 DAYS	10 DAYS	24 DAYS	TWO TIMES	21 DAYS DELAYED
...	...	...	...	...	...	...
100	50 DAYS	90 DAYS	24 DAYS	7 DAYS	THREE TIMES	10 DAYS ADVANCED

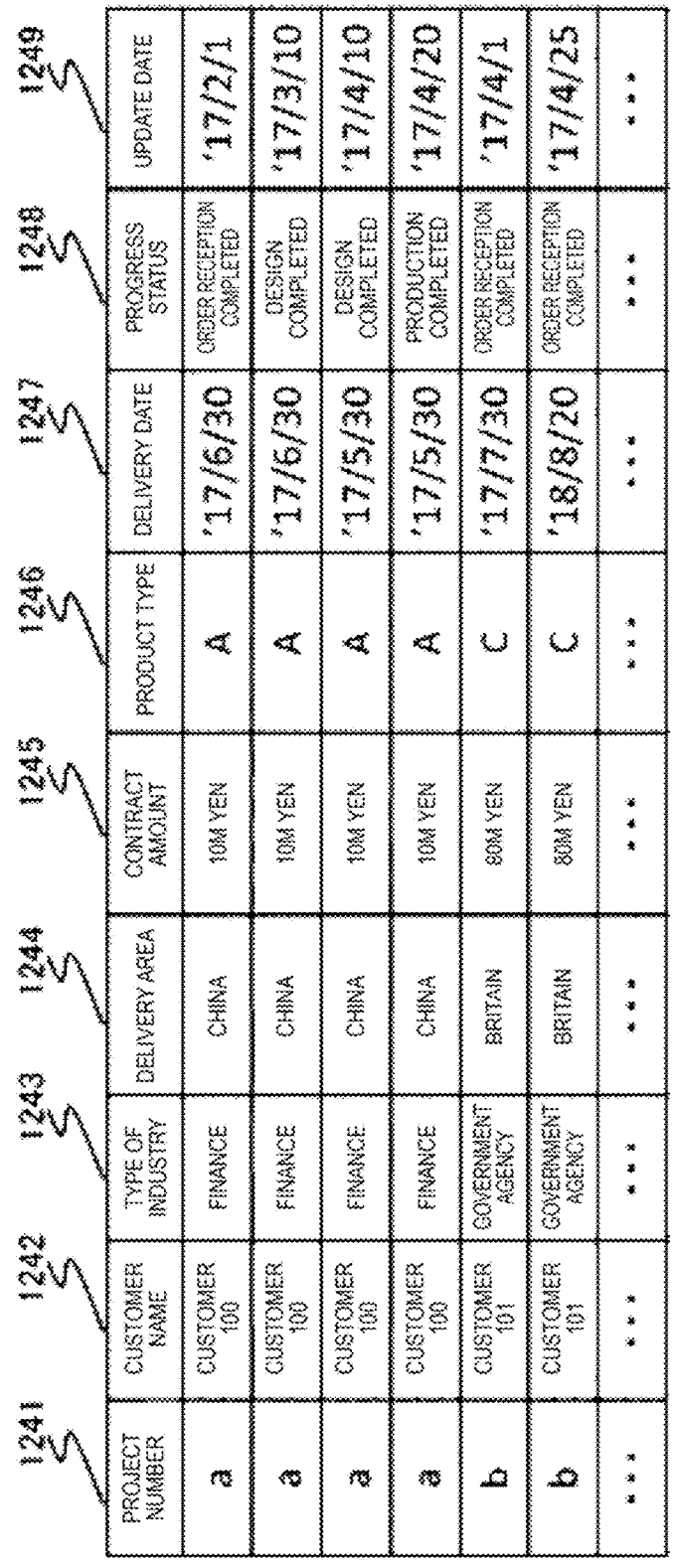
1221 1222 1223 1224 1225 1226 1227

FEATURE AMOUNT INFORMATION 122

[Fig. 4]


1231
1232
1233
1234
1235
1236
CAUSE AND EFFECT ATTRIBUTE VALUE
NUMBER OF ELAPSED DAYS (FROM ORDER RECEPTION TO DESIGN COMPLETION)
NUMBER OF ELAPSED DAYS (FROM DESIGN COMPLETION TO PRODUCTION COMPLETION)
NUMBER OF ELAPSED DAYS (FROM PRODUCTION COMPLETION TO SHIPMENT COMPLETION)
NUMBER OF ELAPSED DAYS (FROM SHIPMENT COMPLETION TO DELIVERY COMPLETION)
NUMBER OF TIMES OF CHANGING DELIVERY DATE
CONTENT OF CHANGING DELIVERY DATE
TYPE OF INDUSTRY, CONTRACT AMOUNT
PRODUCT TYPE
TYPE OF INDUSTRY, DELIVERY AREA
DELIVERY AREA
TYPE OF INDUSTRY, CONTRACT AMOUNT
TYPE OF INDUSTRY
ATTRIBUTE VALUE INFORMATION 123

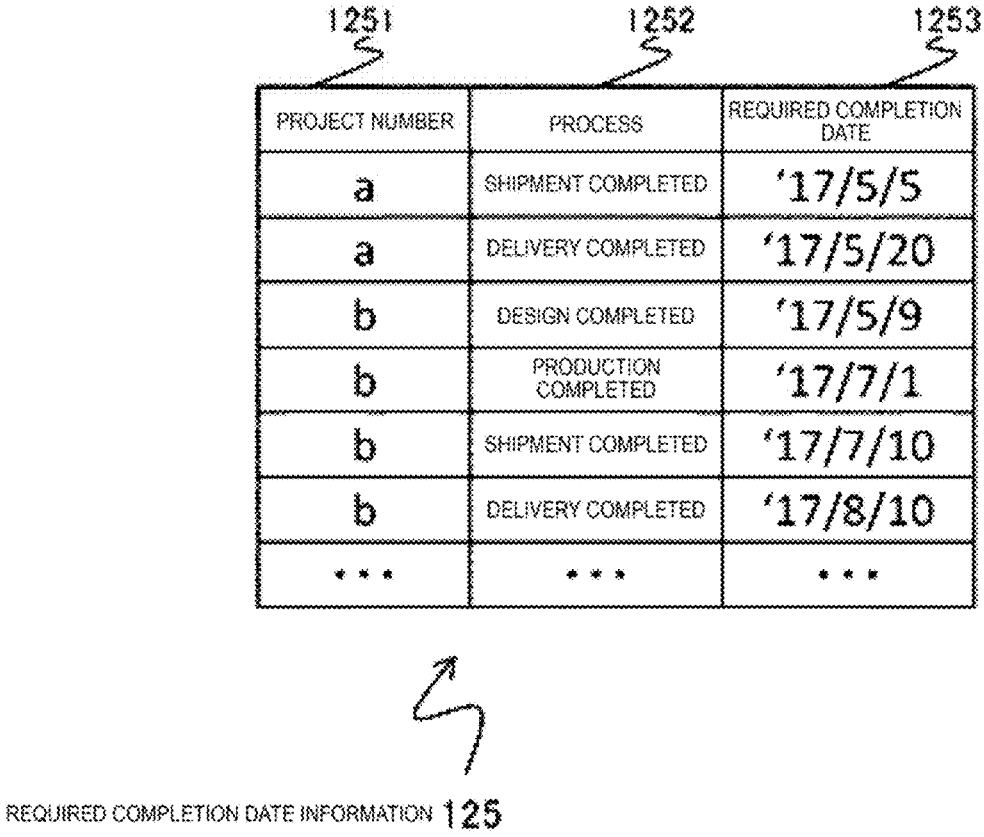
[Fig. 5]



1241 PROJECT NUMBER	1242 CUSTOMER NAME	1243 TYPE OF INDUSTRY	1244 DELIVERY AREA	1245 CONTRACT AMOUNT	1246 PRODUCT TYPE	1247 DELIVERY DATE	1248 PROGRESS STATUS	1249 UPDATE DATE
a	CUSTOMER 100	FINANCE	CHINA	10M YEN	A	'17/6/30	ORDER RECEPTION COMPLETED	'17/2/1
a	CUSTOMER 100	FINANCE	CHINA	10M YEN	A	'17/6/30	DESIGN COMPLETED	'17/3/10
a	CUSTOMER 100	FINANCE	CHINA	10M YEN	A	'17/5/30	DESIGN COMPLETED	'17/4/10
a	CUSTOMER 100	FINANCE	CHINA	10M YEN	A	'17/5/30	PRODUCTION COMPLETED	'17/4/20
b	CUSTOMER 101	GOVERNMENT AGENCY	BRITAIN	80M YEN	C	'17/7/30	ORDER RECEPTION COMPLETED	'17/4/1
b	CUSTOMER 101	GOVERNMENT AGENCY	BRITAIN	80M YEN	C	'18/8/20	ORDER RECEPTION COMPLETED	'17/4/25
...	...	...	...	...	...	...	...	...

ORDERED PROJECT INFORMATION 124

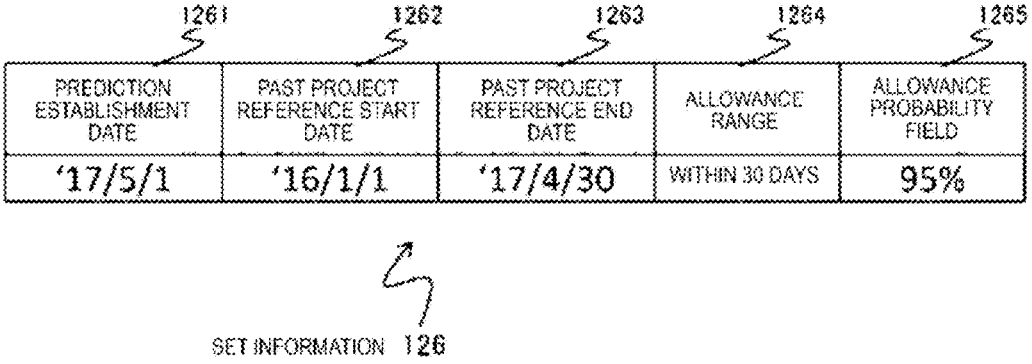
[Fig. 6]



1251 PROJECT NUMBER	1252 PROCESS	1253 REQUIRED COMPLETION DATE
a	SHIPMENT COMPLETED	'17/5/5
a	DELIVERY COMPLETED	'17/5/20
b	DESIGN COMPLETED	'17/5/9
b	PRODUCTION COMPLETED	'17/7/1
b	SHIPMENT COMPLETED	'17/7/10
b	DELIVERY COMPLETED	'17/8/10
• • •	• • •	• • •

