IM10580

Managing Factory Operations with the Internet of Things

Dr. Nancy Diaz-Elsayed, Autodesk

Aniruddha Deodhar, Autodesk

Learning Objectives

- Determine how IoT can help factory owners reduce energy consumption and costs
- Learn how to access performance analytics for the production floor
- Discover energy-intensive processes and idling equipment
- Discover how high-frequency sensor information can help reduce maintenance costs

Description

Our smartphones are filled with apps that track numerous things like our heart rate, running speed, and sleep patterns, but what can this new world of internet-connected devices do for our work lives in industry? Growth of a new class of products called “connected devices” or the “Internet of Things (IoT)” will usher in a new era of smarter, more cost-effective factories. These devices will make production data visible and useful, and will do much to help factory managers make more strategic decisions. This class will cover emerging trends in the Internet of Things and introduce a new, easy-to-implement application for managing factory operations. The cloud-based application uses data collected from wireless, non-intrusive sensors, and displays it in the context of a digital model in order to deliver actionable insights for energy and production management.

Your AU Experts

Nancy Diaz-Elsayed *is a sustainable manufacturing specialist at Autodesk, Inc., where she manages products and strategic partnerships for the sustainable operation of factories. She received her BS in mechanical engineering with a minor in management from the Massachusetts Institute of Technology. She obtained her MS and PhD in mechanical engineering from the University of California, Berkeley, where she also received a certificate in engineering and business for sustainability (EBS) and the management of technology (MOT).*

Aniruddha Deodhar *is a senior sustainable buildings product manager at Autodesk, Inc., where he is responsible for delivering streamlined energy-efficiency solutions for commercial buildings. He brought to market industry’s first rapid-energy modeling solutions that make attaining green-energy retrofits quicker and more cost effective. He also co-developed C-FACT, a business-friendly, open-source approach to corporate greenhouse gas-reduction targets that won the #1 spot among public companies in a recent ranking. Recently he developed and brought to market LEED Automation technologies and iPAD-based energy analysis and audit tools. Aniruddha brings more than 15 years’ experience in high technology in Asia, Europe, and North America. Aniruddha received his MBA with distinction from the Kellogg School of Management and his BASc in computer engineering with honors from Nanyang Technological University in Singapore.*

Managing Energy

Aquila provides the Sustainability Manager and Facilities Manager with granular, real-time data and actionable insights so that they can manage energy consumption, lower costs, and advance towards meeting their sustainability initiatives.

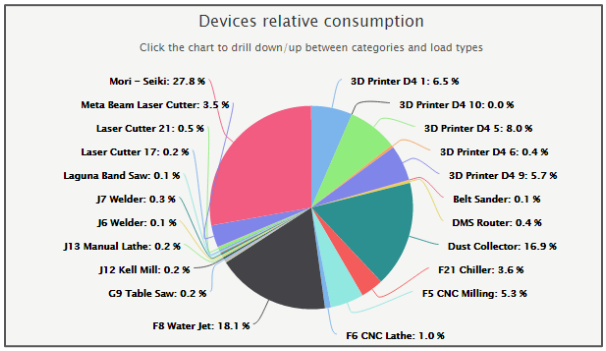
FIGURE 1: SUMMARY OF USER ROLES FOR ENERGY MANAGEMENT

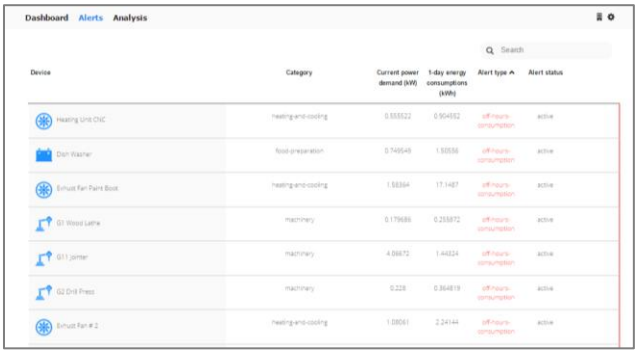
Configuring Alerts

Aquila automatically creates the following rules for energy management: 1) the device is on during off hours and 2) the device is on standby for too long. The Facilities Manager can change the definition of the "Standby" state in the "Device configuration" section of Aquila via the Alerts page. The Facilities Manager can also create rules for energy management in Panoramic Power's dashboard such as an alert for when a device has been on for too long. The alerts from Panoramic Power are streamed to Aquila and can be mapped onto 2D plans in Aquila for easy access.

