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(54) **IMPROVING CUSTOMER NET SATISFACTION SCORE ON DELIVERY USING MACHINE LEARNING**

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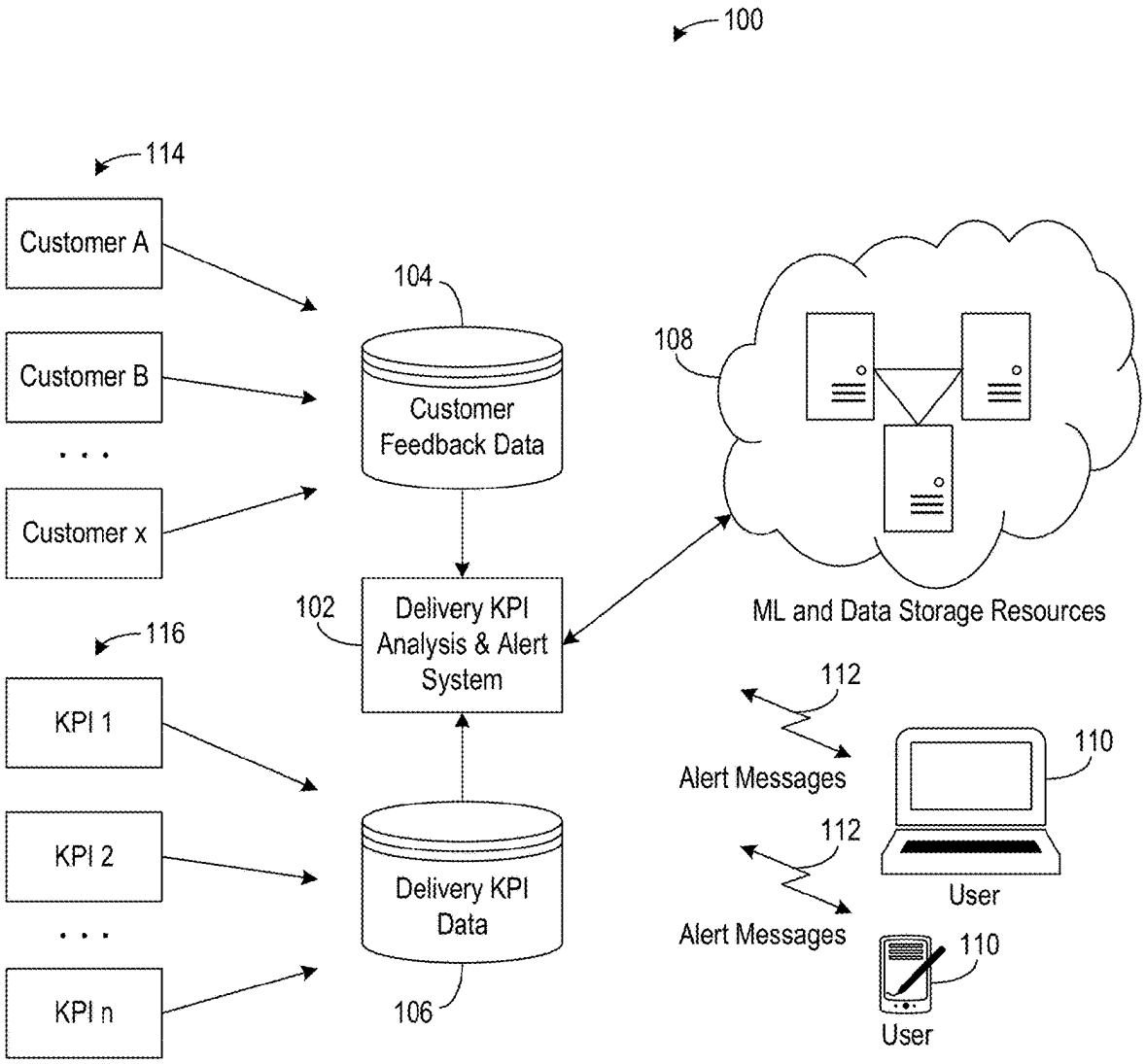
CPC ***G06Q 30/0203*** (2013.01); ***G06Q 30/01*** (2013.01)

(57) **ABSTRACT**

Systems/methods for deriving insight from delivery KPI data uses machine learning to improve customer NSSoD. The systems/methods group customers into clusters based on their delivery experience, then correlates the NSSoD from customers in a cluster with their delivery related KPIs to identify high impacting KPIs for a customer. The delivery related KPIs may be a predefined set of KPIs selected as needed for a particular application. The systems/methods generate a customer specific KPI score based on KPI data for the most recent month for the customer and historical KPI data over the past 12 months for the entire cluster for the predefined set of KPIs. The use of historical KPI data provides a larger set of data on which to perform analysis, thereby offering more accurate insight. The above approach allows companies to focus on specific delivery KPIs within a cluster that are likely to increase the NSSoD.



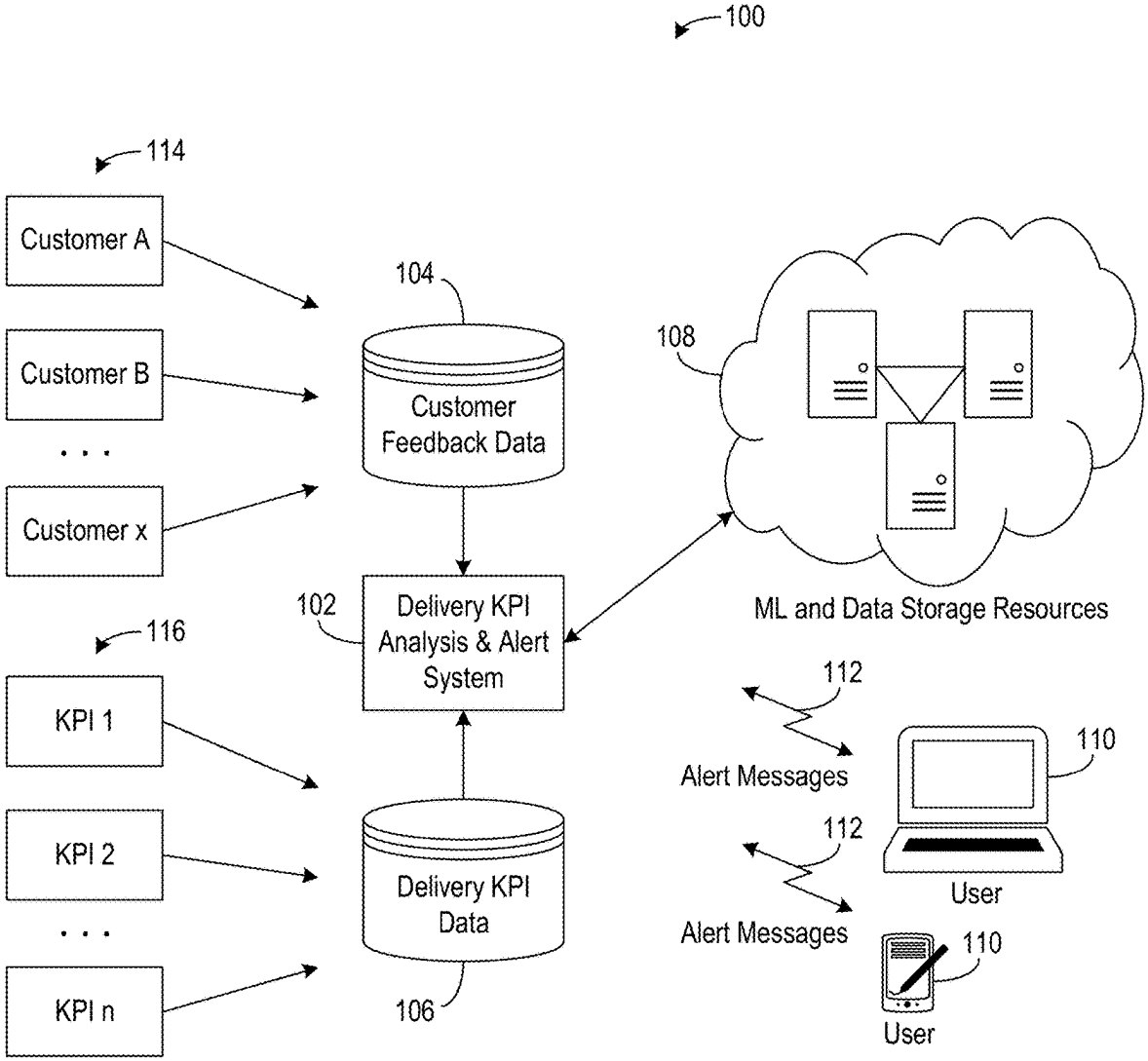

100
114
Customer A
Customer B
Customer x
104
Customer Feedback Data
108
ML and Data Storage Resources
102
Delivery KPI Analysis & Alert System
116
KPI 1
KPI 2
KPI n
Delivery KPI Data
106
112
Alert Messages
110
User
112
Alert Messages
110
User

FIG. 1

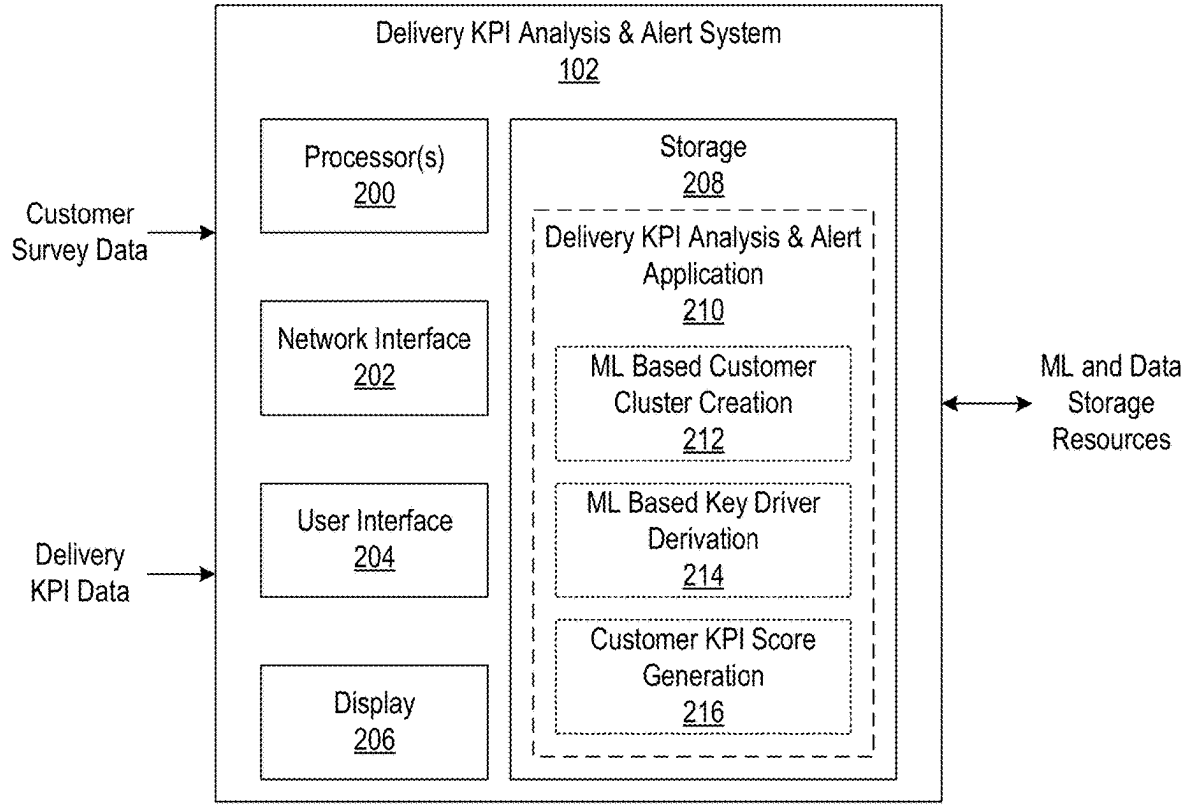

Delivery KPI Analysis & Alert System
102
Processor(s)
200
Storage
208
Delivery KPI Analysis & Alert Application
210
ML Based Customer Cluster Creation
212
ML Based Key Driver Derivation
214
Customer KPI Score Generation
216
Network Interface
202
User Interface
204
Display
206
Customer Survey Data
Delivery KPI Data
ML and Data Storage Resources

