

AN OPERATOR TRAINING APPARATUS FOR A MANUFACTURING ENVIRONMENT AND A METHOD OF USE THEREOF

5 FIELD OF THE INVENTION

The invention relates to a novel operator training apparatus for training operators in a simulated manufacturing environment.

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BACKGROUND OF THE INVENTION

In a typical manufacturing plant, the manufacturing process parameters are measured using field control devices. These field control devices measure critical and non-critical parameters throughout the manufacturing process. Therefore, the monitoring and control of these field control devices throughout the manufacturing process is important. It is imperative that operators of the manufacturing plant are properly trained to identify and evoke proper recovery measures should field control devices fail, or when parameters obtained from these devices indicate an abnormality in the manufacturing process.

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The present method adopted to train operators involve the use of training simulators

In a present method, a trainer conducts the training by first demonstrating proper recovery measures whilst the trainer simulation is running. The parameter values received from the field control devices in response to the recovery measures or operations adopted are visually presented, for e.g. in a trend graph. The trend graph generated by the trainer's demonstration would therefore reflect a 'correct' trend graph, or a reference trend graph from which a trainee's performance is evaluated. This trend graph may be developed by the monitoring of a certain variable in the simulation model, or a few variables.

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After the trainer has completed the demonstration, the trainees will begin the same simulation model and emulate the responses previously demonstrated. The form of the trainee's trend graph in comparison to that of the trainer's trend graph would therefore represent a trainee's performance. In other words, the degree of differential between a trainer and trainee's trend graph will reflect a trainee's performance. However, the performance of the trainee can only be evaluated after the simulation has ended. This is not time effective as the trainee will have to run through the entire simulation module again to correct any responses made in error.

Further, a trainer is unable to do a real time comparison of a trainee's trend graph with that of the trainer's 'correct' trend graph whilst the trainee's simulation is running as seen in US 4629430 and US 6823280. Therefore, any mistake or incorrect responses cannot be immediately corrected.

In the prior art, there are presently no available means to save or load historical trends, or to allow the viewing and comparison of two or more trend graphs. The available means are presently limited to real-time systems, as seen in US 4718025, US 5226118, US 5257206, US 5440478, US 5768148, US 6229536, US 7023440 and CA 2189331.

Figure 1 shows an example method performed by a trainer. The trainer first configures the variable(s) to be monitored to form a trend graph and then starts the simulation model. The variables that are monitored are saved in real time to form the trend graph as the simulation model. Once the simulation ends, the trainer then loads the historical values of the variables that form the trend graph of the trainer's response.

It is an object of the present invention to ameliorate one or all of the above problems.

SUMMARY OF THE INVENTION

According to an aspect of the invention there is provided an operator training apparatus for a manufacturing environment including an instructor tool kit for the use of a trainer, said instructor tool kit further including a monitor module, an evaluation module and a central controller, a plant simulation model to enact the plant simulation for the manufacturing environment, at least one operator console for the use of a trainee, a storage device to store a response of a trainer and/ or a trainee.

Preferably, the evaluation module further includes a retrieving section to retrieve a response from a trainer and/ or a trainee, and a comparing section to compare a response from a trainer and a trainee.

Still preferably, the comparing section further includes a reference table, said reference table including a trainer's response indicator or a baseline response indicator from which a trainee's response may be compared.

In a second embodiment, the evaluation module further includes a message section to provide a message to a trainee during a simulation.

Preferably, the message section further includes an input means to allow a trainer to input messages which may be displayed during a trainee simulation.

Still preferably, the input means is a dialogue box.

In a third embodiment, the evaluation module further includes a scoring section to tabulate a score of a trainee.

Preferably, the scoring section compares the differential between the trainer and trainee's response.

Still preferably, the scoring section compares the differential between the baseline and trainee's response.

5 In a variation, the scoring section further includes a tabulation means to tabulate an eventual score of a trainee.

In a fourth embodiment, the evaluation module further includes an alerting section.

10 Preferably, the alerting section is in the form of a triggering means.

Still preferably, the triggering means triggers a display of a pre-determined message during a trainee simulation.

15 Preferably, the triggering means is activated by a trainer.

Preferably, the triggering means is activated when a differential between the trainer and trainee's response indicator exceeds a pre-determined limit.