Reducing Energy Consumption

In Aquila, the Sustainability Manager can view energy KPIs with respect to normalizing factors such as the size of the building, number of occupants, or production units manufactured on the main dashboard. They can work with the facilities and the manufacturing teams to lower the energy consumption of the building support equipment and the machinery, respectively. To help prioritize their efforts, they can identify the devices that consume the most energy and the greatest opportunities for cost savings on the "Analysis" page, and access device-level alerts on the "Alerts" page or 2D plan.

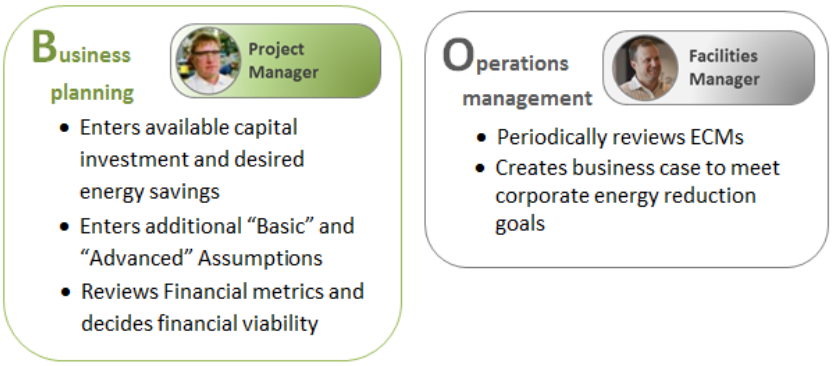




FIGURES 2 (A) AND (B): POWER BREAKDOWN OF DEVICES AND SUMMARY OF ALERTS

Financial Analysis of New Energy Projects

Project Managers can conduct a cost benefit analysis of new energy management projects by calculating financial metrics such as Net Present Value, Discounted Payback, and Internal Rate of Return based on their real consumption data and the desired Energy Conservation Measure (ECM).



FIGURES 3: SUMMARY OF USER ROLES FOR FINANCIAL ANALYSIS

The tool is useful in a number of ways: 1) compare various energy conservation measures based on budgetary constraints and create a business case, 2) understand the financial thresholds that must be met for desired operational savings, and 3) assess project viability during due diligence of an asset acquisition.

Aquila uses default values to create a sample scenario. The Project Manager change Basic and Advanced Assumptions to create more realistic scenarios for the desired Energy Conservation Measures, and share their findings with key stakeholders in their organization such as the Facilities Manager and Sustainability Manager.