REQUIRED COMPLETION DATE INFORMATION 125

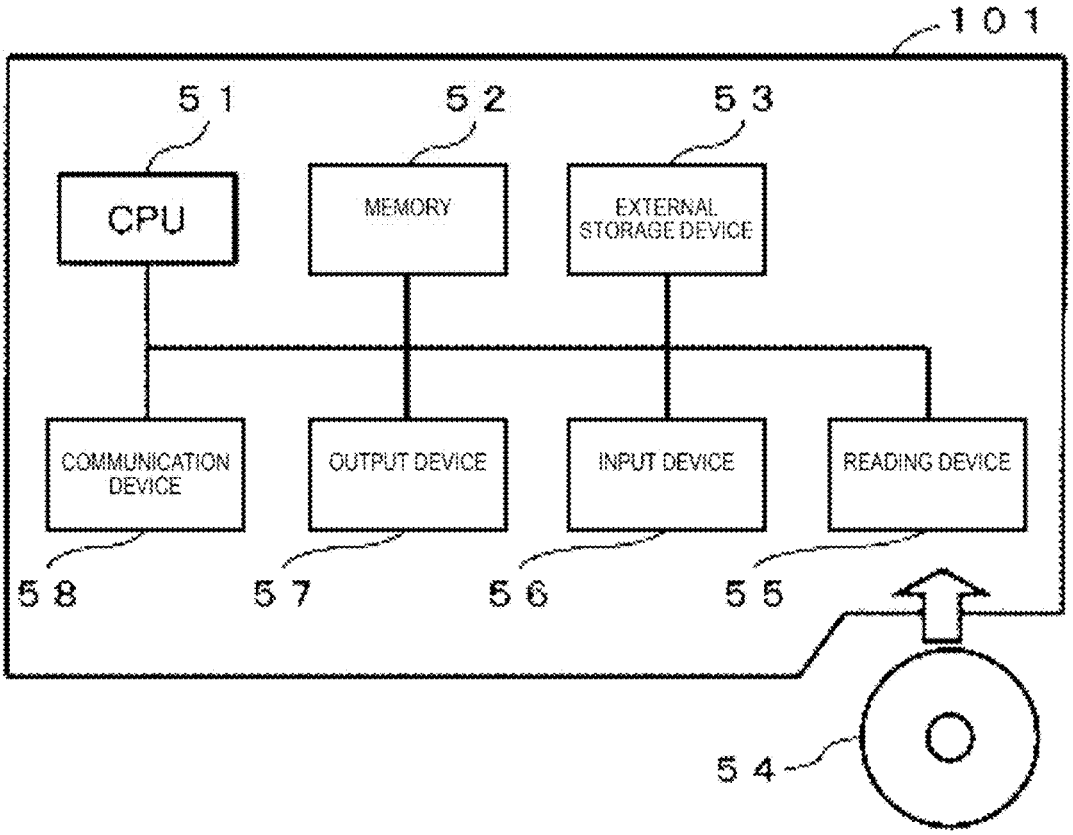
[Fig. 7]



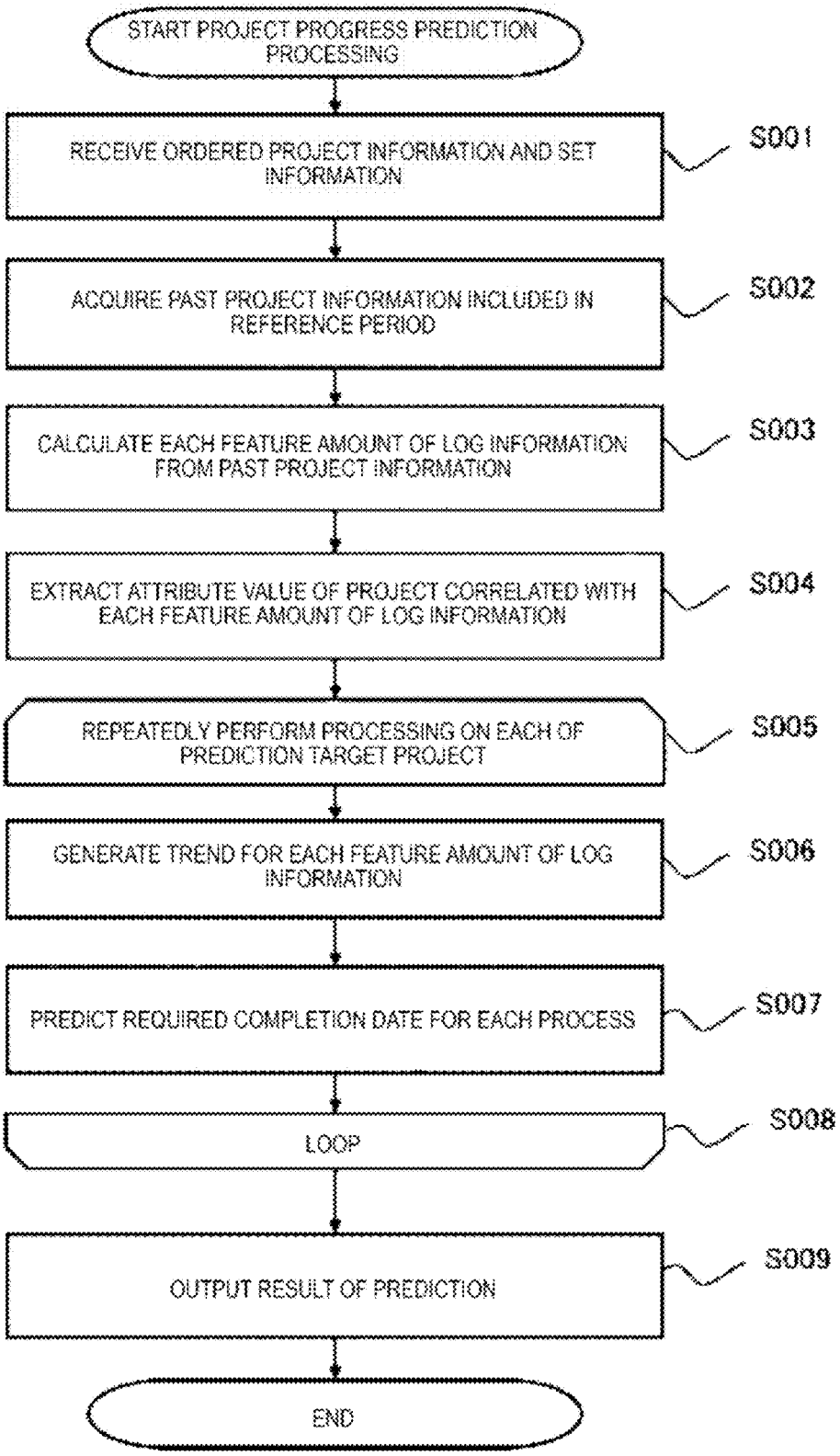
1261 PREDICTION ESTABLISHMENT DATE	1262 PAST PROJECT REFERENCE START DATE	1263 PAST PROJECT REFERENCE END DATE	1264 ALLOWANCE RANGE	1265 ALLOWANCE PROBABILITY FIELD
'17/5/1	'16/1/1	'17/4/30	WITHIN 30 DAYS	95%

SET INFORMATION 126

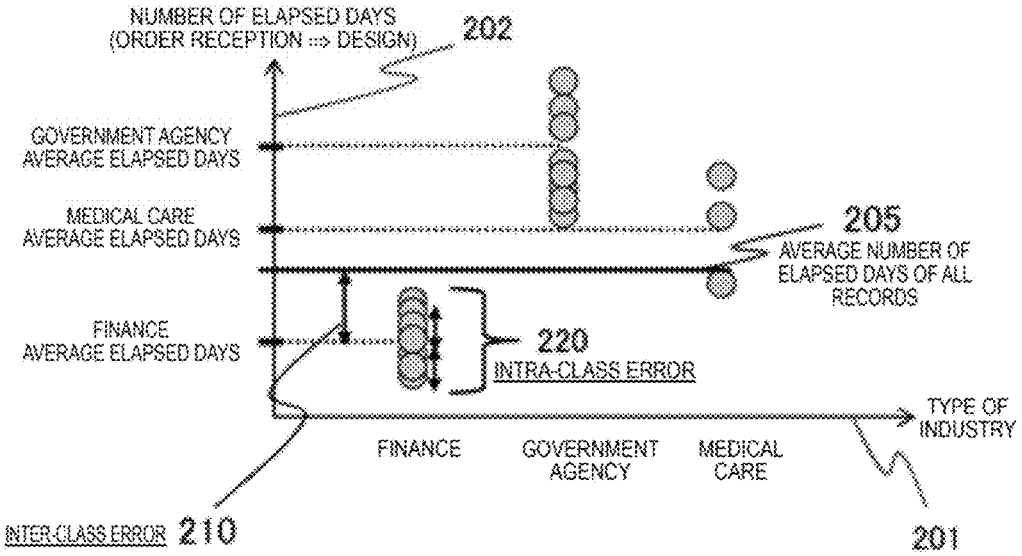
[Fig. 8]


101
51
52
53
CPU
MEMORY
EXTERNAL STORAGE DEVICE
COMMUNICATION DEVICE
OUTPUT DEVICE
INPUT DEVICE
READING DEVICE
58
57
56
55
54

[Fig. 9]


START PROJECT PROGRESS PREDICTION PROCESSING
RECEIVE ORDERED PROJECT INFORMATION AND SET INFORMATION
S001
ACQUIRE PAST PROJECT INFORMATION INCLUDED IN REFERENCE PERIOD
S002
CALCULATE EACH FEATURE AMOUNT OF LOG INFORMATION FROM PAST PROJECT INFORMATION
S003
EXTRACT ATTRIBUTE VALUE OF PROJECT CORRELATED WITH EACH FEATURE AMOUNT OF LOG INFORMATION
S004
REPEATEDLY PERFORM PROCESSING ON EACH OF PREDICTION TARGET PROJECT
S005
GENERATE TREND FOR EACH FEATURE AMOUNT OF LOG INFORMATION
S006
PREDICT REQUIRED COMPLETION DATE FOR EACH PROCESS
S007
LOOP
S008
OUTPUT RESULT OF PREDICTION
S009
END

[Fig. 10]



AVERAGE ELAPSED DAY GRAPH 200

[Fig. 11]

TYPE OF INDUSTRY	INTER-CLASS ERROR	INTRA-CLASS ERROR
FINANCE	100	200
GOVERNMENT AGENCY	200	400
MEDICAL CARE	50	300

EXAMPLE OF ERROR 250

[Fig. 12]