20 According to another aspect of the invention, there is provided a method of training using a training simulator including loading and running the simulation program, conducting a trainer simulation, demonstrating a proper recovery measure according to the simulation, generating a response indicator in response to the simulation, storing the response indicator to a storage device, starting the simulation for at least one trainee, retrieving and displaying the trainer's response and comparing the trainee's response with the
25 trainer's response when the simulation is in session

In a second embodiment, the method further includes providing instructional messages during the trainee simulation.

30 In a third embodiment, the method further includes providing a score according to a response of the trainee.

In a fourth embodiment, the method further includes alerting the trainer when the response of the trainee does not result in a response indicator within an acceptable range.

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DESCRIPTION OF THE FIGURES

In order that the present invention might be more fully understood, embodiments of the invention will be described, by way of example only, with reference to the accompanying
10 drawings, in which:

Figure 1 shows a method of training of the prior art.

Figure 2 shows an apparatus of the present invention.

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Figure 3 shows an example illustration of a response indicator of the present invention.

Figure 4A shows a first embodiment of the apparatus of the evaluation module.

20 Figure 4B shows a second embodiment of the method of the evaluation module.

Figure 4C shows a dialogue box to be used in the present invention.

Figure 4D shows an example display on a trainee's console of the present invention.

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Figure 4E shows a third embodiment of the method of the evaluation module.

Figure 4F shows a comparison display of the response indicators of the trainer and the
trainee.

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Figure 4G shows a fourth embodiment of the method of the present invention.

Figure 4H shows an example display on a trainer's console of the score of a trainee
5 during a desired time period.

Figure 5 shows a first embodiment of the method of the present invention.

Figure 6 shows a second embodiment of the method of the present invention.
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Figure 7 shows a third embodiment of the method of the present invention.

Figure 8 shows a fourth embodiment of the method of the present invention.

15 In each of the embodiments and variations, the same reference numerals have been used for similar components, merely for ease of understanding the specification.

DETAILED DESCRIPTION OF THE INVENTION

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Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. While the invention will be described in conjunction with the preferred embodiments, it will be understood that they are not intended to limit the invention to these embodiments. On the contrary, the
25 invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims. Furthermore, in the following detailed description of the present invention, numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, it will be obvious to one of ordinary skill of the art that the present
30 invention may be practiced without these specific details. In other instances, well known methods, procedures, components, and features have not been described in detail as not to unnecessarily obscure aspects of the present invention.

The invention relates to an operator training apparatus for a manufacturing environment in the form of an Operator Training System (OTS) for use in the training of operators in the manufacturing environment. According to the invention, as shown in Figure 2, there is provided a training simulator or Operator Training System (OTS). The OTS contains an Instructor Tool Kit (ITK) 100 for the use of the trainer, a Plant Simulation Model 20, and at least one Operator Console 30 for the use of the trainee and an OTS Central Controller 40. The OTS Central Controller 40 coordinates the execution of different OTS modules and helps with any data exchange between them. The ITK 100 is the GUI to aid the trainer in carrying out training sessions. The Operator Console 30 receives trainee input to handle the instruments or field control devices in the Plant Simulation Model 20.

The Instructor Tool Kit includes a Monitor Module 110, an Evaluation Module 120, an ITK Central Controller 130, and may have further modules such as an Instructor Variable or Malfunction 140, etc. The ITK Central Controller communicates with different ITK Modules as well as the OTS Central Controller 40 so that information may be shared among these modules. The Monitor Module 110 provides a trend graph of the variables in the Plant Simulation Model 20. The Evaluation Module 120 helps a trainer in assessing a trainee's skill level.

The trainee Console 30 is installed on a different computer than the one the ITK 100 is installed, so that the trainer and the trainee can have a different set of views and functionalities. The apparatus further includes a storage device 50 in the form of a hard disk, to store the response of the trainer, and the trainee.

The storage device 50 allows the storage and subsequent retrieval of the response indicators of the trainer and the trainee. This system allows a trainer to dynamically compare his response indicator, to that of the trainee's so that any discrepancies in the response indicators (inevitably due to mistakes made by the trainee) can be highlighted in real time. This also allows a trainer to immediately rectify a trainee's error. In this way, training will be more effective.

Alternatively, the OTS is wired to a distributed control system (DCS) and the trainee can work on a terminal of the DCS. The DCS can have a facility to show trend graphs.

Figure 3 shows an example illustration of a response indicator 210 in the form of a trend graph 211, which may be stored and subsequently retrieved on the storage device.

