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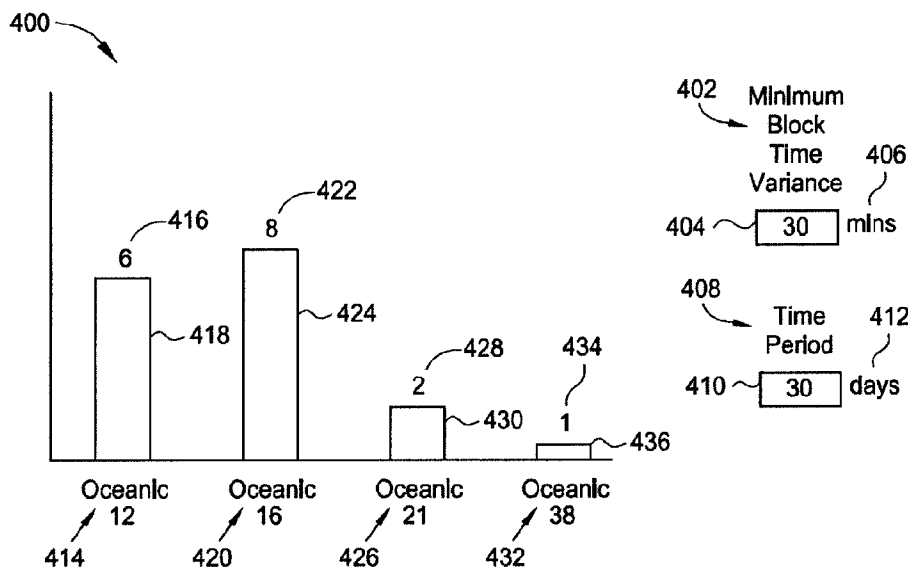
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(57) Abrégé/Abstract:

Method and apparatus for generating and outputting dynamic variance reports for vehicle operations. The dynamic variance reports enable a vehicle operations scheduler to understand trends, patterns, or the like in variances between planned vehicle operations and actual vehicle operations. The understanding of the variances provided by the dynamic variance reports enable the scheduler to apply buffers to vehicle operations plans so that planned vehicle operations more closely match actual vehicle operations and crew assignments are less likely to be disrupted.

ABSTRACT

Method and apparatus for generating and outputting dynamic variance reports for vehicle operations. The dynamic variance reports enable a vehicle operations scheduler to understand trends, patterns, or the like in variances between planned vehicle operations and actual vehicle operations. The understanding of the variances provided by the dynamic variance reports enable the scheduler to apply buffers to vehicle operations plans so that planned vehicle operations more closely match actual vehicle operations and crew assignments are less likely to be disrupted.

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RETROSPECTIVE ANALYSIS OF VEHICLE OPERATIONS

5 BACKGROUND

Aspects described herein relate to vehicle operation planning, and more specifically, to generating dynamic reports that enable improved scheduling of vehicles and vehicle operators.

SUMMARY

- 10 According to one aspect, a computer-implemented method includes storing electronic data for actual vehicle operations and planned vehicle operations in a data structure on a computer-readable medium. The actual and planned vehicle operations data includes data for different vehicle operations and the data for the different vehicle operations includes multiple instances of the different vehicle operations. The
- 15 computer-implemented method includes calculating at least one variance for at least one personnel time limit criterion for the multiple instances of the different vehicle operations, based on one or more differences between the actual vehicle operations data and the planned vehicle operations data. The computer-implemented method also includes generating at least one electronic dynamic variance report based on the
- 20 calculated at least one variance and based on the at least one user-adjustable criterion.

- According to one aspect, a computer program product for generating dynamic reports related to vehicle operations includes a computer-readable storage medium having computer-readable program code embodied therewith. The computer-readable
- 25 program code is executable by one or more computer processors to store electronic data for actual vehicle operations and planned vehicle operations in a data structure on a computer-readable medium. The the actual and planned vehicle operations data includes data for different vehicle operations and the data for the different vehicle operations includes multiple instances of the different vehicle operations. The
- 30 computer-readable program code is also executable to calculate at least one variance

for at least one personnel time limit criterion for the multiple instances of the different vehicle operations, based on the actual vehicle operations data and planned vehicle operations data. The computer-readable program code is also executable to generate at least one dynamic variance report based on the calculated at least one variance and
5 based on the at least one user-adjustable criterion.

According to one aspect, a system includes a data structure on a computer-readable medium storing data related to planned vehicle operations and actual vehicle operations. The actual and planned vehicle operations data includes data for different vehicle operations and the data for the different vehicle operations includes multiple
10 instances of the different vehicle operations. The system also includes at least one input device configured to receive at least one user-adjustable criterion. The system also includes a display device. The system also includes a processor in communication with the data structure, the at least one input device, and the display device. The processor is configured to retrieve the actual vehicle operations data and
15 the planned vehicle operations data from the data structure. The processor is also configured to calculate at least one variance for at least one personnel time limit criterion for the multiple instances of the different vehicle operations, based on differences between the actual vehicle operations data and the planned vehicle operations data. The processor is also configured to output to the display device a first
20 at least one dynamic variance report based on the calculated at least one variance and based on the at least one user-adjustable criterion.

In one embodiment, there is provided a computer-implemented method. The method involves storing electronic data for actual vehicle operations and planned vehicle operations in a data structure on a computer-readable medium, the actual and planned
25 vehicle operations data includes data for different vehicle operations, and the data for the different vehicle operations includes multiple instances of the different vehicle operations. The method further involves calculating at least one variance for at least one personnel time limit criterion for the multiple instances of the different vehicle operations, based on one or more differences between the actual vehicle operations
30 data and the planned vehicle operations data, and generating at least one electronic

dynamic variance report based on the calculated at least one variance and based on the at least one user-adjustable criterion.

5 The method may involve receiving a user input of a change to the at least one user-adjustable criterion via an electronic input device, and responsive to the change, re-generating the at least one dynamic variance report based on the calculated at least one variance and based on the changed at least one user-adjustable criterion.

10 The vehicle operations may be flight segments for commercial aircraft. The at least one variance may involve block time variances for the flight segments, the at least one user-adjustable criterion may involve a user-adjustable variance threshold, and the variance report dynamically may change from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable
15 variance threshold being changed from the first variance threshold to the second variance threshold.

The vehicle operations may be multiple instances of a flight segment. The at least one variance may involve block time variances for the multiple instances. The at least one
20 user-adjustable criterion may involve a user-adjustable variance threshold, and the variance report may dynamically change from a first display of instances of the flight segment that exceed a first user-adjustable variance threshold to a second display of instances of the flight segment that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first
25 variance threshold to the second variance threshold.

The vehicle operations may be flight segments for commercial aircraft. The at least one variance may include connection time variances for flight crews for flight segment pairs, the at least one user-adjustable criterion may involve a user-adjustable variance
30 threshold, and the variance report may dynamically change from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of

flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

- 5 The vehicle operations may be flight segments for commercial aircraft. The at least one variance time may involve connection time variances at particular airports, the at least one user-adjustable criterion may involve a user-adjustable variance threshold, and the variance report may dynamically change from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight
10 segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

- The vehicle operations may be flight segments for commercial aircraft, the at least one
15 variance may involve duty time variances for flight crews for itineraries of flight segments, the at least one user-adjustable criterion may involve a user-adjustable variance threshold, and the variance report may dynamically change from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance
20 threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

- The vehicle operations may be flight segments for commercial aircraft. The at least one variance may involve instances in which an aircraft does not operate a pre-
25 planned itinerary of flight segments, the at least one user-adjustable criterion may comprise a user-adjustable number of instances, and the variance report may dynamically change from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance
30 threshold being changed from the first variance threshold to the second variance threshold.

The vehicle operations may be flight segments for commercial aircraft, the at least one variance may involve instances in which aircraft departing from a particular airport do not operate a preplanned flight segment. The at least one user-adjustable criterion
5 may involve a user-adjustable number of instances, and the variance report may dynamically change from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance
10 threshold.

The at least one user-adjustable criterion may involve at least one of: time of day, month, year, and season.

15 In another embodiment, there is provided a computer program product for generating dynamic reports related to vehicle operations. The computer program product includes a computer-readable storage medium having computer-readable program code embodied therewith. The computer-readable program code is executable by one or more computer processors to store electronic data for actual vehicle operations and
20 planned vehicle operations in a data structure on a computer-readable medium. The actual and planned vehicle operations data includes data for different vehicle operations, and the data for the different vehicle operations includes multiple instances of the different vehicle operations. The computer-readable program code directs the one or more computer processors to calculate at least one variance for at least one
25 personnel time limit criterion for the multiple instances of the different vehicle operations, based on the actual vehicle operations data and planned vehicle operations data, and to generate at least one dynamic variance report based on the calculated at least one variance and based on the at least one user-adjustable criterion.

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The computer-readable program code may be further executable to receive a change to the at least one user-adjustable criterion, and responsive to the change, re-generate the at least one dynamic variance report based on the calculated at least one variance and based on the changed at least one user-adjustable criterion.

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The at least one user-adjustable criterion may involve at least one of: time of day, month, year, and season.

10 In another embodiment, there is provided a system. The system includes a data structure on a computer-readable medium storing data related to planned vehicle operations and actual vehicle operations. The actual and planned vehicle operations data includes data for different vehicle operations, and the data for the different vehicle operations includes multiple instances of the different vehicle operations. The system further includes at least one input device configured to receive at least one user-
15 adjustable criterion, and further includes a display device, and a processor in communication with the data structure. The at least one input device, the display device, and the processor are configured to retrieve the actual vehicle operations data and the planned vehicle operations data from the data structure, calculate at least one variance for at least one personnel time limit criterion for the multiple instances of the
20 different vehicle operations, based on differences between the actual vehicle operations data and the planned vehicle operations data, and output to the display device a first at least one dynamic variance report based on the calculated at least one variance and based on the at least one user-adjustable criterion.

25 The processor may be further configured to receive a change to the at least one user-adjustable criterion from the at least one input device, and responsive to the change, output to the display device a second at least one dynamic variance report based on the calculated at least one variance and based on the changed at least one user-adjustable criterion.

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The vehicle operations may be flight segments for commercial aircraft. The at least one variance may include block time variances for the flight segments. The at least one user-adjustable criterion may include a user-adjustable variance threshold, and the variance report may dynamically change from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

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- 10 The vehicle operations may be multiple instances of a flight segment. The at least one variance may include block time variances for the multiple instances. The at least one user-adjustable criterion may include a user-adjustable variance threshold, and the variance report may dynamically change from a first display of instances of the flight segment that exceed a first user-adjustable variance threshold to a second display of instances of the flight segment that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.
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- The vehicle operations may be flight segments for commercial aircraft. The at least one variance may include connection time variances for flight crews for flight segment pairs. The at least one user-adjustable criterion may include a user-adjustable variance threshold, and the variance report may dynamically change from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.
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- The vehicle operations may be flight segments for commercial aircraft. The at least one variance time may include connection time variances at particular airports. The at least one user-adjustable criterion may include a user-adjustable variance threshold, and the variance report may dynamically change from a first display of flight segments
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that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

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The vehicle operations may be flight segments for commercial aircraft. The at least one variance may include duty time variances for flight crews for itineraries of flight segments. The at least one user-adjustable criterion may include a user-adjustable variance threshold, and the variance report may dynamically change from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

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The vehicle operations may be flight segments for commercial aircraft. The at least one variance may include instances in which an aircraft does not operate a pre-planned itinerary of flight segments. The at least one user-adjustable criterion may include a user-adjustable number of instances, and the variance report may dynamically change from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

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The vehicle operations may be flight segments for commercial aircraft. The at least one variance may include instances in which aircraft departing from a particular airport do not operate a preplanned flight segment. The at least one user-adjustable criterion may include a user-adjustable number of instances, and the variance report may dynamically change from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance

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threshold being changed from the first variance threshold to the second variance threshold.

The at least one user-adjustable criterion may include at least one of: time of day, month, year, and season.

- 5 In one embodiment, there is provided a computer-implemented method involving causing at least one processor to store electronic data for actual vehicle operations and planned vehicle operations in a data structure in a first tabular format on a non-transitory computer-readable medium. The actual vehicle operations data and the planned vehicle operations data includes data for different vehicle operations. The
- 10 data for the different vehicle operations includes multiple instances of the different vehicle operations. The computer-implemented method further involves causing the at least one processor to convert the actual vehicle operations data and planned vehicle operations data into a second format different from the first tabular format. The second format is compatible with crew planning software. The computer-
- 15 implemented method further involves causing the at least one processor to calculate at least one variance for at least one personnel time limit criterion for the multiple instances of the different vehicle operations, based on one or more differences between the actual vehicle operations data and the planned vehicle operations data. The computer-implemented method further involves causing the at least one
- 20 processor to generate via the crew planning software, and display via a display device, at least one dynamic variance report based on the calculated at least one variance and based on at least one user-adjustable criterion. The at least one user-adjustable criterion includes one or more of a period of time, a time of day, a day of week, a month, a year and a season. The computer-implemented method further
- 25 involves: causing the at least one processor to receive, via an electronic input device, user input from a user changing the at least one user-adjustable criterion; causing the at least one processor to dynamically and in real-time modify the at least one dynamic variance report in response to and based on the changed at least one user-adjustable criterion; and causing the at least one processor to generate via the

crew planning software, and display via the display device, the modified at least one dynamic variance report to the user in real-time.

In another embodiment, there is provided a computer program product for generating dynamic reports related to vehicle operations. The computer program product includes a non-transitory computer-readable storage medium having computer-readable program code embodied therewith. The computer-readable program code is executable by one or more computer processors to store electronic data for actual vehicle operations and planned vehicle operations in a data structure in a first tabular format on a non-transitory computer-readable medium. The actual vehicle operations data and the planned vehicle operations data includes data for different vehicle operations. The data for the different vehicle operations includes multiple instances of the different vehicle operations. The computer-readable program code is further executable by one or more computer processors to convert the actual vehicle operations data and planned vehicle operations data into a second format different from the first tabular format. The second format is compatible with crew planning software. The computer-readable program code is further executable by one or more computer processors to calculate at least one variance for at least one personnel time limit criterion for the multiple instances of the different vehicle operations, based on differences between the actual vehicle operations data and planned vehicle operations data and cause the crew planning software to generate and a display device to display a dynamic variance report based on the calculated at least one variance and based on at least one user-adjustable criterion. The at least one user-adjustable criterion includes one or more of a period of time, a time of day, a day of week, a month, a year and a season. The computer-readable program code is further executable by one or more computer processors to receive user input from a user changing the at least one user-adjustable criterion via an electronic input device, dynamically and in real-time modify the dynamic variance report in response to and based on the changed at least one user-adjustable criterion, and cause the crew planning software to

generate and the display device to display the modified dynamic variance report to the user in real-time.

In another embodiment, there is provided a system, including a data structure in a first tabular format on a non-transitory computer-readable medium storing data related to planned vehicle operations and actual vehicle operations. The actual vehicle operations data and the planned vehicle operations data includes data for different vehicle operations. The data for the different vehicle operations includes multiple instances of the different vehicle operations. The system further includes at least one input device configured to receive at least one user-adjustable criterion, a display device, and a processor in communication with the data structure, the at least one input device, and the display device. The processor is configured to retrieve the actual vehicle operations data and the planned vehicle operations data in the first tabular format from the data structure and convert the actual vehicle operations data and planned vehicle operations data into a second format different from the first tabular format. The second format is compatible with a crew planning software. The processor is further configured to calculate at least one variance for at least one personnel time limit criterion for the multiple instances of the different vehicle operations, based on differences between the actual vehicle operations data and the planned vehicle operations data and generate via the crew planning software and display via the display device a first at least one dynamic variance report based on the calculated at least one variance and based on at least one user-adjustable criterion. The at least one user-adjustable criterion includes one or more of a period of time, a time of day, a day of week, a month, a year and a season. The processor is further configured to receive user input from a user changing the at least one user-adjustable criterion via the at least one input device; dynamically and in real-time modify the first at least one dynamic variance report into a second at least one dynamic variance report in response to and based on the changed at least one user-adjustable criterion; and generate via the crew planning software and display via the display device the second at least one dynamic variance report to the user in real-time.

In another embodiment, there is provided a computer-implemented method, involving: storing, in a non-transitory computer-readable medium and in a first tabular format, planned vehicle operations data corresponding to a plurality of different planned vehicle operations; storing, in the non-transitory computer-readable medium and in the first tabular format, actual vehicle operations data for multiple instances of at least one planned vehicle operation of the plurality of different planned vehicle operations; and converting the actual vehicle operations data and planned vehicle operations data into a second format different from the first tabular format. The second format is compatible with crew planning software. The computer-implemented method further involves: calculating at least one variance for at least one personnel time limit criterion for the multiple instances of the at least one planned vehicle operation, based on one or more differences between the actual vehicle operations data and the planned vehicle operations data; and receiving, via an electronic input device, a user input from a user indicating a value for at least one user-adjustable criterion. The at least one user-adjustable criterion includes one or more of a period of time, a time of day, a day of week, a month, a year and a season. The computer-implemented method further involves: displaying, via a display device and to the user in real-time, at least one dynamic variance report based on the calculated at least one variance and based on the value for the at least one user-adjustable criterion; receiving, via the electronic input device, a second user input from the user of a change to the at least one user-adjustable criterion; updating, dynamically and in real-time, the at least one dynamic variance report in response to and based on the changed at least one user-adjustable criterion; and displaying, via the display device and to the user in real-time, the updated at least one dynamic variance report.

In another embodiment, there is provided a computer program product for generating dynamic reports related to vehicle operations. The computer program product includes a non-transitory computer-readable storage medium having computer-readable program code embodied therewith. The computer-readable program code is executable by one or more computer processors to: store, in a data

structure and in a first tabular format, planned vehicle operations data corresponding to a plurality of different planned vehicle operations; store, in the data structure and in the first tabular format, actual vehicle operations data for multiple instances of at least one planned vehicle operation of the plurality of different planned vehicle operations; and convert the actual vehicle operations data and planned vehicle operations data into a second format different from the first tabular format. The second format is compatible with crew planning software. The computer-readable program code is further executable by one or more computer processors to: calculate at least one variance for at least one personnel time limit criterion for the multiple instances of the at least one planned vehicle operation, based on differences between the actual vehicle operations data and planned vehicle operations data; and receive, via an electronic input device communicatively coupled with the one or more computer processors, a user input from a user indicating a value for at least one user-adjustable criterion. The at least one user-adjustable criterion includes one or more of a period of time, a time of day, a day of week, a month, a year and a season. The computer-readable program code is further executable by one or more computer processors to: display, via a display device communicatively coupled with the one or more computer processors and to the user in real-time, at least one dynamic variance report based on the calculated at least one variance and based on the value for the at least one user-adjustable criterion; receive, via the electronic input device and from the user, a user input changing the at least one user-adjustable criterion; update, dynamically and in real-time, the at least one dynamic variance report in response to and based on the changed at least one user-adjustable criterion; and displaying, via the display device and to the user in real-time, the updated at least one dynamic variance report.