FIG. 2

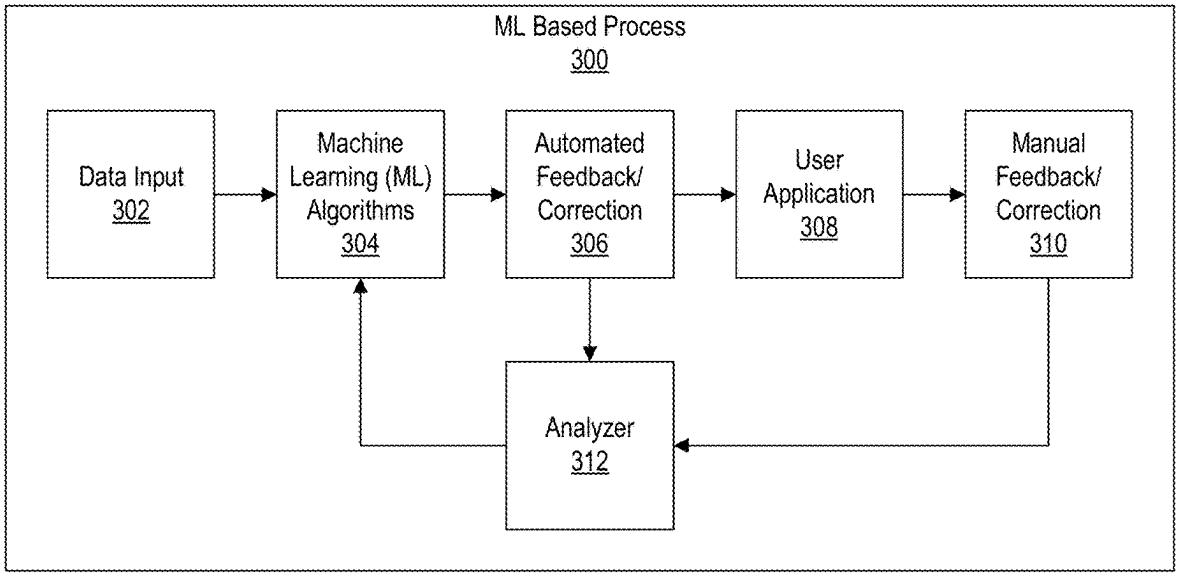

ML Based Process
300
Data Input
302
Machine Learning (ML) Algorithms
304
Automated Feedback/ Correction
306
User Application
308
Manual Feedback/ Correction
310
Analyzer
312

FIG. 3

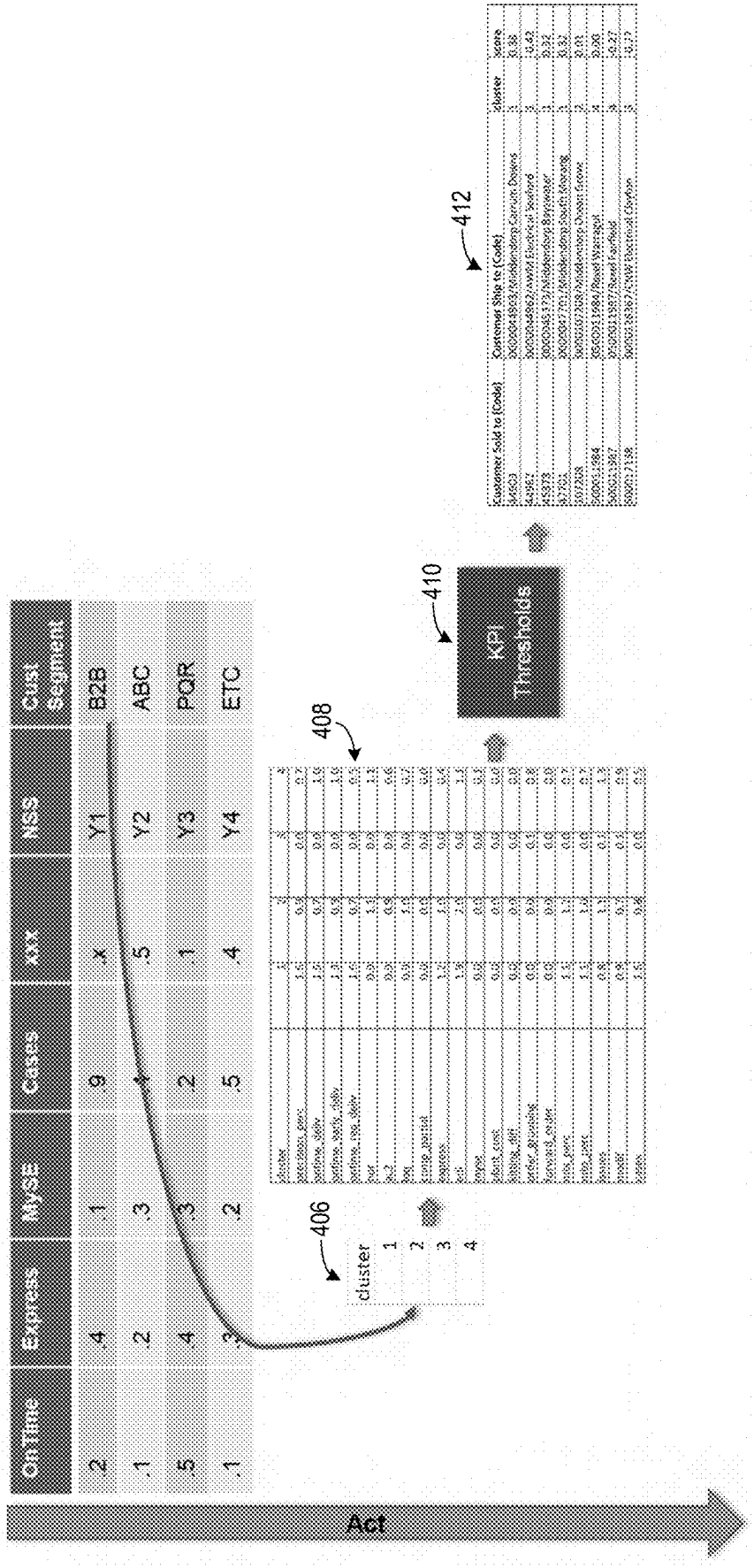

400
402
404
406
408
410
412
OnTime
Express
MySE
Cases
***
NSS
Cust Segment
Y1
Y2
Y3
Y4
B2B
ABC
POR
ETC
cluster
KPI Thresholds
Act

FIG. 4

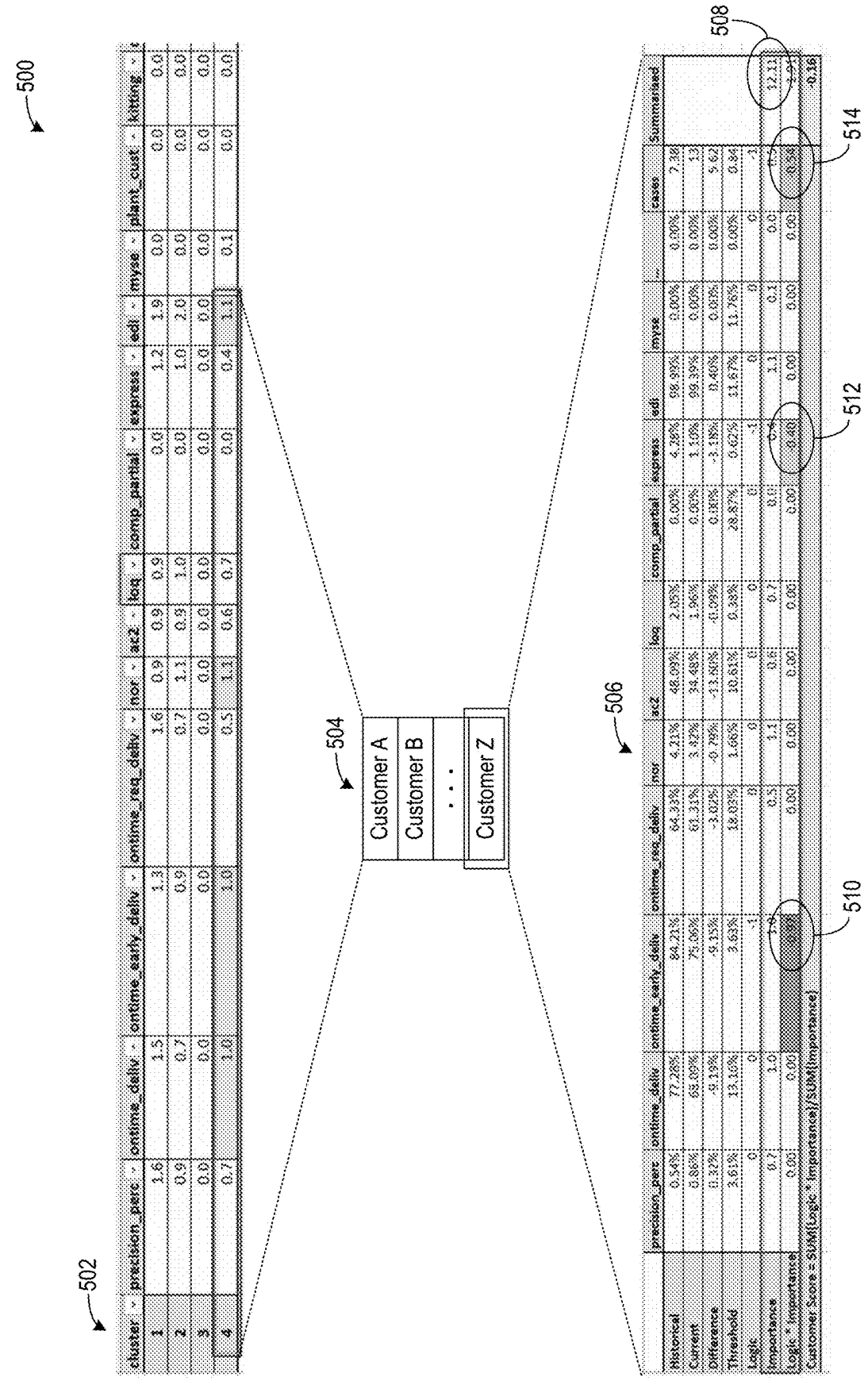

500
502
cluster
precision_perc
ontime_daily
ontime_early_daily
ontime_req_daily
hor
ac2
loq
comp_partial
express
edi
myse
plant_cust
kitting
1
2
3
4
504
Customer A
Customer B
. . .
Customer Z
506
precision_perc
ontime_daily
ontime_early_daily
ontime_req_daily
hor
ac2
loq
comp_partial
express
edi
myse
...
cases
Summarized
Historical
Current
Difference
Threshold
Logic
Importance
Logic * Importance
Customer Score = SUM(Logic * Importance)/SUM(Importance)
508
510
512
514