ATTRIBUTE VALUE	CORRELATION RATIO
TYPE OF INDUSTRY	0.28
CONTRACT AMOUNT	0.25
PRODUCT TYPE	0.21
DELIVERY AREA	0.15

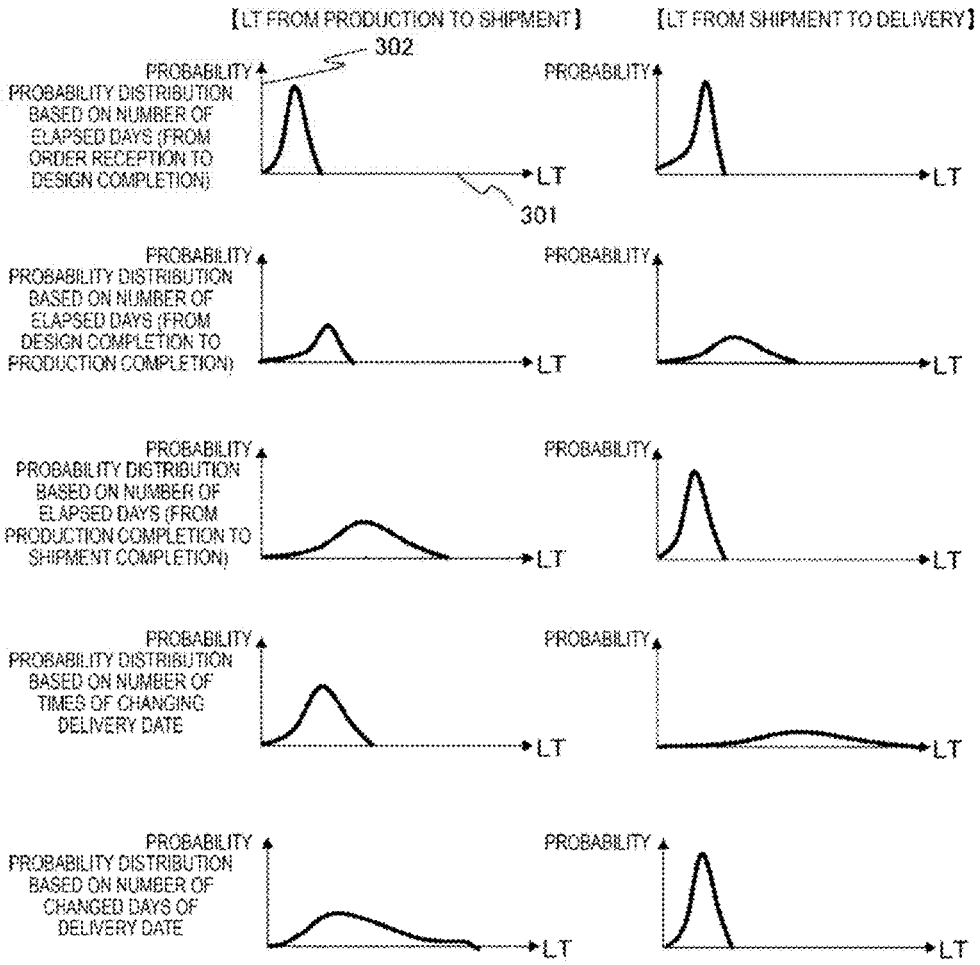
EXAMPLE OF CORRELATION RATIO 260

[Fig. 13]

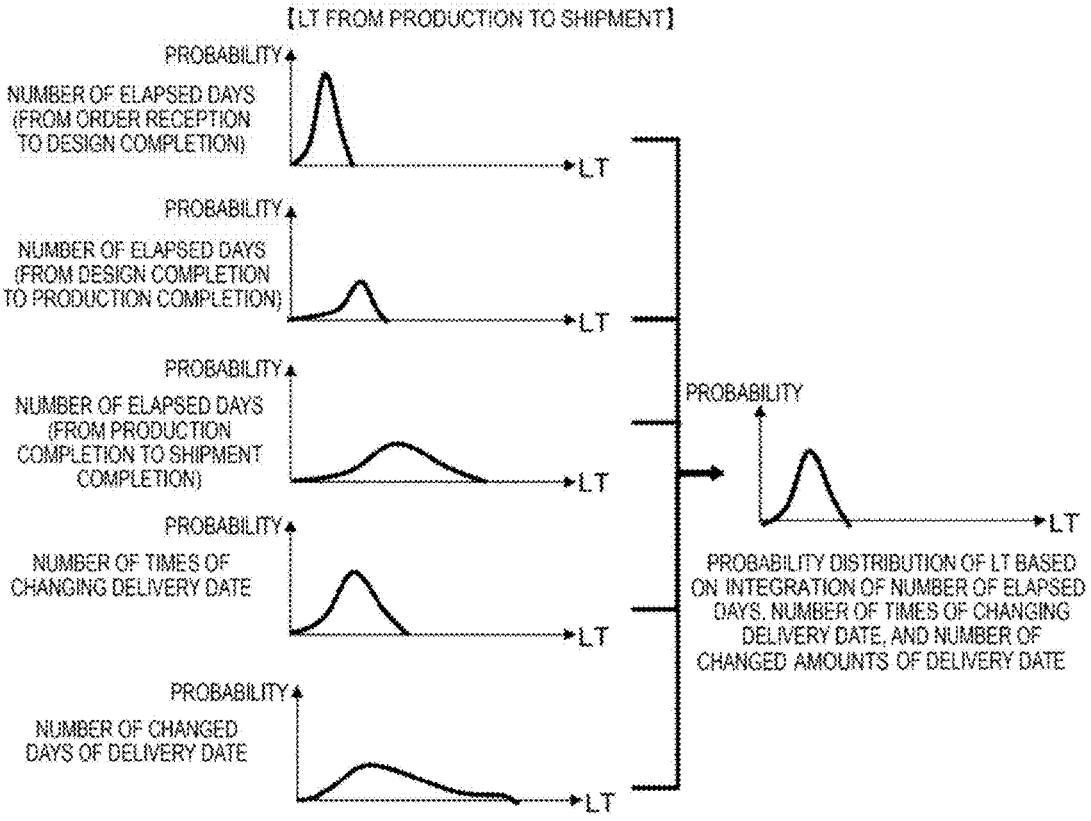
COMBINATION OF ATTRIBUTE VALUES	PROBABILITY (REPEATABILITY)
TYPE OF INDUSTRY	98%
TYPE OF INDUSTRY, CONTRACT AMOUNT	95%
TYPE OF INDUSTRY, CONTRACT AMOUNT, PRODUCT TYPE	90%

EXAMPLE OF COMBINATION OF ATTRIBUTE VALUES 270

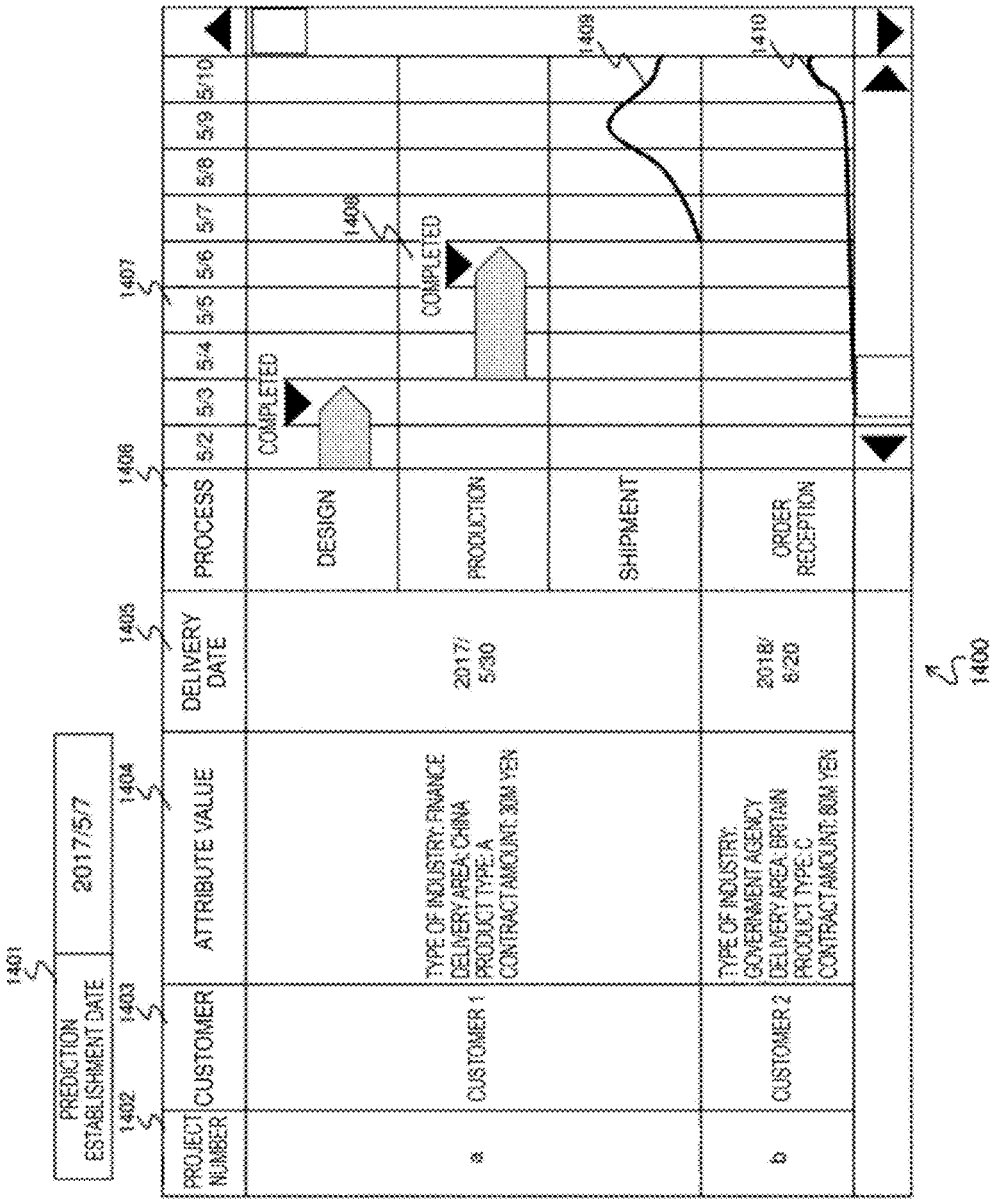
[Fig. 14]


【LT FROM PRODUCTION TO SHIPMENT】
【LT FROM SHIPMENT TO DELIVERY】
302
301
PROBABILITY
PROBABILITY DISTRIBUTION BASED ON NUMBER OF ELAPSED DAYS (FROM ORDER RECEPTION TO DESIGN COMPLETION)
PROBABILITY DISTRIBUTION BASED ON NUMBER OF ELAPSED DAYS (FROM DESIGN COMPLETION TO PRODUCTION COMPLETION)
PROBABILITY DISTRIBUTION BASED ON NUMBER OF ELAPSED DAYS (FROM PRODUCTION COMPLETION TO SHIPMENT COMPLETION)
PROBABILITY DISTRIBUTION BASED ON NUMBER OF TIMES OF CHANGING DELIVERY DATE
PROBABILITY DISTRIBUTION BASED ON NUMBER OF CHANGED DAYS OF DELIVERY DATE
LT