In another embodiment, there is provided a system, including a data structure on a non-transitory computer-readable medium storing, in a first tabular format, (i) planned vehicle operations data related to a plurality of different planned vehicle operations and (ii) actual vehicle operations data for multiple instances of at least one planned vehicle operation of the plurality of different planned vehicle operations.

The system further includes at least one input device configured to receive a value for at least one user-adjustable criterion, a display device, and a processor in communication with the data structure, the at least one input device, and the display device. The processor is configured to retrieve the actual vehicle operations data and the planned vehicle operations data from the data structure and convert the actual vehicle operations data and planned vehicle operations data into a second format different from the first tabular format. The second format is compatible with crew planning software. The processor is further configured to calculate at least one variance for at least one personnel time limit criterion for the multiple instances of the at least one planned vehicle operation, based on one or more differences between the actual vehicle operations data and the planned vehicle operations data, and output to the display device at least one dynamic variance report based on the calculated at least one variance and based on the value for the at least one user-adjustable criterion. The at least one user-adjustable criterion includes one or more of a period of time, a time of day, a day of week, a month, a year and a season. The processor is further configured to receive a change to the at least one user-adjustable criterion by receiving user input via the at least one input device, update, dynamically and in real-time, the at least one dynamic variance report to a modified at least one dynamic variance report in response to and based on the changed at least one user-adjustable criterion, and output to the display device in real-time, the modified at least one dynamic variance report.

In another embodiment, there is provided a non-transitory computer readable medium storing instructions which, when executed by at least one processor, cause the at least one processor to execute the method described above or any of its variants.

In another embodiment, there is provided a system including at least one processor and the non-transitory computer-readable medium described above.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Figure 1A is a block diagram illustrating an exemplary duty schedule for a pilot over a two-day period;

5 Figure 1B is a block diagram illustrating an exemplary duty period for a pilot in which the pilot is planned to perform four flight segments during the duty period;

Figure 1C is a block diagram illustrating an exemplary duty period for a pilot in which the pilot is planned to perform four flight segments, but the fourth flight segment would exceed the pilot's duty period;

Figure 2A is a schematic depiction of a planned itinerary for an aircraft;

10 Figure 2B is a schematic depiction of the actual itinerary flown by the aircraft of Figure 2A;

Figure 3 is a block diagram of a system according to at least one aspect;

15 Figure 4A is an exemplary dynamic variance report according to at least one aspect that shows vehicle operations that included block time variances of thirty minutes or more;

Figure 4B is the exemplary dynamic variance report of Figure 4A in which the variance report has been dynamically changed to show vehicle operations that included block time variances of forty five minutes or more;

Figure 5A is an exemplary dynamic variance report according to at least one aspect that shows morning vehicle operations from Hartsfield International Airport in Atlanta, Georgia (ATL) to LaGuardia Airport in New York City, New York (LGA) that include block time variances of thirty minutes or more in the last thirty days;

- 5 Figure 5B is the exemplary dynamic variance report of Figure 5A in which the display has been dynamically changed to show morning vehicle operations from ATL to LGA with block time variances of sixty minutes or more;

- Figure 5C is the exemplary dynamic variance report of Figure 5A in which the display has been dynamically changed to show afternoon vehicle operations from ATL to LGA
10 with block time variances of thirty minutes or more;

Figure 6A is an exemplary dynamic variance report according to at least one aspect that shows vehicle operation pairs that included connection time variances of thirty minutes or more over the last thirty days;

- Figure 6B is the exemplary dynamic variance report of Figure 6A in which the variance
15 report has been dynamically changed to show vehicle operation pairs that included connection time variances of forty five minutes or more over the last sixty days;

Figure 7A is an exemplary dynamic variance report according to at least one aspect that shows morning vehicle operation pairs at ATL that include connection time variances of thirty minutes or more in the last thirty days;

- 20 Figure 7B is the exemplary dynamic variance report of Figure 7A in which the display has been dynamically changed to show afternoon vehicle operation pairs at ATL with connection time variances of forty five minutes or more in the last thirty days;

- Figure 8A is an exemplary dynamic variance report according to at least one aspect that shows vehicle operations that included duty time variances of thirty minutes or
25 more over the last thirty days;

Figure **8B** is the exemplary dynamic variance report of Figure **8A** in which the variance report has been dynamically changed to show vehicle operations that included duty time variances of fifteen minutes or more over the last thirty days;

5 Figure **9A** is an exemplary dynamic variance report according to at least one aspect that shows morning vehicle operations from ATL to LGA that include duty time variances of thirty minutes or more in the last thirty days;

Figure **9B** is the exemplary dynamic variance report of Figure **9A** in which the display has been dynamically changed to show morning vehicle operations from ATL to LGA with duty time variances of sixty minutes or more in the last thirty days;

10 Figure **10A** is an exemplary dynamic variance report according to at least one aspect that shows vehicle operations that included mismatched rotation variances of ten percent or more over the last thirty days;

15 Figure **10B** is the exemplary dynamic variance report of Figure **10A** in which the variance report has been dynamically changed to show vehicle operations that included mismatched rotation variances of fifteen percent or more over the last thirty days;

20 Figure **11A** is an exemplary dynamic variance report according to at least one aspect that shows days with vehicle operations at ATL that include mismatched rotation variances of ten percent per day or more in the last three hundred and sixty five days; and

Figure **11B** is the exemplary dynamic variance report of Figure **11A** in which the display has been dynamically changed to show days with vehicle operations at ATL that include mismatched rotation variances of twenty percent per day or more in the last three hundred and sixty five days.

DETAILED DESCRIPTION

In the following, reference is made to aspects presented in this disclosure. However, the scope of the present disclosure is not limited to specific described aspects. Instead, any combination of the following features and elements, whether related to
 5 different aspects or not, is contemplated to implement and practice contemplated aspects. Furthermore, although aspects disclosed herein may achieve advantages over other possible solutions or over the prior art, whether or not a particular advantage is achieved by a given aspect is not limiting of the scope of the present disclosure. Thus, the following aspects, features, and advantages are merely
 10 illustrative and are not considered elements or limitations of the appended claims except where explicitly recited in a claim(s). Likewise, reference to “the invention” shall not be construed as a generalization of any inventive subject matter disclosed herein and shall not be considered to be an element or limitation of the appended claims except where explicitly recited in a claim(s).

15 In various industries, assigning personnel (e.g., employees) to tasks or jobs can be limited by personal limits for the personnel. For example, commercial airline pilots have several different personal limits related to the length of time they can be on duty that can limit how the pilots can be assigned to different flight segments.

Figure 1A illustrates a two-day timeline 102 of an exemplary duty scenario 100 for a
 20 pilot of commercial aircraft. In the scenario 100, the pilot has a first duty period 104a during a first day and a second duty period 104b during a second day. The first duty period 104a and the second duty period 104b are separated by a rest period 106. Government regulations (e.g., Federal Aviation Administration regulations), airline regulations, union rules, and the like may dictate personal limits for how long the duty
 25 periods 104a and 104b can be and may also dictate how long the rest period 106 between the two duty periods 104a and 104b needs to be.

Figure 1B provides a more detailed view of an exemplary duty period 104 for a pilot. In the exemplary duty period 104, the pilot has been assigned to an itinerary of four flight

segments **108a**, **108b**, **108c**, and **108d** (collectively, flight segments **108**). Each of the flight segments **108** defines a block time, which is an elapsed time from when an aircraft is pushed back from a gate at a departure airport to when the aircraft stops at a gate at an arrival airport. Again, government regulations, airline regulations, union
 5 rules, and the like can dictate personal limits for how much block time a pilot can accumulate during a duty period **104** and how long the pilot can be on duty.

As shown in Figure **1B**, the duty period **104** can begin at an earlier time than the first flight segment **108a**. As an illustration, a pilot may begin his duty period **104** when he arrives at the airport at **6:00 AM**. However, the pilot's first flight segment may not
 10 depart the gate until **6:45 AM**. In such an instance, a time gap **110a** of forty five minutes exists between the beginning of the pilot's duty period **104** and the beginning of the block time for the first flight segment **108a**. Similarly, the pilot may need time between flight segments to travel from a first aircraft to a second aircraft, review the flight plan for the next flight segment, *etc.* Thus, time gaps **110b**, **110c**, and **110d** are
 15 inserted between flight segments **108** to allow for such pilot transitions. The length of the time gaps **110b**, **110c**, and **110d** that may be needed for pilots to transition can vary depending on the airport, time of day, time of year, *etc.* For example, at a large, busy airport such as O'Hare International Airport in Chicago Illinois, a pilot may need an hour or more to transition from a first aircraft after flying a first flight segment to a
 20 second aircraft for a second flight segment. At a smaller, less-congested airport, a pilot may only need a half-hour to transition from a first aircraft after flying a first flight segment to a second aircraft for a second flight segment. As another example, on a weekday morning when airports are busy, a pilot may need more time to transition from a first flight segment to a second flight segment than may be needed on a
 25 weekend afternoon when the airport may be less crowded.

Ideally, a pilot's duty period **104** includes a time gap **110e** between the end of his last flight segment **108d** and the end of the duty period **104**. Such a time gap **110e** can ensure that the pilot does not exceed his total duty time on the last flight segment. Figure **1C** illustrates an exemplary duty period **104** for a pilot in which the last flight
 30 segment **108d** is delayed in departing. As a result, if the pilot performed the fourth

flight segment, he would exceed his allowable duty time. For example, referring again to Figure 1C, if the fourth flight segment **108d** is delayed such that the aircraft will not arrive at the gate before the pilot's duty period **104** ends or within a predefined window of time after the pilot's duty period **104** ends, then the pilot cannot fly the flight segment

5 **108d**, and a different pilot has to perform the flight segment. By contrast, if the fourth flight segment **108d** takes off on time (as shown in Figure 1B) but is delayed in the air (e.g., by weather) such that the aircraft does not arrive at the gate until after the pilots duty period **104** ends, such an inadvertent overage of the pilot's personal limits is permissible.

10 An operation can have one or more personnel time limit criteria associated with it. Continuing the examples above, a flight segment may have several personnel time limit criteria, such as personnel time limit criteria related to block time, arrival time, and connection time. The personnel time limits may be different based on a priority of an operation. Continuing the examples above, a particular flight segment may have a

15 planned block time of two hours and thirty minutes. A personnel time limit criterion related to block time can be set to two hours and thirty minutes. For high priority flight segments, the personnel time limit criterion related to block time may be increased to three hours to provide a greater likelihood that the pilots assigned to the flight segments will not have run out of time to operate the flight.

20 For commercial airline operations, a flight segment may be defined as an operation planned to depart a first airport at a specific time of day (and possibly a day of the week) and arrive at a second airport at a second specific time of day. For example, an airline may operate hourly flight segments between LaGuardia Airport in New York City and Reagan national Airport in Washington DC. The flight segment leaving LaGuardia

25 at **7** AM each day is considered a first flight segment, a flight segment leaving LaGuardia at **8** AM each day is considered a second flight segment, *etc.* Often, an airline will use the same numerical indicator (e.g., Oceanic **1140** or Oceanic **3288**) for the same flight segment on each day. Alternatively, an airline may treat all flights between a particular city pair (e.g., any flight from Atlanta, Georgia to LaGuardia

30 Airport in New York City, New York) as the same flight segment. However, airlines

sometimes treat weekend flight segments differently than weekday flight segments because airlines may fly different schedules on the weekends and/or air traffic congestion may be reduced. For example, a flight segment from LaGuardia to Reagan National may take one hour gate to gate during the week due to air traffic and the like.

5 However, the same flight segment may only take fifty minutes on the weekend.

Another issue that arises in flight planning is mismatched rotations. A mismatched rotation occurs when an aircraft is scheduled to fly a particular segment but instead a different aircraft flies that segment. Figure 2A illustrates a planned itinerary **200** for an aircraft, wherein the aircraft is scheduled to fly a first segment **212** from Los Angeles, California **202** to Denver Colorado **204**, a second segment **214** from Denver, Colorado **204** to Chicago, Illinois **206**, and a third segment **216** from Chicago, Illinois **206** to Atlanta, Georgia **208**. Referring now to Figure 2B, in various circumstances, the aircraft may fly different segments than planned according to the schedule. Figure 2B illustrates an actual itinerary **200'** for the aircraft, wherein the aircraft actually flies the first segment **212** from Los Angeles, California **202** to Denver, Colorado **204** and the second segment **214** from Denver, Colorado **204** to Chicago, Illinois **206**. However, instead of flying the planned third segment **216** to Atlanta, Georgia **208**, the aircraft instead flies a segment **218** to Newark, New Jersey **210**. Such mismatched rotations can be problematic for several reasons. First, in instances of mismatched rotations, the crew that flies the aircraft may not be legal to fly the actual flight segment. For example, the segment **216** from Chicago, Illinois **206** to Atlanta, Georgia **208** may be scheduled for two hours of flight time whereas the segment **218** from Chicago, Illinois **206** to Newark, New Jersey **210** may be scheduled for two and a half hours of flight time. The extra half hour of flight time to actually fly to Newark, New Jersey **210** could cause the flight crew to exceed a time limit, discussed above. Second, in instances of mismatched rotations, the aircraft could be misplaced with respect to other air crews for future flights. For example, referring to Figures 2A and 2B, a different aircrew may be positioned in Atlanta, Georgia **208** to fly the aircraft two additional destinations. However, aircrew qualified to fly a particular aircraft may not be positioned in Newark, New Jersey **210**. As a result, then aircrew would have to be transported to Newark,

New Jersey **210** to fly the aircraft, potentially resulting in delays and/or expenses. Third, a mismatched rotation could cause a chain reaction of delays. Continuing the example above, suppose that the leg from Denver, Colorado **204** to Chicago, Illinois **206** is delayed by one hour. As a result, the crew flying the Denver, Colorado **204** to Chicago, Illinois **206** leg could still be scheduled to fly the Chicago, Illinois **206** to Atlanta, Georgia **208** route, but on a different aircraft because the aircraft from Denver, Colorado **204** to Chicago, Illinois **206** will now go to Newark, New Jersey **210**. As a result, the flight from Chicago, Illinois **206** to Newark, New Jersey **210** would be delayed while waiting for the aircraft to arrive from Denver, Colorado **204** and the flight from Chicago, Illinois **206** to Atlanta, Georgia **208** will be delayed while waiting for the crew to arrive in Chicago, Illinois **206** from Denver, Colorado **204**.

To avoid exceeding the personal limits of pilots, airlines can employ buffers to account for operating variances. For example, airlines may add an hour of extra block time to a duty period when scheduling the crew to decrease the likelihood that the crew will actually exceed their personal limits. Similarly, an airline may require a minimum connection time (by adding a connection time buffer between flight segments) of an hour and a half regardless of the airport, the time of day, the time of year, or the like. These buffers are often set to a conservative number that will capture most flight operations. However, a significant number of flight operations do not require such large buffers. As a result, significant amounts of crew time can be wasted by these buffers. For example, if the pilot is only allowed eight hours of block time during any given duty period **104**, then an hour of block time buffer only allows the pilot to be planned to fly seven actual block hours. Although such buffers can be wasteful, airlines have not been able to analyze actual flight operations data in a manner that would allow them to fine-tune the buffers they set for various flight operations.

In various aspects described herein, systems and methods operate on large quantities of data related to planned vehicle operations (e.g., flight operations of commercial aircraft) and actual vehicle operations to output the variance reports that illustrate differences and trends in variances between planned and actual vehicle operations. The variance reports are dynamic such that a user can change certain criteria (e.g., a

threshold limit for a variance) and the variance report will quickly update based on the changed criteria. Using these dynamic variance reports, schedule planners for vehicle operations and/or vehicle operators can study and understand different variances that occur for various flight segments based on time of day, day of the week, severity of the variance, and the like. The schedule planners can use this deeper understanding of the variances to provide more accurate buffers to use in future planning for vehicle operations and/or vehicle operators.

Figure 3 illustrates a computer system 300 that can be used to output the various reports that illustrate differences and trends in variances between planned and actual vehicle operations. The computer system 300 includes computer memory 302. The computer memory 302 can include one or more data structures that store electronic data, including planned vehicle operations data 310 and actual vehicle operations data 312. The computer system 300 also includes a processor 304 that can operate on the stored planned vehicle operations data 310 and actual vehicle operations data 312. The processor 304 can transform the stored planned vehicle operations data 310 and the actual vehicle operations data 312 from a first format to a second format. For example, the planned vehicle operations data 310 and the actual vehicle operations data 312 may be stored in the computer memory 302 in a spreadsheet file, such as a Microsoft® Excel® spreadsheet file. The processor 304 could convert the data to a different format, such as a data format compatible with a vehicle operating crew planning program. The crew planning software can be used to assign vehicles to particular routes and to assign different vehicle operators or vehicle operating crews to the routes. An example of such crew planning software is the Jeppesen Crew Pairing software. The Jeppesen Crew Pairing software is used to assign different pilot crews to different routes and Jeppesen Fleet Tracking assigns aircraft to the different routes. The computer processor 304 can operate on the formatted data to generate and output the variance reports. In various aspects, the processor could generate and output the variance reports based on the original format of the data (e.g., a spreadsheet file format). The computer system 300 can include a display device 308 that is in communication with the processor 304. The display device 308 can provide images of

the variance reports generated output by the processor **304**. In various aspects, the display device **308** could be a computer display screen, such as a LCD display. In various other aspects, the display device **308** could include a printer, or the like, that prints paper copies of the variance reports. The computer system **300** also includes

5 input device(s) **306** in communication with the computer processor **304** to enter and/or change user-adjustable criteria for dynamic variance reports. The input device(s) **306** could include a keyboard, a computer mouse, a trackpad, an electronic stylus, and/or the like.

Figure **4A** depicts a display screen view of a dynamic variance report **400** according to various aspects for block time variances for various commercial aircraft flight segments. The dynamic variance report **400** includes two user-adjustable criteria. The first user-adjustable criterion is a minimum block time variance **402** expressed in units of minutes **406**. The display includes an input field **404** in which a user, using the input device(s) **306**, can enter a minimum block time variance. For example, Figure **4A**

15 illustrates the user-adjustable criterion for minimum block time variance **402** being set to thirty minutes, meaning that only flight segments having block time variances of thirty minutes or more are displayed. The second user-adjustable criterion is a time period **408** for the dynamic variance report **400** expressed in units of days **412**. The display includes an input field **410** in which a user, using the input device(s) **306**, can

20 enter a time period for the dynamic variance report **400**. For example, Figure **4A** illustrates the user-adjustable criterion for time period **408** being set to thirty days. Based on the user-adjustable criteria for minimum block time variance **402** and time period **408**, the dynamic variance report **400** displays block time variance information for four flight segments for Oceanic Airlines that had vehicle operations in the past

25 thirty days with block time variances of thirty minutes or more. Oceanic **12** (reference **414**) had a total of six vehicle operations in the last thirty days (i.e., flight segments) that had a block time variance that exceeded thirty minutes. Here, the six vehicle operations are represented both by a numeral display **416** and by a bar graph **418**. Also, Oceanic **16** (reference **420**) had a total of eight vehicle operations in the last

30 thirty days that had a block time variance of thirty minutes or more (represented by the

numeral display **422** and by the bar graph display **424**). Also, Oceanic **21** (reference number **426**) had a total of two vehicle operations in the last thirty days that had a block time variance of thirty minutes or more (represented by the numeral display **428** and by the bar graph display **430**). Finally, Oceanic **38** (reference **432**) had a total of one vehicle operation in the last thirty days that had a block time variance of thirty minutes or more (represented by the numeral display **434** and by the bar graph display **436**).