FIG. 5

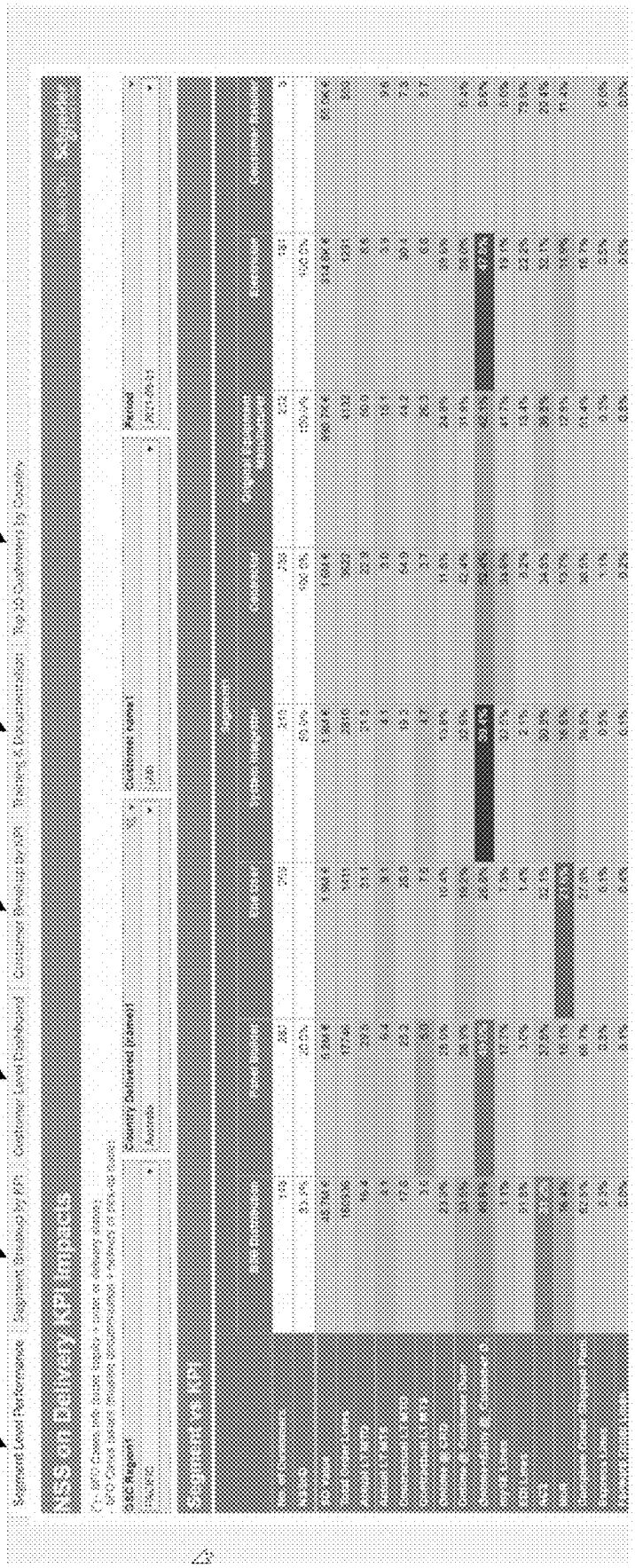


FIG. 6

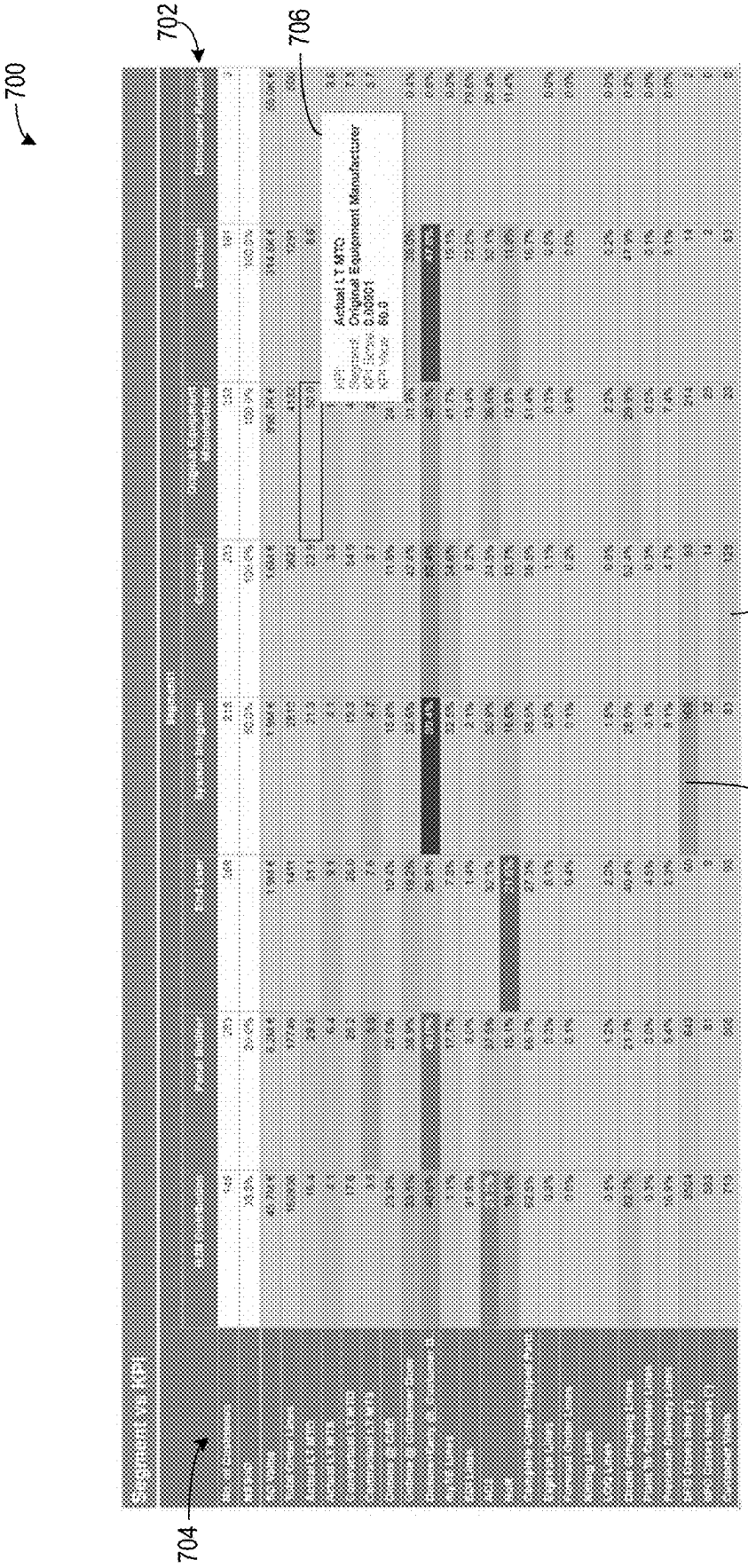


FIG. 7

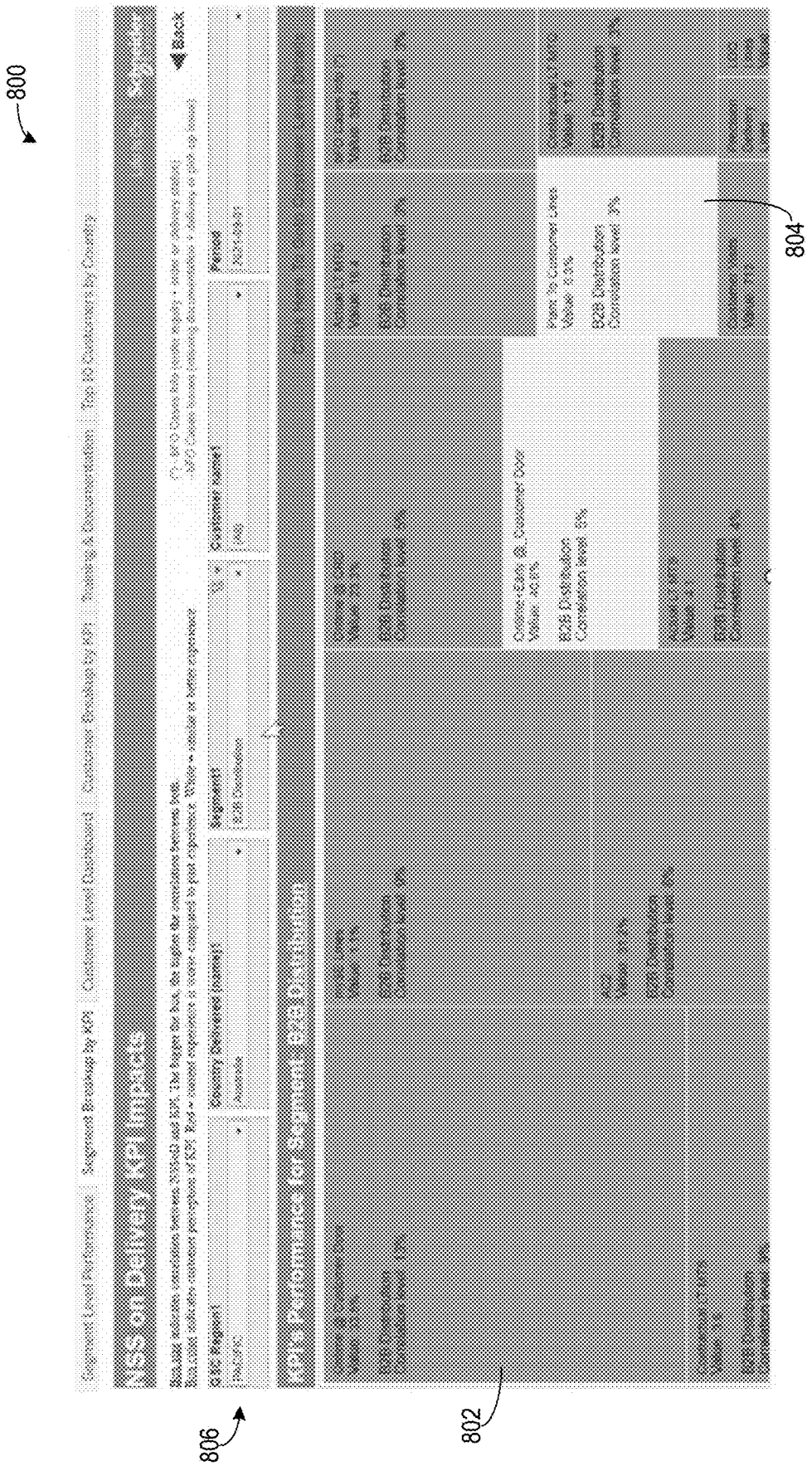


FIG. 8

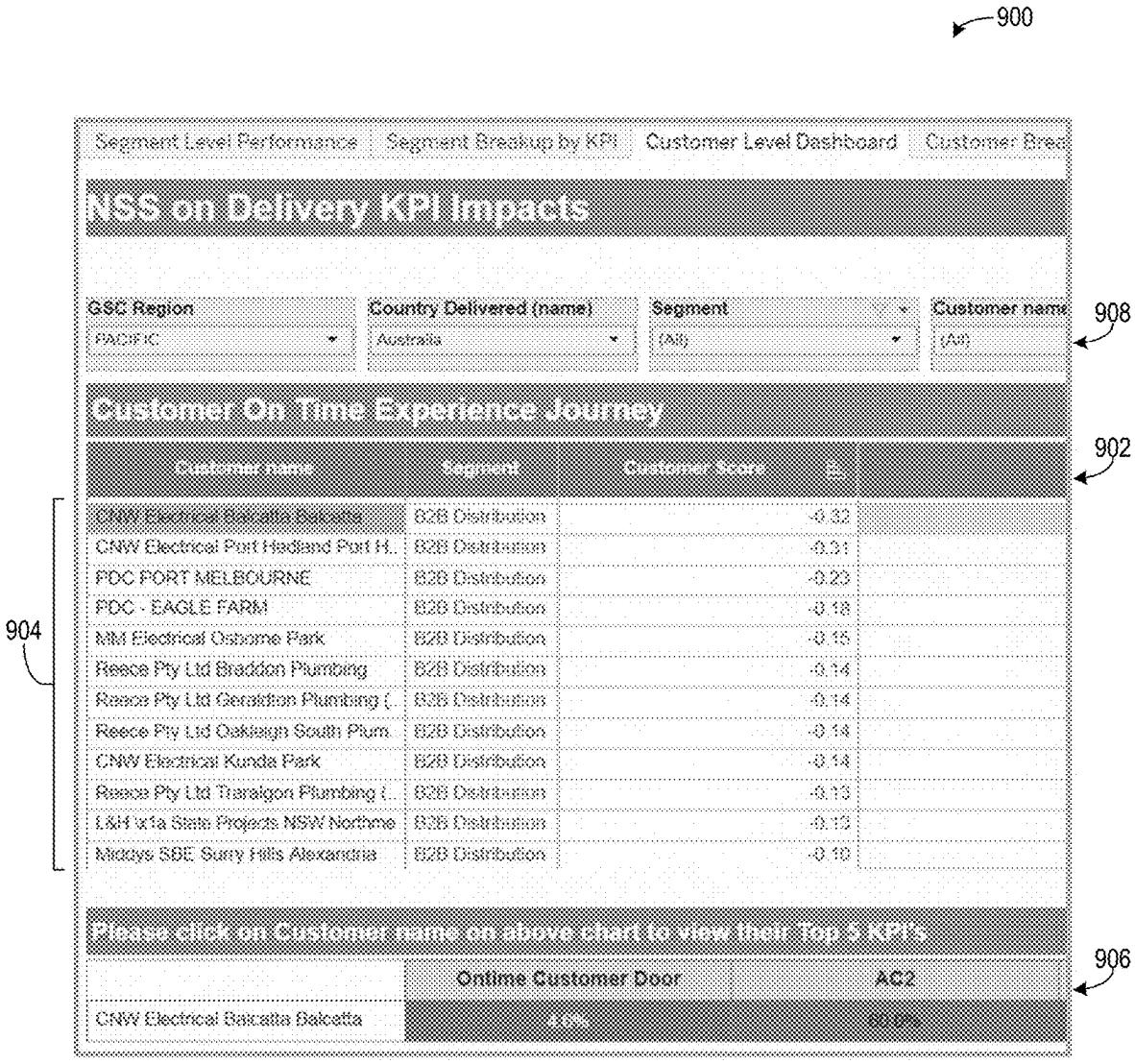

900
Segment Level Performance
Segment Breakup by KPI
Customer Level Dashboard
Customer Brec
NSS on Delivery KPI Impacts
GSC Region
PACIFIC
Country Delivered (name)
Australia
Segment
(All)
Customer name
(All)
908
Customer On Time Experience Journey
902
Customer Name
Segment
Customer Score
CNW Electrical Balcatta Balcatta
B2B Distribution
-0.32
CNW Electrical Port Hedland Port H..
B2B Distribution
-0.31
PDC PORT MELBOURNE
B2B Distribution
-0.23
PDC - EAGLE FARM
B2B Distribution
-0.18
MM Electrical Osborne Park
B2B Distribution
-0.15
Reece Pty Ltd Braddon Plumbing
B2B Distribution
-0.14