[Fig. 15]


【LT FROM PRODUCTION TO SHIPMENT】
PROBABILITY
NUMBER OF ELAPSED DAYS (FROM ORDER RECEPTION TO DESIGN COMPLETION)
LT
PROBABILITY
NUMBER OF ELAPSED DAYS (FROM DESIGN COMPLETION TO PRODUCTION COMPLETION)
LT
PROBABILITY
NUMBER OF ELAPSED DAYS (FROM PRODUCTION COMPLETION TO SHIPMENT COMPLETION)
LT
PROBABILITY
NUMBER OF TIMES OF CHANGING DELIVERY DATE
LT
PROBABILITY
NUMBER OF CHANGED DAYS OF DELIVERY DATE
LT
PROBABILITY
LT
PROBABILITY DISTRIBUTION OF LT BASED ON INTEGRATION OF NUMBER OF ELAPSED DAYS, NUMBER OF TIMES OF CHANGING DELIVERY DATE, AND NUMBER OF CHANGED AMOUNTS OF DELIVERY DATE

[Fig. 16]


1401
PREDICTION ESTABLISHMENT DATE
2017/5/7
1402
PROJECT NUMBER
1403
CUSTOMER
1404
ATTRIBUTE VALUE
1405
DELIVERY DATE
1406
PROCESS
1407
5/2
5/3
5/4
5/5
5/6
5/7
5/8
5/9
5/10
a
CUSTOMER 1
TYPE OF INDUSTRY: FINANCE
DELIVERY AREA: CHINA
PRODUCT TYPE: A
CONTRACT AMOUNT: 30M YEN
2017/5/30
DESIGN
PRODUCTION
SHIPMENT
ORDER RECEPTION
COMPLETED
1408
1409
1410
b
CUSTOMER 2
TYPE OF INDUSTRY: GOVERNMENT AGENCY
DELIVERY AREA: BRITAIN
PRODUCT TYPE: C
CONTRACT AMOUNT: 80M YEN
2018/8/20
1400

PROJECT PROGRESS PREDICTION DEVICE AND PROJECT PROGRESS PREDICTION SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority under 35 U.S.C. § 119 from Japanese Patent Application No. 2018-030852, filed Feb. 23, 2018, the entire disclosure of which is herein expressly incorporated by reference.

TECHNICAL FIELD

[0002] The present invention relates to a project progress prediction device and a project progress prediction system.

BACKGROUND ART

[0003] In infrastructure products such as elevators and storages, an arrangement of procurement, production, and the like is performed according to a required completion date of each process such as design, production, shipment, and the like. Here, in general infrastructure products, since a delivery date may be frequently changed due to external factors such as delays in payment and delays in building construction at a product delivery place, it is necessary to predict the required completion date of each process in a timely manner. As a technology for predicting the required completion date for each process, there is a technology described in PTL 1, in which, for example, an approval time from application to approval completion can be predicted.

CITATION LIST

Patent Literature

[0004] PTL 1: JP-A-2014-238658

SUMMARY OF INVENTION

Technical Problem

[0005] According to the technology described in PTL 1, by extracting a past project having information similar to the registration information at the time of application of the project, and by predicting required time for each approval, the approval time up to the application completion is predicted. However, in the technology described above, since the approval time is predicted using the registration information at the time of application of the project, if the technology is applied to an infrastructure product delivery project where the registration information of the project is changed frequently, there is a high possibility that a prediction accuracy is low. In addition, in the technology described above, the past project similar to a prediction target project is extracted focusing on factors such as the day of the week of the application date and a content of the application, however, it is necessary to select any focused factors. Therefore, if there are a plurality of candidate factors, factors to be focused on cannot be appropriately determined, and as a result, the prediction accuracy cannot be secured. The present invention has been made in view of the above circumstances, and has an object of predicting the required completion date for each process with high accuracy.

Solution to Problem

[0006] In order to solve the problems described above, a project progress prediction device includes: a storage unit that stores log information which is a change history of an attribute value of a project and a feature amount of a delivery date including the number of elapsed days for each process; an attribute value selection unit that selects an attribute value having a predetermined correlation with the delivery date of the project using the log information; a past project extraction unit that extracts a completed project having the attribute value similar to that of a prediction target project from the storage unit using the selected attribute value, and estimates a lead time for each of the feature amounts for non-completed processes of the prediction target project using the feature amount of the delivery date of the extracted completed project; and a progress prediction unit that integrates the estimated lead times between the feature amounts and predicts a probability of a required completion date for each process of the prediction target project.

Advantageous Effects of Invention

[0007] According to the present invention, it is possible to predict the required completion date with high accuracy for each process of the products of which registration information including a delivery date of the project changes frequently. The problems, configurations, and effects other than those described above will be clarified by the description of the embodiments below.

BRIEF DESCRIPTION OF DRAWINGS

[0008] FIG. **1** is a diagram illustrating an example of functional blocks of a project progress prediction device and a project progress prediction system.

[0009] FIG. **2** is a diagram illustrating an example of a data structure of past project information.

[0010] FIG. **3** is a diagram illustrating an example of a data structure of feature amount information.

[0011] FIG. **4** is a diagram illustrating an example of a data structure of attribute value information.

[0012] FIG. **5** is a diagram illustrating an example of a data structure of ordered project information.

[0013] FIG. **6** is a diagram illustrating an example of a data structure of required completion date information.

[0014] FIG. **7** is a diagram illustrating an example of a data structure of set information.

[0015] FIG. **8** is a diagram illustrating an example of a hardware configuration of the project progress prediction device.

[0016] FIG. **9** is a flowchart illustrating an example of project progress prediction processing.

[0017] FIG. **10** is a diagram illustrating an example in which an intra-class error and an inter-class error are visualized.

[0018] FIG. **11** is a diagram illustrating an example of results of calculation the intra-class error and the inter-class error.

[0019] FIG. **12** is a diagram illustrating an example of result of calculating a correlation ratio.

[0020] FIG. **13** is a diagram illustrating an example of a result of calculation of the probability for determining a combination of attribute values to be extracted.

[0021] FIG. **14** is a diagram illustrating an example of trends for each feature amount of log information.

[0022] FIG. **15** is a diagram illustrating an example of a result of combination of the trends for each feature amount of the log information.

[0023] FIG. **16** is a diagram illustrating an example of an output screen.

DESCRIPTION OF EMBODIMENTS

[0024] Hereinafter, an embodiment of the present invention will be described using the drawings. In this description, the term "project" is assumed to refer to a proposal having an attribute value including a type of industry, a delivery area, a product type, and a contract amount that can be a characteristic of the project and an order received from a customer. In the present description, the type of industry, the delivery area, the product type, and the contract amount are taken as the attribute value, but the attribute value is not limited thereto.

[0025] In the present description, the "process" indicates each stage obtained by dividing the states of the project for the sake of convenience from a time the order is received to a time the product is delivered to the customer. In the present description, the process is assumed to be divided into five stages of order reception, design, production, shipping, and delivery, and the process is assumed to be progressed in that order, however, the process is not limited to the five stages and not limited to be progressed in that order.

[0026] In addition, in the present description, the delivery date is assumed to be set for each project and is assumed to refer to a scheduled date of delivering the product to the customer. The registration information of the project is assumed to include the attribute value, the delivery date and the information on the process completed up to a predetermined time point. In the present description, the registration information is assumed to be configured to include the attribute value, the delivery date, and the information on the process completed up to current time point, but not limited thereto.

[0027] In addition, in the present description, the log information is assumed to refer to a change history of the registration information of the project, and the log information is assumed to be expressed by a feature amount such as the number of elapsed days from the registration of the project and the change history of the delivery date. In the present description, the six feature amounts of the log information are assumed to be the number of elapsed days from the order reception to the design, the number of elapsed days from the design to the production, the number of elapsed days from the production to the shipment, the number of elapsed days from the shipment to the delivery, the number of times of changing the delivery date, and the content of changing the delivery date, however, the feature amounts are not limited thereto.

[0028] FIG. **1** is a diagram illustrating an example of functional blocks of a project progress prediction device **101** and a project progress prediction system **100** in the present embodiment. The project progress prediction system **100** in the present embodiment includes the project progress prediction device **101**, a user terminal **103** used by a user, and a database device **104** storing the data of the past project information, and those are communicably connected to each other via a network **102**.

[0029] The user terminal **103** is an information processing device such as a personal computer (PC). The user can input ordered project information, a prediction establishment date, a reference period of the past project to be used in the prediction, an allowance range which is set information necessary for processing by the project progress prediction device **101**, and an allowance probability into the user terminal **103**, and the user terminal **103** has a function of transmitting the received ordered project information, the prediction establishment date, the past project reference period, the allowance range, and the allowance probability to the project progress prediction device **101** via the network **102**.

[0030] Here, the ordered project information is various kinds of information items including the number of days related to the prediction target project. In addition, the prediction target project is a project of which the delivery to the customer has not been completed. The prediction establishment date is a date when the user performs the processing for predicting the required completion date of the prediction target project for each process registered in the ordered project information using the project progress prediction device **101**. In addition, the user terminal **103** has a function of displaying the information output by the project progress prediction device **101** to the user.

[0031] The database device **104** is a computer using a system such as enterprise resources planning (ERP) or the like, or a database conforming thereto that stores data, or using a storage device such as network attached storage (NAS) and database management software.

[0032] The network **102** connects the user terminal **103**, the database device **104**, and the project progress prediction device **101** so as to communicate with each other. The network **102** is any one of a communication network using some or all of the general public lines such as local area network (LAN), wide area network (WAN), virtual private network (VPN), the Internet, and the like.

[0033] The project progress prediction device **101** is an information processing device such as a PC or a server computer, and extracts the log information of the past project information, and then, predicts the required completion date for each process of the prediction target project stored as the ordered project information using the log information of the extracted past project.

[0034] The project progress prediction device **101** includes a calculation unit **110**, a storage unit **120**, and a communication unit **130**. The storage unit **120** stores the past project information **121**, the feature amount information **122**, the attribute value information **123**, the ordered project information **124**, the required completion date information **125**, and the set information **126**.

[0035] Here, an example of the past project information **121** is illustrated in FIG. **2**, an example of the feature amount information **122** is illustrated in FIG. **3**, an attribute value information is illustrated in FIG. **4**, an example of the ordered project information **124** is illustrated in FIG. **5**, an example of the required completion date information **125** is illustrated in FIG. **6**, and an example of the set information **126** is illustrated in FIG. **7**.