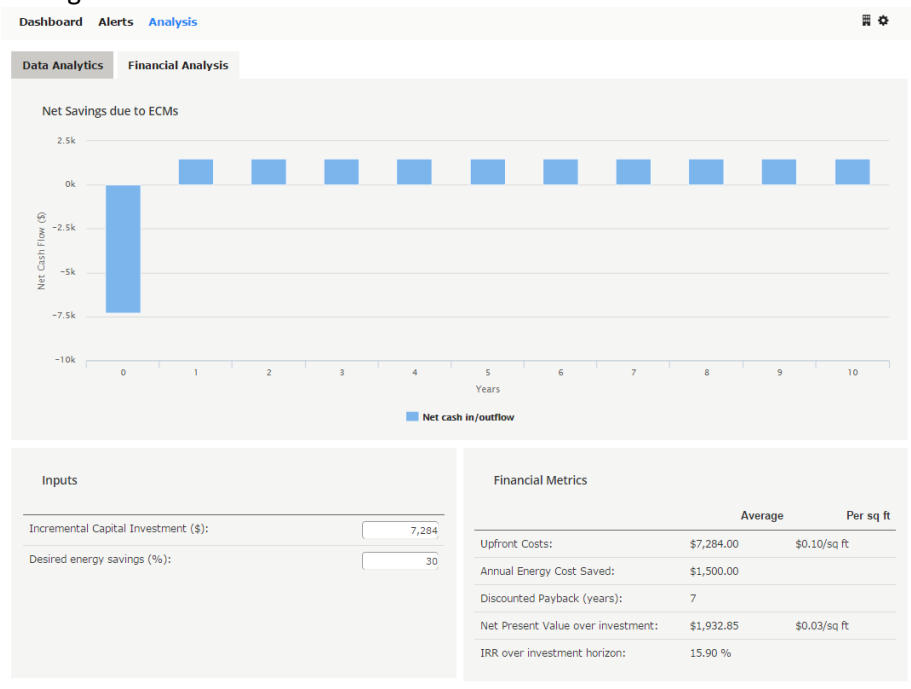


FIGURE 4: RESULTS OF FINANCIAL ASSESSMENT OF ENERGY CONSERVATION PROJECT

Managing Assets

The facilities team is able to increase their awareness of the status of equipment for improved maintenance with the aid of real-time data.

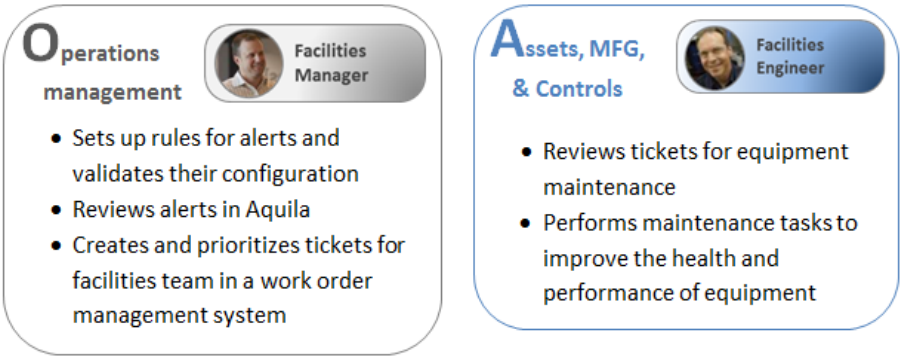


FIGURE 5: SUMMARY OF USER ROLES FOR ASSET MANAGEMENT

Configuring Alerts

Aquila automatically creates the following rules for equipment maintenance: 1) above normal power demand, 2) above normal energy consumption, and 3) cycling too frequently.

Default values that trigger the alerts are set based on data from the first week of data acquisition, and these values can be modified by selecting a device on the alerts tab. A facilities manager also has the ability to create rules for predictive maintenance in Panoramic Power's dashboard, which are then streamed directly to Aquila and can trigger an SMS message, email notification, and/or create a ticket in Autodesk Building Ops. These rules from Panoramic Power include: high/low daily energy consumption, high/low power consumption, circuit overload, device not cycling, device short cycling, device stopped working, and low power factor. The Facilities Manager can upload 2D layouts of their facilities to Aquila in the form of a pdf file and link the real-time data streams to devices in the file for access later.

Maintaining Equipment

At the beginning of their day, the Facilities Manager can take a look at the equipment that require attention on a 2D layout of their facility with mapped data streams.

