According to at least one aspect of the present disclosure, a non-transitory computer readable medium containing thereon sequences of computer executable instructions for managing workflow of an industrial application is provided.

The sequences of computer readable instructions including instructions that instruct at least one processor to provide workflow instructions to a first user, associate identification data with a workpiece, the workpiece being used in the industrial application, associate industrial application state data with one of a first industrial application state and a second industrial application state, the first industrial application state corresponding to a state of the industrial application before operation of a tool on the workpiece, and the second industrial application state corresponding to a state of the industrial application after operation of the tool on the workpiece, associate workpiece state data pertaining to the workpiece with the identification data, update at least the second industrial application state data based on tool operation data associated with the operation of a tool on the workpiece, and upload at least one of the identification data, the first industrial application state data, the second industrial application state data, and the workpiece state data to a service.

In some examples, the workflow instructions further include one or more of selecting an appropriate tool to use on the workpiece, recording the identification data associated with the workpiece, recording the industrial application state data, recording the workpiece state data, and stopping work on the workpiece pending release of a hold associated with the workpiece. In various examples, the instructions further instruct the processor to record completion of a given workflow instruction responsive to the first user indicating completion of the given workflow instruction. In many examples, the instruction further instructing the at least one processor to instruct the service to provide the data to a second user, perform data analytics on the data, the data analytics including building a data model of the workpiece, place a hold on the workpiece responsive to receiving an instruction to place the hold on the workpiece, and release the hold on the workpiece responsive to receiving an instruction to release the hold on the workpiece.

In some examples, the data includes at least one of the industrial application state data, the workpiece state data, and the tool operation data. In various examples, the second user provides the instructions to place the hold on the workpiece and to release the hold on the workpiece. In many examples, the instructions further instructing the at least one processor to instruct the service to provide the data analytics to the second user. In some examples, the

instructions further instructing the at least one processor to change the workflow instructions responsive to inputs from the second user.

According to at least one aspect of the present disclosure, a system for managing workflow of an industrial application is provided. The system comprises at least one sensor, a guidance device configured to provide instructions to a user, the instructions indicating acts of the user to perform, receive from the at least one sensor at least one of tool operation data obtained responsive to the operation of a tool, industrial application state data, and workpiece state data, and provide at least one of the tool operation data, the industrial application state data, and the workpiece state data to a service, and a service configured to receive at least one of the tool operation data, the industrial application state data, and the workpiece state data, perform data analytics on received data, including generating a data model associated with the workpiece, place a hold on the workpiece, release the hold from the workpiece, and audit the received data.

In some examples, the tool operation data is associated with the operation of the tool and is received by the guidance device from the at least one sensor in communication with the guidance device, the at least one sensor being configured to monitor the operation of the tool to produce the tool operation data. In various examples, there is a local client configured to communicate with the guidance device and the service, the guidance device providing the at least one of the tool operation data, the industrial application state data, and the workpiece state data to the local client, and the local client providing the at least one of the tool operation data, the industrial application state data, and the workpiece state data to the service.

In some examples, the local client is further configured to provide updated data to the guidance device in response to receiving at least one of the industrial application state data, the workpiece state data, the tool operation data, data indicative of the hold being placed on the workpiece, and data indicative of the hold being released from the workpiece. In many examples, the industrial application state data includes a first industrial application state data and a second industrial application state data, the first industrial application state data corresponding to a state of the industrial application prior to operation of the tool on the workpiece, and the second industrial application state data corresponding to a state of the industrial application after operation of the tool on the workpiece.

BRIEF DESCRIPTION OF THE DRAWINGS

CLAIMS

1. A method of managing workflow for an industrial application, comprising:

providing a guidance device configured to be communicatively coupled to a tool configured to be used on a workpiece;

obtaining identification data pertaining to the workpiece being used in the industrial application;

obtaining industrial application state data pertaining to at least one state of the industrial application;

obtaining workpiece state data;

operating the tool on the workpiece;

obtaining tool operation data;

uploading to a service, via the guidance device, at least one of the identification data, the industrial application state data, and the tool operation data; and

validating the industrial application state data.

2. The method of claim 1 wherein obtaining industrial application state data pertaining to at least one state of the industrial application includes:

obtaining a first industrial application state data pertaining to the state of the industrial application prior to operation of the tool;

obtaining a second industrial application state data pertaining to the state of the industrial application after operation of the tool; and

uploading at least one of the first and the second industrial application state data to the service.

3. The method of claim 2 wherein the second industrial application state data is based at least in part on the tool operation data.

4. The method of claim 1 further comprising:

obtaining a first workpiece state data corresponding to the state of the workpiece prior to operation of the tool;

obtaining a second workpiece state data corresponding to the state of the workpiece after operation of the tool; and

uploading at least one of the first and the second workpiece state data to the service.

5. The method of claim 4 wherein the second workpiece state data is based at least in part on the tool operation data.

6. The method of claim 1 wherein the industrial application state data is obtained by a set of requirements verified by an end user.

7. The method of claim 1 wherein the tool operation data is obtained from a sensor configured to monitor the operation of the tool on the workpiece.