[0036] FIG. **2** is a diagram illustrating an example of a data structure of the past project information **121**. Information on the registration content of the past project of which the delivery to customer is completed is stored in the past project information **121**. The past project information **121** is configured with a plurality of records, and each record includes a project number field **1211**, a customer name field **1212**, a type of industry field **1213**, a delivery area field

1214, a contract amount field **1215**, a product type field **1216**, a delivery date field **1217**, a progress status field **1218**, and an update date field **1219**.

[0037] In the project number field **1211**, information on the project number for identifying the project is stored. In the customer name field **1212**, information on the customer name of the project is stored. In the type of industry field **1213**, information on the type of industry of the customer is stored. The type of industry has predetermined categories such as "finance", "government agency", "medical care", and the like.

[0038] In the delivery area field **1214**, information on the delivery area to which the product is delivered is stored. The delivery area has predefined categories such as "China", "America", "Britain" and the like. In the contract amount field **1215**, information on the contract amount of the project is stored. In the product type field **1216**, information on the product type ordered by the customer is stored. The product type has predetermined categories such as "product A", "product B", "product C", and the like.

[0039] In the delivery date field **1217**, information on the delivery date, which is the delivery deadline for the customer, is stored. In the progress status field **1218**, among the processes of the order reception, the design, the production, the shipment, and the delivery, the latest information on the process completed up to the time point of the date stored in the update date field **1219**, is stored. For example, if the project of which the project number is "1" in FIG. **2**, the progress status of the record of which the update date is "15/4/2" is "design completion". This indicates that the design is completed as of the time point "15/4/2". In the update date field **1219**, information on the date when the information stored in the delivery date field **1217** and the progress status field **1218** are changed is stored.

[0040] FIG. **3** is a diagram illustrating an example of a data structure of the feature amount information. In the feature amount information **122**, each feature amount (log information) of the past project is stored. The feature amount information **122** is configured with a plurality of records, and each record includes a project number field **1221**, a number of elapsed days (from the order reception to the design completion) field **1222**, a number of elapsed days (from the design completion to the production completion) field **1223**, a number of elapsed days (from the production completion to the shipment completion) field **1224**, a number of elapsed days (from the shipment completion to the delivery completion) field **1225**, a number of times of changing the delivery date field **1226**, and a content of changing the delivery date field **1227**.

[0041] In the project number field **1221**, information on a project number for identifying the project is stored. In the number of elapsed days (from the order reception to the design completion) field **1222**, the number of days required for the design completion from the order reception is stored. In the number of elapsed days (from the design completion to the production completion) field **1223**, the number of days required for the production completion from the design completion is stored. In the number of elapsed days (from the production completion to the shipment completion) field **1224**, the number of days required for the shipment completion from the production completion is stored. In the number of elapsed days (from the shipment completion to the delivery completion) field **1225**, the number of days required for the delivery completion from the shipment completion is stored.

[0042] In the number of times of changing the delivery date field **1226**, the number of times of the delivery date changes from the order reception of the project to the delivery completion is stored. In the content of changing the delivery date field **1227**, information on the number of advanced/delayed days of the delivery date in the record corresponding to the latest update date with reference to the delivery date in the record corresponding to the oldest update date is stored.

[0043] FIG. **4** is a diagram illustrating an example of a structure of the attribute value information. In the attribute value information **123**, item names of the attribute values correlated (cause and effect relationship) with each feature amount of the log information of the past project is stored. The attribute value information **123** is configured with one record, and the record includes a number of elapsed days (from the order reception to the design completion) field **1231**, a number of elapsed days (from the design completion to the production completion) field **1232**, a number of elapsed days (from the production completion to the shipment completion) field **1233**, a number of elapsed days (from the shipment completion to the delivery completion) field **1234**, a number of times of changing the delivery date field **1235**, and a content of changing the delivery date field **1236**.

[0044] In the number of elapsed days (from the order reception to the design completion) field **1231**, information on the attribute value correlated with the number of elapsed days from the order reception to the design completion is stored. In the number of elapsed days (from the design completion to the production completion) field **1232**, information on the attribute value correlated with the number of elapsed days from the design completion to the production completion is stored.

[0045] In the number of elapsed days (from the production completion to the shipment completion) field **1233**, information on the attribute value correlated with the number of elapsed days from the production completion to the shipment completion is stored. In the number of elapsed days (from the shipment completion to the delivery completion) field **1234**, information on the attribute value correlated with the number of elapsed days from the shipment completion to the delivery completion. In the number of times of changing the delivery date field **1235**, information on the attribute value correlated with the number of times of changing the delivery date is stored. In the content of changing the delivery date field **1236**, information on the attribute value correlated with the content of changing the delivery date is stored.

[0046] FIG. **5** is a diagram illustrating an example of a data structure of the ordered project information. Particularly, in the ordered project information **124**, an example of information at the time of the prediction establishment date "17/5/1" is illustrated. In the ordered project information **124**, information on the prediction target project is stored. The ordered project information **124** is configured with a plurality of records, and each record includes a project number field **1241**, a customer name field **1242**, a type of industry field **1243**, a delivery area field **1244**, a contract

amount field **1245**, a product type field **1246**, a delivery date field **1247**, a progress status field **1248**, and an update date field **1249**.

[0047] In the project number field **1241**, information on the project number for identifying the project is stored. In the customer name field **1242**, information on the customer name of the project is stored. In the type of industry field **1243**, information on the type of industry of the customer is stored. The type of industry has predetermined categories such as "finance", "government agency", "medical care" and the like.

[0048] In the delivery area field **1244**, information on the delivery area of the product is stored. The delivery area has predetermined categories such as "China", "America", "Britain", and the like. In the contract amount field **1245**, information on the contract amount of the project is stored. In the product type field **1246**, information on the product type ordered by the customer is stored. The product type has predetermined categories such as "product A", "product B", "product C", and the like.

[0049] In the delivery date field **1247**, information on the delivery date, which is the delivery deadline for the customer, is stored. In the progress status field **1248**, among the processes of order reception, design, production, shipment, and delivery, information on the latest process that is completed up to the time point of the date stored in the update date field **1249**, is stored. For example, in a case of the project of which the project number is "a" in FIG. **5**, the progress status of the record of which the update date is "17/3/10" is "design completion". This indicates that the design is completed up to the time point "17/3/10". In the update date field **1249**, information on the dates when the information stored in the delivery date field **1247** and the progress status field **1248** are changed is stored.

[0050] FIG. **6** is a diagram illustrating an example of a data structure of required completion date information. In the required completion date information **125**, the result of prediction of the required completion date of the prediction target project is stored. The required completion date information **125** is configured with a plurality of records, and each record includes a project number field **1251**, a process field **1252**, and a required completion date field **1253**.

[0051] In the project number field **1251**, information on the project number for identifying the project is stored. In the process field **1252**, information on the process to be predicted is stored. In the required completion date field **1253**, information on the required completion date of the process stored in the process field **1252** is stored.

[0052] FIG. **7** is a diagram illustrating an example of a data structure of set information. In the set information **126**, set information necessary for processing by the project progress prediction device **101** is stored. The set information **126** is configured with one record, and the record includes a prediction establishment date field **1261**, a past project reference start date field **1262**, a past project reference end date field **1263**, an allowance range field **1264**, and an allowance probability field **1265**.

[0053] In the prediction establishment date field **1261**, a performing date of the prediction of the required completion date for each process of the prediction target project registered in the ordered project information **124** by the user using the project progress prediction device **101**, is stored. In the past project reference start date field **1262**, the reference start date of the past project to be used in the prediction is stored. In the past project reference end date field **1263**, a reference end date of the past project to be used in the prediction is stored. In the allowance range field **1264**, information specifying an allowance range regarding a confidence interval used when the attribute value selection unit **111** selects the attribute value of the project from the log information of the past project, is stored.

[0054] In the allowance probability field **1265**, an allowance probability used when the attribute value selection unit **111** selects the attribute value of the project from the log information of the past project, and used for determining whether or not the confidence interval falls within the allowance range is stored.

[0055] Returning to the description of FIG. **1**, the calculation unit **110** derives an attribute value (item) correlated with each feature amount of the log information of the past project, specifies a trend (creation of a probability distribution of the lead time) for each feature amount of the log information of the past project, and calculates the probability distribution of the lead time as the prediction of the required completion date for each process. The calculation unit **110** includes an attribute value selection unit **111**, a past project extraction unit **112**, a progress prediction unit **113**, an input receiving unit **114**, and an output generation unit **115**.

[0056] The attribute value selection unit **111** reads the past project information **121** stored in the storage unit **120**, calculates the feature amount, and stores the result in the feature amount information **122**. In addition, the attribute value selection unit **111** derives an attribute value (item) correlated with each feature amount of the log information of the past project using the generated feature amount information **122**, and stores the derived result in the attribute value information **123**.

[0057] The past project extraction unit **112** extracts the past project whose attribute value is similar to the log information of the prediction target project in the ordered project information **124** by referring to the feature amount information **122** from the past project information **121**.

[0058] The progress prediction unit **113** predicts the required completion date for each process of the prediction target project based on the past project similar to the prediction target project extracted by the past project extraction unit **112**. In addition, when the required completion date of the prediction target project is predicted for each process, the progress prediction unit **113** stores the result in the required completion date information **125**.

[0059] The input receiving unit **114** receives the ordered project information transmitted from the user terminal **103** connected via the network **102**, the information on the prediction establishment date, the reference period of the past project to be used in the prediction, the allowance range, and the allowance probability. In addition, the input receiving unit **114** has a function of receiving the past project information from the database device **104**. Furthermore, the input receiving unit **114** stores the received ordered project information in the ordered project information **124** in the storage unit **120**, and stores the received past project information in the past project information **121**. In addition, the input receiving unit **114** stores the received prediction establishment date, the past project reference period, the allowance range, and the allowance probability in the set information **126**.

[0060] The output generation unit **115** transmits the information on the prediction establishment date received by the

input receiving unit **114** and the required completion date information **125** to the user terminal **103** connected by the network **102**, and generates output information to display the required completion date of each process of the prediction target project to the user.

[0061] The communication unit **130** communicates with other devices via the network **102**.

[0062] FIG. **8** is a diagram illustrating an example of a hardware structure of the project progress prediction device. The project progress prediction device **101** is realized by a central processing unit (CPU) **51**, a memory **52**, an external storage device **53** such as a hard disk drive (HDD), a reading device **55** for reading and writing information from and into a portable storage medium **54** such as a compact disk (CD), a digital versatile disk (DVD), an input device **56** such as a keyboard, a mouse, and a barcode reader, an output device **57** such as a display, and a computer including a communication device **58** for communicating with another computer via a communication network such as a network **102**, or a computer system including a plurality of such computers.

[0063] For example, the calculation unit **110** can be realized by loading a predetermined program stored in the external storage device **53** into the memory **52** and executing the program by the CPU **51**, and the storage unit **120** can be realized by the CPU **51** using the memory **52** or the external storage device **53**.