Figure **4B** illustrates an updated display of the dynamic variance report **400'** after the user-adjustable criteria have been changed. For example, the input field **404** for the minimum block time variance **402** has been changed to forty five minutes and the input field **410** for the time period **408** has been changed to sixty days. In the updated display of the dynamic variance report **400'**, Oceanic **12** (reference **414** in Figure **4A**) no longer appears, meaning that none of the block time variances for Oceanic **12** in the last sixty days were at least forty five minutes. However, Oceanic **6** (reference **438**) has been added to the dynamic variance report **400'** and had a total of twelve block time variances (represented by the numeral display **440** and by the bar graph display **442**), meaning that Oceanic **6** had block time variances for forty five minutes or more between thirty one and sixty days ago but no block time variances of thirty minutes or more in the last thirty days. Such a dynamic presentation of data could cause a schedule planner to investigate operations related to Oceanic **6** in greater detail to identify the cause of the block time variances for Oceanic **6** and to determine whether a buffer for block time variances for future Oceanic **6** vehicle operations should be adjusted. The remaining three vehicle operations from Figure **4A** (Oceanic **16**, Oceanic **21**, and Oceanic **38**) shown in the updated display of the dynamic variance report **400'** are the same. However, in some instances, the numbers of instances of block time variances have changed. For example, Oceanic **21** (reference number **426**) only has one block time variance of **45** minutes or more, as indicated by the numeral **428'** and the bar graph **430'**.

Figure **5A** illustrates a display for a dynamic variance report **450** for vehicle operations along a particular route (i.e., a particular flight segment). In this case, the route is from

Hartfield International Airport in Atlanta, Georgia (ATL) to LaGuardia Airport in New York City, New York (LGA). The dynamic variance report **450** displays the vehicle operations based on the day of the week **470**. The dynamic variance report **450** includes three user-adjustable criteria. The first user-adjustable criterion is a minimum

5 block time variance **452** expressed in units of minutes **456**. The display includes an input field **454** in which a user, using the input device(s) **306**, can enter a minimum block time variance to be displayed. For example, Figure **5A** illustrates the user-adjustable criterion for minimum block time variance **452** being set to thirty minutes, meaning that only flight segments having block time variances of thirty minutes or

10 more are displayed. The second user-adjustable criterion is a time period **408** for the dynamic variance report **400** expressed in units of days **412**. The display includes an input field **410** in which a user, using the input device(s) **306**, can enter a time period for the dynamic variance report **400**. The third user-adjustable criterion is a time of day **464**. The display includes a field **466** that displays the selected time of day (morning in

15 Figure **5A**) and a drop-down icon **468** the user could select the drop-down icon **468** using a computer mouse or the like to change the selected time of day to mid day, afternoon, early evening, late evening, overnight, or the like. Other user-adjustable criteria could include selecting a month, a year, and/or a season. Based on the user-adjustable criteria, the dynamic variance report **450** shows that there were twelve

20 operations on Mondays in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **472** and the bar graph **474**). Additionally, the dynamic variance report **450** shows that there were ten operations on Tuesday in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **476** and the bar graph **478**). Also, the dynamic variance report **450**

25 shows that there were eight operations on Wednesdays in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **480** and the bar graph **482**). Also, the dynamic variance report **450** shows that there were eleven operations on Thursdays in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **484** and the bar graph **486**). Also, the

30 dynamic variance report **450** shows that there were seven operations on Fridays in the last thirty days that had block time variances of thirty minutes or greater (indicated by

the numeral **488** and the bar graph **490**). Also, the dynamic variance report **450** shows that there was one operation on Saturdays in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **492** and the bar graph **494**). Also, the dynamic variance report **450** shows that there was one operation on

5 Sundays in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **496** and the bar graph **498**).

From the dynamic variance report **450**, it is clear that in this instance, the block time variances are smaller on the weekends than during the weekdays. As a result, a scheduler could define a buffer for block times for the weekend days that is different

10 from a buffer for block times on weekdays.

Figure **5B** illustrates an updated display of the block time variance report **450'** in which the user-adjustable minimum block time variance criterion has been changed to sixty minutes (indicated in the input field **454**). In general, the numbers of vehicle operations with block time variances that are sixty minutes or more are less than the

15 number of vehicle of block time variances that are thirty minutes or more. For example, the dynamic variance report **450'** shows that there were ten operations on Mondays in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **472'** and the bar graph **474'**). Additionally, the dynamic variance report **450'** shows that there were seven operations on Tuesday in

20 the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **476'** and the bar graph **478'**). Also, the dynamic variance report **450'** shows that there were three operations on Wednesdays in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **480'** and the bar graph **482'**). Also, the dynamic variance report **450'** shows that there were seven

25 operations on Thursdays in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **484'** and the bar graph **486'**). Also, the dynamic variance report **450'** shows that there were five operations on Fridays in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **488'** and the bar graph **490'**). Also, the dynamic variance report **450'**

30 shows that there were no operations on Saturdays in the last thirty days that had block

time variances of thirty minutes or greater (indicated by the numeral **492'** and absent bar graph **494'**). Also, the dynamic variance report **450'** shows that there was one operation on Sundays in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **496** and the bar graph **498**). By comparing the dynamic variance report **450** in Figure **5A** with the updated dynamic variance report **450'** shown in Figure **5B**, a scheduler could see that many of the variances that exceeded thirty minutes also exceeded sixty minutes. Thus, a buffer of thirty minutes may not be sufficient to reduce variances. Similarly, a buffer of sixty minutes may not be sufficient to reduce variances. In various aspects and/or circumstances, a scheduler could continue to adjust the user-adjustable criteria for minimum block time variance **452** until the number of operations that exceed the variance is suitably low. The resulting value for the user-adjustable criteria for minimum block time variance **452** could then be used by the scheduler to assign a block time buffer for operations from ATL to LGA.

Figure **5C** is another updated display of the dynamic variance report **450''** in which the user-adjustable criterion for the minimum block time variance **452** is set to thirty minutes (as indicated by the input field **454**), but the time of day criterion **464** has been changed to afternoon (as indicated by the input field **466**). In general, the numbers of vehicle operations with block time variances that are thirty minutes or more in the afternoon are less than the number of vehicle of block time variances that are thirty minutes or more in the morning. For example, the dynamic variance report **450''** shows that there were four vehicle operations on Mondays in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **472''** and the bar graph **474''**). Additionally, the dynamic variance report **450''** shows that there were four vehicle operations on Tuesday in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **476''** and the bar graph **478''**). Also, the dynamic variance report **450''** shows that there were four vehicle operations on Wednesdays in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **480''** and the bar graph **482''**). Also, the dynamic variance report **450''** shows that there were six vehicle operations

on Thursdays in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **484**" and the bar graph **486**"). Also, the dynamic variance report **450**" shows that there were eight vehicle operations on Fridays in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **488**" and the bar graph **490**"). Also, the dynamic variance report **450**" shows that there was one operation on Saturdays in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **492**" and the bar graph **494**"). Also, the dynamic variance report **450**" shows that there were three operations on Sundays in the last thirty days that had block time variances of thirty minutes or greater (indicated by the numeral **496**" and the bar graph **498**"). By comparing the dynamic variance report **450** in Figure 5A with the updated dynamic variance report **450**" shown in Figure 5C, a scheduler could see that fewer operations in the afternoon had block time variances of thirty minutes or more than operations in the morning. Thus, a smaller buffer could be used for afternoon operations than morning operations. In various aspects and/or circumstances, a scheduler could continue to adjust the user-adjustable criteria for minimum block time variance **452** until the number of operations that exceed the variance in the morning and in the afternoon is acceptably low. The resulting values for the user-adjustable criteria for minimum block time variance **452** for the morning and the afternoon could then be used by the scheduler to assign block time buffers for operations from ATL to LGA for morning and afternoon operations, respectively.

The dynamic variance reports **450**, **450'**, and **450"** shown in Figures 5A-5C also show that the number of operations with block time variances of thirty minutes or more goes down as the week progresses for morning operations from ATL to LGA. By contrast, the dynamic variance reports **450**, **450'**, and **450"** show that the number of operations with block time variance of thirty minutes or more goes up as the week progresses for afternoon operations from ATL to LGA. Such trends identified from the dynamic variance reports **450**, **450'**, and **450"** could provide motivation for a scheduler or other person to identify reasons for such trends. For example, morning flights to LGA could experience delays early in the week due to businessman traveling to New York City for

business. By contrast, afternoon flights to LGA could experience delays later in the week due to individuals traveling to New York City for a weekend vacation. Again, a scheduler could use the information from the dynamic variance reports **450**, **450'**, and **450"**, and any underlying reasons discovered by studying the data) to adjust buffers for block time variance for operations from ATL to LGA.

Figure **6A** illustrates a display of a dynamic variance report **500** for different vehicle operation pairs, wherein the variance is a connection time variance. A connection time variance is a difference between a scheduled time for a vehicle operating crew (e.g., a flight crew) to transfer from one vehicle to another (e.g. from one aircraft to another at an airport). The dynamic variance report **500** includes two user-adjustable criteria. The first user-adjustable criterion is a minimum connection time variance **502** expressed in units of minutes **506**. The display includes an input field **504** in which a user, using the input device(s) **306**, can enter a minimum connection time variance to be displayed. For example, Figure **6A** illustrates the user-adjustable criterion for minimum connection time variance **502** being set to thirty minutes, meaning that only flight segment pairs having connection time variances of thirty minutes or more are displayed. The second user-adjustable criterion is a time period **508** for the dynamic variance report **500** expressed in units of days **512**. The display includes an input field **510** in which a user, using the input device(s) **306**, can enter a time period for the dynamic variance report **500**. For example, Figure **6A** illustrates the user-adjustable criterion for the time period **508** being set to thirty days. Based on the user-adjustable criteria for minimum connection time variance **502** and time period **508**, the dynamic variance report **500** displays connection time variance information for four flight segment pairs for Oceanic Airlines. Vehicle operators connecting from Oceanic **15** to Oceanic **29** (reference **514**) had a total of **12** connection operations in the last thirty days that had a connection time variance that exceeded thirty minutes (represented by the numeral display **516** and by the bar graph display **518**). Also, vehicle operators connecting from Oceanic **22** to Oceanic **16** (reference **520**) had a total of eight connection operations in the last thirty days that have connection time variances exceeded thirty minutes (represented by the numeral display **522** and by the bar graph

display **524**). Also, vehicle operators connecting from Oceanic **35** and Oceanic **17** (reference **523**) had a total of seven vehicle operations in the last thirty days that have connection time variances exceeded thirty minutes (represented by the numeral display **525** and by the bar graph display **526**). Finally, vehicle operators connecting
 5 from Oceanic **99** to Oceanic **5** (reference **528**) had a total of two vehicle operations in the last thirty days that had a connection time variance that exceeded thirty minutes (represented by the numeral display **530** and by the bar graph display **532**).

Figure **6B** illustrates an updated display of the dynamic variance report **500'** after the user-adjustable criteria have been changed. For example, the input field **504** for the
 10 minimum connection time variance **502** has been changed to forty five minutes and the input field **510** for the time period **508** has been changed to sixty days. In the updated display of the dynamic variance report **500'**, the connection from Oceanic **22** to Oceanic **16** (reference **520** in Figure **6A**) no longer appears, meaning that none of the connection time variances in the last sixty days were at least forty five minutes.
 15 However, a connection from Oceanic **9** to Oceanic **12** (reference **534**) does appear and had a total of seven connection time variances (represented by the numeral display **536** and by the bar graph display **538**), meaning that the vehicle operators connecting from Oceanic **9** to Oceanic **12** had connection time variances of at least forty five minutes between thirty one and sixty days ago but no connection time
 20 variances of thirty minutes or more in the last thirty days. Such a dynamic presentation of data could cause a schedule planner to investigate operations related to Oceanic **9** and Oceanic **12** in greater detail to identify the cause of the connection time variances for these vehicle operations and to determine whether a buffer for connection time variances for the flights should be adjusted. The remaining three connections from
 25 Figure **6A** (Oceanic **15** to Oceanic **29**, Oceanic **35** to Oceanic **17**, and Oceanic **99** to Oceanic **5**) shown in the updated display of the dynamic variance report **500'** are the same. However, in some instances, the numbers of instances of block time variances have changed. For example, the number of instances of connection variances from Oceanic **15** to Oceanic **29** increased to **17** instances of connection time variances of

forty five minutes over sixty days, as indicated by the numeral **516** and the bar graph **518**.

Figure 7A illustrates a display for a dynamic variance report **550** for connection time variances at a particular airport. In this case, the airport is Hartfield International Airport in Atlanta Georgia (ATL) **551**. The dynamic variance report **550** displays the vehicle operations based on day of the week **570**. The dynamic variance report **550** includes three user-adjustable criteria. The first user-adjustable criterion is a minimum connection time variance **552** expressed in units of minutes **556**. The display includes an input field **554** in which a user, using the input device(s) **306**, can enter a minimum connection time variance to be displayed. For example, Figure 7A illustrates the user-adjustable criterion for minimum connection time variance **552** being set to thirty minutes, meaning that only flight segments having connection time variances of thirty minutes or more are displayed. The second user-adjustable criterion is a time period **558** for the dynamic variance report **550** expressed in units of days **562**. The display includes an input field **560** in which a user, using the input device(s) **306**, can enter a time period for the dynamic variance report **550**. The third user-adjustable criterion is a time of day **564**. The display includes a field **566** that displays the selected time of day (morning in Figure 7A) and a drop-down icon **568**. The user could select the drop-down icon **568** using a computer mouse or the like to change the selected time of day to mid day, afternoon, early evening, late evening, overnight, or the like. Based on the user-adjustable criteria, the dynamic variance report **550** shows that there were fifty operations on Mondays in the last thirty days and in the mornings that had connection time variances of thirty minutes or greater (indicated by the numeral **572** and the bar graph **574**). Additionally, the dynamic variance report **550** shows that there were forty operations on Tuesdays in the last thirty days and in the mornings that had connection time variances of thirty minutes or greater (indicated by the numeral **576** and the bar graph **578**). Also, the dynamic variance report **550** shows that there were thirty operations on Wednesdays in the last thirty days and in the mornings that had connection time variances of thirty minutes or greater (indicated by the numeral **580** and the bar graph **582**). Also, the dynamic variance report **550** shows that there were

thirty operations on Thursdays in the last thirty days and in the mornings that had connection time variances of thirty minutes or greater (indicated by the numeral **584** and the bar graph **586**). Also, the dynamic variance report **550** shows that there were fifty operations on Fridays in the last thirty days and in the mornings that had connection time variances of thirty minutes or greater (indicated by the numeral **588** and the bar graph **590**). Also, the dynamic variance report **550** shows that there were fifteen operations on Saturdays in the last thirty days and in the mornings that had connection time variances of thirty minutes or greater (indicated by the numeral **592** and the bar graph **594**). Also, the dynamic variance report **550** shows that there were fifteen operations on Sundays in the last thirty days and in the mornings that had connection time variances of thirty minutes or greater (indicated by the numeral **596** and the bar graph **598**).

Figure **7B** illustrates an updated display of the block time variance report **550'** in which the user-adjustable minimum connection time variance criterion has been changed to forty five minutes (indicated in the input field **554**) and the time of day criterion has been changed to afternoon (indicated in the input field **566**). Based on the user-adjustable criteria, the dynamic variance report **550'** shows that there were sixty five operations on Mondays in the last thirty days and in the afternoons that had connection time variances of thirty minutes or greater (indicated by the numeral **572'** and the bar graph **574'**). Additionally, the dynamic variance report **550'** shows that there were forty five operations on Tuesdays in the last thirty days and in the afternoons that had connection time variances of thirty minutes or greater (indicated by the numeral **576'** and the bar graph **578'**). Also, the dynamic variance report **550'** shows that there were forty five operations on Wednesdays in the last thirty days and in the afternoons that had connection time variances of thirty minutes or greater (indicated by the numeral **580'** and the bar graph **582'**). Also, the dynamic variance report **550'** shows that there were forty four operations on Thursdays in the last thirty days and in the afternoons that had connection time variances of thirty minutes or greater (indicated by the numeral **584'** and the bar graph **586'**). Also, the dynamic variance report **550'** shows that there were sixty operations on Fridays in the last thirty days and in the afternoons

that had connection time variances of thirty minutes or greater (indicated by the numeral **588'** and the bar graph **590'**). Also, the dynamic variance report **550'** shows that there were ten operations on Saturdays in the last thirty days and in the afternoons that had connection time variances of thirty minutes or greater (indicated by the numeral **592'** and the bar graph **594'**). Also, the dynamic variance report **550'** shows that there were fifty operations on Sundays in the last thirty days and in the afternoons that had connection time variances of thirty minutes or greater (indicated by the numeral **596'** and the bar graph **598'**).

Based on a comparison between the dynamic variance reports in Figures **7A** and **7B**, a scheduler could determine that the connection time variances are worse in the afternoon in general than in the morning. As a result, the scheduler could use different connection time buffers for the morning and the afternoon.

Figure **8A** depicts a display screen view of a dynamic variance report **600** according to various aspects for duty time variances for various commercial aircraft flight segments.

The dynamic variance report **600** includes two user-adjustable criteria. The first user-adjustable criterion is a minimum duty time variance **602** expressed in units of minutes **606**. The display includes an input field **604** in which a user, using the input device(s) **306**, can enter a minimum duty time variance to be displayed. For example, Figure **8A** illustrates the user-adjustable criterion for minimum duty time variance **602** being set to thirty minutes, meaning that only flight segments having duty time variances of thirty minutes or more are displayed. The second user-adjustable criterion is a time period **608** for the dynamic variance report **600** expressed in units of days **612**. The display includes an input field **610** in which a user, using the input device(s) **306**, can enter a time period for the dynamic variance report **400**. For example, Figure **8A** illustrates the user-adjustable criterion for time period **608** being set to thirty days. Based on the user-adjustable criteria for minimum duty time variance **602** and time period **608**, the dynamic variance report **600** displays duty time variance information for four flight segments for Oceanic Airlines. Twelve percent of the vehicle operations for Oceanic **15** (reference **613**) in the last thirty days (i.e., flight segments) had a duty time variance that exceeded thirty minutes. Here, the twelve percent of vehicle operations is

represented both by a numeral display **614** and by a bar graph **616**. Also, forty percent of the vehicle operations for Oceanic **33** (reference number **618**) in the last thirty days had a duty time variances exceeded thirty minutes (represented by the numeral display **620** and by the bar graph display **622**). Also, twenty five percent of the vehicle operations for Oceanic **67** (reference number **624**) in the last thirty days had a duty time variances exceeded thirty minutes (represented by the numeral display **626** and by the bar graph display **628**). Also, thirty three percent of the vehicle operations for Oceanic **71** (reference number **630**) in the last thirty days had a duty time variances exceeded thirty minutes (represented by the numeral display **632** and by the bar graph display **634**).