Reece Pty Ltd Geraldton Plumbing (..
B2B Distribution
-0.14
Reece Pty Ltd Oakleigh South Plum..
B2B Distribution
-0.14
CNW Electrical Kunda Park
B2B Distribution
-0.14
Reece Pty Ltd Traralgon Plumbing (..
B2B Distribution
-0.13
L&H \x1a State Projects NSW Northme..
B2B Distribution
-0.13
Middys SBE Surry Hills Alexandria
B2B Distribution
-0.10
904
Please click on Customer name on above chart to view their Top 5 KPIs
906
Ontime Customer Door
AC2
CNW Electrical Balcatta Balcatta

FIG. 9

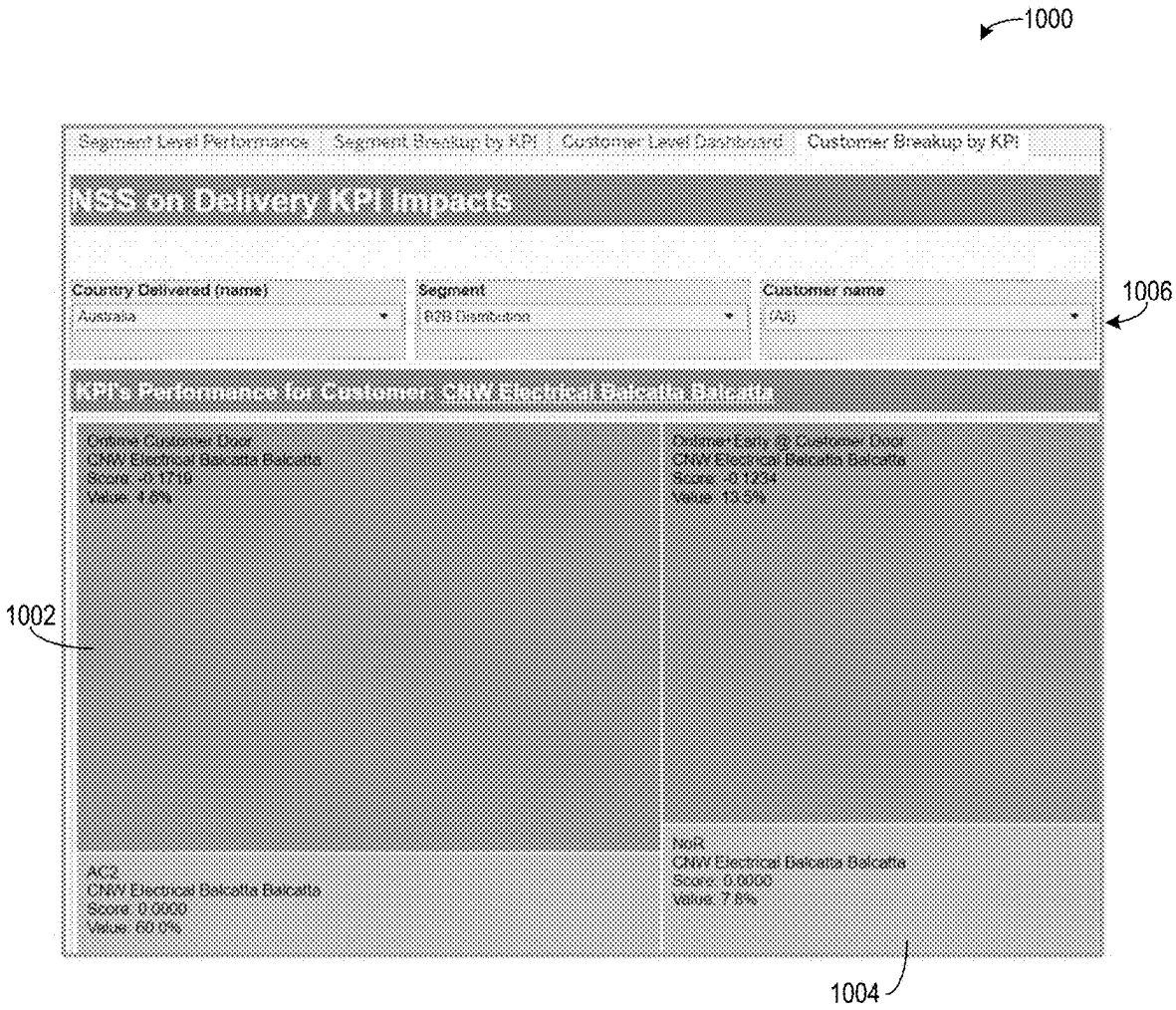

1000
Segment Level Performance
Segment Breakup by KPI
Customer Level Dashboard
Customer Breakup by KPI
NSS on Delivery KPI Impacts
Country Delivered (name)
Australia
Segment
B2B Distribution
Customer name
(All)
1006
KPI's Performance for Customer: CMW Electrical Balcatta Balcatta
1002
1004