[0064] This predetermined program may be downloaded to the external storage device **53** from the storage medium **54** via the reading device **55** and loaded onto the memory **52**, and then, may be executed by the CPU **51**.

[0065] The program may also be loaded onto the memory **52** directly from the storage medium **54** via the reading device **55**, and may be executed by the CPU **51**.

[0066] Not being limited thereto, the project progress prediction device **101** may be realized by, for example, an application specific integrated circuit (ASIC) or a microcomputer.

[0067] FIG. **9** is a diagram illustrating an example of a flowchart of the project progress prediction processing. The project progress prediction processing is started when an instruction is received from the user.

[0068] The project progress prediction processing is started, for example, in response to a start command from the user to the user terminal **103** on a premise that equal to or more than a predetermined number of past project information items are recorded in the database device **104**.

[0069] First, the user terminal **103** receives the ordered project information, the prediction establishment date which is the set information, the reference period of past project which is to be used in the prediction, the allowance range, and the allowance probability from the user (STEP **S001**). The user terminal **103** transmits the received information to the project progress prediction device **101** via the network **102**.

[0070] Next, the input receiving unit **114** acquires the past project information included in the reference period (STEP **S002**). Specifically, the input receiving unit **114** of the project progress prediction device **101** which received operation information in **S001** acquires all the past project information in which a part or all of the period from the order reception to the delivery completion is included in the reference period of the past project received from user terminal **103** in STEP **S001** from the database device **104**, and stores the information in the past project information **121** stored in the storage unit **120**. Furthermore, the input receiving unit **114** stores the ordered project information received from the user terminal **103** in STEP **S001** in the ordered project information **124**. In addition, the input receiving unit **114** stores the prediction establishment date received from the user terminal **103**, the reference period of the past project, the allowance range, and the allowance probability in the set information **126**.

[0071] Next, the attribute value selection unit **111** calculates each feature amount of the log information from the past project information (STEP **S003**). Specifically, the attribute value selection unit **111** of the calculation unit **110** calculates each feature amount of the log information of the past project information from the past project stored in the past project information **121**, and stores the result of calculation in the feature amount information **122**. As a calculation method, there is a method in which the required period of each process is calculated for each project. Hereinafter, an example of processing for calculating each feature amount of the log information of the past project information from the past project information **121** will be described.

[0072] The attribute value selection unit **111** calculates the number of elapsed days from the order reception of each project to the design using the progress status field **1218** and the update date field **1219** of the past project information **121**. The attribute value selection unit **111** acquires a record whose progress status field **1218** is "order reception completion" and a record whose progress status field **1218** is "design completion", and calculates the number of elapsed days from order reception to design using the difference between the dates of two records stored in the update date field **1219**.

[0073] Here, if there are a plurality of records whose progress status field **1218** are "order reception completion", the record of which the date stored in the update date field **1219** is oldest is acquired. Similarly, if there are a plurality of records whose progress status field **1218** are "design completion", the record of which the date stored in the update date field **1219** is oldest date is acquire. For example, in the case of the project whose project number field **1211** is "1" in FIG. **2**, there are two records whose progress status field **1218** are "order reception completion". The attribute value selection unit **111** acquires the record of which the date stored in the update date field **1219** is "15/2/24" which is older than the other as a record of "order reception completion".

[0074] Similarly, in the example of FIG. **2**, there are two records whose progress status field **1218** is "design completion". In this case also, the attribute value selection unit **111** acquires a record of which the date stored in the update date field **1219** is "15/4/2" which is older than the other as a record of "design completion". Thereafter, the attribute value selection unit **111** calculates the number of elapsed days from the order reception to the design using the difference between each acquired date as "15/4/2"−"15/2/24"="37 days".

[0075] Through the similar processing, the attribute value selection unit **111** respectively calculates the number of elapsed days from the design completion to the production completion, the number of elapsed days from the production completion to the shipment completion, the number of elapsed days from the shipment completion to the delivery completion.

[0076] The attribute value selection unit **111** acquires a record whose progress status field **1218** is "design completion" and a record whose progress status field **1218** is "production completion", and calculates the number of elapsed days from the design completion to the production completion using the difference between the dates stored in the update date field **1219** of the acquired two records. For example, in the case of the project whose project number field **1211** is "1" in FIG. **2**, the attribute value selection unit **111** acquires "15/4/2" as the date corresponding to the "design completion" and acquires "15/8/2" as the date corresponding to the "production completion", and then, calculates the number of elapsed days from the design completion to the production completion from the difference between the two dates as "15/8/2"−"15/4/2"="122 days".

[0077] The attribute value selection unit **111** acquires a record whose progress status field **1218** is "production completion" and a record whose progress status field **1218** is "shipment completion", and calculated the number of elapsed days from the production completion to the shipment completion using the difference between the dates stored in the update date field **1219** of the acquired two records. For example, in the case of the project whose project number field **1211** is "1" in FIG. **2**, the attribute value selection unit **111** acquires "15/8/2" as the date corresponding to the "production completion" and "15/9/10" as the date corresponding to the "shipment completion", and then, calculates the number of elapsed days from the production completion to the shipment completion from the difference between the two dates as "15/9/10"−"15/8/2"="39 days".

[0078] The attribute value selection unit **111** acquires a record whose progress status field **1218** is "shipment complete" and a record whose progress status field **1218** is "delivery completed", and calculates the number of elapsed days from the shipment completion to the completion of delivery using the difference between the dates stored in the update date field **1219** of the acquired two records. For example, in the case of the project whose project number field **1211** is "1" in FIG. **2**, the attribute value selection unit **111** acquires "15/9/10" as the date corresponding to the "shipment completion" and acquires "15/9/20" as the date corresponding to the "delivery completed", and then, calculates the number of elapsed days from the shipment completion to the delivery completion using the difference between the two dates as "15/9/20"−"15/9/10"="10 days".

[0079] The attribute value selection unit **111** aggregates the number of times the date stored in the delivery date field **1217** of the past project information **121** is changed on a project basis, and calculates the number of times of changing the delivery date. For example, in the case of the project whose project number is "1" in FIG. **2**, the dates in the delivery date field **1217** is changed in three times as "15/7/30"→"15/8/30"→"15/9/5"→"15/9/30" on the project basis, the attribute value selection unit **111** calculates the number of times of changing the delivery date as three times.

[0080] Then, with regard to the date stored in the delivery date field **1217** in the past project information **121**, the attribute value selection unit **111** calculates the advanced or delayed days of the delivery date at the time of delivery to the customer compared to the delivery date registered at the time of ordering, and then, calculates the content of changing the delivery date. For example, in the case of the project whose project number field **1211** is "1" in FIG. **2**, the attribute value selection unit **111** reads a fact that the delivery date at the time of order reception is "15/7/30" and that the final delivery date is "15/9/30" from the delivery date field **1217**. The attribute value selection unit **111** calculates a fact that there is "62 day delay" from the fact that "15/7/30"−"15/9/30"="−62 days", as the content of changing the delivery date.

[0081] Next, the attribute value selection unit **111** stores each feature amount (number of elapsed days for each process) of the calculated log information of the past project information in the feature amount information **122**. Specifically, the attribute value selection unit **111** stores the project number in the project number field **1221**, stores the number of elapsed days from the order reception to the design completion in the number of elapsed days (from the order reception to the design completion) field **1222**, stores the number of elapsed days from the design completion to the production completion in the number of elapsed days (from the design completion to the production completion) field **1223**, stores the number of elapsed days from the production to the shipment in the number of elapsed days (from the production completion to the shipment completion) field **1224**, stores the number of elapsed days from the shipment to the delivery in the number of elapsed days (from the shipment completion to the delivery completion) field **1225**, stores the number of times of changing the delivery date in the number of times of changing the delivery date field **1226**, and stores the content of changing the delivery date in the content of changing the delivery date field **1227**. For example, in the case of the project whose project number is "1" in FIG. **2**, the attribute value selection unit **111** stores "1" in the project number field **1221**, stores "37 days" in the number of elapsed days (from the order reception to the design completion) field **1222**, stores "122 days" in the number of elapsed days (from the design completion to the production completion) field **1223**, stores "39 days" in the number of elapsed days (from the production completion to the shipment completion) field **1224**, stores "10 days" in the number of elapsed days (from the shipment completion to the delivery completion) field **1225**, stores "three times" in the number of times of changing the delivery date field **1226**, and stores "62 days delayed" in the content of changing the delivery date field **1227**.

[0082] Next, the attribute value selection unit **111** extracts the attribute value of the project correlated with each feature amount of the log information (STEP S**004**). Specifically, the attribute value selection unit **111** extracts the attribute value correlated with each feature amount (the number of elapsed days) of the log information of the past project information using the feature amount information **122**, and stores the extracted attribute values in the attribute value information **123**.

[0083] Hereinafter, an example of the processing for extracting the attribute values correlated with the number of elapsed days from the order reception to the design completion will be described in detail below. The attribute value selection unit **111** extracts the attribute values each correlated with the number of elapsed days from the design to the production completion, which is the feature amount of other log information of the past project, the number of elapsed days from the production completion to the shipment completion, the number of elapsed days from the shipment completion to the delivery completion, the number of times of changing the delivery date, and the content of changing the delivery date, through the similar processing.

[0084] There are several methods for extracting the correlated attribute values, and in this example, an example using correlation ratios commonly used in correlation analysis will be described. First, the attribute value selection unit **111** calculates the correlation ratio of each attribute value, and analyze the correlation between the number of elapsed days from the order reception to the design completion and each of the attribute values. By taking an example of the type industry among the attribute values, the method of calculating the correlation ratio will be described. First, in order to calculate the correlation ratio, the attribute value selection unit **111** calculates an average value of the numbers of elapsed days from the order reception to the design completion of all the records stored in the feature amount information **122**. In the example of the feature amount information **122** in FIG. **3**, the attribute value selection unit **111** calculates the average value of the numbers of elapsed days from the order reception to the design completion as (37 days+90 days+37 days++50 days)/100=70 days.

[0085] Next, the attribute value selection unit **111** reads the past project information **121**, groups each of the records in the feature amount information **122** into each type of industry such as "finance", "government agency", "medical care", and calculate an inter-class error and an intra-class error for each type of industry. Here, the inter-class error in the present embodiment is a square error of the average value of all the records and the average value of the records of each type of industry. In addition, the intra-class error in the present embodiment is a square sum error of the average value of the records of each type of industry and each of the records. FIG. **10** illustrates an example of the intra-class error and the inter-class error. FIG. **11** illustrates an example of the result of calculation of the intra-class error and the inter-class error for each type of industry.