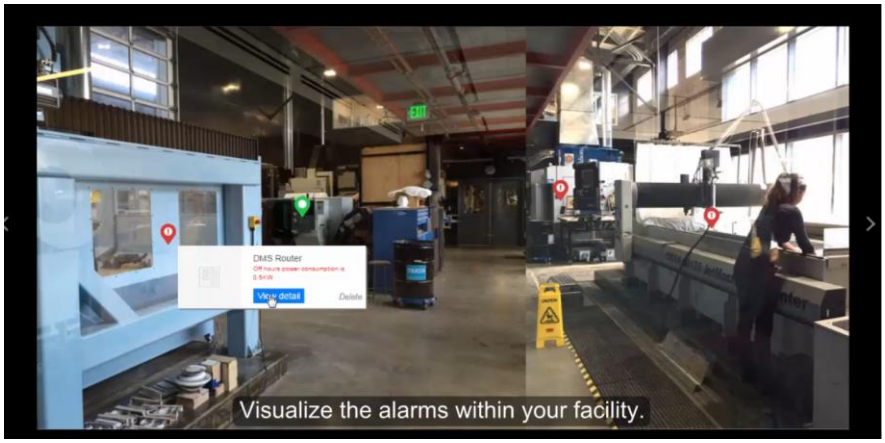
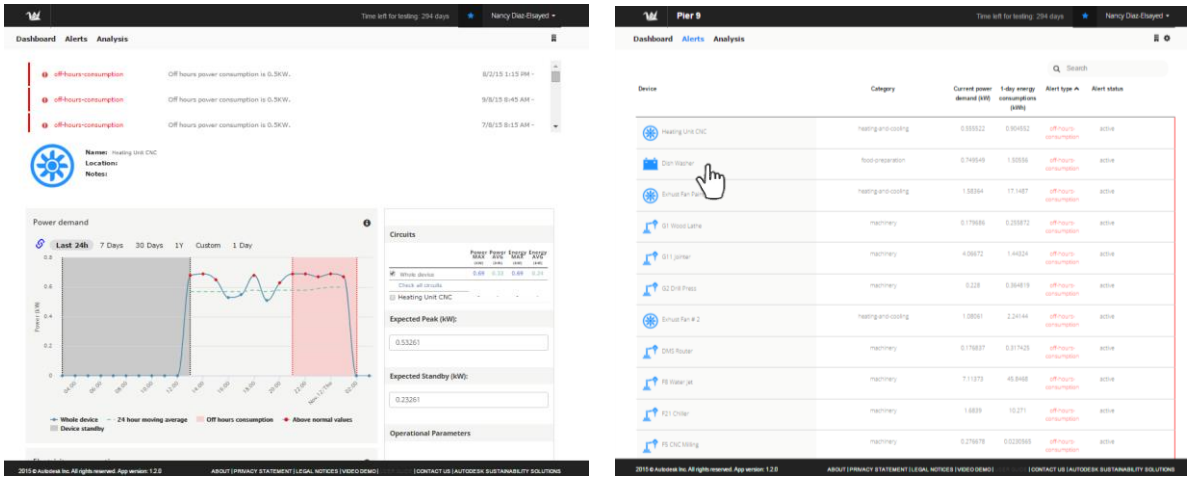


FIGURE 6: ALERTS MAPPED ONTO A 2D IMAGE OF A FACILITY

Clicking on the “View detail” button provides them with more information about that alert (see the image on the left, below). Alerts are also summarized within Aquila by device on the “Alerts” page.



FIGURES 7 (A) AND (B): DEVICE DETAILS VIEW AND SUMMARY OF ALERTS

After reviewing the alerts, the Facilities Manager can create and prioritize tickets for the maintenance team in their preferred work order system. Autodesk Building Ops, for example, allows users to create, update, and track tickets on their mobile device or via an online dashboard. The Facilties Engineer can then view power data and historical alerts on Aquila as they troubleshoot the problem.

Managing the Environment

The Facilities Manager and Engineer can better manage the thermal comfort of employees with insight about the temperature inside the office. Furthermore, factories that implement strict temperature controls to manufacture precision parts can validate the expected performance of their HVAC system.

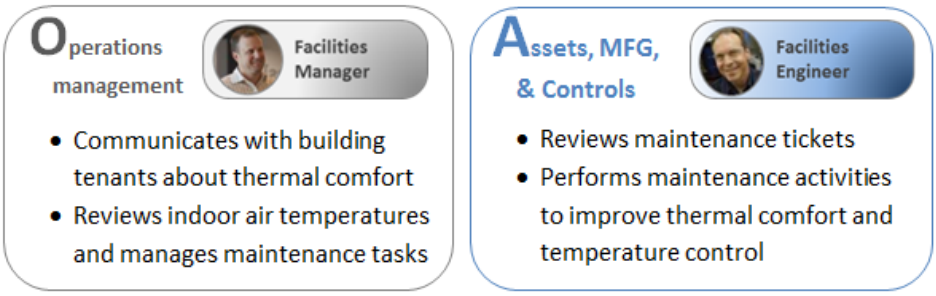


FIGURE 8: SUMMARY OF USER ROLES FOR ENVIRONMENTAL MANAGEMENT

Once Aquila has the 2D layout files of the facility, the Facilities Manager can map temperature data streams to locations in that file. The example in figure 9 shows an office space with data streaming from wireless temperature sensors in real-time.