A first example embodiment of the evaluation module 120 is as shown in Figure 4A. The evaluation module includes a retrieving section 121, and comparing section 122. The retrieval section retrieves the responses from a trainer and/ or a trainee, to form a response indicator(s). The trainee's response indicator is compared with that of the trainer's response indicator so that a trainer can establish the performance of the trainee. A trainee's real-time reference indicator during a desired time period may be viewed on a display. In an example, the trainer goes through the simulation and his responses are retrieved by the retrieving section 121 of the evaluation module 120 to form a trainer's response indicator. The trainer's response indicator is stored within the evaluation module 120, possibly in a reference table, from which a trainee's responses may be compared against. In the absence of a trainer's response indicator, the reference table may store a baseline response indicator from which a trainee's response may be compared.

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In a second embodiment of the evaluation module 120 as shown in Figure 4B further includes a means to display a pre-determined message during a trainee simulation in the form of a message section 123. The message section further includes an input means to allow a trainer to input messages which may be displayed during the trainee simulation. According to the invention, the input means is a dialogue box as shown in Figure 4C. In this embodiment, an example of the display on a trainee's console is shown in Figure 4D.

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In a third embodiment of the evaluation module 120 as shown in Figure 4E, the evaluation module further includes a scoring section 124 to tabulate a score of a trainee. The comparing section 122 compares a response indicator of a trainee, and a trainer. The comparing section 122 compares the response indicator values at each pre-

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determined interval during the simulation, or at a time when a response is required from the trainee, to compare and calculate the differential between the trainer and trainee's response. In a variation of the comparing section, the reference table provides at least a range of an acceptable differential between a trainer and trainee's response indicator throughout the simulation. This reference table will quantify, in the form of a score, what a differential in the response indicators relates to, and provides a tabulation means to tabulate an eventual score of the trainee. An example illustration of a display of the comparison is shown in Figure 4F, showing a response indicator 210 of a trainer 211, and a trainee 212. The degree of differential indicates a performance of a trainee.

In a fourth embodiment of the invention, the evaluation module further provides an alerting section 125 in the form of a triggering means to trigger a display of the pre-determined messages as shown in Figure 4G. The triggering means may trigger a display of the pre-determined message at intervals during a trainee simulation. This manner of triggering is preferably suited for instructional messages, whereby the nature or content of the messages displayed to a trainee console guides a trainee during the trainee simulation.

In a variation, the triggering means is activated when the trainee's response is wrong. For example, when the response indicator of the trainee indicates a value beyond the pre-determined limits, or, where the differential between the trainer and trainee's response indicator exceeds a pre-determined limit. This manner of triggering is preferably suited for corrective messages to be displayed to a trainee. In another variation, the triggering means may trigger a display to a trainer's console to alert the trainer to the trainee's inaccurate response so that a trainer may take immediate steps to rectify the trainee's error.

In yet another variation, the triggering conditions of the triggering means are manipulated by a trainer.

In a variation, the display includes a score of a trainee during a desired time period. In this variation, the trainer may input a start and stop time to define a desired time period,

and the score relating to this desired time period is calculated. An example display on a trainer's console is as seen in Figure 4H. In the example display, a trainer may decide to store the results of a trainee, by checking on the "Send result to Eval module" checkbox to effect a communication between the display, the response indicator, and the storage

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According to a second aspect of the invention, there is provided a method of instructing trainees by using a training simulator, or an Operator Training System (OTS) of the prior art. The first embodiment, as seen in Figure 5, includes the steps of loading and running

10 the simulation programme on a trainer's console, demonstrating proper recovery measures to the simulation programme, generating a response indicator in response to the simulation, storing the response indicator to a storage device, restarting the simulation for at least one trainee to enact the recovery measures, retrieving and displaying the trainer's response and comparing the trainee's response with the trainer's

15 response when the simulation is in session.

In a further embodiment, a trainer views the trainee's response in terms of a response indicator during the simulation and compares the trainee's response indicator with the trainer's response indicator. A proper response to the simulation will inevitably lead to a

20 form at the trainer's response indicator. Therefore, a measure of a trainee's skill level is inversely proportional to the differential between the trainer and trainee's response indicators. The invention provides a means to allow a trainer to arrest any mistakes made by the trainee before the end of the trainee's simulation session.