[0086] FIG. **10** is a diagram illustrating an example in which the intra-class error and the inter-class error are visualized. In FIG. **10**, an average number of elapsed day graph **200** is illustrated. The average number of elapsed day graph **200** is a two-dimensional graph in which the type of industry is indicated on an X axis **201** and the number of elapsed days of the process is indicated on a Y axis **202**. The performance of the number of elapsed days of all processes, that is, the processes of all the projects are represented as the total record average number of elapsed days **205**, an error width between the average number of elapsed days of the type of industry and the average number of elapsed days **205** of all records is represented as the inter-class error **210**, and an error width between the average number of elapsed days of the project within the type of industry and the number of elapsed days of the individual project is represented as the intra-class error **220**.

[0087] FIG. **11** is a diagram illustrating an example of the result of calculation of intra-class error and the inter-class error. In FIG. **11**, an error example **250** is illustrated. The inter-class error of the type of industry "finance" is 100 and the intra-class error thereof is 200. In addition, the inter-class error of the type of industry "government agency" is 200, and the intra-class error thereof is 400. The inter-class error of the type of industry "medical care" is 50, and the intra-class error thereof is 300.

[0088] Then, the attribute value selection unit **111** calculates the correlation ratio using (sum of the intra-class errors of each type of industry)/(sum of the intra-class errors of each type of industry+sum of inter-class errors of each type of industry). In a case of the error example **250**, the attribute value selection unit **111** calculates the correlation ratio of the attribute value of the "type of industry" as (100+200+50)/(100+200+50+200+400+300)=0.28. The attribute value selection unit **111** also performs the processing for calculating the above correlation ratio for other attribute values. An example of the result of calculation of the correlation ratio of each attribute value is illustrated in FIG. **12**.

[0089] FIG. **12** is a diagram illustrating an example of the result of calculation of the correlation ratio. In FIG. **12**, as a correlation ratio example **260**, the attribute values are rearranged in a descending order of the correlation ratio. In the correlation ratio example **260**, the correlation ratio for each of the single attribute values are 0.28 for the attribute value "type of industry", 0.25 for the attribute value "contract amount", 0.21 for the attribute value "product type", and 0.15 for the attribute value "delivery area".

[0090] Subsequently, the attribute value selection unit **111** combines the attribute values in an order of large correlation ratio, and determine the number of attribute values to be used for the extraction. In the present embodiment, in order to consider the repeatability of the past trend, the idea of statistical confidence interval is applied. The attribute value selection unit **111** sequentially combines the attribute values in an order of a large correlation ratio and determines whether or not the confidence interval of the average value of the records grouped under the condition of the combined attribute value is equal to or higher than the designated allowance probability and falls within the allowance range. If the confidence interval is equal to or higher than the designated allowance probability and falls within the allowance range, the attribute value selection unit **111** further evaluates the confidence interval by combining the attribute values, and if not falls within the allowance range, ends the processing for evaluating the combination of the attribute values, and then, determines the combination of the attribute values that finally falls within the allowance range as the number of attribute values.

[0091] For the allowance range of the confidence interval and the allowance probability used in this processing, the information stored in the allowance range field **1264** and the allowance probability field **1265** in the set information **126**, are respectively used. In a case of the set information **126** illustrated in FIG. **7**, the attribute value selection unit **111** performs the processing with the allowance range as "within 30 days" and allowance probability as "95%".

[0092] FIG. **13** is a diagram illustrating an example of the result of calculation of the probability for determining the combination of the attribute values to be extracted. In FIG. **13**, the probability (repeatability) that the confidence interval falls within the allowance range is illustrated in the case of combining the attribute values in an order of the large correlation ratio illustrated in FIG. **12**. When the set condition illustrated in FIG. **7** is used, if the allowance probability that falls within the allowance range of the confidence interval is set to "equal to or higher than 95%", since the repeatability of the combination of attribute values "type of industry, contract amount, and product type" is "90%", it can be said that the repeatability is lower than the allowance probability. In this case, the attribute value selection unit **111** determines "type of industry, contract amount" that falls within allowance probability (95% or more) as a combination of attribute values to be extracted. The attribute value selection unit **111** stores the "type of industry and contract

amount" which is the result of extraction in the number of elapsed days (from the order reception to the design completion) field **1221** of the attribute value information **123**.

[0093] The evaluation method based on the correlation ratio and the confidence interval is illustrated in the present embodiment, however, the extraction of the attribute value is not limited to this method, and other methods may be used.

[0094] The attribute value selection unit **111** extracts the correlated attribute values through the similar processing for each of the number of elapsed days from the design completion to the production completion, the number of elapsed days from the production completion to the shipment completion, the number of elapsed days from the shipment completion to the delivery completion, the number of times of changing the delivery date, and the content of changing the delivery date, and respectively stores the combination of each attribute values in the number of elapsed days (from the design completion to the production completion) field **1232**, in the number of elapsed days (from the production completion to the shipment completion) field **1233**, in the number of elapsed days (from the shipment completion to the delivery completion) field **1234**, in the number of times of changing the delivery date field **1235**, and in the content of changing the delivery date field **1236** of the attribute value information **123**.

[0095] Subsequently, the past project extraction unit **112** and the progress prediction unit **113** repeatedly performs the processing items in STEPs S**006** and S**007** on each of the prediction target projects stored in the ordered project information **124** (STEP S**005** and STEP S**008**)

[0096] The past project extraction unit **112** generates a trend for each feature amount of the log information (STEP S**006**). Specifically, the past project extraction unit **112** extracts the past project (delivery completed project) whose log information is similar to that of the prediction target project stored in the ordered project information **124** to be predicted, by comparing with the past project information **121** and the feature amount information **122**, and generates a probability distribution (trend) of lead time (hereinafter referred to as LT) up to the non-completed process of the prediction target project for each feature amount (for each process) of the log information.

[0097] For example, the past project extraction unit **112** calculates each feature amount of the log information of the prediction target project from ordered project information **124** through the processing similar to STEP S**003**. However, since the all processes up to the delivery are not completed, in the prediction target project, the feature amounts of a part of the processes cannot be calculated among feature amounts of the number of elapsed days from the order reception to the design completion, the number of elapsed days from the design completion to the production completion, the number of elapsed days from the production completion to the shipment completion, and the number of elapsed days from the shipment completion to the delivery completion. Therefore, the past project extraction unit **112** calculates the feature amount including only the process currently completed through the process same as in STEP S**003**, and for the feature amount including the process next to the process currently completed, the number of elapsed days is temporally calculated based on the difference between the prediction establishment date and the update date of the completed process. The feature amount including the process one after next to the process currently completed is not calculated.

[0098] In a case of the project of which the project number field **1241** illustrated in FIG. **5** is "a", the production process is currently completed. Therefore, the past project extraction unit **112** calculates the number of elapsed days from the order reception to the design completion and the number of elapsed days from the design completion to the production completion through the same processing similar to STEP S**003**, and the results of the calculation of the numbers of elapsed days are "17/3/10"−"17/2/1"="37 days" and "17/4/20"−"17/3/10'="41 days". In addition, the past project extraction unit **112** calculates the number of elapsed days from the production completion to the shipment completion based on the difference between the prediction establishment date and the update date of production completion. In FIG. **5**, since the prediction establishment date of the data is "15/5/1", the past project extraction unit **112** calculates the number of elapsed days from the production completion to the shipment completion as "17/5/1"−"'17/4/20"="11 days". The past project extraction unit **112** does not calculate the feature amount for the number of elapsed days from the shipment completion to the delivery completion including the process "delivery" that is one after next to the "production" which is currently completed.

[0099] The past project extraction unit **112** performs the processing similar to STEP S**003** for the number of times of changing the delivery date and the content of changing the delivery date. In a case of the project of which the project number **1241** illustrated in FIG. **5** is "a", the number of times of changing the delivery date is calculated as "1", and the content of changing the delivery date is calculated as "31 days advanced" from "17/6/30"−"17/5/30"="31".

[0100] Next, the past project extraction unit **112** extracts the past project whose attribute value is similar to the log information of the prediction target project calculated above from each feature amount of the log information, and calculates the probability distribution of the LT up to the non-completed process of the prediction target project. However, the past project extraction unit **112** does not extract the past project for the feature amount not calculated in the log information of the above prediction target project.

[0101] In the example in FIG. **5**, in a case of the project of which the project number **1241** is "a", since the project is in a state in which the production is completed and the shipment is not completed, the past project extraction unit **112** does not calculate the number of elapsed days from shipment completion to the delivery completion. For this reason, for the past project similar to the prediction target project, the extraction processing is not performed for this feature amount.

[0102] Hereinafter, the content of processing by the past project extraction unit **112** will be described by taking the number of elapsed days from the order reception to the design completion among the feature amounts of the log information as an example. Through the similar processing, the past project extraction unit **112** extracts the past project similar to the prediction target project in each of the number of elapsed days from the design completion to the production completion, the number of elapsed days from the production completion to the shipment completion, the number of elapsed days from the shipment completion to the delivery completion, the number of times of changing the

delivery date, and the content of changing the delivery date, and generates the probability distribution of the LT up to non-completed process.

[0103] First, the past project extraction unit **112** extracts the past project of which the number of elapsed days from the order reception to the design is same as that of the prediction target project or similar to that in a certain degree (for example, an error of approximately 10% is allowed or the allowance range of the error is designated by the user) from the feature amount information **122**. For example, in a case of the project of which the project number **1241** illustrated in FIG. **5** is "a", since the number of elapsed days from the order reception to the design completion is 37 days, the past project extraction unit **112** extracts the past project of which the number of elapsed days (from the order reception to the design completion) field **1222** is 37 days or 33 to 41 days from the feature amount information **122**. In a case of the feature amount information **122** illustrated in FIG. **3**, the past project extraction unit **112** extracts the past project (project number "1" and "3") of which the number of elapsed days (from the order reception to the design completion) field **1222** is 37 days.

[0104] Next, the past project extraction unit **112** extracts a past project of which the attribute value matches that of the prediction target project from the extracted past project based on the attribute value stored in the attribute value information **123**. For the number of elapsed days from the order reception to the design completion, the past project extraction unit **112** extracts the past project of which the attribute value stored in the number of elapsed days (from the order reception to the design completion) field **1231** of the attribute value information **123** is similar to that of the prediction target project. For example, in the example in FIG. **3**, the past project extraction unit **112** extracts the past project whose contents of the "type of industry" and the "contract amount" match that of the prediction target project or similar to that in a certain degree (for example, the digit of the amount in the contract amount matches each other or the allowance range of the error is designated by the user).

[0105] For example, among the order reception projects in FIG. **5**, in a case of the project of which the project number **1241** is "a", since the type of industry is "finance" and the contract amount is "10M yen", the project extraction unit **112** extracts the past project whose type of industry is "finance" and the contract amount is similar to "10M yen" from the previously extracted past project. If there are past projects whose project number is "1", "2", or 3, the past project extraction unit **112** extracts the past project whose project number is "1" as a similar project.