FIG. 10

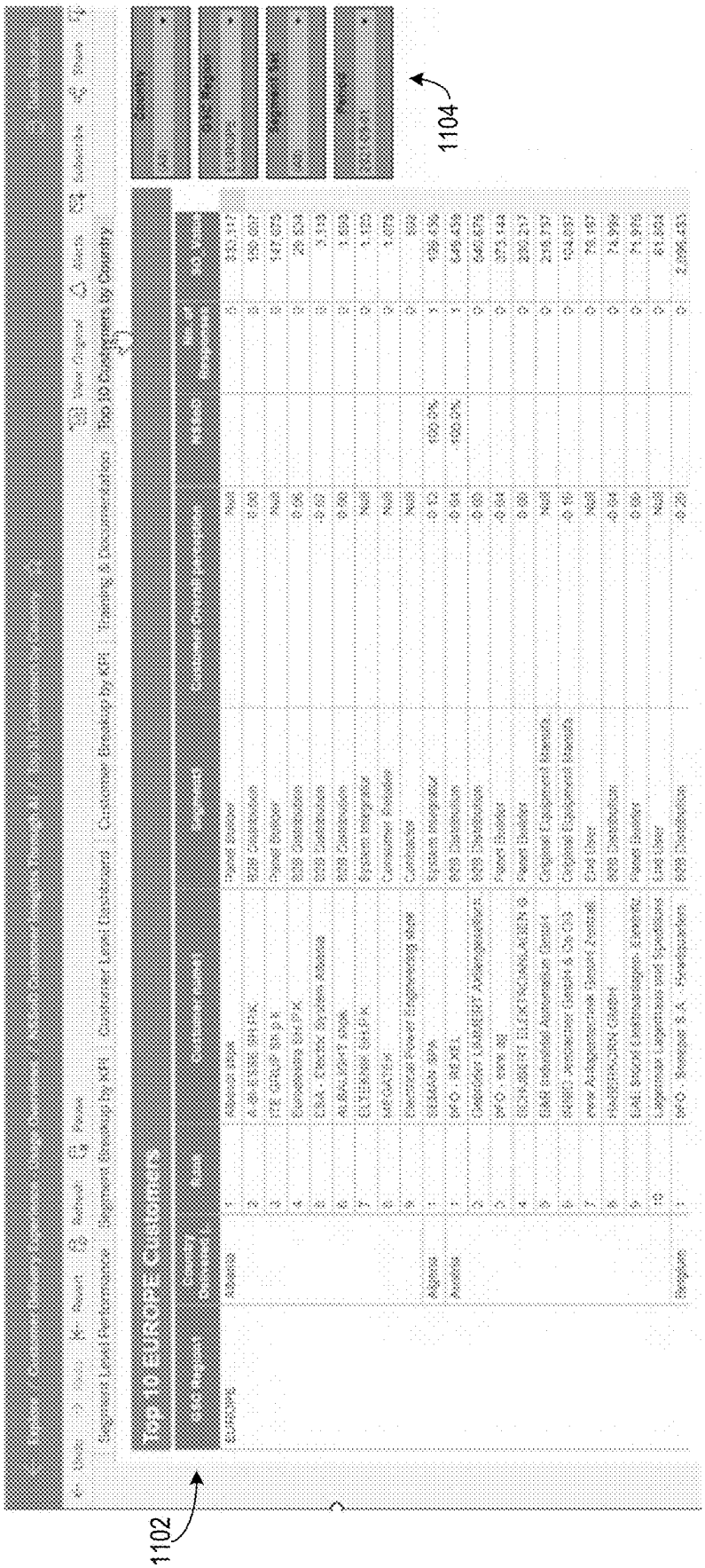


FIG. 11

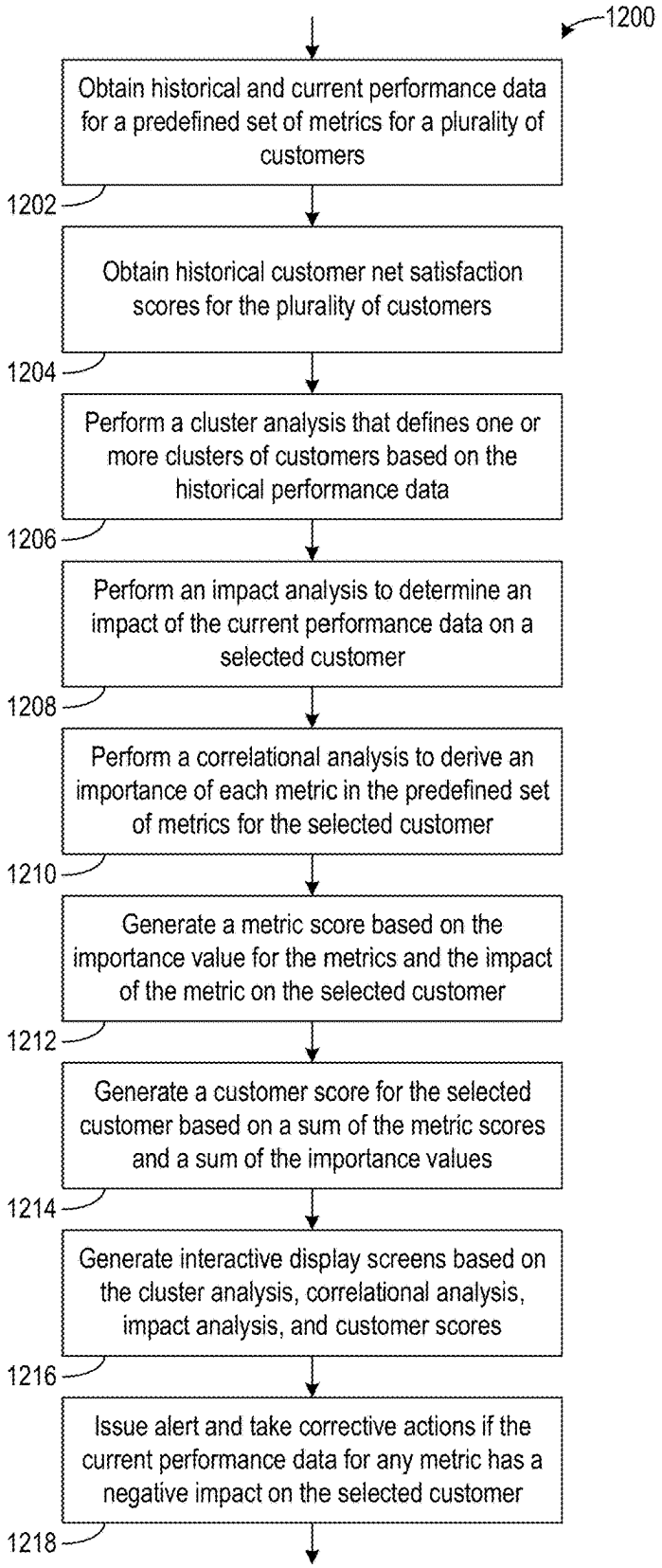

1200
Obtain historical and current performance data for a predefined set of metrics for a plurality of customers
1202
Obtain historical customer net satisfaction scores for the plurality of customers
1204
Perform a cluster analysis that defines one or more clusters of customers based on the historical performance data
1206
Perform an impact analysis to determine an impact of the current performance data on a selected customer
1208
Perform a correlational analysis to derive an importance of each metric in the predefined set of metrics for the selected customer
1210
Generate a metric score based on the importance value for the metrics and the impact of the metric on the selected customer
1212
Generate a customer score for the selected customer based on a sum of the metric scores and a sum of the importance values
1214
Generate interactive display screens based on the cluster analysis, correlational analysis, impact analysis, and customer scores
1216
Issue alert and take corrective actions if the current performance data for any metric has a negative impact on the selected customer
1218

FIG. 12

IMPROVING CUSTOMER NET SATISFACTION SCORE ON DELIVERY USING MACHINE LEARNING

TECHNICAL FIELD

[0001] The present disclosure relates to techniques for improving customer satisfaction through the use machine learning, and particularly to systems and methods that use machine learning to derive insight from key performance indicators (KPI) for improving customer Net Satisfaction Score on Delivery (NSSoD).

BACKGROUND

[0002] Net Satisfaction Score on Delivery (NSSoD) is a metric often used by companies to measure customer satisfaction with the delivery of a product or service by the companies. This customer satisfaction metric can serve as a useful tool for companies to identify areas in their delivery process that can be improved to enhance customer satisfaction. One way to calculate the NSSoD for a company is through a survey wherein customers rate their experience with a particular delivery by that company on a scale of 0 to 10, with 0 indicating dissatisfied and 10 indicating satisfied. The NSSoD for the company can then be found by taking an average of the customer ratings.

[0003] The above approach, however, lumps all customers together and fails to account for the preferences of different types of customers. As customer experience forms the basis of any company's success, it is imperative that companies understand why a given customer is happy or unhappy with a given delivery experience. In particularly, companies need to be aware how changes in their internal delivery related KPIs, such as time of delivery, quantity delivered, and so on, may affect various customer perceptions. For example, a business-to-business (B2B) customer may be more concerned about customer support for a product compared to, say, on-time delivery of the product.

[0004] Accordingly, while progress has been made in the area of customer satisfaction, improvements are continually needed.

SUMMARY

[0005] Embodiments of the present disclosure provide systems and methods for deriving insight from delivery KPI data using machine learning (ML) to improve customer NSSoD. The systems and methods begin by grouping customers into clusters based on their delivery experience, then correlating the NSSoD provided by the customers in a cluster with their delivery related KPIs to thereby identify high impacting KPIs for the cluster that are likely to influence the customers within the cluster. The delivery related KPIs may be a predefined set of KPIs that may be selected as needed for a particular application. The above approach allows companies to focus on specific delivery KPIs within a cluster that are likely to increase the NSSoD for a given customer within the cluster.

[0006] In one embodiment, the systems and methods herein generate a customer specific KPI score that reflects a customer's delivery experience. This customer KPI score is calculated based on KPI data for the most recent month for the customer and historical KPI data over the past 12 months for the entire cluster for the predefined set of KPIs. The use of historical KPI data for all customers within a cluster provides a larger set of data on which to perform analysis, thereby offering more accurate insight on a customer compared to data for a single customer or small number of customers. The KPI score for each customer, which can range from −1 to +1 in some embodiments (the KPI Score formula is given later herein), serves as an indicator of a business' overall delivery performance and its impact on a customer's perception of the business. A negative KPI score indicates poor performance on the KPIs and a positive score indicates good performance.

[0007] In some embodiments, the disclosed systems and methods present the scores for each customer on a dashboard that can be displayed on any suitable display, such as a laptop, tablet, mobile device and the like. The dashboard allows a user to filter the scores according to various filters, such as on a cluster level, a segment level, a country level, and the like. The scores may also be color coded according to the score values, such that a negative score may be displayed in an appropriate shade of red, whereas a positive score may be displayed in an appropriate shade of green.

[0008] In some embodiments, the dashboard may also provide the scores and results of the analysis in the form of a Box Tree Map that displays the importance of each KPI for an individual customer, a segment of customers, and the like. The Box Tree Map visualizes the scores and results as a set of nested rectangles or "boxes" that represent certain categories within a selected dimension or parameter and are ordered in a hierarchy or "tree." The Box Tree Map represents a part-to-whole relationship that allows a user quickly to compare quantities, patterns, and other information displayed in a visually limited space. In such embodiments, the higher the importance of a KPI, the larger the area or size of the rectangles or "boxes used to display the KPI. In some embodiments, the dashboard may also highlight the top five high impacting KPIs. In some embodiments, the dashboard also has an alerting function that automatically notifies the user whenever a KPI score is negative, decreasing, or otherwise suggests a customer is being negatively impacted.

[0009] In general, in one aspect, embodiments of the present disclosure relate to a system for improving customer satisfaction. The system comprises, among other things, a processor, a display unit coupled to the processor, and a storage unit accessible by the processor. The storage unit stores an application thereon that, when executed by the processor, causes the system to obtain performance data for a predefined set of metrics for a plurality of customers, the performance data including historical performance data for the predefined set of metrics and current performance data for the predefined set of metrics. The application, when executed by the processor, also causes the system to perform an impact analysis using the historical performance data for the predefined set of metrics for the plurality of customers and current performance data for the predefined set of metrics for a selected customer, the impact analysis determining whether each metric in the predefined set of metrics has a negative impact, a positive impact, or a neutral impact on the selected customer. The application, when executed by the processor, further causes the system to perform a corrective action related to the selected customer in response to a determination that the metric has a negative impact on the selected customer.

[0010] In general, in another aspect, embodiments of the present disclosure relate to a method for improving customer satisfaction. The method comprises, among other things,

obtaining performance data for a predefined set of metrics for a plurality of customers, the performance data including historical performance data for the predefined set of metrics and current performance data for the predefined set of metrics. The method also comprises performing an impact analysis using the historical performance data for the predefined set of metrics for the plurality of customers and current performance data for the predefined set of metrics for a selected customer, the impact analysis determining whether each metric in the predefined set of metrics has a negative impact, a positive impact, or a neutral impact on the selected customer. The method further comprises performing a corrective action related to the selected customer in response to a determination that the metric has a negative impact on the selected customer.

[0011] In general, in yet another aspect, embodiments of the present disclosure relate to a computer-readable medium storing computer-readable instructions thereon. The computer-readable instructions cause a processor to, among other things, obtain performance data for a predefined set of metrics for a plurality of customers, the performance data including historical performance data for the predefined set of metrics and current performance data for the predefined set of metrics. The computer-readable instructions also cause the processor to perform an impact analysis using the historical performance data for the predefined set of metrics for the plurality of customers and current performance data for the predefined set of metrics for a selected customer, the impact analysis determining whether each metric in the predefined set of metrics has a negative impact, a positive impact, or a neutral impact on the selected customer. The computer-readable instructions further cause the processor to perform a corrective action related to the selected customer in response to a determination that the metric has a negative impact on the selected customer.

[0012] In accordance with any one or more of the foregoing embodiments, the plurality of customers constitutes a cluster of customers, the cluster of customers being selected from several clusters of customers, each cluster of customers being defined by the application causing the system to perform a cluster analysis based on the historical performance data for the predefined set of metrics.

[0013] In accordance with any one or more of the foregoing embodiments, the application further causes the system to obtain historical customer net satisfaction scores for the plurality of customers, each net satisfaction score having a value within a predefined range of values, and perform a correlational analysis using the historical performance data for the predefined set of metrics and the customer net satisfaction scores, the correlational analysis providing an importance value of each metric in the predefined set of metrics.

[0014] In accordance with any one or more of the foregoing embodiments, the application further causes the system to generate a metric score for each metric in the predefined set of metrics based on the importance value for the metric and the impact of the metric on the selected customer.

[0015] In accordance with any one or more of the foregoing embodiments, the application further causes the system to generate a customer score for the selected customer based on a sum of metric scores for the predefined set of metrics and a sum of importance values for the predefined set of metrics, the customer score providing an indication of a likelihood that the selected customer will increase or decrease its net satisfaction score based on the current performance data for the predefined set of metrics.

[0016] In accordance with any one or more of the foregoing embodiments, the application further causes the system to generate one or more interactive display screens based on the cluster analysis, the correlational analysis, the impact analysis, and the customer scores, the one or more interactive display screens allowing a user to selectively display a result of the cluster analysis, the correlational analysis, the impact analysis, and/or the customer scores.

