

A METHOD AND SYSTEM FOR MONITORING ASSETS

Field of Invention

The present invention relates to a method and system for monitoring assets, in particular, for measuring and comparing the performance of assets.

Background

In the prior systems, the performance of Plant Assets, such as heat exchanger, control valves, rotating equipments, motors, compressors, pumps, blowers, turbines, generators, agitators, conveyors, furnaces is monitored through the running of various diagnostics for measuring the availability, usability, reliability and return on investment (“**ROI**”) of each Plant Asset. Each diagnostics has one or more key performance indicators (“**KPI**”). The KPI help to detect and identify the problematic assets in a plant that require maintenance or remedial action. Additionally, they are used to compare performance of Plant Assets.

However, the results of individual diagnostics are not reflective of the overall performance of a Plant Asset. For example, diagnostics measuring availability of a Plant Asset do not take into account the usability or efficiency of the Plant Asset. The comparison of Plant Assets based on all diagnostics is done by manually analyzing the data from each individual diagnostics. The analysis of behavior of problems occurring on Plant Assets and the comparison of said behavior is also done manually.

Further, comparison techniques in the prior art systems relies on the availability of similar diagnostics for similar Plant Assets. It would not be possible to compare Plant Assets which do not have a similar diagnostics.

Therefore, there is a need for a system and method for measuring and comparing the performance of Plant Assets that takes into account the cumulative results of individual diagnostics.

Summary

The present invention is a system which solves the problems associated with the manual compilation and analysis of the results from individual diagnostics and

facilitates the measurement and comparison of the performance of Plant Assets by providing a single performance index known as Bad Actor Detection Frequency (“BADF”) performance index which takes into account the cumulative results of individual diagnostics of a Plant Asset. The BADF performance index can be used as a single point of reference to indicate the overall performance of individual Plant Assets, or to compare performance between Plant Assets.

In accordance with a first aspect of the invention, there is disclosed a system for monitoring Plant Asset performance. The system comprises a diagnostics module for measuring the diagnostics data of at least one Plant Asset, a Database interfacing with said diagnostic module for storing said diagnostics data, and a Calculator interfacing with said Database for retrieving said diagnostics data and calculating a BADF performance index.

Preferably, the system further comprises at least one Individual Plant Diagnostics.

More preferably, the system further comprises an Asset Comparator interfacing with said Calculator for comparing the BADF performance index values of two or more Plant Assets, sorting the Plant Assets according to its BADF performance index values and displaying the Plant Assets according to their BADF performance index values.

Still preferably, the Calculator performs the steps of identifying one or more Plant Asset to be measured, identifying one or more Individual Plant Diagnostics required for the measurement of the performance of said Plant Asset, identifying the relevant minimum benchmarks to be achieved in each of said Individual Plant Diagnostics, identifying the time duration which the measurement of asset performance is to be conducted, identifying a suitable time interval within the time duration which the measurement of asset performance is to be conducted, executing each of the said Individual Plant Diagnostics during said time window, adding the total number of times said Plant Asset fall below said minimum benchmark for all of said Individual Plant Diagnostics executed during said time window and dividing the number of time intervals in said time window by said total number of times said Plant Asset fall below said minimum benchmark for all of said Individual Plant Diagnostics executed

during said time window to obtain a BADF performance index for measuring the performance of the asset.

In accordance with a second aspect of the invention, there is disclosed a method of monitoring Plant Asset performance. The method comprises the steps of identifying at least one Plant Asset to be measured, identifying at least one Individual Plant Diagnostics required for the measurement of the performance of said Plant Asset, identifying the key performance indicators to be achieved in each of said Individual Plant Diagnostics, identifying the time duration which the measurement of asset performance is to be conducted, identifying a suitable time interval within the time duration which the measurement of asset performance is to be conducted, executing each of the said Individual Plant Diagnostics during said time duration, adding the total number of times said Plant Asset fall above said key performance indicators for each time interval for each said Individual Plant Diagnostics executed during said time duration and dividing the number of time intervals in said time duration by said total number of times said Plant Asset fall above said key performance indicators for each time interval for each said Individual Plant Diagnostics executed during said time duration to obtain a BADF performance index for measuring the performance of the asset.

Preferably, the method further comprises the steps of comparing the BADF performance index for each of the Plant Assets and sorting the Plant Assets in accordance with their BADF performance index values.