Figure **8B** illustrates an updated display of the dynamic variance report **600'** after the user-adjustable criteria have been changed. For example, the input field **604** for the minimum duty time variance **602** has been changed to fifteen minutes. In the updated display of the dynamic variance report **600'**, the percentages for Oceanic **15** (reference number **613**), Oceanic **33** (reference number **618**), and Oceanic **71** (reference number **630**) have increased, meaning that there were other some duty time variances of at least fifteen minutes but less than thirty minutes. The percentages for Oceanic **67** (reference number **624**) have not changed, meaning that all of the duty time variances were more than thirty minutes. Also, an additional vehicle operation, Oceanic **35** (reference number **636**) has been added to the dynamic variance report **600'**. Thirty percent of the vehicle operations for Oceanic **35** (reference number **636**) in the last thirty days had a duty time variance that exceeded fifteen minutes (represented by the numeral display **638** and by the bar graph display **640**). However, Oceanic **35** (reference number **636**) did not have any duty time variances in the last thirty days that exceeded thirty minutes because Oceanic **35** does not appear on the dynamic variance report **600** shown in Figure **6A**. Such a dynamic presentation of data could be used by a scheduler to set duty time buffers for various vehicle operations. For example, the scheduler could set a thirty minute buffer for Oceanic **35**, which did not have any duty time variances of thirty minutes or more, and forty five minute duty time buffers for Oceanic **15**, Oceanic **33**, Oceanic **67**, and Oceanic **71**, which had duty time

variances in excess of thirty minutes. In various instances, the scheduler could continue to adjust the minimum duty time variance criterion **602** (using the input field **604**) to find a variance level at which most of the different flight operations have been removed from the dynamic variance report **600** and/or the number (or percentages) of instances of flight operations that exceed the specified minimum duty time criterion **602** is suitably low. The scheduler could then set the duty time buffer for the operations to be equal to this value for the minimum duty time variance criterion **602**.

Figure **9A** illustrates a display for a dynamic variance report **650** for vehicle operations along a particular route. In this case, the route is from Hartsfield International Airport in Atlanta Georgia (ATL) to LaGuardia Airport in New York City, New York (LGA) (indicated by reference number **651**). The dynamic variance report **650** displays variance data for the vehicle operations based on day of the week **670**. The dynamic variance report **650** includes three user-adjustable criteria. The first user-adjustable criterion is a minimum duty time variance **652** expressed in units of minutes **656**. The display includes an input field **654** in which a user, using the input device(s) **306**, can enter a minimum duty time variance **652** to be displayed. For example, Figure **9A** illustrates the user-adjustable criterion for minimum duty time variance **652** being set to thirty minutes, meaning that only flight segments having duty time variances of thirty minutes or more are displayed. The second user-adjustable criterion is a time period **658** for the dynamic variance report **650** expressed in units of days **662**. The display includes an input field **410** in which a user, using the input device(s) **306**, can enter a time period for the dynamic variance report **650**. The third user-adjustable criterion is a time of day **664**. The display includes a field **666** that displays the selected time of day (morning in Figure **9A**) and a drop-down icon **668** the user could select the drop-down icon **668** using a computer mouse or the like to change the selected time of day to mid day, afternoon, early evening, late evening, overnight, or the like. Based on the user-adjustable criteria, the dynamic variance report **650** shows that twenty five percent of the vehicle operations on Monday mornings in the last thirty days had duty time variances of thirty minutes or greater (indicated by the numeral **672** and the bar graph **674**). Additionally, the dynamic variance report **650** shows that twenty percent

of the vehicle operations on Tuesday mornings in the last thirty days had duty time variances of thirty minutes or greater (indicated by the numeral **676** and the bar graph **678**). Also, the dynamic variance report **650** shows that nineteen percent of the vehicle operations on Wednesday mornings in the last thirty days had duty time

5 variances of thirty minutes or greater (indicated by the numeral **680** and the bar graph **682**). Also, the dynamic variance report **650** shows that twenty percent of the vehicle operations on Thursday mornings in the last thirty days had duty time variances of thirty minutes or greater (indicated by the numeral **684** and the bar graph **686**). Also,

10 the dynamic variance report **650** shows that thirty percent of the vehicle operations on Friday mornings in the last thirty days had duty time variances of thirty minutes or greater (indicated by the numeral **688** and the bar graph **690**). Also, the dynamic variance report **650** shows that six percent of the vehicle operations on Saturday mornings in the last thirty days had duty time variances of thirty minutes or greater (indicated by the numeral **692** and the bar graph **694**). Also, the dynamic variance

15 report **650** shows that five percent of the vehicle operations on Sunday mornings in the last thirty days had duty time variances of thirty minutes or greater (indicated by the numeral **696** and the bar graph **698**).

From the dynamic variance report **650**, it's clear that in this instance, the duty time variances are significantly smaller on the weekends than during the weekdays. As a

20 result, a scheduler could define a buffer for duty times for the weekend days that is different from a buffer for duty times on weekdays.

Figure **9B** illustrates an updated display of the dynamic variance report **650'** in which the user-adjustable minimum duty time variance criterion has been changed to sixty minutes (indicated in the input field **654**). In general, the numbers of vehicle

25 operations with duty time variances that are sixty minutes or more are less than the number of vehicle of duty time variances that are thirty minutes or more. For example, the dynamic variance report **650'** shows that twelve percent of the vehicle operations on Monday mornings in the last thirty days had duty time variances of sixty minutes or greater (indicated by the numeral **672'** and the bar graph **674'**). Additionally, the

30 dynamic variance report **650'** shows that eight percent of the vehicle operations on

Tuesday mornings in the last thirty days had duty time variances of sixty minutes or greater (indicated by the numeral **676'** and the bar graph **678'**). Also, the dynamic variance report **650'** shows that eight percent of the vehicle operations on Wednesday mornings in the last thirty days had duty time variances of sixty minutes or greater (indicated by the numeral **680'** and the bar graph **682'**). Also, the dynamic variance report **650'** shows that twelve percent of the vehicle operations on Thursday mornings in the last thirty days had duty time variances of sixty minutes or greater (indicated by the numeral **684'** and the bar graph **686'**). Also, the dynamic variance report **650'** shows that twenty percent of the vehicle operations on Friday mornings in the last thirty days had duty time variances of sixty minutes or greater (indicated by the numeral **688'** and the bar graph **690'**). Also, the dynamic variance report **650'** shows that none of the vehicle operations on Saturday mornings in the last thirty days had duty time variances of sixty minutes or greater (indicated by the numeral **692'** and (absent) bar graph **694'**). Also, the dynamic variance report **650'** shows that two percent of the vehicle operations on Sunday mornings in the last thirty days had duty time variances of sixty minutes or greater (indicated by the numeral **696'** and the bar graph **698'**). By comparing the dynamic variance report **650** in Figure **9A** with the updated dynamic variance report **650'** shown in Figure **9B**, a scheduler could see that many of the variances that exceeded thirty minutes also exceeded **60** minutes. Thus, a buffer of thirty minutes may not be sufficient to reduce variances. Similarly, a buffer of **60** minutes may not be sufficient to reduce variances. In various aspects and/or circumstances, a scheduler could continue to adjust the user-adjustable criteria for minimum duty time variance **652** until the number of operations that exceed the variance is acceptably low. The resulting value for the user-adjustable criteria for minimum duty time variance **652** could then be used by the scheduler to assign a duty time buffer for operations from ATL to LGA.

Figure **10A** depicts a display screen view of a dynamic variance report **700** according to various aspects for mismatched rotation variances for various commercial aircraft flight segments. The dynamic variance report **700** includes two user-adjustable criteria. The first user-adjustable criterion is a minimum mismatched rotation variance

702 expressed as a percentage of vehicle operations **706**. The display includes an input field **704** in which a user, using the input device(s) **306**, can enter a minimum mismatched rotation variance to be displayed. For example, Figure **10A** illustrates the user-adjustable criterion for minimum mismatched rotation variance **702** being set to ten percent, meaning that only flight segments having mismatched rotation variances of ten percent or more are displayed. The second user-adjustable criterion is a time period **708** for the dynamic variance report **700** expressed in units of days **712**. The display includes an input field **710** in which a user, using the input device(s) **306**, can enter a time period for the dynamic variance report **700**. For example, Figure **10A** illustrates the user-adjustable criterion for time period **708** being set to thirty days. Based on the user-adjustable criteria for minimum mismatched rotation variance **702** and time period **708**, the dynamic variance report **700** displays mismatched rotation variance information for four flight segments for Oceanic Airlines. Thirty percent of the vehicle operations for Oceanic **11** (reference number **714**) in the last thirty days (i.e., flight segments) had a mismatched rotation variance. Here, the thirty percent of vehicle operations is represented both by a numeral display **716** and by a bar graph **718**. Also, fifteen percent of the vehicle operations for Oceanic **13** (reference number **720**) in the last thirty days had a mismatched rotation variance (represented by the numeral display **722** and by the bar graph display **724**). Also, fifteen percent of the vehicle operations for Oceanic **18** (reference number **728**) in the last thirty days had a mismatched rotation variance (represented by the numeral display **730** and by the bar graph display **732**). Also, ten percent of the vehicle operations for Oceanic **76** (reference number **734**) in the last thirty days had a mismatched rotation variance (represented by the numeral display **736** and by the bar graph display **738**).

Figure **10B** illustrates an updated display of the dynamic variance report **700'** after the user-adjustable criteria have been changed. For example, the input field **704** for the minimum mismatched rotation variance **702** has been changed to fifteen percent. In the updated display of the dynamic variance report **700'**, the percentages for Oceanic **11** (reference number **714**), Oceanic **13** (reference number **720**), and Oceanic **18** (reference number **728**) are the same because each flight segment had mismatched

rotation variances of at least fifteen percent. However, Oceanic **76** (reference number **734**) does not appear in the updated dynamic variance report **700** because fewer than fifteen percent of the flight segments had mismatched rotation variances. Such a dynamic presentation of data could be used by a scheduler to identify vehicle
5 operations with significant mismatched rotation problems.

Figure **11A** illustrates a display for a dynamic variance report **750** for vehicle operations at Hartsfield International Airport in Atlanta Georgia (ATL) (indicated by reference number **751**). The dynamic variance report **750** displays variance data for the vehicle operations based on day of the week **770**. The dynamic variance report
10 **750** includes three user-adjustable criteria. The first user-adjustable criterion is a minimum mismatched rotation variance **752** expressed as a percentage per day **756**. The display includes an input field **754** in which a user, using the input device(s) **306**, can enter a minimum mismatched rotation variance **752** to be displayed. For example, Figure **11A** illustrates the user-adjustable criterion for minimum mismatched rotation
15 variance **752** being set to ten percent per day, meaning that only days that have more than ten percent of flights having mismatched rotations are displayed. The second user-adjustable criterion is a time period **758** for the dynamic variance report **750** expressed in units of days **762**. The display includes an input field **760** in which a user, using the input device(s) **306**, can enter a time period for the dynamic variance
20 report **750**. Here, the time period has been set to three hundred and sixty five days. The third user-adjustable criterion is a time of day **764**. The display includes a field **766** that displays the selected time of day ("all" in Figure **11A**) and a drop-down icon **768**. The user could select the drop-down icon **768** using a computer mouse or the like to change the selected time of day to mid day, afternoon, early evening, late
25 evening, overnight, or the like. Based on the user-adjustable criteria, the dynamic variance report **750** shows that forty Mondays in the last three hundred and sixty five days had mismatched rotation variances in excess of ten percent at ATL (indicated by the numeral **772** and the bar graph **774**). Also, the dynamic variance report **750** shows that thirty Tuesdays in the last three hundred and sixty five days had
30 mismatched rotation variances in excess of ten percent at ATL (indicated by the

numeral **776** and the bar graph **778**). Also, the dynamic variance report **750** shows that twelve Wednesdays in the last three hundred and sixty five days had mismatched rotation variances in excess of ten percent at ATL (indicated by the numeral **780** and the bar graph **782**). Also, the dynamic variance report **750** shows that ten Thursdays in the last three hundred and sixty five days had mismatched rotation variances in excess of ten percent at ATL (indicated by the numeral **784** and the bar graph **786**). Also, the dynamic variance report **750** shows that fifteen Fridays in the last three hundred and sixty five days had mismatched rotation variances in excess of ten percent at ATL (indicated by the numeral **788** and the bar graph **790**). Also, the dynamic variance report **750** shows that one Saturday in the last three hundred and sixty five days had mismatched rotation variances in excess of ten percent at ATL (indicated by the numeral **792** and the bar graph **794**). Also, the dynamic variance report **750** shows that one Sunday in the last three hundred and sixty five days had mismatched rotation variances in excess of ten percent at ATL (indicated by the numeral **796** and the bar graph **798**).

From the dynamic variance report **750**, it's clear that in this instance, the mismatched rotation variances are significantly smaller on the weekends than during the weekdays. As a result, a scheduler could put in place more resources (e.g., back up flight crews) at ATL during the week than on the weekend.

Figure **11B** illustrates an updated display of the dynamic variance report **750'** for mismatched rotations in which the user-adjustable minimum mismatched rotation variance criterion has been changed to twenty percent per day (indicated in the input field **754**). In general, the number of days with mismatched rotation variances at ATL in excess of twenty percent is less than the number of days with mismatched rotation variances that are ten percent per day. For example, the dynamic variance report **750'** shows that thirty Mondays in the last three hundred and sixty five days had mismatched rotation variances in excess of twenty percent at ATL (indicated by the numeral **772'** and the bar graph **774'**). Also, the dynamic variance report **750'** shows that eighteen Tuesdays in the last three hundred and sixty five days had mismatched rotation variances in excess of twenty percent at ATL (indicated by the numeral **776'**

and the bar graph **778'**). Also, the dynamic variance report **750'** shows that six Wednesdays in the last three hundred and sixty five days had mismatched rotation variances in excess of twenty percent at ATL (indicated by the numeral **780'** and the bar graph **782'**). Also, the dynamic variance report **750'** shows that two Thursdays in
5 the last three hundred and sixty five days had mismatched rotation variances in excess of twenty percent at ATL (indicated by the numeral **784'** and the bar graph **786'**). Also, the dynamic variance report **750'** shows that seven Fridays in the last three hundred and sixty five days had mismatched rotation variances in excess of twenty percent at ATL (indicated by the numeral **788'** and the bar graph **790'**). Also, the dynamic
10 variance report **750'** shows that no Saturdays in the last three hundred and sixty five days had mismatched rotation variances in excess of twenty percent at ATL (indicated by the numeral **792'** and the absent bar graph **794'**). Also, the dynamic variance report **750'** shows that no Sundays in the last three hundred and sixty five days had mismatched rotation variances in excess of twenty percent at ATL (indicated by the
15 numeral **796'** and the bar graph **798'**).

The exemplary dynamic variance reports outline certain types of variance reports that could be used in the aviation industry. Other types of dynamic variance reports could also be provided for the aviation industry or for other types of vehicle operations. Additionally, the formats of the variance reports, including the presentation of the
20 numbers of instances of variances as absolute numbers or percentages and graphical presentations as bar graphs, are for illustration purposes only. Other presentations of variance data, including different numeric presentation and different graphical presentations of are contemplated. The dynamic variance reports enable a vehicle operations scheduler to understand certain variances and trends in those variances.
25 The scheduler can then use that understanding to apply suitable buffers to the different vehicle operations that result in the actual vehicle operations being closer to the planned vehicle operations.

The descriptions of the various aspects have been presented for purposes of illustration, but are not intended to be exhaustive or limited to the aspects disclosed.
30 Many modifications and variations will be apparent to those of ordinary skill in the art

without departing from the scope and spirit of the described aspects. The terminology used herein was chosen to best explain the principles of the aspects, the practical application or technical improvement over technologies found in the marketplace, or to enable others of ordinary skill in the art to understand the aspects disclosed herein.

- 5 Aspects described herein may take the form of an entirely hardware aspect, an entirely software aspect (including firmware, resident software, micro-code, etc.) or an aspect combining software and hardware aspects that may all generally be referred to herein as a “circuit,” “module” or “system.”

- 10 Various aspects may be a system, a method, and/or a computer program product. The computer program product may include a computer readable storage medium (or media) having computer readable program instructions thereon for causing a processor to carry out aspects described herein.

- The computer readable storage medium can be a tangible device that can retain and store instructions for use by an instruction execution device. The computer readable storage medium may be, for example, but is not limited to, an electronic storage device, a magnetic storage device, an optical storage device, an electromagnetic storage device, a semiconductor storage device, or any suitable combination of the foregoing. A non-exhaustive list of more specific examples of the computer readable storage medium includes the following: a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), a static random access memory (SRAM), a portable compact disc read-only memory (CD-ROM), a digital versatile disk (DVD), a memory stick, a floppy disk, a mechanically encoded device such as punch-cards or raised structures in a groove having instructions recorded thereon, and any suitable combination of the foregoing. A computer readable storage medium, as used herein, is not to be construed as being transitory signals *per se*, such as radio waves or other freely propagating electromagnetic waves, electromagnetic waves propagating through a waveguide or
- 15
- 20
- 25

other transmission media (e.g., light pulses passing through a fiber-optic cable), or electrical signals transmitted through a wire.

Computer readable program instructions described herein can be downloaded to respective computing/processing devices from a computer readable storage medium
5 or to an external computer or external storage device via a network, for example, the Internet, a local area network, a wide area network and/or a wireless network. The network may comprise copper transmission cables, optical transmission fibers, wireless transmission, routers, firewalls, switches, gateway computers and/or edge servers. A network adapter card or network interface in each computing/processing
10 device receives computer readable program instructions from the network and forwards the computer readable program instructions for storage in a computer readable storage medium within the respective computing/processing device.

Computer readable program instructions for carrying out operations of various aspects may be assembler instructions, instruction-set-architecture (ISA) instructions, machine
15 instructions, machine dependent instructions, microcode, firmware instructions, state-setting data, or either source code or object code written in any combination of one or more programming languages, including an object oriented programming language such as Smalltalk, C++ or the like, and conventional procedural programming languages, such as the "C" programming language or similar programming languages.
20 The computer readable program instructions may execute entirely on the user's computer, partly on the user's computer, as a stand-alone software package, partly on the user's computer and partly on a remote computer or entirely on the remote computer or server. In the latter scenario, the remote computer may be connected to the user's computer through any type of network, including a local area network (LAN)
25 or a wide area network (WAN), or the connection may be made to an external computer (for example, through the Internet using an Internet Service Provider). In some aspects, electronic circuitry including, for example, programmable logic circuitry, field-programmable gate arrays (FPGA), or programmable logic arrays (PLA) may execute the computer readable program instructions by utilizing state information of

the computer readable program instructions to personalize the electronic circuitry, in order to perform aspects described herein.