[0017] In accordance with any one or more of the foregoing embodiments, the one or more interactive display screens displays the impact analysis using boxes having different colors and/or different sizes.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] FIG. **1** illustrates an exemplary system for monitoring customer satisfaction in accordance with embodiments of the present disclosure;

[0019] FIG. **2** illustrates an exemplary delivery KPI analysis and alert system, and application thereon, in accordance with embodiments of the present disclosure;

[0020] FIG. **3** illustrates an exemplary ML-based process that may be employed by the delivery KPI analysis and alert application in accordance with embodiments of the present disclosure;

[0021] FIG. **4** illustrates an exemplary high-level flow diagram for a delivery KPI analysis and alert application in accordance with embodiments of the present disclosure;

[0022] FIG. **5** illustrates exemplary scores and results produced by a delivery KPI analysis and alert application in accordance with embodiments of the present disclosure;

[0023] FIG. **6** illustrates an exemplary interactive dashboard for displaying the scores and results produced by a delivery KPI analysis and alert application in accordance with embodiments of the present disclosure;

[0024] FIG. **7** illustrates an exemplary segment level performance screen for displaying the scores and results produced by a delivery KPI analysis and alert application in accordance with embodiments of the present disclosure; and

[0025] FIG. **8** illustrates an exemplary segment breakup by KPI screen for displaying the scores and results produced by a delivery KPI analysis and alert application in accordance with embodiments of the present disclosure;

[0026] FIG. **9** illustrates an exemplary customer level dashboard screen for displaying the scores and results produced by a delivery KPI analysis and alert application in accordance with embodiments of the present disclosure;

[0027] FIG. **10** illustrates an exemplary customer breakup by KPI screen for displaying the scores and results produced by a delivery KPI analysis and alert application in accordance with embodiments of the present disclosure;

[0028] FIG. **11** illustrates an exemplary top 10 customers by country screen for displaying the scores and results produced by a delivery KPI analysis and alert application in accordance with embodiments of the present disclosure; and

[0029] FIG. **12** illustrates an exemplary method that may be used by or with a delivery KPI analysis and alert application in accordance with embodiments of the present disclosure.

DETAILED DESCRIPTION

[0030] This description and the accompanying drawings illustrate exemplary embodiments of the present disclosure and should not be taken as limiting, with the claims defining the scope of the present disclosure, including equivalents. Various mechanical, compositional, structural, electrical, and operational changes may be made without departing from the scope of this description and the claims, including equivalents. In some instances, well-known structures and techniques have not been shown or described in detail so as not to obscure the disclosure. Further, elements and their associated aspects that are described in detail with reference to one embodiment may, whenever practical, be included in other embodiments in which they are not specifically shown or described. For example, if an element is described in detail with reference to one embodiment and is not described with reference to a second embodiment, the element may nevertheless be claimed as included in the second embodiment.

[0031] Referring now to FIG. **1**, a system **100** is shown that can be used by companies and businesses to monitor customer satisfaction according to embodiments of the present disclosure. The customer satisfaction monitoring system **100** depicted here can be used by businesses to monitor various areas of customer satisfaction, such as pricing, quality control, ease-of-use, and the like, but is set up specifically to monitor customer satisfaction on delivery of products and/or services. The customer satisfaction monitoring system **100** applies ML techniques to historical NSSoD survey data and actual customer experience data to identify specific customers and key KPIs that influence customer satisfaction for those customers, thereby leading to improved NSSoD scores. This allows businesses to develop mitigation plans that address specific customers and KPIs for those customers.

[0032] As FIG. **1** shows, the customer satisfaction monitoring system **100** includes a delivery KPI analysis and alert system **102**, a customer feedback database **104**, an internal delivery KPI database **106**, and ML and data storage resources, generally indicated at **108**. The delivery KPI analysis and alert system **102** is coupled to receive customer feedback data from the database **104** and also coupled to receive internal delivery KPI data from the database **106**. These databases **104**, **106** may reside on a private enterprise network, or the databases **104**, **106** may be hosted on the ML and data storage resources **108**, or a combination of both options. Thereafter, the delivery KPI analysis and alert system **102** uses machine learning resources from, for example, the ML and data storage resources **108**, to analyze the customer feedback data and the delivery KPI data to derive insight for improving customer NSSoD. Such a delivery KPI analysis and alert system **102** may be used by businesses to monitor customer satisfaction on product and/or service delivery, and issue warnings and alerts to one or more users **110** as needed over a wired or wireless communication link **112**.

[0033] In some embodiments, the customer feedback data in the customer feedback database **104** may include various types of feedback from customers and potential customers. Examples of customers from which feedback may be obtained are generally indicated at **114** and may include business-to-business (B2B) companies, business-to-end-customer (B2C) companies, wholesale and retail distributors, general contractors and subcontractors, panel builders, original equipment manufacturers (OEM), system integrators, end users, and the like. The customer feedback data may include responses to general or specific questions, numerical ratings (e.g., 0 to 10), NSSOD scores, free-form natural language feedback, as well as other suitable feedback known to those skilled in the art. The customer feedback data may be provided directly by the customers, or the feedback data may be obtained from a third-party aggregator of such data.

[0034] In some embodiments, the internal KPI data in the delivery KPI database **106** may be data for a predefined set of internal delivery KPIs tracked by a business. The particular internal delivery KPIs in the predefined set of KPIs may vary depending on the type of business. Data for individual KPIs may be in the form of a percentage ranging from 0 to 100 or a corresponding decimal value, or the data may represent an average or other numerical representation, depending on the KPIs. An exemplary set of internal delivery KPIs is generally indicated at **116** and may include: Actual Lead Time for Made to Stock (MTS), Actual Lead Time for Made to Order (MTO), On-time @CRD (Customer Requested Date), On-Time at Customer Door, On-time and Early Delivery at Customer Door; Order placement details in mySE Line and EDI Line; Number of Reschedules (NOR); Actual Second Commitment Date (AC2); Complete Order Shift Particulars; delivery capabilities such as Express Line, Forwards Order Line, Kitting Line; Large Order Quantity (LOQ); Order Grouping Line, Plant to Customer Line, Precision Delivery Line; and Customer Care Centre (CCC) cases recorded on Bridge Front Office (BFO) for Information (Customer asks CCC for information), Issues (refers to missing documentation or delivery issue), and Number of Customer Visits made.

[0035] As for the ML and data storage resources **108**, such resources may be private enterprise computing resources, publicly available cloud-based resources, and/or any other suitable resources that can provide data storage and execution of machine learning models and algorithms. Examples of suitable ML and data storage resources **108** may be any of the cloud-based offerings from Amazon (i.e., Amazon Web services), Microsoft (i.e., Microsoft Azure), Google (i.e., Google Cloud), and the like.

[0036] In accordance with embodiments of the disclosure, the delivery KPI analysis and alert system **102** may use the ML and data storage resources **108** to analyze and process the customer feedback data in the database **104** and the delivery KPI data in the database **106** as discussed further herein. Among other things, this allows the delivery KPI analysis and alert system **102** to identify and cluster similar groups of customers based on their delivery experience, as reflected by the internal delivery KPI data. The analysis and alert system **102** can then provide insights on the importance of each delivery KPI to a given customer, and derive a KPI score (also called a customer perception score) for a given customer. The KPI score for a given customer may be obtained using the KPI data for the current month for that customer and the KPI data for the previous 12 months (i.e., historical data) for the cluster to which the customer belongs. Such an arrangement ensures that the KPI score for a given customer closely corresponds to the preferences for the respective cluster and the impact on the overall NSSOD.

[0037] In the foregoing embodiments, if the difference between the current KPI data for a given customer and historical KPI data (e.g., previous 12 months) for the cluster

exceeds a certain threshold value or range, the delivery KPI analysis and alert system **102** may issue an alert to the one or more users **110** to notify and request the users **110** to take appropriate corrective action. The alerts may be sent via the wired or wireless connection **112** to a computing device of the users **110**, such as a phone, tablet, or other mobile device, or a laptop, desktop, or other computing device. In some embodiments, the delivery KPI analysis and alert system **102** may also automatically perform one or more actions instead of, or in addition to, requesting the users **110** perform the corrective actions. Examples of actions that may be automatically performed by the analysis and alert system **102** include requiring a user **110** to manually acknowledge an alert for a customer. For example, the delivery KPI analysis and alert system **102** may lock out certain user privileges with respect to the customer, such as access to the customer's account, or disable order entry for the customer, until the user **110** take steps to clear an alert flag for the customer.

[0038] It should be noted that although the systems and methods herein are described with respect to delivery KPIs, embodiments of the present disclosure are not so limited. In general, the principles and teachings disclosed herein are applicable to any performance metrics that can affect customer satisfaction. Examples of non-delivery KPI performance metrics include customer query response time, frequency of contact with customers, frequency of customer social media postings, targeted customer advertising expenditures, and the like.

[0039] FIG. **2** shows the delivery KPI analysis and alert system **102** in more detail according to some embodiments. The analysis and alert system **102** in this example has a processing unit **200** that includes at least one processor, a network interface **202**, a user interface **204**, a display unit **206**, and a storage unit **208**, among other components. Operation of these components is generally well known and only a brief description is provided here for economy. In general, the processing unit **200** is responsible for overall operation of the analysis and alert system **102**, including various complex processing operations, data capture and storage operations, corrective action operations, and the like. The network interface **202** allows the analysis and alert system **102** to communicate with external systems, including local systems that are on premise as well as network systems like the cloud-based ML and data storage resources **108**. The user interface **204** allows one or more users **110** to use or otherwise interact with the analysis and alert system **102**, while the display unit **206** displays graphics, images, videos, and other media content for the analysis and alert system **102**. The storage unit **208** meanwhile stores operational software and data used by and with the processing unit **200** to perform the various operations mentioned above, and other functions.

[0040] The storage unit **208** in this example may be any non-transitory storage unit known to those skilled in the art, including volatile memory (e.g., RAM), nonvolatile memory (e.g., Flash), magnetic memory, optical memory, and the like. This storage unit **208** stores a plurality of applications thereon that may be run by the processing unit **200**. These applications may include a delivery KPI analysis and alert application **210**, or rather the computer-readable instructions therefor, in some embodiments. The analysis and alert application **210** may contain several functional components, such as an ML-based customer cluster creation component **212**, an ML-based key driver derivation component **214**, and a customer KPI score generation component **216**. The customer cluster creation component **212**, as the name suggests, may employ an ML-based process to identify and cluster similar groups of customers based on the delivery KPI therefor. The key driver derivation component **214** may employ an ML-based process to determine an importance of each KPI for a given customer. And the customer KPI score generation component **216** operates to generate a KPI score for each customer.

[0041] FIG. **3** shows an exemplary ML-based process **300** that may be employed by various ML-based components of the delivery KPI analysis and alert application **210**, including the ML-based customer cluster creation component **212** and the ML-based key driver derivation component **214**. In general, the ML-based process **300** may be employed by any component that requires some form of machine learning to analyze data and detect or recognize patterns in the data. In the example shown, the ML-based process **300** includes a data input component **302**, one or more ML models or algorithms **304**, an automated feedback/correction component **306**, a user application **308**, a manual feedback/correction component **310**, and an analyzer **312**. Examples of algorithms that may be used with the ML-based process **300** include K-Means Clustering, Random Forest, Correlational Analysis, Natural Language Processing, and the like.

[0042] In operation, the data input component **302** receives data (e.g., customer ratings, customer NSSoD scores, customer survey responses, delivery KPI data, etc.) and, after appropriate pre-processing, feeds the data to the one or more ML models **304**. The ML models **304** use machine learning and neural network processing techniques to extract relevant features from the data in accordance with training data used to develop the models. The automated feedback/correction component **306** applies rules and algorithms configured to detect errors in the output received from ML models **304**. These errors are used to auto correct the model output and are fed back to the ML models **304** via the analyzer **312** to update the processing of the ML models **304**. The processed output from automated feedback/correction component **306** is then displayed to a user for validation via the user application **308**. The corrections made by the user are captured by the manual feedback/correction component **310** and fed back into the ML models **304** via the analyzer **312**. This allows the ML models **304** to continuously improve evaluation and extraction of relevant features from the input data.

[0043] Referring next to FIG. **4**, an exemplary flow diagram **400** is shown that graphically illustrates at a high level the process embodied by the delivery KPI analysis and alert application **210**. As will be discussed, the process uses data analytics and machine learning techniques to provide insights that can help prioritize KPI related actionable items and thereby increase the likelihood of improving NSSoD scores.