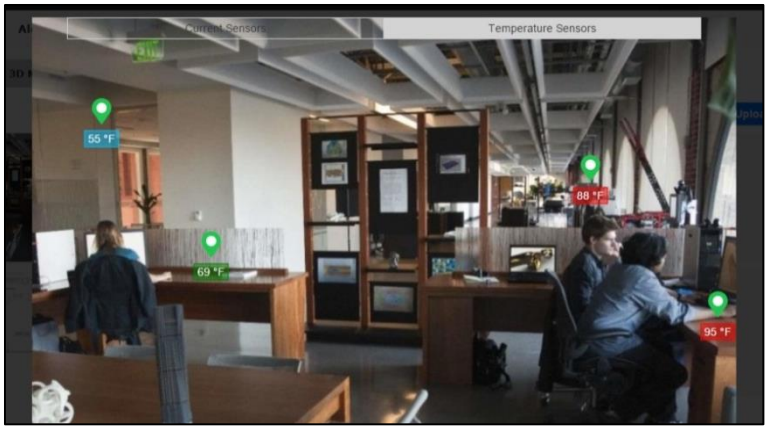


FIGURE 9: VIEW OF THE TEMPERATURE VARIATION IN A FACILITY FOR EVALUATING THERMAL COMFORT

Insight into Equipment Utilization

Power data can be very telling about what a machine is doing. Machines typically have two or three states. For those devices with two states, like a band saw, they are either off or operating. So, when this type of machine is operating, it is consuming more than 0 kW of power. Alternatively, a machine with three states, like a CNC machine tool, has an idling or standby state where it still consumes power, but at a lower rate than if it were operating and processing material. Power data is used within Aquila to identify the state of the devices within a facility. This information can in turn be used by Manufacturing Engineers and Industrial Engineers to monitor equipment performance, enhance future designs of production lines, and validate simulation models of factory operations.

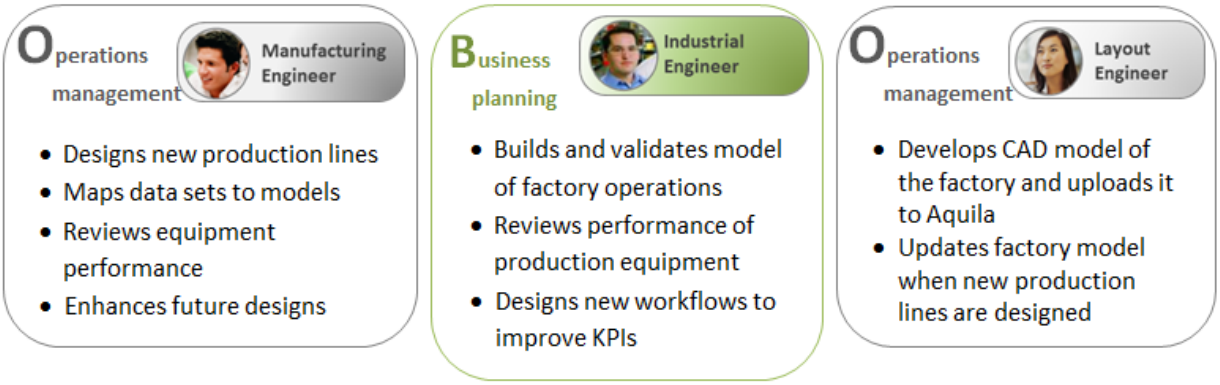
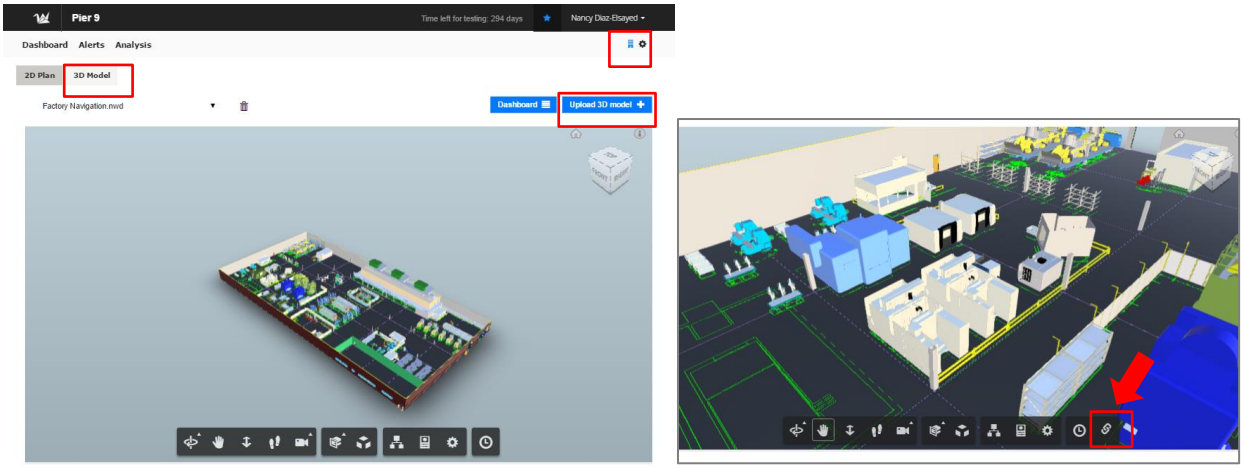