Aspects are described herein with reference to flowchart illustrations and/or block diagrams of methods, apparatus (systems), and computer program products according to aspects. It will be understood that each block of the flowchart illustrations and/or block diagrams, and combinations of blocks in the flowchart illustrations and/or block diagrams, can be implemented by computer readable program instructions.

These computer readable program instructions may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks. These computer readable program instructions may also be stored in a computer readable storage medium that can direct a computer, a programmable data processing apparatus, and/or other devices to function in a particular manner, such that the computer readable storage medium having instructions stored therein comprises an article of manufacture including instructions which implement aspects of the function/act specified in the flowchart and/or block diagram block or blocks.

The computer readable program instructions may also be loaded onto a computer, other programmable data processing apparatus, or other device to cause a series of operational steps to be performed on the computer, other programmable apparatus or other device to produce a computer implemented process, such that the instructions which execute on the computer, other programmable apparatus, or other device implement the functions/acts specified in the flowchart and/or block diagram block or blocks.

The flowchart and block diagrams in the Figures illustrate the architecture, functionality, and operation of possible implementations of systems, methods, and

computer program products according to various aspects. In this regard, each block in the flowchart or block diagrams may represent a module, segment, or portion of instructions, which comprises one or more executable instructions for implementing the specified logical function(s). In some alternative implementations, the functions noted
5 in the block may occur out of the order noted in the figures. For example, two blocks shown in succession may, in fact, be executed substantially concurrently, or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved. It will also be noted that each block of the block diagrams and/or flowchart illustration, and combinations of blocks in the block diagrams and/or flowchart
10 illustration, can be implemented by special purpose hardware-based systems that perform the specified functions or acts or carry out combinations of special purpose hardware and computer instructions.

Aspects may be provided to end users through a cloud computing infrastructure. Cloud computing generally refers to the provision of scalable computing resources as
15 a service over a network. More formally, cloud computing may be defined as a computing capability that provides an abstraction between the computing resource and its underlying technical architecture (e.g., servers, storage, networks), enabling convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management
20 effort or service provider interaction. Thus, cloud computing allows a user to access virtual computing resources (e.g., storage, data, applications, and even complete virtualized computing systems) in "the cloud," without regard for the underlying physical systems (or locations of those systems) used to provide the computing resources.

25 Typically, cloud computing resources are provided to a user on a pay-per-use basis, where users are charged only for the computing resources actually used (e.g. an amount of storage space consumed by a user or a number of virtualized systems instantiated by the user). A user can access any of the resources that reside in the cloud at any time, and from anywhere across the Internet. In context of aspects
30 described herein, a user may access applications (e.g., applications that generate and

output dynamic variance reports) or related data available in the cloud. For example, the dynamic variance report application could execute on a computing system in the cloud and operate on the planned and actual vehicle operation data to generate and output dynamic variance reports. In such a case, the dynamic variance application
5 could store the dynamic variance reports at a storage location in the cloud. Doing so allows a user to access this information from any computing system attached to a network connected to the cloud (e.g., the Internet).

While the foregoing is directed to aspects, other and further aspects may be devised without departing from the basic scope thereof, and the scope thereof is determined by
10 the claims that follow.

EMBODIMENTS IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A computer-implemented method, comprising:

- 5 causing at least one processor to store electronic data for actual vehicle operations and planned vehicle operations in a data structure in a first tabular format on a non-transitory computer-readable medium, wherein the actual vehicle operations data and the planned vehicle operations data includes data for different vehicle operations, and wherein the data
- 10 for the different vehicle operations includes multiple instances of the different vehicle operations;
- causing the at least one processor to convert the actual vehicle operations data and planned vehicle operations data into a second format
- 15 different from the first tabular format, wherein the second format is compatible with crew planning software;
- causing the at least one processor to calculate at least one variance for at least one personnel time limit criterion for the multiple instances of the
- 20 different vehicle operations, based on one or more differences between the actual vehicle operations data and the planned vehicle operations data;
- causing the at least one processor to generate via the crew planning software, and display via a display device, at least one dynamic variance
- 25 report based on the calculated at least one variance and based on at least one user-adjustable criterion, wherein the at least one user-adjustable criterion comprises one or more of a period of time, a time of day, a day of week, a month, a year and a season;

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causing the at least one processor to receive, via an electronic input device, user input from a user changing the at least one user-adjustable criterion;

5 causing the at least one processor to dynamically and in real-time modify the at least one dynamic variance report in response to and based on the changed at least one user-adjustable criterion; and

10 causing the at least one processor to generate via the crew planning software, and display via the display device, the modified at least one dynamic variance report to the user in real-time.

2. The computer-implemented method of claim 1, wherein:

15 the vehicle operations are flight segments for commercial aircraft,

the at least one variance comprises block time variances for the flight segments,

20 the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

25 the dynamic variance report comprises a first display of flight segments that exceed a first user-adjustable variance threshold and wherein the at least one processor causes the dynamic variance report to dynamically become the modified dynamic variance report comprising a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first user-adjustable variance threshold to the second user-adjustable variance threshold.

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3. The computer-implemented method of claim 1, wherein:

the vehicle operations are multiple instances of a flight segment,

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the at least one variance comprises block time variances for the multiple instances,

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the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

15

the dynamic variance report comprises a first display of instances of the flight segment that exceed a first user-adjustable variance threshold and wherein the at least one processor causes the dynamic variance report to dynamically become the modified dynamic variance report comprising a second display of instances of the flight segment that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first user-adjustable variance threshold to the second user-adjustable variance threshold.

20

4. The computer-implemented method of claim 1, wherein:

the vehicle operations are flight segments for commercial aircraft,

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the at least one variance comprises connection time variances for flight crews for flight segment pairs,

the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

30

the dynamic variance report comprises a first display of flight segments that exceed a first user-adjustable variance threshold and wherein the at least one processor causes the dynamic variance report to dynamically become the modified dynamic variance report comprising a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first user-adjustable variance threshold to the second user-adjustable variance threshold.

5

10 **5.** The computer-implemented method of claim 1, wherein:

the vehicle operations are flight segments for commercial aircraft,

the at least one variance comprises connection time variances at particular airports,

15

the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

the dynamic variance report comprises a first display of flight segments that exceed a first user-adjustable variance threshold and wherein the at least one processor causes the dynamic variance report to dynamically become the modified dynamic variance report comprising a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first user-adjustable variance threshold to the second user-adjustable variance threshold.

20

25

6. The computer-implemented method of claim 1, wherein:

30

the vehicle operations are flight segments for commercial aircraft,

the at least one variance comprises duty time variances for flight crews for itineraries of flight segments,

5

the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

10

the dynamic variance report comprises a first display of flight segments that exceed a first user-adjustable variance threshold and wherein the at least one processor causes the dynamic variance report to dynamically become the modified dynamic variance report comprising a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first user-adjustable variance threshold to the second user-adjustable variance threshold.

15

7. The computer-implemented method of claim 1, wherein:

20

the vehicle operations are flight segments for commercial aircraft,

the at least one variance comprises instances in which an aircraft does not operate a pre-planned itinerary of flight segments,

25

the at least one user-adjustable criterion further comprises a user-adjustable number of instances, and

30

the dynamic variance report comprises a first display of flight segments that exceed a first user-adjustable number of instances and wherein the at least one processor causes the dynamic variance report to dynamically

become the modified dynamic variance report comprising a second display of flight segments that exceed a second user-adjustable number of instances upon the user-adjustable number of instances being changed from the first user-adjustable number of instances to the second user-adjustable number of instances.

5

8. The computer-implemented method of claim 1, wherein:

the vehicle operations are flight segments for commercial aircraft,

10

the at least one variance comprises instances in which aircraft departing from a particular airport do not operate a pre-planned flight segment,

the at least one user-adjustable criterion further comprises a user-adjustable number of instances, and

15

the dynamic variance report comprises a first display of flight segments that exceed a first user-adjustable number of instances and wherein the at least one processor causes the dynamic variance report to dynamically become the modified dynamic variance report comprising a second display of flight segments that exceed a second user-adjustable number of instances upon the user-adjustable number of instances being changed from the first user-adjustable number of instances to the second user-adjustable number of instances.

20

25

9. A computer program product for generating dynamic reports related to vehicle operations, the computer program product comprising:

a non-transitory computer-readable storage medium having computer-readable program code embodied therewith, the computer-readable program code executable by one or more computer processors to:

- 5 store electronic data for actual vehicle operations and planned vehicle operations in a data structure in a first tabular format on a non-transitory computer-readable medium, wherein the actual vehicle operations data and the planned vehicle operations data includes data for different vehicle operations, and wherein the data
- 10 for the different vehicle operations includes multiple instances of the different vehicle operations;
- 15 convert the actual vehicle operations data and planned vehicle operations data into a second format different from the first tabular format, wherein the second format is compatible with crew planning software;
- 20 calculate at least one variance for at least one personnel time limit criterion for the multiple instances of the different vehicle operations, based on differences between the actual vehicle operations data and planned vehicle operations data;
- 25 cause the crew planning software to generate and a display device to display a dynamic variance report based on the calculated at least one variance and based on at least one user-adjustable criterion, wherein the at least one user-adjustable criterion comprises one or more of a period of time, a time of day, a day of week, a month, a year and a season;

receive user input from a user changing the at least one user-adjustable criterion via an electronic input device;

5 dynamically and in real-time modify the dynamic variance report in response to and based on the changed at least one user-adjustable criterion; and

10 cause the crew planning software to generate and the display device to display the modified dynamic variance report to the user in real-time.

10. The computer program product of claim 9, wherein:

15 the vehicle operations comprise multiple instances of a flight segment,

the at least one variance comprises block time variances for the multiple instances,

20 the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

25 the dynamic variance report comprises a first display of instances of the flight segment that exceed a first user-adjustable variance threshold and wherein the computer-readable program code is executable by the one or more computer processors to cause the dynamic variance report to dynamically become the modified dynamic variance report comprising a second display of instances of the flight segment that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first user-adjustable variance threshold
30 to the second user-adjustable variance threshold.

11. The computer program product of claim 9, wherein:

the vehicle operations comprise flight segments for commercial aircraft,

5

the at least one variance comprises connection time variances for flight crews for flight segment pairs,

the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

10

the dynamic variance report comprises a first display of flight segments that exceed a first user-adjustable variance threshold and wherein the computer-readable program code is executable by the one or more computer processors to cause the dynamic variance report to dynamically become the modified dynamic variance report comprising a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first user-adjustable variance threshold to the second user-adjustable variance threshold.

15

20

12. The computer program product of claim 9, wherein:

the vehicle operations comprise flight segments for commercial aircraft,

25

the at least one variance comprises connection time variances at particular airports,

the at least one user-adjustable criterion comprises a user-adjustable variance threshold, and

30

the dynamic variance report comprises a first display of flight segments that exceed a first user-adjustable variance threshold and wherein the computer-readable program code is executable by the one or more computer processors to cause the dynamic variance report to dynamically become the modified dynamic variance report comprising a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

13. The computer program product of claim 9, wherein:

the vehicle operations comprise flight segments for commercial aircraft,

the at least one variance comprises duty time variances for flight crews for itineraries of flight segments,

the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

the dynamic variance report comprises a first display of flight segments that exceed a first user-adjustable variance threshold and wherein the computer-readable program code is executable by the one or more computer processors to cause the dynamic variance report to dynamically become the modified dynamic variance report comprising a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first user-adjustable variance threshold to the second user-adjustable variance threshold.

14. The computer program product of claim **9**, wherein:

the vehicle operations comprise flight segments for commercial aircraft,

5 the at least one variance comprises instances in which an aircraft does not operate a pre-planned itinerary of flight segments,

the at least one user-adjustable criterion further comprises a user-adjustable number of instances, and

10

the dynamic variance report comprises a first display of flight segments that exceed a first user-adjustable number of instances and wherein the computer-readable program code is executable by the one or more computer processors to cause the dynamic variance report to dynamically become the modified dynamic variance report comprising a second display of flight segments that exceed a second user-adjustable number of instances upon the user-adjustable number of instances being changed from the first user-adjustable number of instances to the second user-adjustable number of instances.

15

20

15. The computer program product of claim **9**, wherein:

the vehicle operations comprise flight segments for commercial aircraft,

25 the at least one variance comprises instances in which aircraft departing from a particular airport do not operate a pre-planned flight segment,

the at least one user-adjustable criterion further comprises a user-adjustable number of instances, and

30

the dynamic variance report comprises a first display of flight segments that exceed a first user-adjustable number of instances and wherein the computer-readable program code is executable by the one or more computer processors to cause the dynamic variance report to dynamically become the modified dynamic variance report comprising a second display of flight segments that exceed a second user-adjustable number of instances upon the user-adjustable number of instances being changed from the first user-adjustable number of instances to the second user-adjustable number of instances.

16. A system, comprising:

a data structure in a first tabular format on a non-transitory computer-readable medium storing data related to planned vehicle operations and actual vehicle operations, wherein the actual vehicle operations data and the planned vehicle operations data includes data for different vehicle operations, and wherein the data for the different vehicle operations includes multiple instances of the different vehicle operations;

at least one input device configured to receive at least one user-adjustable criterion;

a display device; and

a processor in communication with the data structure, the at least one input device, and the display device, the processor configured to:

retrieve the actual vehicle operations data and the planned vehicle operations data in the first tabular format from the data structure;

convert the actual vehicle operations data and planned vehicle operations data into a second format different from the first tabular format, wherein the second format is compatible with a crew planning software;

5

calculate at least one variance for at least one personnel time limit criterion for the multiple instances of the different vehicle operations, based on differences between the actual vehicle operations data and the planned vehicle operations data;

10

generate via the crew planning software and display via the display device a first at least one dynamic variance report based on the calculated at least one variance and based on at least one user-adjustable criterion, wherein the at least one user-adjustable criterion comprises one or more of a period of time, a time of day, a day of week, a month, a year and a season;

15

receive user input from a user changing the at least one user-adjustable criterion via the at least one input device;

20

dynamically and in real-time modify the first at least one dynamic variance report into a second at least one dynamic variance report in response to and based on the changed at least one user-adjustable criterion; and

25

generate via the crew planning software, and display via the display device, the second at least one dynamic variance report to the user in real-time.

30 **17.** The system of claim **16**, wherein:

the vehicle operations are flight segments for commercial aircraft,

5

the at least one variance comprises block time variances for the flight segments,

the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

10

the first dynamic variance report comprises a first display of flight segments that exceed a first user-adjustable variance threshold and wherein the processor is configured to cause the first dynamic variance report to dynamically become the second dynamic variance report comprising a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first user-adjustable variance threshold to the second user-adjustable variance threshold.

15

18. The system of claim **16**, wherein:

20

the vehicle operations are multiple instances of a flight segment,

the at least one variance comprises block time variances for the multiple instances,

25

the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

30

the first dynamic variance report comprises a first display of instances of the flight segment that exceed a first user-adjustable variance threshold

and wherein the processor is configured to cause the first dynamic variance report to dynamically become the second dynamic variance report comprising a second display of instances of the flight segment that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first user-adjustable variance threshold to the second user-adjustable variance threshold.

19. The system of claim **16**, wherein:

the vehicle operations are flight segments for commercial aircraft,

the at least one variance comprises connection time variances for flight crews for flight segment pairs,

the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

the first dynamic variance report comprises a first display of flight segments that exceed a first user-adjustable variance threshold and wherein the processor is configured to cause the first dynamic variance report to dynamically become the second dynamic variance report comprising a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first user-adjustable variance threshold to the second user-adjustable variance threshold.

20. The system of claim **16**, wherein:

the vehicle operations are flight segments for commercial aircraft,

the at least one variance comprises connection time variances at particular airports,

5

the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

10

the first dynamic variance report comprises a first display of flight segments that exceed a first user-adjustable variance threshold and wherein the processor is configured to cause the first dynamic variance report to dynamically become the second dynamic variance report comprising a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first user-adjustable variance threshold to the second user-adjustable variance threshold.

15

21. The system of claim **16**, wherein:

the vehicle operations are flight segments for commercial aircraft,

20

the at least one variance comprises duty time variances for flight crews for itineraries of flight segments,

the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

25

the first dynamic variance report comprises a first display of flight segments that exceed a first user-adjustable variance threshold and wherein the processor is configured to cause the first dynamic variance report to dynamically become the second dynamic variance report comprising a second display of flight segments that exceed a second

30

user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first user-adjustable variance threshold to the second user-adjustable variance threshold.

5 **22.** The system of claim **16**, wherein:

the vehicle operations are flight segments for commercial aircraft,

10 the at least one variance comprises instances in which an aircraft does not operate a pre-planned itinerary of flight segments,

the at least one user-adjustable criterion further comprises a user-adjustable number of instances, and

15 the first dynamic variance report comprises a first display of flight segments that exceed a first user-adjustable number of instances and wherein the processor is configured to cause the first dynamic variance report to dynamically become the second dynamic variance report comprising a second display of flight segments that exceed a second
20 user-adjustable number of instances upon the user-adjustable number of instances being changed from the first user-adjustable number of instances to the second user-adjustable number of instances.

23. The system of claim **16**, wherein:

25

the vehicle operations are flight segments for commercial aircraft,

the at least one variance comprises instances in which aircraft departing from a particular airport do not operate a pre-planned flight segment,

30

the at least one user-adjustable criterion further comprises a user-adjustable number of instances, and

5 the first dynamic variance report comprises a first display of flight segments that exceed a first user-adjustable number of instances and wherein the processor is configured to cause the first dynamic variance report to dynamically become the second dynamic variance report comprising a second display of flight segments that exceed a second user-adjustable number of instances upon the user-adjustable number of
10 instances being changed from the first user-adjustable number of instances to the second user-adjustable number of instances.

24. A computer-implemented method, comprising:

15 storing, in a non-transitory computer-readable medium and in a first tabular format, planned vehicle operations data corresponding to a plurality of different planned vehicle operations;

20 storing, in the non-transitory computer-readable medium and in the first tabular format, actual vehicle operations data for multiple instances of at least one planned vehicle operation of the plurality of different planned vehicle operations;

25 converting the actual vehicle operations data and planned vehicle operations data into a second format different from the first tabular format, wherein the second format is compatible with crew planning software;

calculating at least one variance for at least one personnel time limit criterion for the multiple instances of the at least one planned vehicle

operation, based on one or more differences between the actual vehicle operations data and the planned vehicle operations data;

receiving, via an electronic input device, a user input from a user indicating a value for at least one user-adjustable criterion, wherein the at least one user-adjustable criterion comprises one or more of a period of time, a time of day, a day of week, a month, a year and a season; and

displaying, via a display device and to the user in real-time, at least one dynamic variance report based on the calculated at least one variance and based on the value for the at least one user-adjustable criterion;

receiving, via the electronic input device, a second user input from the user of a change to the at least one user-adjustable criterion;

updating, dynamically and in real-time, the at least one dynamic variance report in response to and based on the changed at least one user-adjustable criterion; and

displaying, via the display device and to the user in real-time, the updated at least one dynamic variance report.