[0044] As an initial step, customers are divided into segments based on various market factors, such as business type, product type, service type, and the like, in a manner known to those skilled in the art. Illustrative customer segments are indicated at **402** and may include B2B companies, B2C companies, wholesale and retail distributors, general contractors and subcontractors, panel builders, OEMs, system integrators, end users, and the like. Delivery KPI data for each customer segment is indicated at **404** and

may be stored, for example, in the delivery KPI database **106**. The segment delivery KPI data reflects an average KPI for each customer in the segment.

[0045] Next, the delivery KPI analysis and alert application **210**, via the ML-based customer cluster creation component **212** thereof, groups the segment level customers **402** into clusters based on similarities in their delivery experience. For purposes herein, each customer belongs to a single cluster. The delivery experience refers to the delivery related services provided to the customers, as reflected by the delivery KPI data for the customer. The grouping or clustering may be performed, for instance, by applying K-Means Clustering or similar ML algorithms to the delivery KPI data for the customers. In general, K-Means Clustering uses vector quantization techniques to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean. In the example of FIG. **4**, the customer cluster creation component **212** has grouped the customers in the B2B segment into four clusters, Clusters **1-4**, indicated at **406**. The average KPI values for each of the clusters is shown at **408**, with the leftmost column listing the individual KPIs that make up the delivery KPI data for the clusters in this example. The clustering has the effect of grouping together customers that share similar delivery experience.

[0046] Once clustering is performed, the delivery KPI analysis and alert application **210**, via the ML-based key driver derivation component **214** thereof, derives the importance of the individual KPIs to the cluster. The key driver derivation component **214** may perform the derivation of the importance for each KPI by applying, for instance, Random Forest or similar ML algorithms to the delivery KPI data for the customers in the cluster, and the NSSoD scores provided by the customers. The Random Forest algorithm basically combines the outputs of multiple decision trees to reach a single result. In this way, the Random Forest algorithm can process the delivery KPI data against the NSSoD scores to find a relationship between the delivery KPI data and the NSSoD scores. In some embodiments, the importance of each KPI to the cluster is given in percentages such that the various KPI importance values add up to 1.0 (or 100%). In some embodiments, a predefined alternative numerical range may be used instead of 100% to indicate the importance of each KPI, which range may be selected as needed for a particular implementation.

[0047] As part of the importance derivation process, the key driver derivation component **214** accounts for the impact that a trend in KPI values may have on NSSoD score. For example, the key driver derivation component **214** may find that an increasing trend in "Number of Reschedules (NoR)" tends to have a negative correlation or a negative impact on the customer NSSoD. In contrast, the key driver derivation component **214** may find that a similar increasing trend in "On-Time at Customer Door" tends to have a positive correlation or a positive impact on the customer NSSoD. In some embodiments, the key driver derivation component **214** may use Correlational Analysis or similar ML algorithms to determine the negative or positive impact of a given KPI trend on the NSSOD. Correlational Analysis is commonly employed to identify any dependency that may exist between two variables. In the present example, Correlational Analysis can be used to analyze historical data for each KPI against past NSSoD scores to determine whether an increase or decrease in a particular KPI has a positive or negative impact on the NSSoD.

[0048] In some embodiments, whether a particular KPI has a positive or negative impact on NSSoD can be captured using an exemplary variable called Logic. The exemplary Logic variable may be assigned a value of −1 for a particular KPI if the impact of the KPI on NSSoD is negative, a value of +1 for the KPI if the impact of the KPI on NSSoD is positive, and a value of 0 if the impact is neutral.

[0049] Thereafter, the delivery KPI analysis and alert application **210**, via the customer KPI score generation component **216** thereof, calculates a KPI score for each customer and a customer score (also called a customer perception score) for each customer in a given cluster. In some embodiments, the score generation component **216** generates the KPI score for each customer on a one-month basis. For the present month, the score generation component **216** uses the average KPI percentages of the previous 12 months for the entire cluster and the actual KPI percentage for the present month for each customer in that cluster. Thus, if only half of all deliveries for the present month were delivered on time for a particular customer, then "On-time Delivery" would be 50 percent (or 0.5) for that customer. The difference between the 12-month percentage and the present month percentage is then calculated and compared against a KPI threshold range, generally indicated at **410**. In some embodiments, the KPI threshold range may be selected as 1.5 times the standard deviation of the past 12 months of data collected for a respective KPI, as follows:

$$KPI \text{ Percentage Difference} = \text{Historical average of } KPI \text{ for previous 12 months} - \text{Present value of } KPI \text{ for present month} \quad (1)$$

$$KPI \text{ Threshold Range} = -1.5 * Std\ Dev \text{ to } +1.5 * Std\ Dev \quad (2)$$

[0050] In the foregoing, if the calculated KPI percentage difference is within the KPI threshold range, a value of 0 is assigned to the Logic variable, whereas if the KPI percentage difference is found to be above or below the KPI threshold range, a value of +1 or −1, respectively, is assigned to the Logic variable, as follows:

$$\text{If } KPI \text{ Percentage Difference is} < \text{Negative } KPI \text{ Threshold, then Logic} = -1 \quad (3)$$

$$\text{If } KPI \text{ Percentage Difference is} > \text{Positive } KPI \text{ Threshold, then Logic} = +1 \quad (4)$$

$$\text{If } KPI \text{ Percentage Difference within } KPI \text{ Threshold Range, then Logic} = 0 \quad (5)$$

[0051] The customer KPI score generation component **216** may then calculate the customer scores, generally indicated at **412** (where the rightmost column shows the customer KPI scores), using the KPI scores, as follows:

$$KPI \text{ Score} = \text{Logic} * KPI \text{ Importance} \quad (6)$$

$$\text{Customer Score} = (\text{Sum of } KPI \text{ Scores})/(\text{Sum of } KPI \text{ Importance}) \quad (7)$$

[0052] In the above calculations, the value of KPI Importance is determined by the ML-based key driver derivation component **214** using the Random Forest algorithm, as described earlier. The foregoing approach provides users with an assessment of how a specific customer reacts to the delivery experience, and how important different KPIs are to that customer.

[0053] FIG. **5** shows exemplary results **500** produced by the delivery KPI analysis and alert application **210** operating as described above based on an exemplary set of customer feedback data and an exemplary set of delivery KPI data for a predefined set of KPIs. In this example, customers in the B2B segment have been clustered into four clusters, Clusters **1-4**, as indicated at **502**. The customers in each of the clusters reacted similarly to one another with respect to their delivery experience, as reflected by the KPI data, such that certain KPIs have similar importance to the customers in each cluster. For example, for Cluster **1** customers, precision delivery (1.6), On-time Delivery (1.5), On-time+Early Deliveries (1.6), Express (1.2), and EDI (1.9) had the highest importance, whereas for Cluster **2** customers, NoR (1.1) and EDI (2.0) had the highest importance, but Precision Delivery, On-time Delivery, and On-Time+Early Deliveries had less importance compared to Cluster **1** customers, while for Cluster **3** customers, no KPIs had particularly high importance, and for Cluster **4** customers, On-time Delivery (1.0), On-time+Early Deliveries (1.0), NoR (1.1) and EDI (1.1) had the highest importance.

[0054] In the FIG. **5** example, the customers making up Cluster **4** include Customers A to Z, generally indicated at **504**. The results for one of these customers, Customer Z, is broken out in detail at **506**. These results include historical data for 12 months of KPIs for Customers A to Z ("Historical" row), current month of KPI data for Customer Z ("Current" row), difference between the first and second rows ("Difference" row), value of threshold range ("Threshold" row), value of Logic variable ("Logic" row), KPI importance value (Importance row), KPI score ("Logic*Importance" row), and customer score ("Customer Score" row). The results show that for Customer Z, the KPIs with the highest importance are On-time Delivery (1.0), On-time+Early Deliveries (1.0), NoR (1.1) and EDI (1.1), as indicated by the data in the Importance row. The total importance of all delivery KPIs for Customer Z is 12.11, as indicated at **508**.

[0055] In addition, it can be seen that three of the delivery KPIs, On-time+Early Deliveries, Express Delivery, and number of Customer Care Cases, have a Logic variable value of −1, as shown in the Logic row. This means that those three KPIs had a negative impact on NSSoD for Customer Z. The remaining delivery KPIs have a Logic variable value of 0, which means that those KPIs had a neutral impact on NSSoD for Customer Z. Calculating the KPI score for the three negative KPIs as indicated above in Equation (6) produces KPI scores of −0.97, −0.40, and −0.54, respectively, as indicated at **510**, **512**, and **514**. The customer score may then be calculated using the KPI scores as indicated above in Equation (7), resulting in a customer score of −0.16 (or −16 percent). This means that the three negative KPIs above reduced the likelihood by 16 percent that Customer Z will improve its NSSoD rating based on its most recent delivery experience. A user may then take appropriate corrective action upon being notified or otherwise made aware of the three negative KPIs for Customer Z.

[0056] FIG. **6** shows an exemplary dashboard **600** that may be used to notify or otherwise make a user aware of KPI scores, customer scores, and other aspects of the embodiments discussed herein. Such a dashboard **600** may be displayed on any suitable display, such as a laptop, tablet, mobile device and the like. In some embodiments, the dashboard **600** may comprise a plurality of interactive screens that allow a user to not only view data and discern insight, but also filter the data according to various filters, such as by cluster, segment, country, customer, and the like, among other functionality. The scores may also be color coded according to the score values, such that a negative score may be displayed in an appropriate shade of red, whereas a positive score may be displayed in an appropriate shade of green.

[0057] In the present embodiment, the dashboard **600** has several tabs across the top of the screen, each tab representing a different dashboard screen designed to provide different types of information. For example, there is a segment level performance tab **602**, a segment breakup by KPI tab **604**, a customer level dashboard tab **606**, a customer breakup by KPI tab **608**, a training and documentation tab **610**, and a top 10 customers by country tab **612**. The user may use the tabs **602-612** to select an appropriate screen based on the desired information.

[0058] FIG. **7** shows an exemplary segment level performance screen **700** that may be selected via the segment level performance tab **602**. This dashboard screen **700** is in the form of a table, with columns **702** representing the segment level customers, while rows **704** represent number of customers, NSSoD, and delivery KPIs. Each cell in the dashboard screen **700** provides the user with KPI data for a particular KPI and a particular segment. The user may also hover a cursor over or otherwise select one of the cells to display a pop-up window **706** containing more detailed information about the segment and the KPI, such as the segment identifier, KPI score for the segment and KPI value for the segment. In addition, each cell may be filled with a different color to represent the impact of the KPI for that cell. For example, cell **708** may have a green color to indicate that the data in the cell reflects good KPI performance, whereas cell **710** may have a red color to indicate that the data in the cell reflects poor KPI performance. Different shades of green or red may be used to indicate different degrees of good or poor KPI performance. A gray color or similar neutral color may be used to indicate a neutral KPI performance.

[0059] FIG. **8** shows an exemplary segment breakup by KPI screen **800** that may be selected via the segment breakup by KPI tab **604**. This dashboard screen **800** is in the form of a Box Tree Map with boxes that contain KPI data for a specific segment, in this case a B2B customer segment called "B2B Distribution." Each box, one of which is indicated at **802**, displays data for a particular KPI of that segment. The size of each box also reflects the KPI importance and impact of the KPI for that segment, with bigger boxes reflecting greater KPI importance and impact, and vice versa. Thus, for example, box **802** is larger than box **804**, which means the KPI represented by box **802** has greater importance and impact compared to the KPI represented by box **804**. In addition, a different color, such as green or red (or shades thereof), may be used to indicate whether a box reflects good, poor, or neutral KPI performance. In the example shown, box **802** has a red color that

reflects poor KPI performance, while box **804** has a gray color that reflects neutral KPI performance. In addition, one or more data filters, generally indicated at **806**, may be provided to allow a user to filter the data, for example, by customer segment, country, region, customer name, and time period. The data filters may be in the form of a drop-down list of filter options from which the user may select.