[0106] The past project extraction unit **112** generates the probability distribution of the LT of the non-completed process excluding the process currently completed based on the extracted past project. In a case of the project of which the project number **1241** illustrated in the example in FIG. **5** is "a", since the non-completed processes are the "shipment" and the "delivery", using the extracted past project, the probability distribution of LT from the production completion to the shipment completion and the probability distribution of the LT from the shipment completion to the delivery completion are generated. The past project extraction unit **112** generates the probability distribution of the LT from the production completion to the shipment completion using the number of elapsed days from the production completion to the shipment completion of the extracted past project, and generates the probability distribution of the LT from the shipment completion to the delivery completion using the number of elapsed days from the shipment completion to the delivery completion of the extracted past project.

[0107] The past project extraction unit **112** performs the processing performed on the number of elapsed days from the order reception to the design completion also on each of the number of elapsed days from the design completion to the production completion, the number of elapsed days from the production completion to the shipment completion, the number of elapsed days from the shipment completion to the delivery completion, the number of times of changing the delivery date, the content of changing the delivery date. However, if the project number **1241** of a project illustrated in FIG. **5** is "a", since only the production is completed, the past project extraction unit **112** does not calculate the LT for the number of elapsed days from the shipment completion to the delivery completion. In FIG. **14**, for the project of which the project number **1241** is "a" in the example in FIG. **5**, the probability distributions of the LT up to the non-completed process that is generated for each feature amount of the log information by the past project extraction unit **112** are illustrated.

[0108] FIG. **14** is a diagram illustrating an example of trends for each feature amount of the log information. In FIG. **14**, the probability distribution of the LT of non-completed process from the production to the shipment and the probability distribution of the LT of non-completed process from the shipment to the delivery are illustrated. Each probability distribution is the result of calculating the LT probability distribution of non-completed process based on the feature amount of the process of interest among the feature amounts of multiple processes of the past similar project. In the present embodiment, the probability distribution is represented by a two-dimensional graph with the LT on the X axis **301** and the probability on the Y axis **302**.

[0109] Next, the progress prediction unit **113** predicts the required completion date for each process (STEP **S007**). Specifically, the progress prediction unit **113** predicts the required completion date for each process of the prediction target project by combining the trend (probability distribution of the LT) for each feature amount of the log information generated by the past project extraction unit **112** in STEP **S006**. In this processing, first, the progress prediction unit **113** predicts the probability distribution of each of the LTs of the non-completed process of the final prediction target project the as the completion date by combining the trends for each feature amount of the log information generated by the past project extraction unit **112** in STEP **S006**. In the present embodiment, the trends for each feature amount of the log information is combined using the Bayesian estimation that is often used in statistics. However, the present invention is not limited thereto, and other methods may be used. FIG. **15** illustrates an example of the result of deriving the probability distribution of the LT from the production to the shipment based on the compound feature amount in which the trends for each feature amount of the log information illustrated in FIG. **14** are combined.

[0110] FIG. **15** is a diagram illustrating an example of the result of combination of the trends for each feature amount of the log information. On the left side of an arrow in FIG. **15**, the results of estimation of the probability distribution of the LT from the production completion to the shipment

completion based on each feature amount are illustrated. By integrating the results by the Bayesian estimation, the result of estimation of the integrated LT probability distribution is obtained on the right side of the arrow.

[0111] The progress prediction unit **113** predicts the required completion date of the non-completed process based on the probability distribution of the LT derived by the Bayesian estimation. To that end, the progress prediction unit **113** calculates an average value of the probability distribution of the LT, and calculates the required completion date of the non-completed process by adding the calculated average value to the update date of the currently completed process. In the present embodiment, the average value of the probability distribution of LT is added to the update date of the currently completed process, but the number of days calculated by statistical sampling such as the Monte Carlo method may be added.

[0112] In the example in FIG. **5**, in a case of the project of which the project number **1241** is "a", it is assumed that the progress prediction unit **113** calculates the average value of LT from the production completion to the shipment completion as 15 days, and calculates the average value of LT from the shipment completion to the delivery completion as 15 days. In addition, in FIG. **5**, since the date on which the production is completed is "17/4/20", the progress prediction unit **113** calculates the required completion date of the shipment as "17/4/20"+15 (day)="17/5/5", and calculates the required completion date of the delivery as "17/4/20"+15 (day)+15 (day)="17/5/20".

[0113] The progress prediction unit **113** stores the required completion date of the predicted non-completed process in the required completion date information **125** together with the process information. In FIG. **5**, in a case of the project of which the project number **1241** is "a", when storing the required completion date of shipment, the progress prediction unit **113** stores "a" in the project number field **1251**, "shipment completion" in the process field **1252**, and "17/5/5" in the required completion date field **1253**.

[0114] The output generation unit **115** generates an output screen **1400** indicating result of prediction of the required completion date for each process of the prediction target project based on the ordered project information **124** and the required completion date information **125**, and transmits the output screen **1400** to the user terminal **103** via the network **102** to display the screen (STEP S**009**). The above-described is the flow of the project progress prediction processing. FIG. **16** illustrates an example of the output screen **1400**.

[0115] FIG. **16** is a diagram illustrating an example of the output screen. In FIG. **16**, an example of the output screen **1400** is illustrated. In the output screen **1400**, the prediction establishment date field **1401**, the project number field **1402**, the customer field **1403**, the attribute value field **1404**, the delivery date field **1405**, the process field **1406**, a date field **1407**, a completion mark **1408**, a first LT probability distribution graph **1409** and a second LT probability distribution graph **1410**.

[0116] In the prediction establishment date field **1401**, the information on the prediction establishment date designated by the user is displayed. In the project number field **1402**, the project number of the prediction target project is displayed. In the customer field **1403**, the customer name of the prediction target project is displayed. In the attribute value field **1404**, the attribute value of the prediction target project is displayed. In the delivery date field **1405**, the delivery date of the prediction target project is displayed. In the process field **1406**, the target process is displayed. In the date field **1407**, the date is displayed. For each process, the completion mark **1408**, or the first LT probability distribution graph **1409** and the second LT probability distribution graph **1410** is displayed.

[0117] The completion mark **1408** is provided at the position of the date corresponding to the completion date of the completed process. The first LT probability distribution graph **1409** is provided at the position of the date corresponding to the completion date of the process next to the completed process, that is, the process in progress, with the date on the horizontal axis and the probability on the vertical axis. The second LT probability distribution graph **1410** is provided at the position of the date corresponding to the completion date of the process one after next to the completed process, that is, the process not started yet, with the date on the horizontal axis and the probability on the vertical axis.

[0118] The above-described is the project progress prediction system according to the embodiment of the present invention. According to the project progress prediction system, it is possible to predict the required completion date of the product for each process with high accuracy, of which the registration information including the delivery date of the project changes frequently.

[0119] The project progress prediction device and the project progress prediction system according to the embodiment of the present invention generate the trend for each feature amount of the log information and predict a required completion date for each process by combining the trends for each feature amount. In this way, it becomes possible to predict the required completion date for each process with high accuracy, which is not possible in the related art.

REFERENCE SIGNS LIST

[0120] **100** project progress prediction system
[0121] **101** project progress prediction device
[0122] **102** network
[0123] **103** user terminal
[0124] **104** database
[0125] **110** calculation unit
[0126] **111** attribute value selection unit
[0127] **112** past project extraction unit
[0128] **113** progress prediction unit
[0129] **114** input receiving unit
[0130] **115** output generation unit
[0131] **120** storage unit
[0132] **121** past project information
[0133] **122** feature amount information
[0134] **123** attribute value information
[0135] **124** ordered project information
[0136] **125** required completion date information
[0137] **126** set information
[0138] **130** communication unit
[0139] **1400** output screen

1. A project progress prediction device comprising:

a storage unit that stores log information which is a change history of an attribute value of a project and a feature amount of a delivery date including the number of elapsed days for each process;

an attribute value selection unit that selects an attribute value having a predetermined correlation with the delivery date of the project using the log information;

a past project extraction unit that extracts a completed project having the attribute value similar to that of a prediction target project from the storage unit using the selected attribute value, and estimates a lead time for each of the feature amounts for non-completed processes of the prediction target project using the feature amount of the delivery date of the extracted completed project; and

a progress prediction unit that integrates the estimated lead times between the feature amounts and predicts a probability of a required completion date for each process of the prediction target project.

2. The project progress prediction device according to claim **1**,

wherein the attribute value selection unit extracts the feature amount relating to at least the number of elapsed days for each process of the project from the log information, and estimates a lead time which is based on the number of elapsed days for each of the non-completed processes of the prediction target project.

3. The project progress prediction device according to claim **1**,

wherein the attribute value selection unit extracts the feature amounts relating to at least the number of elapsed days for each process of the project and the number of times of changing the delivery date from the log information, and estimates a lead time which is based on the number of elapsed days for each process and a lead time which is based on the number of times of changing the delivery date, for each of the non-completed processes of the prediction target project.

4. The project progress prediction device according to claim **1**,

wherein, in selecting the attribute value having a predetermined correlation with the delivery date of the project, the attribute value selection unit selects a combination of the attribute values such that the delivery date has a correlation equal to or greater than a predetermined value with regard to a plurality of combinations of the attribute values and a repeatability satisfies a predetermined criterion.

5. The project progress prediction device according to claim **1**,

wherein, in selecting the attribute value having a predetermined correlation with the delivery date of the project, the attribute value selection unit selects a combination of the attribute values such that the correlation of the attribute value using an inter-class error and an intra-class error with the delivery date is equal to or greater than a predetermined value for a plurality of combinations of the attribute values and a confidence interval satisfies a predetermined criterion when the attribute values are combined in an order of high correlation.

6. The project progress prediction device according to claim **1**,

wherein, in processing for integrating the estimated lead times between the feature amounts, the progress prediction unit integrates the estimated lead times between the feature amounts using the Bayesian estimation and predicts a probability of the required completion date.

7. The project progress prediction device according to claim **1**, further comprising:

an output generation unit that generates a completion date of the completed processes of the prediction target project, and a probability of the required completion date of the non-completed processes estimated by the progress prediction unit, as an output.

8. A project progress prediction system comprising:

a storage unit that stores log information which is a change history of an attribute value of a project and a feature amount of a delivery date including the number of elapsed days for each process;

an attribute value selection unit that selects an attribute value having a predetermined correlation with the delivery date of the project using the log information;

a past project extraction unit that extracts a completed project having the attribute value similar to that of a prediction target project from the storage unit using the selected attribute value, and estimates a lead time for each of the feature amounts for non-completed processes of the prediction target project using the feature amount of the delivery date of the extracted completed project; and

a progress prediction unit that integrates the estimated lead times between the feature amounts and predicts a probability of a required completion date for each process of the prediction target project.

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