25. The computer-implemented method of claim **24**,

wherein the vehicle operations are flight segments for a commercial aircraft,

wherein the at least one variance comprises block time variances for the flight segments,

wherein the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

wherein the variance report dynamically changes from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

26. The computer-implemented method of claim **24**,

wherein the vehicle operations are multiple instances of a flight segment,

wherein the at least one variance comprises block time variances for the multiple instances,

wherein the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

wherein the variance report dynamically changes from a first display of instances of the flight segment that exceed a first user-adjustable variance threshold to a second display of instances of the flight segment that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

27. The computer-implemented method of claim **24**,

wherein the vehicle operations are flight segments for commercial aircraft,

wherein the at least one variance comprises connection time variances for flight crews for flight segment pairs,

5 wherein the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

10 wherein the variance report dynamically changes from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

15 **28.** The computer-implemented method of claim **24**,

wherein the vehicle operations are flight segments for commercial aircraft,

20 wherein the at least one variance time comprises connection time variances at particular airports,

wherein the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

25 wherein the variance report dynamically changes from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance
30 threshold.

29. The computer-implemented method of claim **24**,

wherein the vehicle operations are flight segments for commercial aircraft,

wherein the at least one variance comprises duty time variances for flight crews for itineraries of flight segments,

wherein the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

wherein the variance report dynamically changes from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

30. The computer-implemented method of claim **24**,

wherein the vehicle operations are flight segments for commercial aircraft,

wherein the at least one variance comprises instances in which an aircraft does not operate a pre-planned itinerary of flight segments,

wherein the at least one user-adjustable criterion further comprises a user-adjustable number of instances, and

wherein the variance report dynamically changes from a first display of flight segments that exceed a first user-adjustable variance threshold to a

second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

5

31. The computer-implemented method of claim **24**,

wherein the vehicle operations are flight segments for commercial aircraft,

10

wherein the at least one variance comprises instances in which aircraft departing from a particular airport do not operate a preplanned flight segment,

15

wherein the at least one user-adjustable criterion further comprises a user-adjustable number of instances, and

20

wherein the variance report dynamically changes from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

25

32. A computer program product for generating dynamic reports related to vehicle operations, the computer program product comprising:

a non-transitory computer-readable storage medium having computer-readable program code embodied therewith, the computer-readable program code executable by one or more computer processors to:

30

store, in a data structure and in a first tabular format, planned vehicle operations data corresponding to a plurality of different planned vehicle operations;

5 store, in the data structure and in the first tabular format, actual vehicle operations data for multiple instances of at least one planned vehicle operation of the plurality of different planned vehicle operations;

10 convert the actual vehicle operations data and planned vehicle operations data into a second format different from the first tabular format, wherein the second format is compatible with crew planning software;

15 calculate at least one variance for at least one personnel time limit criterion for the multiple instances of the at least one planned vehicle operation, based on differences between the actual vehicle operations data and planned vehicle operations data;

20 receive, via an electronic input device communicatively coupled with the one or more computer processors, a user input from a user indicating a value for at least one user-adjustable criterion, wherein the at least one user-adjustable criterion comprises one or more of a period of time, a time of day, a day of week, a month, a year and a
25 season;

display, via a display device communicatively coupled with the one or more computer processors and to the user in real-time, at least one dynamic variance report based on the calculated at least one

variance and based on the value for the at least one user-adjustable criterion;

5

receive, via the electronic input device and from the user, a user input changing the at least one user-adjustable criterion;

10

update, dynamically and in real-time, the at least one dynamic variance report in response to and based on the changed at least one user-adjustable criterion; and

displaying, via the display device and to the user in real-time, the updated at least one dynamic variance report.

33. A system, comprising:

15

a data structure on a non-transitory computer-readable medium storing, in a first tabular format, (i) planned vehicle operations data related to a plurality of different planned vehicle operations and (ii) actual vehicle operations data for multiple instances of at least one planned vehicle operation of the plurality of different planned vehicle operations;

20

at least one input device configured to receive a value for at least one user-adjustable criterion;

25

a display device; and

a processor in communication with the data structure, the at least one input device, and the display device, the processor configured to:

retrieve the actual vehicle operations data and the planned vehicle operations data from the data structure;

5 convert the actual vehicle operations data and planned vehicle operations data into a second format different from the first tabular format, wherein the second format is compatible with crew planning software;

10 calculate at least one variance for at least one personnel time limit criterion for the multiple instances of the at least one planned vehicle operation, based on one or more differences between the actual vehicle operations data and the planned vehicle operations data;

15 output to the display device at least one dynamic variance report based on the calculated at least one variance and based on the value for the at least one user-adjustable criterion, wherein the at least one user-adjustable criterion comprises one or more of a period of time, a time of day, a day of week, a month, a year and a season;

20 receive a change to the at least one user-adjustable criterion by receiving user input via the at least one input device;

25 update, dynamically and in real-time, the at least one dynamic variance report to a modified at least one dynamic variance report in response to and based on the changed at least one user-adjustable criterion; and

30 output to the display device in real-time, the modified at least one dynamic variance report.

34. The system of claim **33**,

wherein the vehicle operations are flight segments for commercial aircraft,

wherein the at least one variance comprises block time variances for the flight segments,

wherein the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

wherein the variance report dynamically changes from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

35. The system of claim **33**,

wherein the vehicle operations are multiple instances of a flight segment,

wherein the at least one variance comprises block time variances for the multiple instances,

wherein the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

wherein the variance report dynamically changes from a first display of instances of the flight segment that exceed a first user-adjustable

variance threshold to a second display of instances of the flight segment that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

5

36. The system of claim **33**,

wherein the vehicle operations are flight segments for commercial aircraft,

10

wherein the at least one variance comprises connection time variances for flight crews for flight segment pairs,

wherein the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

15

wherein the variance report dynamically changes from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

20

37. The system of claim **33**,

25

wherein the vehicle operations are flight segments for commercial aircraft,

wherein the at least one variance time comprises connection time variances at particular airports,

wherein the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

wherein the variance report dynamically changes from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

38. The system of claim **33**,

wherein the vehicle operations are flight segments for commercial aircraft,

wherein the at least one variance comprises duty time variances for flight crews for itineraries of flight segments,

wherein the at least one user-adjustable criterion further comprises a user-adjustable variance threshold, and

wherein the variance report dynamically changes from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

39. The system of claim **33**,

wherein the vehicle operations are flight segments for commercial aircraft,

wherein the at least one variance comprises instances in which an aircraft does not operate a pre-planned itinerary of flight segments,

5 wherein the at least one user-adjustable criterion further comprises a user-adjustable number of instances, and

10 wherein the variance report dynamically changes from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being changed from the first variance threshold to the second variance threshold.

15 **40.** The system of claim **33**,

wherein the vehicle operations are flight segments for commercial aircraft,

20 wherein the at least one variance comprises instances in which aircraft departing from a particular airport do not operate a preplanned flight segment,

25 wherein the at least one user-adjustable criterion further comprises a user-adjustable number of instances, and

wherein the variance report dynamically changes from a first display of flight segments that exceed a first user-adjustable variance threshold to a second display of flight segments that exceed a second user-adjustable variance threshold upon the user-adjustable variance threshold being

changed from the first variance threshold to the second variance threshold.

5 **41.** A non-transitory computer readable medium storing instructions which, when executed by at least one processor, cause the at least one processor to execute the method of any one of claims **1** to **8** and **24** to **31**.

42. A system comprising:

10 at least one processor; and

the non-transitory computer-readable medium of claim **41**.

15-0420 (BOCO/0176US)

1/12

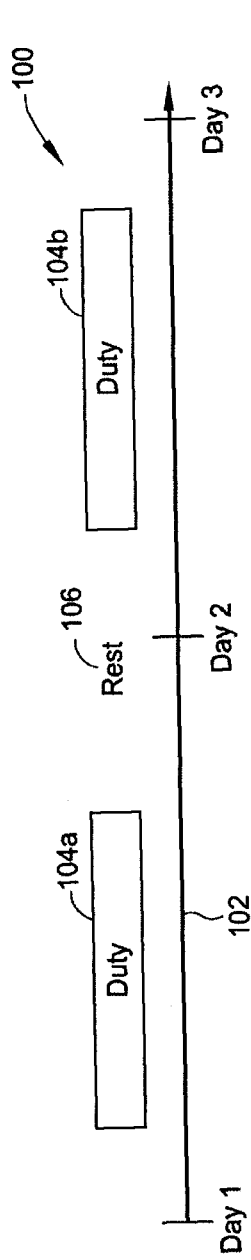


FIG. 1A

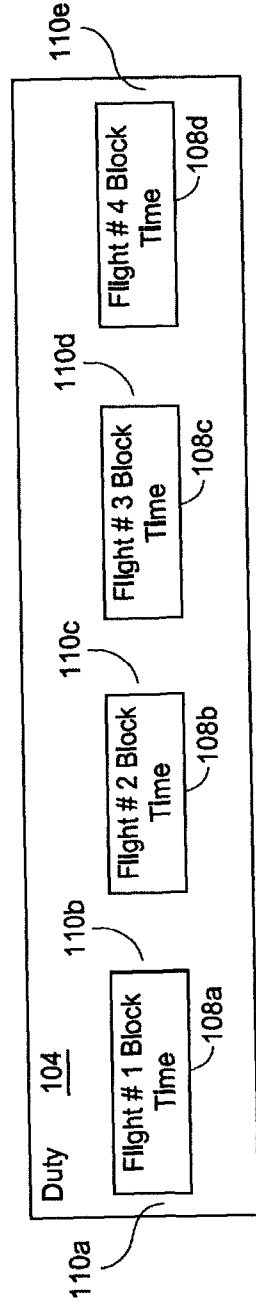


FIG. 1B

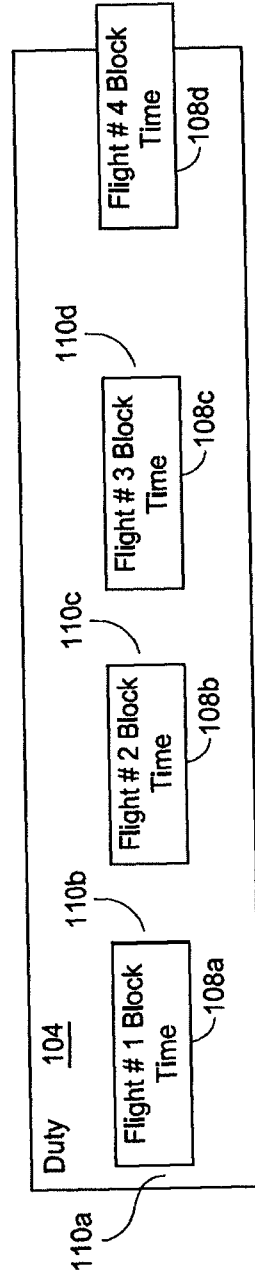


FIG. 1C

15-0420 (BOCO/0176US)

2/12

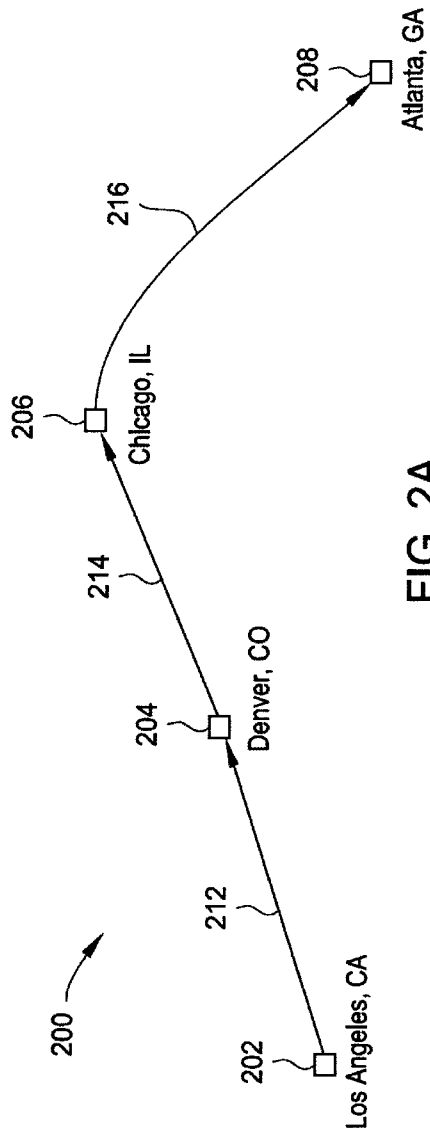


FIG. 2A

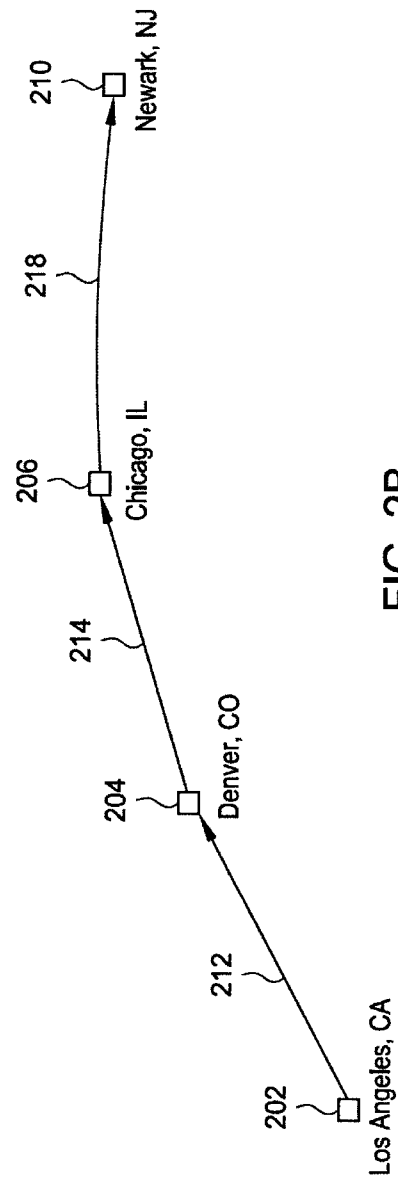


FIG. 2B

15-0420 (BOCO/0176US)

3/12

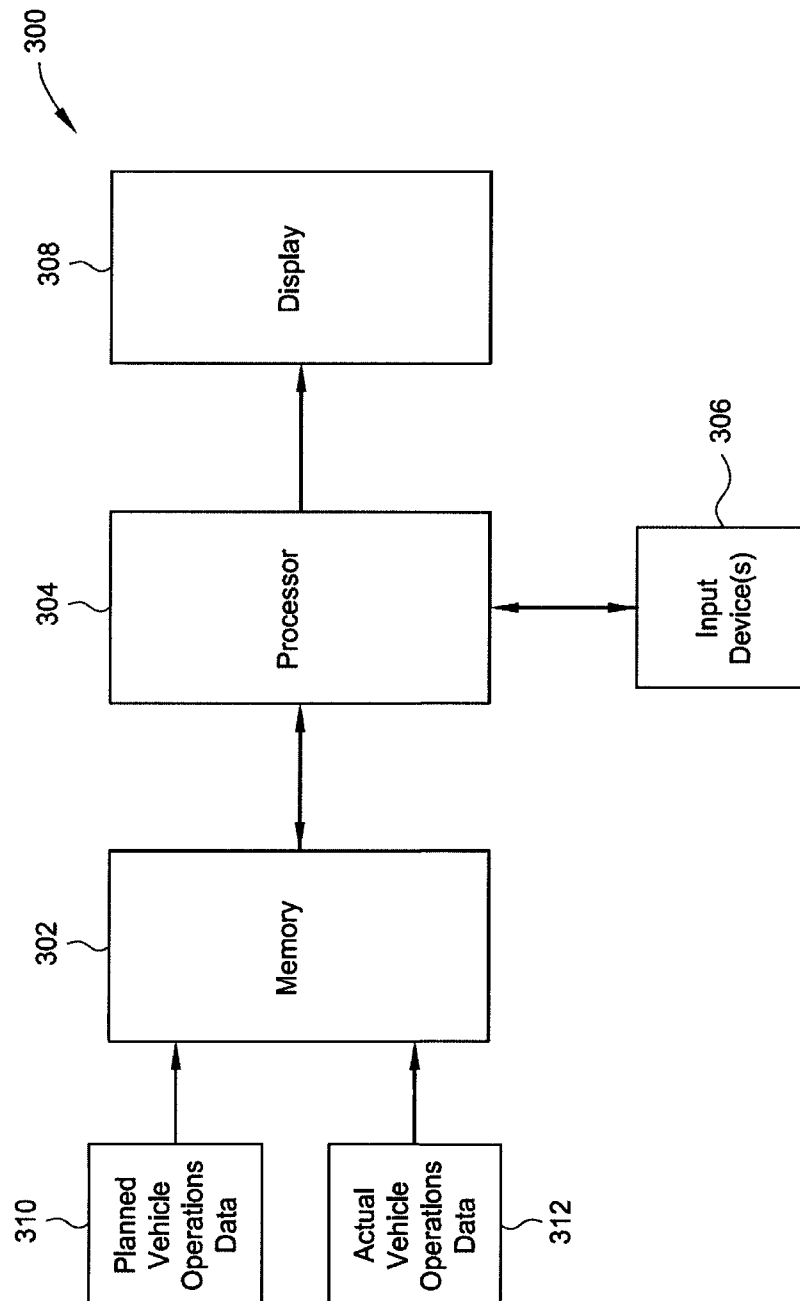


FIG. 3

15-0420 (BOCO/0176US)