[0060] FIG. **9** shows an exemplary customer level dashboard screen **900** that may be selected via the customer level dashboard tab **606**. This dashboard screen **900** is also in the form of a table, with columns **902** representing the segment level customers ("Customer name" column), the segment to which they belong ("Segment" column), and the customer score ("Customer Score" column), while rows **904** contain the information and data for each column. Selecting one of the customers in the customer name column brings up and displays the top 5 KPIs for that customer, indicated generally at **906**. In some embodiments, one or more data filters in the form of a drop-down list, generally indicated at **908**, may also be provided to allow a user to filter the data, for example, by customer segment, country, region, customer name, and time period.

[0061] FIG. **10** shows an exemplary customer breakup by KPI screen **1000** that may be selected via the customer breakup by KPI tab **608**. This dashboard screen **1000**, like the dashboard screen **800**, is in the form of a Box Tree Map with boxes that contain KPI data for a specific customer, in this case a customer called "CNW Electrical Balcatta Balcatta." Each box **1002** again displays data for a particular KPI for that customer. The size of each box again reflects the KPI importance and impact of the KPI for that customer, with bigger boxes reflecting greater KPI importance and impact, and vice versa. Thus, for example, box **1002** is larger than box **1004**, which means the KPI represented by box **1002** has greater importance and impact compared to the KPI represented by box **1004**. And as before, a different color, such as green or red (or shades thereof), may be used to indicate whether a box reflects good, poor, or neutral KPI performance. In the example shown, box **1002** has a red color that reflects poor KPI performance, while box **1004** has a green color that reflects good KPI performance. In addition, one or more data filters **1006** may be provided in the form of a drop-down list to allow a user to filter the data, for example, by customer segment, country, region, customer name, and time period.

[0062] FIG. **11** shows an exemplary top 10 customers by country screen **1100** that may be selected via the top 10 customers by country tab **612**. This dashboard screen **1100**, as the name suggests, provides a list of the top 10 customers sorted according to the countries where customer deliveries were made. The customers are listed in several columns, generally indicated at **1102**, including a column for geographical region, country delivered, customer ranking, customer name, customer segment, customer overall perception (i.e., customer score), and SS, number of responses, and sales order value. In some embodiments, one or more data filters **1104** may be provided in the form of a drop-down list to allow a user to filter the data, for example, by country, region, segment, and time period.

[0063] Thus far, a number of specific embodiments have been shown and described for the delivery KPI analysis and alert system **102** and the application **210** thereof. Following now is a description of a general method that may be used by or with the analysis and alert system **102** and the application **210** thereof.

[0064] Referring to FIG. **12**, a flowchart **1200** is shown representing a method that may be used by or with the delivery KPI analysis and alert system **102** and the application **210** thereof. The method generally begins at block **1202** performance data is obtained for a predefined set of metrics for a plurality of customers. The performance data includes historical performance data (e.g., 12 months) for the predefined set of metrics and current performance data (e.g., current month) for the predefined set of metrics. In some embodiments, the predefined set of metrics may be a predefined set of delivery KPIs, although alternative performance metrics may be used.

[0065] At block **1204**, customer net satisfaction scores for the plurality of customers may be obtained. In some embodiments, the net satisfaction scores may be historical (e.g., 12 months) NSSoD scores fort the plurality of customers.

[0066] At block **1206**, a cluster analysis is performed based on the historical performance data for the predefined set of metrics. The cluster analysis groups customers into clusters based on the similarity of their experiences, as reflected by the historical performance data for the predefined set of metrics. In some embodiments, the cluster analysis is performed using K-Means clustering or similar ML-based algorithms. In some embodiments, each customer belongs to a single cluster, and clustering is performed on a customer segment basis, such that customers from different segments are not mixed together.

[0067] At block **1208**, an impact analysis is performed using the historical performance data for the predefined set of metrics and the current performance data for the predefined set of metrics for a selected customer. The impact analysis determines whether each metric in the predefined set of metrics has a negative impact, a positive impact, or a neutral impact on the selected customer. In some embodiments, the impact analysis may be performed using Equations (1)-(5) above.

[0068] At block **1210**, a correlational analysis is performed using the historical performance data for the predefined set of metrics and the customer net satisfaction scores. The correlational analysis provides an importance value of each metric in the predefined set of metrics for the selected customer.

[0069] At block **1212**, a metric score generated for each metric in the predefined set of metrics based on the importance value for the metric and the impact of the metric on the selected customer. In some embodiments, the metric score may be generated using Equation (6) above.

[0070] At block **1214**, a customer score is generated for the selected customer based on a sum of metric scores for the predefined set of metrics and a sum of importance values for the predefined set of metrics. The customer score provides an indication of a likelihood that the selected customer will increase or decrease its net satisfaction score based on the current performance data for the predefined set of metrics. In some embodiments, the customer score may be generated using Equation (7) above.

[0071] At block **1216**, one or more interactive display screens are generated based on the cluster analysis, the correlational analysis, the impact analysis, and the customer scores. The one or more interactive display screens allows a user to selectively display a result of the cluster analysis, the

correlational analysis, the impact analysis, and/or the customer scores. In some embodiments, the one or more interactive display screens displays the impact analysis using boxes having different colors and/or different sizes.

[0072] At block **1218**, an alert may be issued and corrective actions may be taken if the current performance data for any metric indicates a negative impact on the selected customer. In some embodiments, corrective actions may include locking out certain user privileges with respect to the selected customer, such as access to the customer's account, or disabling order entry for the customer, until a user take steps to clear an alert flag for the customer.

[0073] While a number of embodiments have been disclosed and described herein, it is to be understood that the above description is intended to be illustrative, and not restrictive. Many other implementation examples are apparent upon reading and understanding the above description and modifications and variations may be made within the scope of the appended claims. Accordingly, the specification and drawings are to be regarded in an illustrative sense rather than a restrictive sense. The scope of the disclosure should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled.

I/We claim:

1. A system for improving customer satisfaction, comprising:

a processor;

a display unit coupled to the processor; and

a storage unit accessible by the processor, the storage unit storing an application thereon that, when executed by the processor, causes the system to:

obtain performance data for a predefined set of metrics for a plurality of customers, the performance data including historical performance data for the predefined set of metrics and current performance data for the predefined set of metrics;

perform an impact analysis using the historical performance data for the predefined set of metrics for the plurality of customers and current performance data for the predefined set of metrics for a selected customer, the impact analysis determining whether each metric in the predefined set of metrics has a negative impact, a positive impact, or a neutral impact on the selected customer; and

perform a corrective action related to the selected customer in response to a determination that the metric has a negative impact on the selected customer.

2. The system of claim **1**, wherein the plurality of customers constitutes a cluster of customers, the cluster of customers being selected from several clusters of customers, each cluster of customers being defined by the application causing the system to perform a cluster analysis based on the historical performance data for the predefined set of metrics.

3. The system of claim **2**, wherein the application further causes the system to:

obtain historical customer net satisfaction scores for the plurality of customers, each net satisfaction score having a value within a predefined range of values; and

perform a correlational analysis using the historical performance data for the predefined set of metrics and the customer net satisfaction scores, the correlational analysis providing an importance value of each metric in the predefined set of metrics.

4. The system of claim **3**, wherein the application further causes the system to generate a metric score for each metric in the predefined set of metrics based on the importance value for the metric and the impact of the metric on the selected customer.

5. The system of claim **4**, wherein the application further causes the system to generate a customer score for the selected customer based on a sum of metric scores for the predefined set of metrics and a sum of importance values for the predefined set of metrics, the customer score providing an indication of a likelihood that the selected customer will increase or decrease its net satisfaction score based on the current performance data for the predefined set of metrics.

6. The system of claim **5**, wherein the application further causes the system to generate one or more interactive display screens based on the cluster analysis, the correlational analysis, the impact analysis, and the customer scores, the one or more interactive display screens allowing a user to selectively display a result of the cluster analysis, the correlational analysis, the impact analysis, and/or the customer scores.

7. The system of claim **6**, wherein the one or more interactive display screens displays the impact analysis using boxes having different colors and/or different sizes.

8. A method for improving customer satisfaction, comprising:

obtaining performance data for a predefined set of metrics for a plurality of customers, the performance data including historical performance data for the predefined set of metrics and current performance data for the predefined set of metrics;

performing an impact analysis using the historical performance data for the predefined set of metrics for the plurality of customers and current performance data for the predefined set of metrics for a selected customer, the impact analysis determining whether each metric in the predefined set of metrics has a negative impact, a positive impact, or a neutral impact on the selected customer; and

performing a corrective action related to the selected customer in response to a determination that the metric has a negative impact on the selected customer.

9. The method of claim **8**, wherein the plurality of customers constitutes a cluster of customers, the cluster of customers being selected from several clusters of customers, each cluster of customers being defined by performing a cluster analysis based on the historical performance data for the predefined set of metrics.

10. The method of claim **9**, further comprising:

obtaining historical customer net satisfaction scores for the plurality of customers, each net satisfaction score having a value within a predefined range of values; and

performing a correlational analysis using the historical performance data for the predefined set of metrics and the customer net satisfaction scores, the correlational analysis providing an importance value of each metric in the predefined set of metrics.

11. The method of claim **10**, further comprising generating a metric score for each metric in the predefined set of metrics based on the importance value for the metric and the impact of the metric on the selected customer.

12. The method of claim **11**, further comprising generating a customer score for the selected customer based on a sum of metric scores for the predefined set of metrics and a

sum of importance values for the predefined set of metrics, the customer score providing an indication of a likelihood that the selected customer will increase or decrease its net satisfaction score based on the current performance data for the predefined set of metrics.

13. The method of claim **12**, further comprising generating one or more interactive display screens based on the cluster analysis, the correlational analysis, the impact analysis, and the customer scores, the one or more interactive display screens allowing a user to selectively display a result of the cluster analysis, the correlational analysis, the impact analysis, and/or the customer scores.

14. The method of claim **13**, further comprising displaying the impact analysis on the one or more interactive display screens displays using boxes having different colors and/or different sizes.

15. A computer-readable medium storing computer-readable instructions for causing a processor to:

obtain performance data for a predefined set of metrics for a plurality of customers, the performance data including historical performance data for the predefined set of metrics and current performance data for the predefined set of metrics;

perform an impact analysis using the historical performance data for the predefined set of metrics for the plurality of customers and current performance data for the predefined set of metrics for a selected customer, the impact analysis determining whether each metric in the predefined set of metrics has a negative impact, a positive impact, or a neutral impact on the selected customer; and

perform a corrective action related to the selected customer in response to a determination that the metric has a negative impact on the selected customer.

16. The computer-readable medium of claim **15**, wherein the plurality of customers constitutes a cluster of customers, the cluster of customers being selected from several clusters of customers, each cluster of customers being defined by the computer-readable instructions causing the processor to perform a cluster analysis based on the historical performance data for the predefined set of metrics.

17. The computer-readable medium of claim **16**, wherein the computer-readable instructions further cause the processor to:

obtain historical customer net satisfaction scores for the plurality of customers, each net satisfaction score having a value within a predefined range of values; and

perform a correlational analysis using the historical performance data for the predefined set of metrics and the customer net satisfaction scores, the correlational analysis providing an importance value of each metric in the predefined set of metrics.

18. The computer-readable medium of claim **17**, wherein the computer-readable instructions further cause the processor to generate a metric score for each metric in the predefined set of metrics based on the importance value for the metric and the impact of the metric on the selected customer.

19. The computer-readable medium of claim **18**, wherein the computer-readable instructions further cause the processor to generate a customer score for the selected customer based on a sum of metric scores for the predefined set of metrics and a sum of importance values for the predefined set of metrics, the customer score providing an indication of a likelihood that the selected customer will increase or decrease its net satisfaction score based on the current performance data for the predefined set of metrics.

20. The computer-readable medium of claim **19**, wherein the computer-readable instructions further cause the processor to generate one or more interactive display screens based on the cluster analysis, the correlational analysis, the impact analysis, and the customer scores, the one or more interactive display screens allowing a user to selectively display a result of the cluster analysis, the correlational analysis, the impact analysis, and/or the customer scores.

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