More preferably, the method further comprises the steps of sorting the Plant Assets in a descending order according to their BADF performance index values, providing a rank value counter, setting said rank value counter to one (1), providing a previous BADF performance index counter, setting said previous BADF performance index counter to zero (0), determining whether the BADF performance index value of a first Plant Asset is zero (0), if the BADF performance index value of said first Plant Asset is zero (0), assigning a rank of zero (0) to said Plant Asset and if the BADF performance index value of said first Plant Asset is not zero (0), determining if the BADF performance index value of said first Plant Asset is higher the value of the previous BADF performance index counter. If the BADF performance index value of

said first Plant Asset is higher than the value of the previous BADF performance index counter, assigning said first Plant Asset with a rank equal to the value of the rank value counter and updating the value of the previous BADF performance index counter with the BADF performance index value of said first Plant Asset and if the BADF performance index value of said first Plant Asset is not higher than the value of the previous BADF performance index counter, incrementing the rank value counter and updating the value of the previous BADF performance index counter with the BADF performance index value of said first Plant Asset.

Preferably, the steps are repeated for each subsequent Plant Asset

Still preferably, the method further comprising the steps of providing a Database of Plant Assets, identifying suitable categories for said Plant Assets in said Database, sorting said Plant Assets in said Database according to their categories and sorting the Plant Assets in each category in accordance with their BADF performance index values.

Brief Description of Drawings

Fig. 1 is a component diagram of a system of one preferred embodiment of the invention;

Fig. 1a is a data model of the diagnostics module;

Fig. 2 is a flow chart of a method of the preferred embodiment of the invention;

Fig. 3 is a flow chart showing the performance index calculation process;

Fig. 4 is a flow chart showing the Asset Ranking Process;

Fig. 5 is an example of the graphic User Interface of the asset comparator in the dual asset comparator mode; and

Fig. 6 is an example of the graphical User Interface of the asset comparator in the asset category comparator mode.

Detailed Description

A system and a method for measuring and comparing Plant Asset performance are described hereinafter.

An embodiment of the invention is described in the detailed description provided hereinafter is in accordance with Figs. 1 to 4 of the drawings, in which like elements are numbered with like reference numerals.

With reference to Fig. 1 and 1a, a system 10 for monitoring Plant Assets such as for example 12a, 12b and 12c according to an embodiment of the invention is described.

The system 10 comprises a Diagnostics Module 20, a Calculator 30 and an Asset Comparator 40. The Diagnostics Module 20 further comprises of a number of Individual Plant Diagnostics 22a, 22b, 22c and preferably a Database 24. In the Diagnostics Module 20, Individual Plant Diagnostics 22a, 22b, 22c are run for corresponding Plant Assets 12a, 12b, 12c. Preferably, the diagnostics data is stored in Database 24. The Plant Assets 12a, 12b, 12c to be monitored and the suitable Individual Plant Diagnostics 22a, 22b, 22c of the Diagnostics Module 20 are identified and set by the user through the User Interface 42 of the Asset Comparator 40. Alternatively, they may be pre-determined.

In the Diagnostics Module 20, each Individual Plant Diagnostics 22a, 22b, 22c will have a bad actor flag (the “**BadActorFlag**”) and one or more KPI. Plant Assets 12a, 12b, 12c are flagged as a bad actor when any one of the KPI in an Individual Plant Diagnostics 22a, 22b, 22c exceeds a pre-determined benchmark. Some examples of KPIs are, time in control, time in premode, fouling index, total efficient time, thermal performance, total availability time. At the end of a pre-determined time interval for the running of Individual Plant Diagnostics 22a, 22b, 22c, the Diagnostics Module 20 performs a closure function. The closure function of the Diagnostics Module 20 summarises the results of the Individual Plant Diagnostics 22a, 22b, 22c and analyses them for bad actor incidents. If a Plant Asset 12a, 12b, 12c is flagged as a bad actor for any one of the KPI, it shall be marked as a bad actor for the corresponding Individual Plant Diagnostics 22a, 22b, 22c. The BadActorFlag for the Individual Plant

Diagnostics 22a, 22b, 22c is set to “TRUE”. The respective status of each BadActorFlag is preferably stored in Database 24 for further processing.

The Calculator 30 retrieves the BadActorFlag status for each Plant Asset 12a, 12b, 12c from the Database 24 and calculates a BADF performance index value for each Plant Asset 12a, 12b, 12c. The resulting BADF performance index values for each Plant Asset 12a, 12b, 12c are preferably stored in a Database 24.