4/12

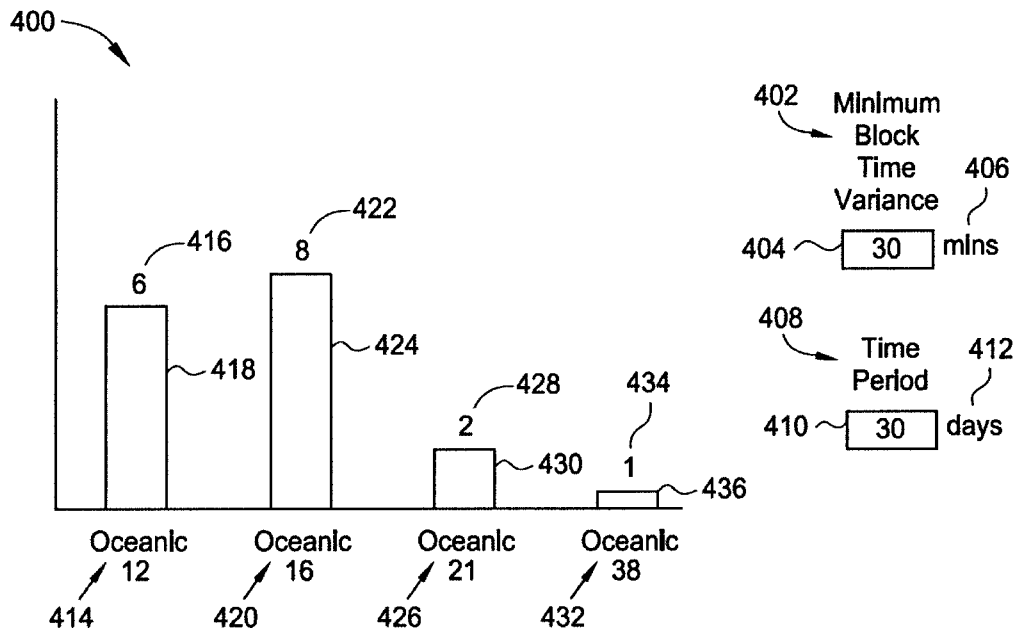


FIG. 4A

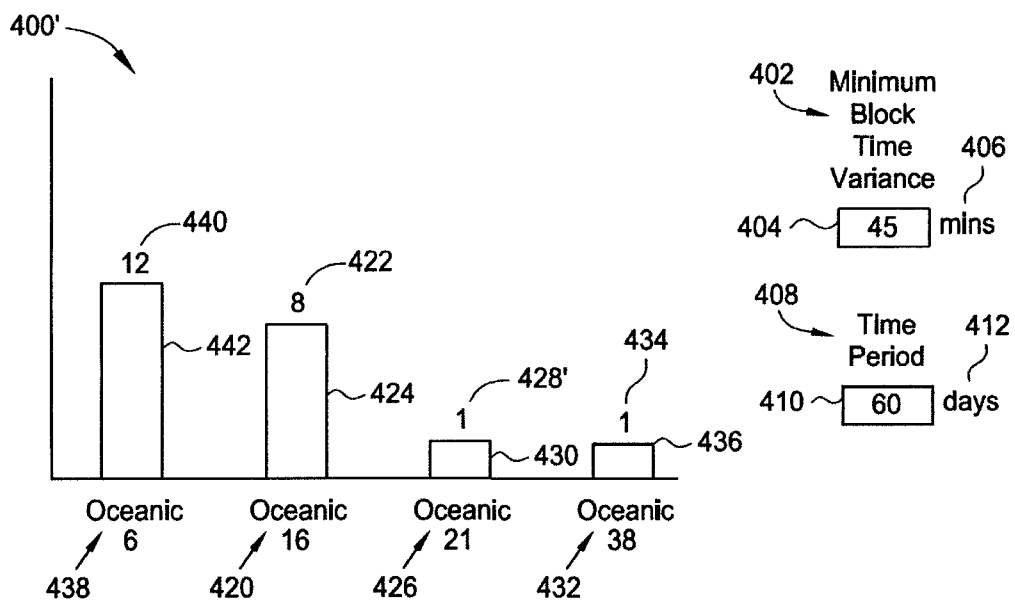


FIG. 4B

15-0420 (BOCO/0176US)

5/12

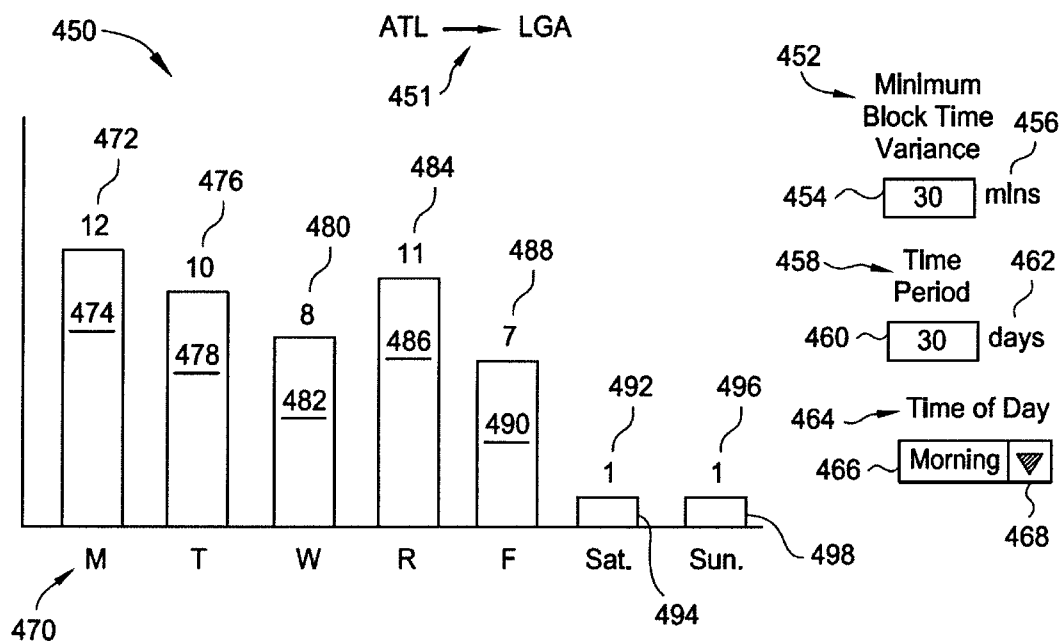


FIG. 5A

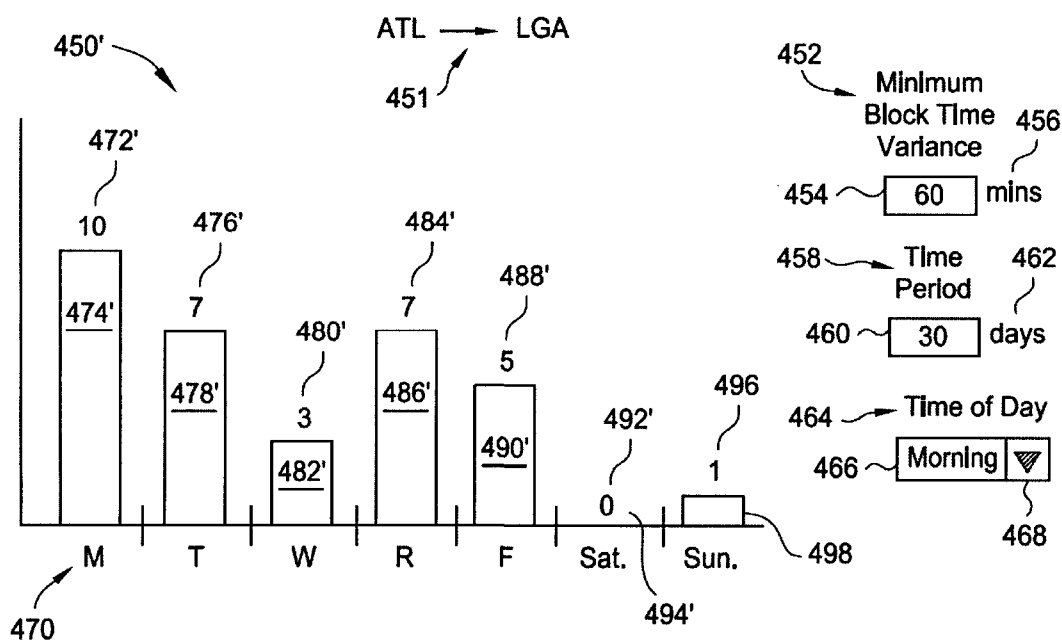


FIG. 5B

15-0420 (BOCO/0176US)

6/12

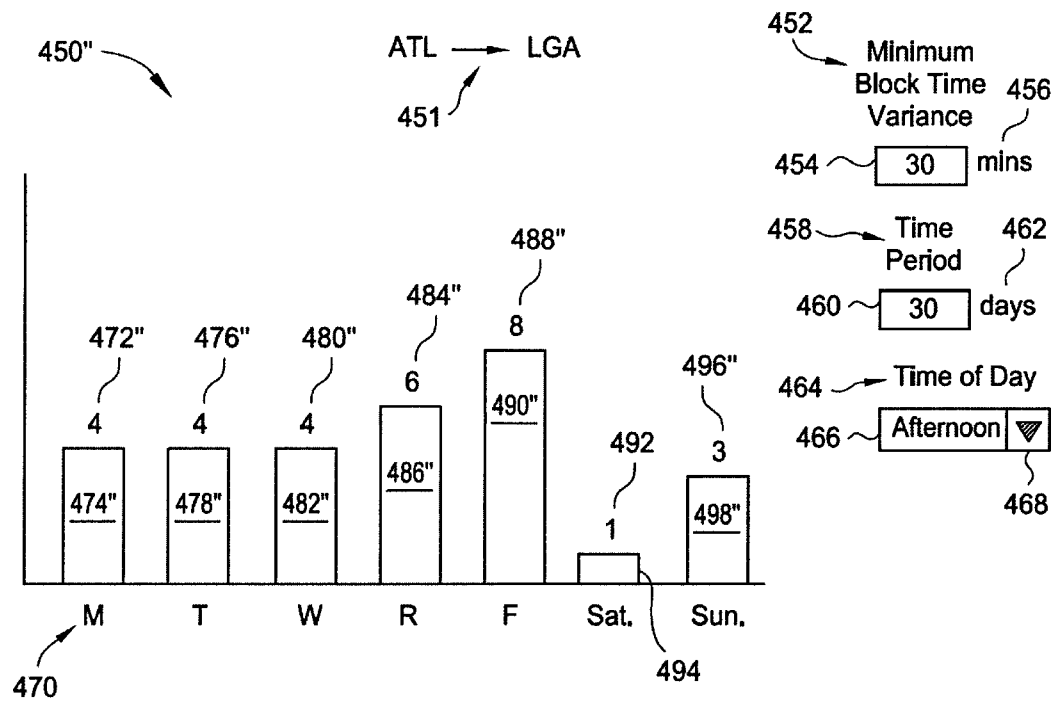


FIG. 5C

15-0420 (BOCO/0176US)

7/12

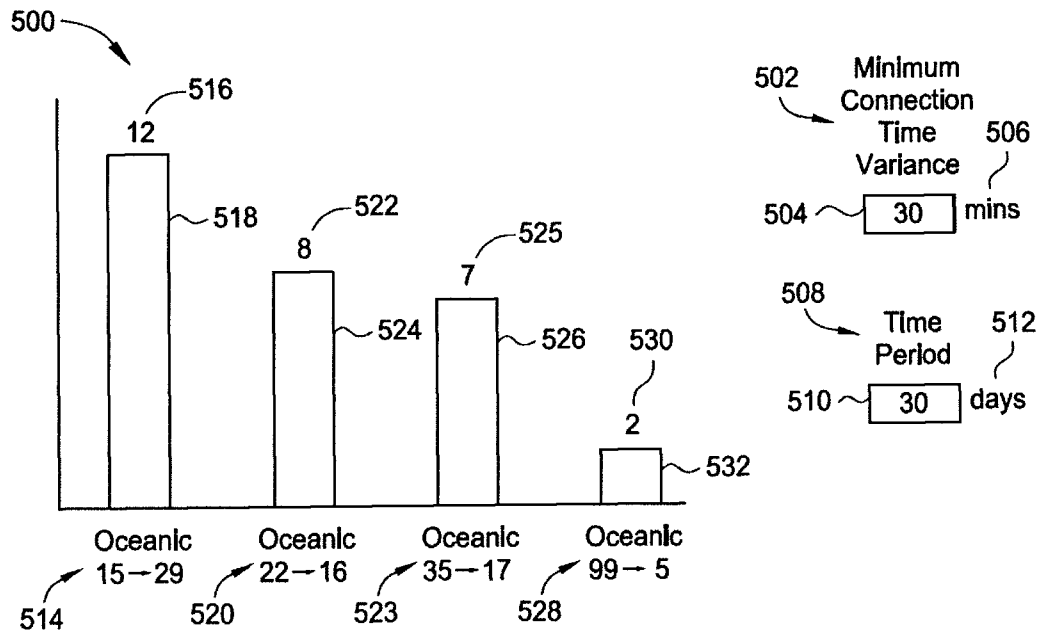


FIG. 6A

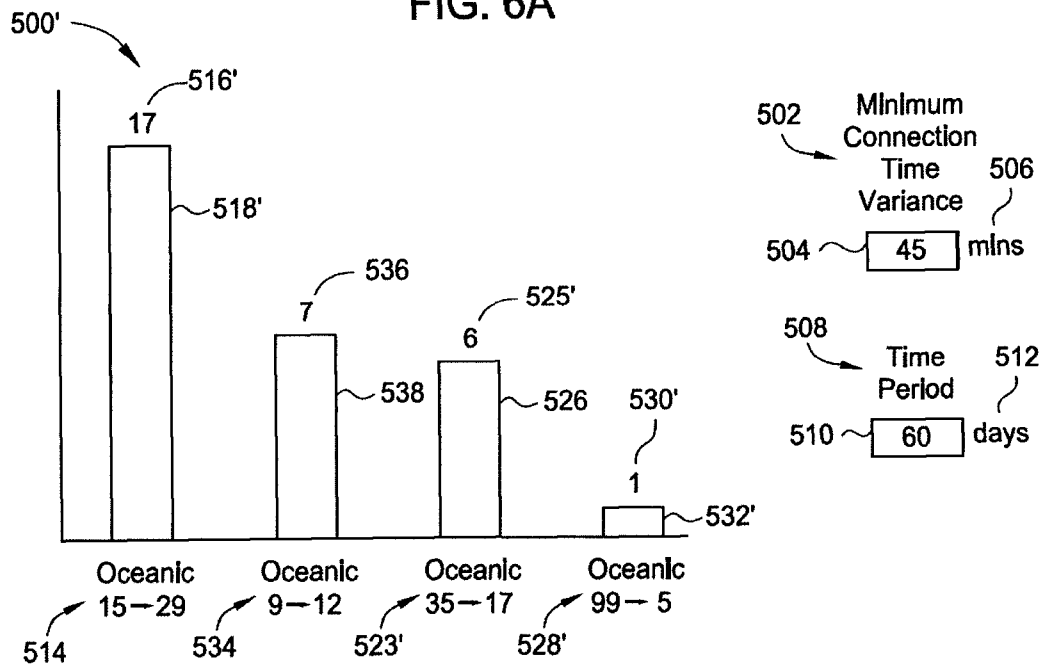


FIG. 6B

15-0420 (BOCO/0176US)

8/12

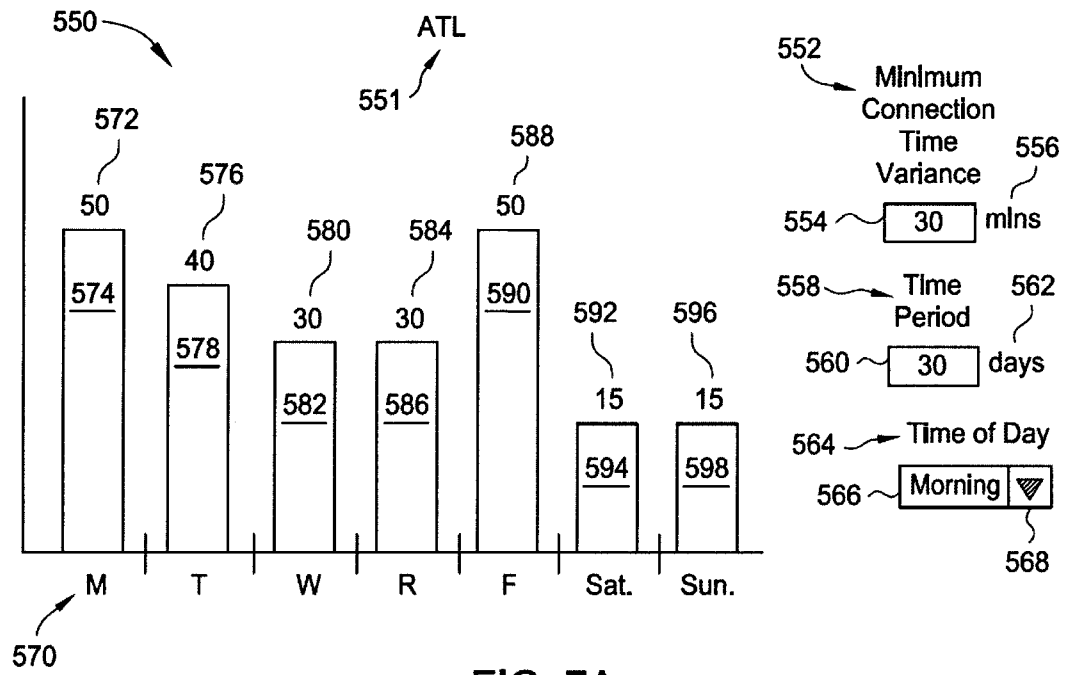


FIG. 7A

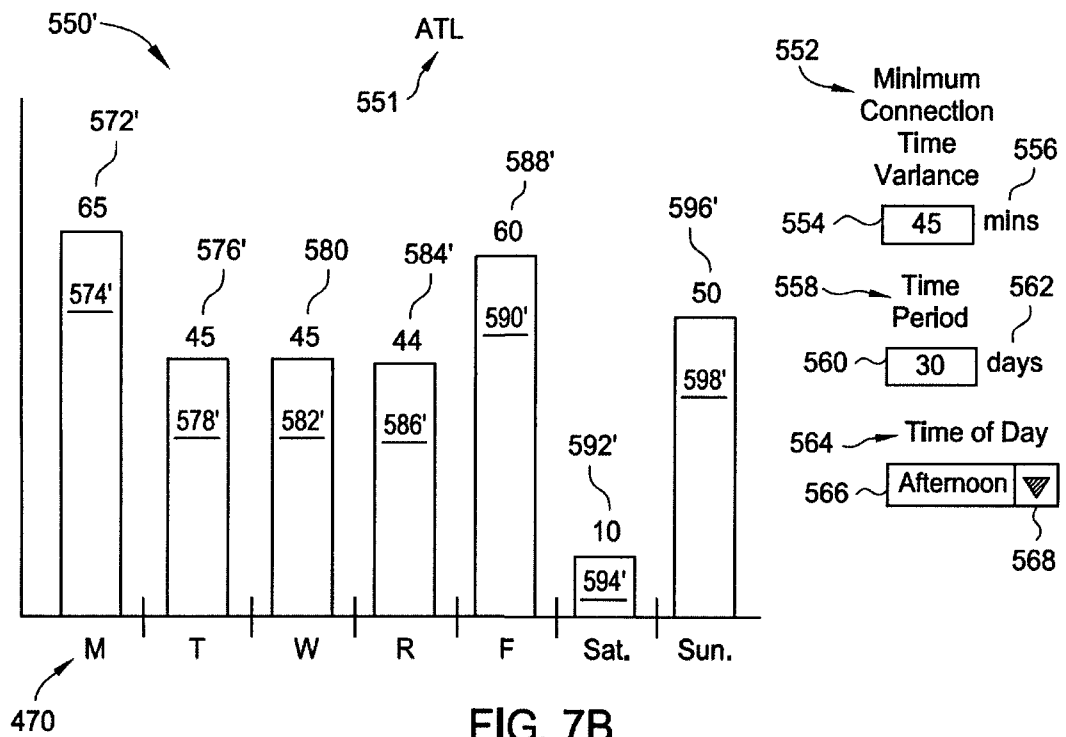


FIG. 7B

15-0420 (BOCO/0176US)