25 In a second embodiment of the invention, the method further includes providing a message during the trainee simulation. Preferably, the message is an instructional or prompt message to help the trainee during the simulation, this method is as shown in Figure 6.

30 In a third embodiment as shown in Figure 7, the method further includes comparing the response indicator of the trainee to the trainer's response, and thereafter providing a score of the trainee.

The score may be provided by a visual comparison of the differential value between the trainer and trainee's response indicator. In a variation, the score is system generated in that a measure of the absolute difference between the trainer and trainee's response indicators provides a score of the trainee. In another variation, a pre-determined weightage is provided to each of the responses, and a score is calculated as a factor of the weightage and differential between the response indicators of the trainee and the trainer.

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- 10 In a fourth embodiment as shown in Figure 8, the method further includes alerting the trainer should a trainee provide a response that does not result in a response indicator that is within an acceptable range of the trainer's response.

In the embodiments, the response indicator is a trend graph.

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The embodiments of the invention have been advanced by way of example only, and modifications are possible within the scope of the invention as defined by the appended claims.

CLAIMS:

1. An operator training apparatus for a manufacturing environment including
an instructor tool kit for the use of a trainer;
5 said instructor tool kit further including a monitor module; an evaluation module
and a central controller;
a plant simulation model to enact the plant simulation for the manufacturing
environment;
at least one operator console for the use of a trainee;
10 a storage device to store a response of a trainer and/ or a trainee.
2. An operator training apparatus for a manufacturing environment according to
claim 1, wherein the evaluation module further includes a retrieving section to retrieve a
response from a trainer and/ or a trainee, and a comparing section to compare a
15 response from a trainer and a trainee.
3. An operator training apparatus for a manufacturing environment according to
claim 2, wherein the comparing section further includes a reference table, said reference
table including a trainer's response indicator or a baseline response indicator from which
20 a trainee's response may be compared.
4. An operator training apparatus for a manufacturing environment according to any
one of claims 1 to 3, wherein the evaluation module further includes a message section
to provide a message to a trainee during a simulation.
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5. An operator training apparatus for a manufacturing environment according to
claim 4, wherein the message section further includes an input means to allow a trainer
to input messages which may be displayed during a trainee simulation.
- 30 6. An operator training apparatus for a manufacturing environment according to
claim 5, wherein the input means is a dialogue box.

7. An operator training apparatus for a manufacturing environment according to any one of claims 1 to 6, wherein the evaluation module further includes a scoring section to tabulate a score of a trainee.
- 5 8. An operator training apparatus for a manufacturing environment according to claim 7, wherein the scoring section compares the differential between the trainer and trainee's response.
9. An operator training apparatus for a manufacturing environment according to
10 claim 7, wherein the scoring section compares the differential between the baseline and trainee's response.
10. An operator training apparatus for a manufacturing environment according to any one of claims 7 to 9, wherein the scoring section further includes a tabulation means to
15 tabulate an eventual score of a trainee.
11. An operator training apparatus for a manufacturing environment according to any one of claims 1 to 10, wherein the evaluation module further includes an alerting section.
- 20 12. An operator training apparatus for a manufacturing environment according to claim 11, wherein the alerting section is in the form of a triggering means.
13. An operator training apparatus for a manufacturing environment according to claim 12, wherein the triggering means triggers a display of a pre-determined message
25 during a trainee simulation.
14. An operator training apparatus for a manufacturing environment according to claim 11, wherein the triggering means is activated by a trainer.
- 30 15. An operator training apparatus for a manufacturing environment according to claim 12, wherein the triggering means is activated when a differential between the trainer and trainee's response indicator exceeds a pre-determined limit.

16. A method of training using a training simulator including loading and running the simulation program, conducting a trainer simulation, demonstrating a proper recovery measure according to the simulation;
- 5 generating a response indicator in response to the simulation;
storing the response indicator to a storage device;
starting the simulation for at least one trainee;
retrieving and displaying the trainer's response; and
comparing the trainee's response with the trainer's response when the simulation is in
10 session.
17. A method of training according to claim 16, wherein the method further includes providing instructional messages during the trainee simulation.
- 15 18. A method according to any one of claims 16 or 17, wherein the method further includes providing a score according to a response of the trainee.
19. A method according to any one of claims 16 to 18, wherein the method further includes alerting the trainer when the response of the trainee does not result in a
20 response indicator within an acceptable range.