The Asset Comparator 40 retrieves the BADF performance index values for each Plant Asset 12a, 12b, 12c from the Calculator 30 or the Database 24. The Asset Comparator 40 then compares, sorts and displays the Plant Assets 12a, 12b, 12c according to their BADF performance index values.

A data model of an example of the Diagnostics Module 20 is illustrated in Fig. 1a. In the example, each Plant Asset 12a, 12b is measured by two Individual Plant Diagnostics 22a', 22a'' and 22b', 22b'', respectively. Each of the Individual Plant Diagnostics 22a', 22a'' and “22b', 22b''” further includes a BadActorFlag 26a', 26a'' and 26b', 26b'', respectively.

With reference to Fig. 2, a method 200 for monitoring Plant Assets 12a, 12b, 12c is described. In Step 202, the list of Plant Asset 12a, 12b, 12c to be compared, the time duration for monitoring the Plant Asset 12a, 12b, 12c and the time interval for each Individual Plant Diagnostics 22a, 22b, 22c is determined by the user through the User Interface 42 of the Asset Comparator 40. Alternatively, they may be pre-determined. Next in Step 204, a first Plant Asset 12a, 12b or 12c is selected. In Step 206, the process of calculating the BADF performance index for the said selected first Plant Asset 12a, 12b or 12c is performed. Next in step 208, a poll is conducted to determine if all the Plant Assets 12a, 12b, 12c have been processed according to Step 206. If all the Plant Assets 12a, 12b, 12c have not been processed according to Step 206, Step 204 is repeated for the next Plant Asset 12a, 12b or 12c. If all the Plant Assets 12a, 12b, 12c have been processed according to Step 206, Step 210 is executed. In Step 210, the process for ranking Plant Assets is performed. The results of the process in Step 210 are displayed in a further Step 212.

Fig. 3 illustrates a method 300 for calculating BADF performance index for a Plant Asset 12a, 12b, 12c for a time duration of monitoring the Plant Assets 12a, 12b, 12c applied in Step 206. In Step 302, a Bad Actor Detection Counter 50 is provided for recording bad actor incidents is provided and is first set to zero (0). In Step 304, a list of Individual Plant Diagnostics 22a, 22b, 22c for each corresponding Plant Asset 12a, 12b, 12c is determined. The list of Individual Plant Diagnostics 22a, 22b, 22c may be determined by the user through the User Interface 42 of the Asset Comparator 40. Alternatively, it may be pre-determined and retrieved from a Database 24.

Next in Step 306, a first time interval within the time duration for monitoring the Plant Asset 12a, 12b, 12c as determined in Step 202 is selected, and Step 308 is executed for each Individual Plant Diagnostics 22a, 22b or 22c in said selected time interval. In Step 308, a first Individual Plant Diagnostics 22a, 22b, 22c is selected and Step 310 is executed for said selected Individual Plant Diagnostics 22a, 22b or 22c. In Step 310, the BadActorFlag for the said selected Individual Plant Diagnostics 22a, 22b or 22c is read from the Diagnostics Modules 20. Alternatively, the BadActorFlag for the said selected Individual Plant Diagnostics 22a, 22b or 22c is read from the Database 24. Next in Step 312, if the BadActorFlag of the said selected Individual Plant Diagnostics 22a, 22b or 22c is set to "TRUE", Step 314 is executed. If the BadActorFlag of the said selected Individual Plant Diagnostics 22a, 22b or 22c is set to "FALSE", Step 316 is executed. In Step 314, the Bad Actor Detection Counter 50 is incremented by a value of one (1). Next, in Step 316, a poll is conducted to determine if all the Individual Plant Diagnostics 22a, 22b and 22c for said selected time interval have been processed according to Steps 310 to 314. If all the Individual Plant Diagnostics 22a, 22b and 22c for said selected time interval have not been processed according to Steps 310 to 314, Step 308 is repeated for the next Individual Plant Diagnostics 22a, 22b or 22c. If all the Individual Plant Diagnostics 22a, 22b and 22c for said selected time interval have been processed according to Steps 310 to 314, Step 318 is executed. In Step 318, a poll is conducted to determine if all the Individual Plant Diagnostics 22a, 22b and 22c for all the time intervals within the time duration monitoring the Plant Asset 12a, 12b and 12c have been processed according to Steps 310 to 314. If all the Individual Plant Diagnostics 22a, 22b and 22c for all the time intervals within the time duration monitoring the Plant Asset 12a, 12b and 12c have not been processed according to Steps 310 to 314, Step 306 is repeated for the next

time interval within the time duration for monitoring the Plant Asset 12a, 12b and 12c. If all the Individual Plant Diagnostics 22a, 22b and 22c for all the time intervals within the time duration monitoring the Plant Asset 12a, 12b and 12c have been processed according to Steps 310 to 314, Step 320 is executed.