9/12

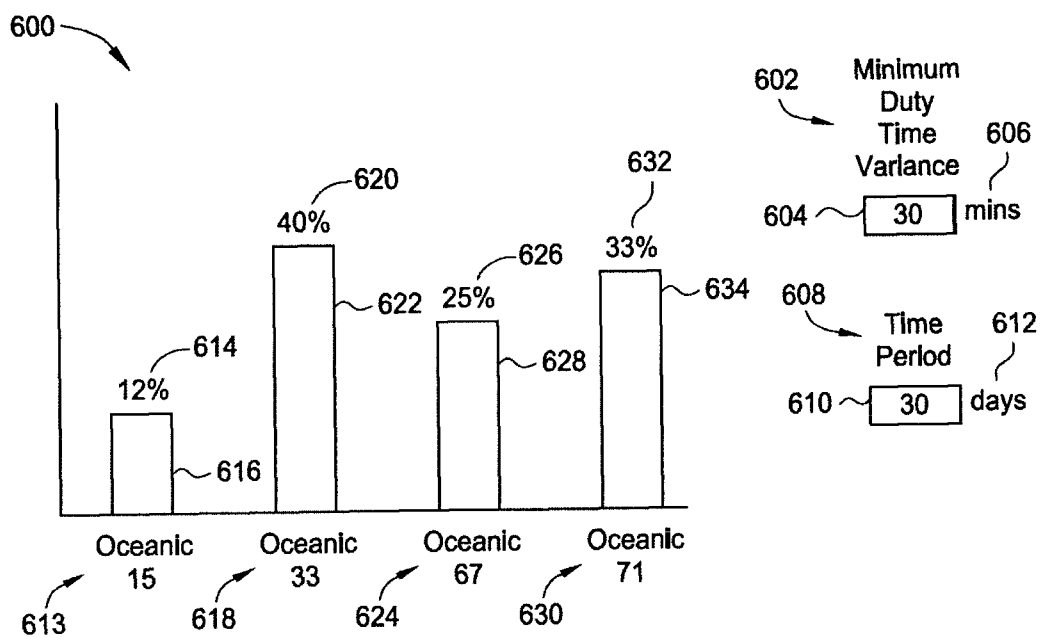


FIG. 8A

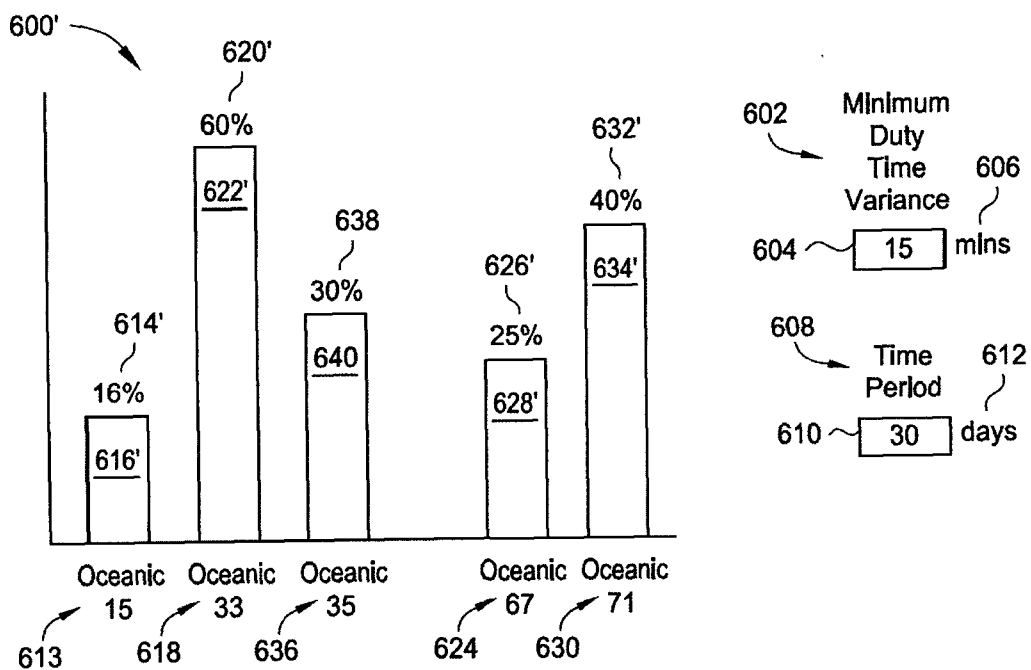


FIG. 8B

15-0420 (BOCO/0176US)

10/12

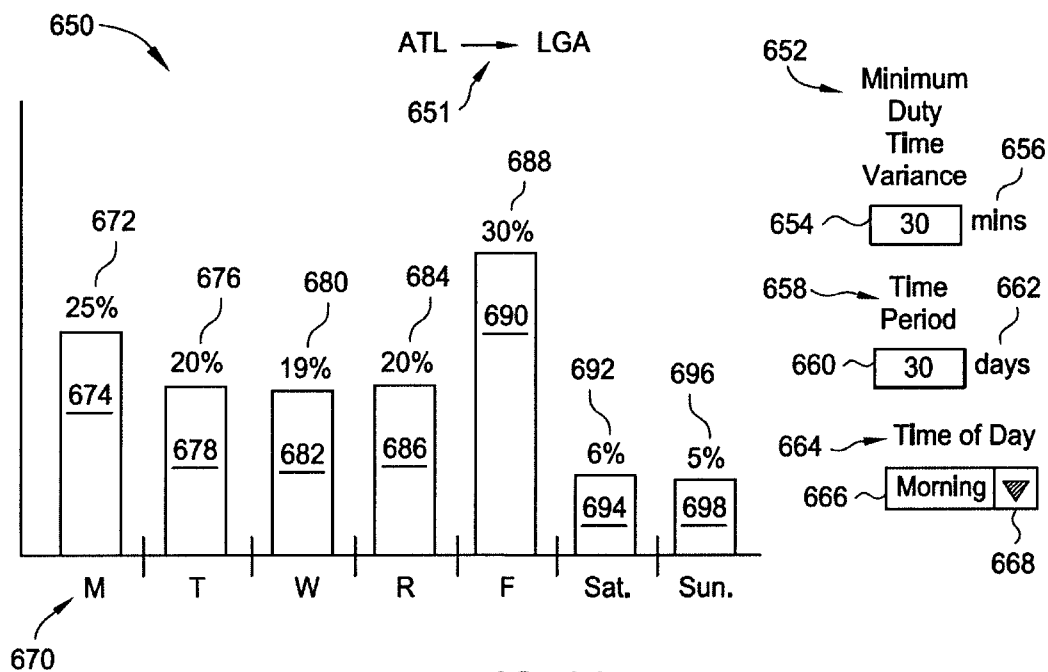


FIG. 9A

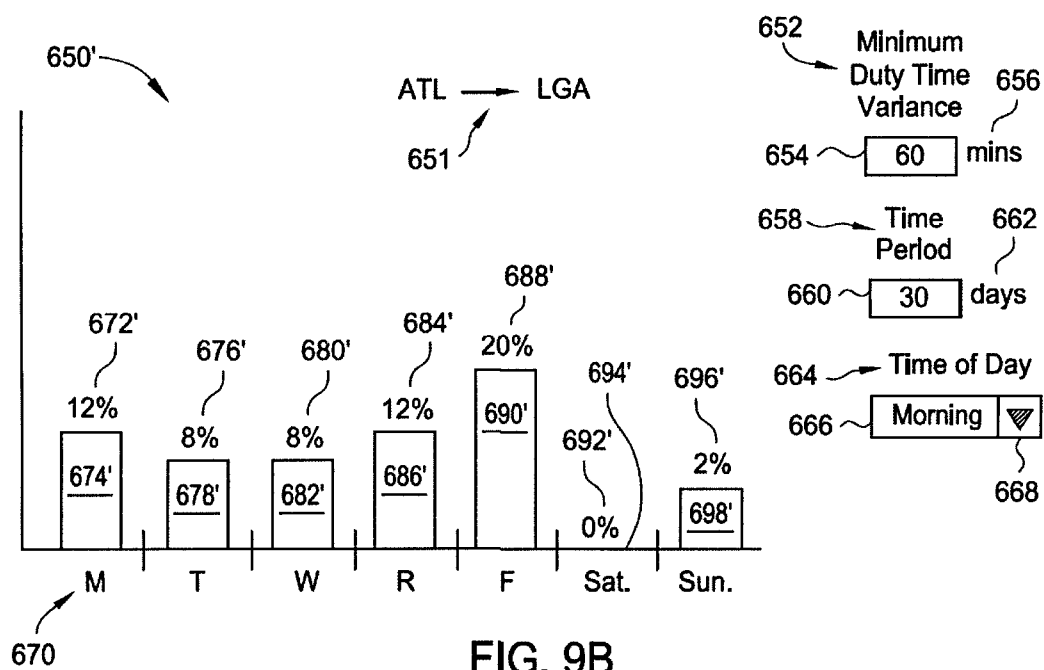


FIG. 9B

15-0420 (BOCO/0176US)

11/12

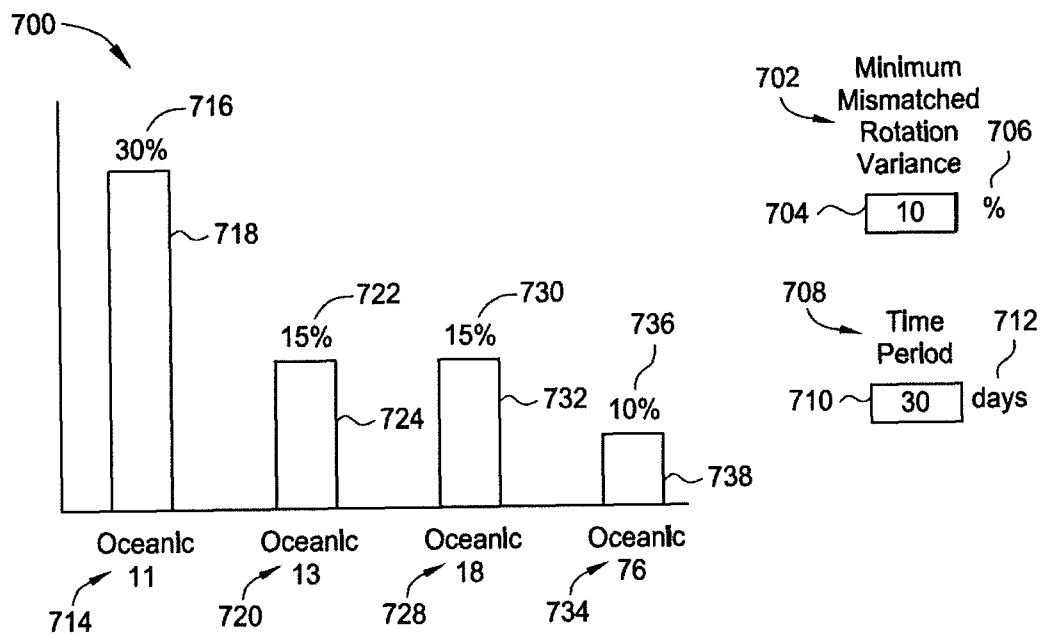


FIG. 10A

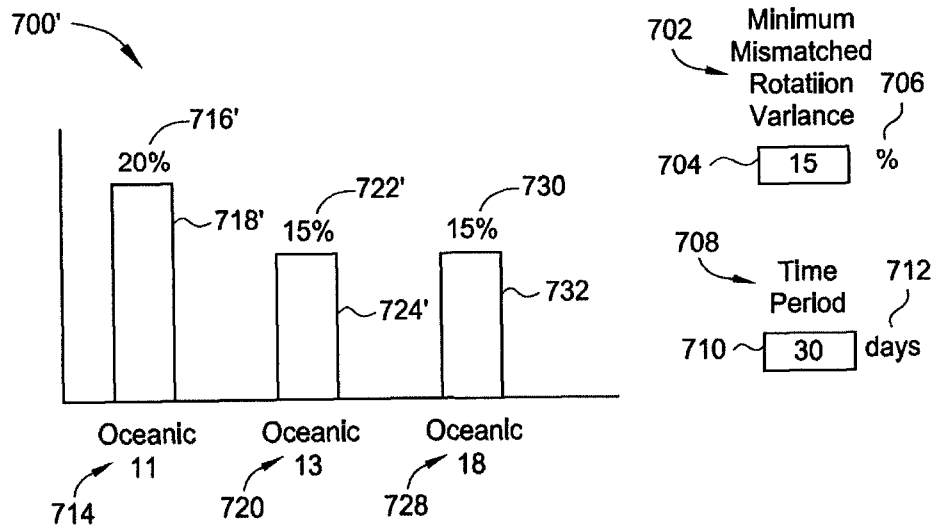


FIG. 10B

15-0420 (BOCO/0176US)

12/12

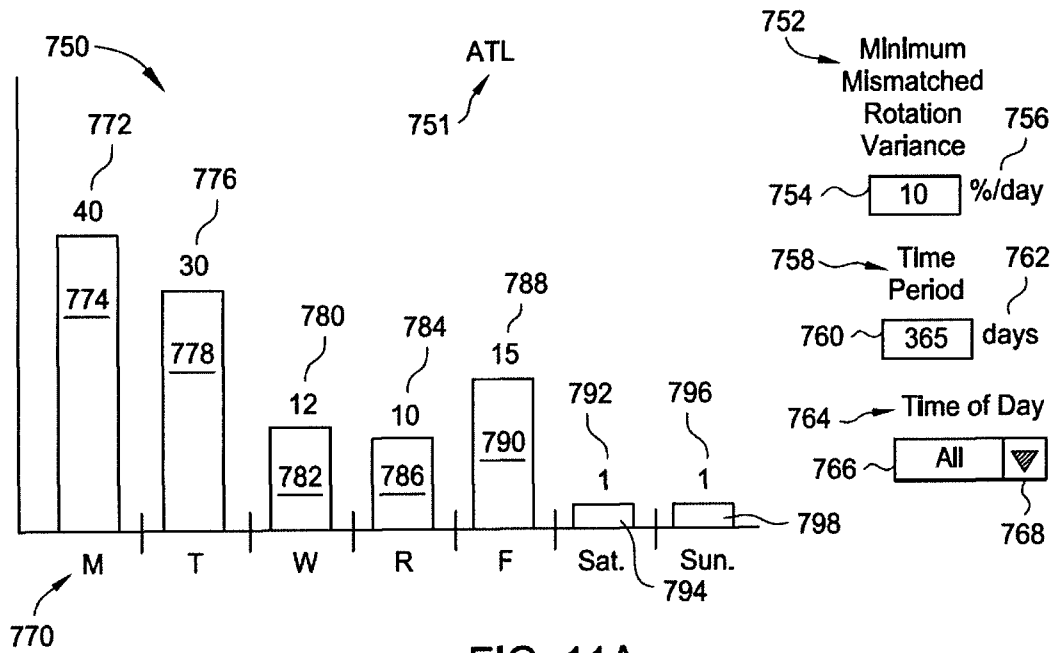


FIG. 11A

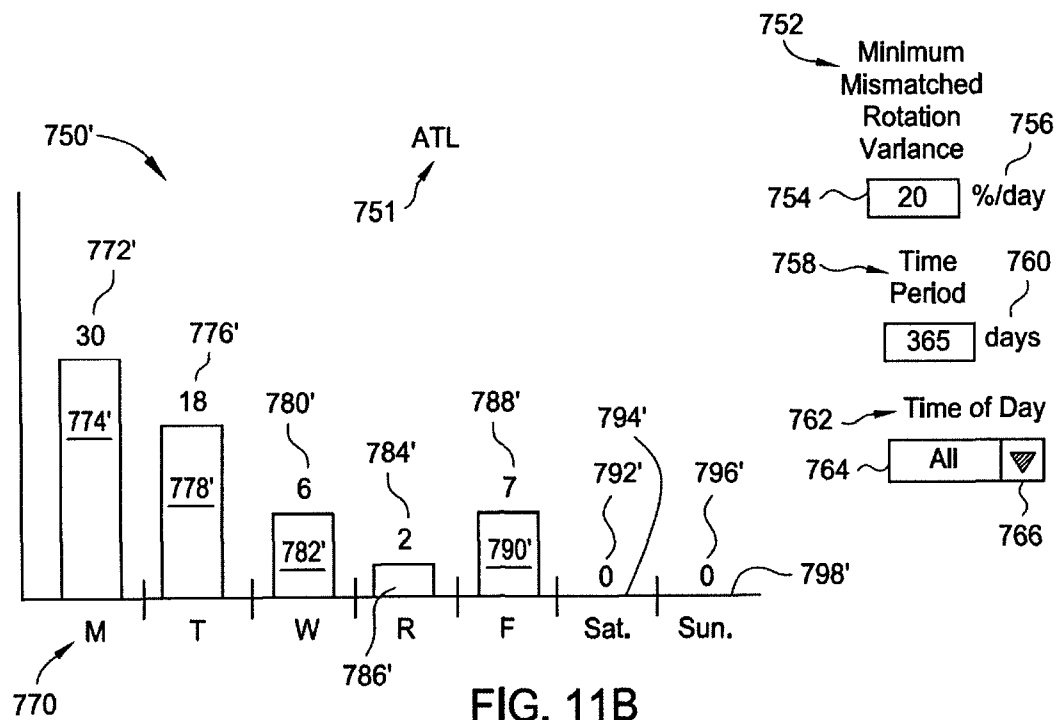
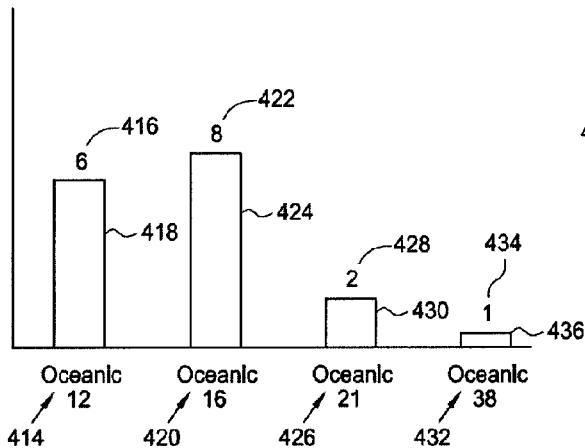


FIG. 11B

400



402 Minimum
Block
Time
Variance 406

404 30 mins

408 Time
Period 412

410 30 days