8. The method of claim 1 wherein validating the industrial application state data includes:

flagging the workpiece for review responsive to determining that an error in the operation of the tool may have occurred;

performing a quality check on the workpiece; and

releasing the workpiece from review.

9. The method of claim 1 wherein the service analyzes the data it receives and provides analytic information to a user, the analytic information including a data model for the workpiece based on at least the industrial application state data.

10. The method of claim 9 wherein validating the industrial application state data includes reviewing the analytic information.

11. The method of claim 1 wherein uploading to a service via the guidance device further comprises:

transmitting the industrial application state data from a client installed on the guidance device to a local client communicatively coupled to the client;

transmitting the industrial application state data from the local client to a server communicatively coupled to the local client, the server hosting a database configured to store the industrial application state data; and

transmitting the industrial application state data from the server to the service, the service being configured to perform operations on the industrial application state data.

12. The method of claim 11 wherein the operations the service is configured to perform on the industrial application state data include:

data analytics; and

building a data model of the industrial application associated with the industrial application state data.

13. The method of claim 1 wherein the guidance device is further configured to provide workflow instructions to the end user, the instructions instructing the end user on at least one of:

which workpiece to operate the tool on;

when to collect the industrial application state data; and

when to collect the tool operation data.

14. The method of claim 13 wherein providing workflow instructions to the end user causes the guidance device to update the information displayed to the end user.

15. A non-transitory computer readable medium containing thereon sequences of computer executable instructions for managing workflow of an industrial application, the sequences of computer readable instructions including instructions that instruct at least one processor to:

provide workflow instructions to a first user;

associate identification data with a workpiece, the workpiece being used in the industrial application;

associate industrial application state data with one of a first industrial application state and a second industrial application state, the first industrial application state corresponding to a state of the industrial application before operation of a tool on the workpiece, and the second

industrial application state corresponding to a state of the industrial application after operation of the tool on the workpiece;

associate workpiece state data pertaining to the workpiece with the identification data;

update at least the second industrial application state data based on tool operation data associated with the operation of a tool on the workpiece; and

upload at least one of the identification data, the first industrial application state data, the second industrial application state data, and the workpiece state data to a service.

16. The non-transitory computer readable medium of claim 15, wherein the workflow instructions further include one or more of:

selecting an appropriate tool to use on the workpiece;

recording the identification data associated with the workpiece;

recording the industrial application state data;

recording the workpiece state data; and

stopping work on the workpiece pending release of a hold associated with the workpiece.

17. The non-transitory computer readable medium of claim 16 wherein instructions further instruct the processor to record completion of a given workflow instruction responsive to the first user indicating completion of the given workflow instruction.

18. The non-transitory computer readable medium of claim 15, the instruction further instructing the at least one processor to instruct the service to:

provide the data to a second user;

perform data analytics on the data, the data analytics including building a data model of the workpiece;

place a hold on the workpiece responsive to receiving an instruction to place the hold on the workpiece; and

release the hold on the workpiece responsive to receiving an instruction to release the hold on the workpiece.

19. The non-transitory computer readable medium of claim 18, wherein the data includes at least one of the industrial application state data, the workpiece state data, and the tool operation data.

20. The non-transitory computer readable medium of claim 18, wherein the second user provides the instructions to place the hold on the workpiece and to release the hold on the workpiece.

21. The non-transitory computer readable medium of claim 18, the instructions further instructing the at least one processor to instruct the service to provide the data analytics to the second user.

22. The non-transitory computer readable medium of claim 18, the instructions further instructing the at least one processor to change the workflow instructions responsive to inputs from the second user.

23. A system for managing workflow of an industrial application, the system comprising:
at least one sensor;
a guidance device configured to:
provide instructions to a user, the instructions indicating acts of the user to perform;
receive from the at least one sensor at least one of tool operation data obtained responsive to the operation of a tool, industrial application state data, and workpiece state data; and
provide at least one of the tool operation data, the industrial application state data, and the workpiece state data to a service; and
a service configured to:
receive at least one of the tool operation data, the industrial application state data, and the workpiece state data;
perform data analytics on received data, including generating a data model associated with the workpiece;

place a hold on the workpiece;
release the hold from the workpiece; and
audit the received data.

24. The system of claim 23, wherein the tool operation data is associated with the operation of the tool and is received by the guidance device from the at least one sensor in communication with the guidance device, the at least one sensor being configured to monitor the operation of the tool to produce the tool operation data.

25. The system of claim 22 further comprising a local client configured to communicate with the guidance device and the service, the guidance device providing the at least one of the tool operation data, the industrial application state data, and the workpiece state data to the local client, and the local client providing the at least one of the tool operation data, the industrial application state data, and the workpiece state data to the service.

26. The system of claim 25, wherein the local client is further configured to provide updated data to the guidance device in response to receiving at least one of:
the industrial application state data,
the workpiece state data,
the tool operation data,
data indicative of the hold being placed on the workpiece, and
data indicative of the hold being released from the workpiece.

27. The system of claim 22 wherein the industrial application state data includes a first industrial application state data and a second industrial application state data, the first industrial application state data corresponding to a state of the industrial application prior to operation of the tool on the workpiece, and the second industrial application state data corresponding to a state of the industrial application after operation of the tool on the workpiece.