In Step 320, the value of the Bad Actor Detection Counter 50 is read. If the value of the Bad Actor Detection Counter 50 is zero (0), the BADF performance index value for the Plant Asset 12a, 12b or 12c is assigned as zero (0) in Step 322. If the value of the Bad Actor Detection Counter 50 is more than zero (0), the BADF performance index value is calculated in Step 324 using the following formula: -

BADF performance index (for a Plant Asset 12a, 12b or 12c) = Number of time intervals within a time duration / value of Bad Actor Detection Counter 50 for the Plant Asset 12a, 12b or 12c

Using the above calculation, the better performing assets have a higher BADF performance index value.

Fig. 4 illustrates a method 400 for ranking Plant Assets 12a, 12b and 12c applied in Step 208. In Step 402, the Plant Assets 12a, 12b and 12c are sorted in a descending order according to their BADF performance index value. A Rank Value Counter 52 for assigning rank to a Plant Asset 12a, 12b or 12c is provided and first set to one (1), and a Previous BADF Performance Index Value Counter 54 for storing previous BADF performance index value is provided and first set to zero (0). Next in Step 404, a first Plant Asset 12a, 12b or 12c in the list of Plant Assets 12a, 12b and 12c as determined in Step 202 is selected, Step 406 is then executed for said selected Plant Asset 12a, 12b or 12c. In Step 406, the BADF performance index value of the said selected Plant Asset 12a, 12b or 12c is checked for a zero (0) value. If the BADF performance index value of said selected Plant Asset 12a, 12b or 12c is zero (0), Step 408 is executed. Otherwise, Step 410 is executed. In Step 408, the said selected Plant Asset 12a, 12b or 12c is assigned an asset rank of zero (0), and Step 404 is repeated for each subsequent Plant Asset 12a, 12b or 12c. In Step 410, the BADF performance index value of said selected Plant Asset 12a, 12b or 12c is then compared with the Previous BADF Performance Index Value Counter 54. If the BADF performance

index value of the Plant Asset is lower than the value of the Previous BADF Performance Index Value Counter 54, Step 412 is executed. Otherwise, Step 414 is executed. In Step 412, the value of the Rank Value Counter 52 is incremented by one (1). Next, in Step 414, the said selected Plant Asset 12a, 12b or 12c is assigned an asset rank equal to the value of the Rank Value Counter 52, and the Previous BADF Performance Index Value Counter 54 is updated with the BADF performance index value of the said selected Plant Asset 12a, 12b or 12c. Next in Step 416, a poll is conducted to determine if all the Plant Assets 12a, 12b and 12c in the list of Plant Assets 12a, 12b and 12c have been processed according to Steps 406 to 414. If all the Plant Assets 12a, 12b and 12c in the list of Plant Assets 12a, 12b and 12c have not been processed according to Steps 406 to 414, Step 404 is repeated for the next Plant Asset 12a, 12b or 12c in the list of Plant Assets 12a, 12b and 12c.

In a further preferred embodiment of the invention, the graphic User Interface 42 of the Asset Comparator 40 provides two types of asset comparator modes, a dual asset comparator mode as illustrated in Fig. 5 and asset category comparator mode as illustrated in Fig. 6. In a dual asset comparator mode, the BADF performance index values of two selected Plant Assets 502, 504 will be compared, and the said compared Plant Asset 502, 504 with the higher BADF performance index value will be highlighted 506 for the user's attention. In a category asset comparison, the BADF performance index values of all the Plant Assets 12a, 12b and 12c within a selected Plant Asset category 602 will be compared, ranked and arranged according to their BADF performance index value in a report 604 for the user's attention.

It is to be understood that the foregoing description of several preferred embodiments is intended to be purely illustrative of the principles of the invention, rather than exhaustive thereof, and that changes and variations will be apparent to those skilled in the art, and that the present invention is not intended to be limited other than as expressly set forth in the following claims.

Claims

1. A system for monitoring Plant Asset performance comprising:
 - a. a diagnostics module for measuring the diagnostics data of at least one Plant Asset,
 - b. a Database interfacing with said diagnostic module for storing said diagnostics data ; and
 - c. a Calculator interfacing with said Database for retrieving said diagnostics data and calculating a BADF performance index.
2. The system for monitoring Plant Asset performance as claimed in claim 1, wherein the diagnostics module further comprises at least one Individual Plant Diagnostics.
3. The system for monitoring Plant Asset performance as claimed in claims 1 or 2, further comprising an Asset Comparator interfacing with said Calculator for comparing the BADF performance index values of two or more Plant Assets, sorting the Plant Assets according to its BADF performance index values and displaying the Plant Assets according to their BADF performance index values.
4. The system for monitoring Plant Asset performance as claimed in claims 1, 2 or 3, wherein the Calculator performs the steps of: -
 - a. identifying one or more Plant Asset to be measured;
 - b. identifying one or more Individual Plant Diagnostics required for the measurement of the performance of said Plant Asset;
 - c. identifying the relevant minimum benchmarks to be achieved in each of said Individual Plant Diagnostics;
 - d. identifying the time duration during which the measurement of asset performance is to be conducted;
 - e. identifying a time interval within the time duration which the measurement of asset performance is to be conducted;

- f. executing each of the said Individual Plant Diagnostics during said time duration;
 - g. adding the total number of times said Plant Asset fall below said minimum benchmark for all of said Individual Plant Diagnostics executed during said time duration; and
 - h. dividing the number of time intervals in said time duration by said total number of times said Plant Asset fall below said minimum benchmark for all of said Individual Plant Diagnostics executed during said time duration to obtain a BADF performance index for measuring the performance of the asset.
- 5. A method of monitoring Plant Asset performance comprising the steps of:
 - a. identifying at least one Plant Asset to be measured;
 - b. identifying at least one Individual Plant Diagnostics required for the measurement of the performance of said Plant Asset;
 - c. identifying the relevant minimum benchmarks to be achieved in each of said Individual Plant Diagnostics;
 - d. identifying the time duration during which the measurement of asset performance is to be conducted;
 - e. identifying a time interval within the time duration which the measurement of asset performance is to be conducted;
 - f. executing each of the said Individual Plant Diagnostics during said time duration;
 - g. adding the total number of times said Plant Asset fall below said minimum benchmark for all of said Individual Plant Diagnostics executed during said time duration; and
 - h. dividing the number of time intervals in said time duration by said total number of times said Plant Asset fall below said minimum benchmark for all of said Individual Plant Diagnostics executed during said time duration to obtain a BADF performance index for measuring the performance of the asset.

6. A method as claimed in claim 5, further comprising the steps of comparing the BADF performance index for each of the Plant Assets and sorting the Plant Assets in accordance with their BADF performance index values.
7. A method as claimed in claim 5, further comprising the steps of:
 - a. sorting the Plant Assets in a descending order according to their BADF performance index values;
 - b. providing a rank value counter;
 - c. setting said rank value counter to one (1);
 - d. providing a previous BADF performance index counter;
 - e. setting said previous BADF performance index counter to zero (0);
 - f. determining whether the BADF performance index value of a first Plant Asset is zero (0), and if the BADF performance index value of said first Plant Asset is zero (0), assigning a rank of zero (0) to said Plant Asset.
8. A method as claimed in claim 7, having the further step of: if the BADF performance index value of said first Plant Asset is not zero (0), determining if the BADF performance index value of said first Plant Asset is higher the value of the previous BADF performance index counter, and if the BADF performance index value of said first Plant Asset is higher than the value of the previous BADF performance index counter, assigning said first Plant Asset with a rank equal to the value of the rank value counter and updating the value of the previous BADF performance index counter with the BADF performance index value of said first Plant Asset.
9. A method as claimed in claim 8, having the further step of: if the BADF performance index value of said first Plant Asset is not higher than the value of the previous BADF performance index counter, incrementing the rank value counter and updating the value of the previous BADF performance index counter with the BADF performance index value of said first Plant Asset.

10. A method as claimed in any one of claims 7, 8 or 9, wherein the steps are repeated for each subsequent Plant Asset.
11. A method as claimed in any one of claims 6 to 10, further comprising the steps of:
 - a. providing a Database of Plant Assets;
 - b. identifying suitable categories for said Plant Assets in said Database;
 - c. sorting said Plant Assets in said Database according to their categories;
and
 - d. sorting the Plant Assets in each category in accordance with their BADF performance index values.