FIGURE 10: SUMMARY OF USER ROLES FOR THE EVALUATION OF EQUIPMENT UTILIZATION

Configuration of Models and Devices

In the facilities section of Aquila, the Layout Engineer uploads a model of their facility. By clicking on a device, they can link the device in the large model viewer to a data stream, and provide users with access to device-level information within the context of a 3D model.



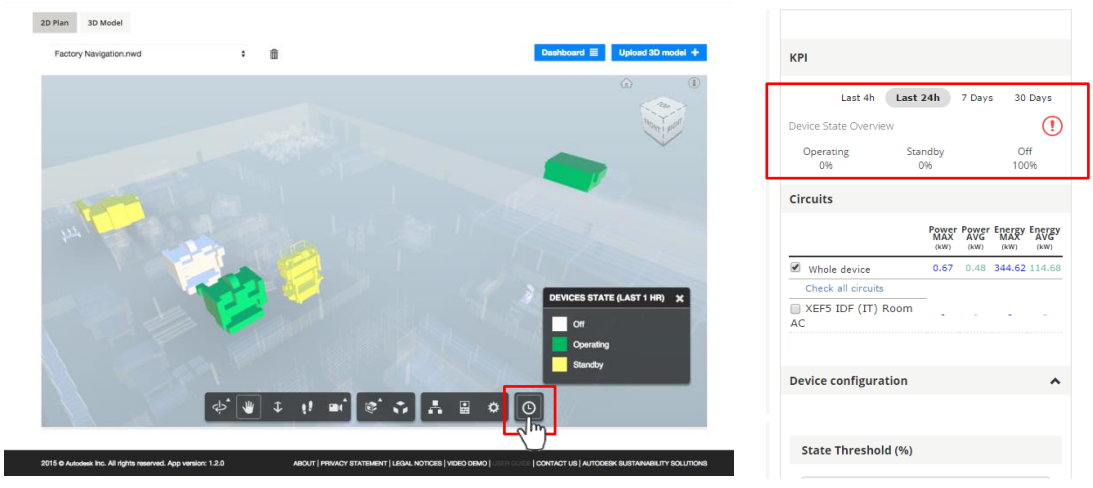
FIGURES 11 (A) AND (B): UPLOADING A 3D MODEL AND LINKING ASSETS

A device is considered to be in standby mode when it is greater than 0kW, but less than the "Expected Standby" power in the device details page of Aquila. By default, if the device operates < 90% of the time during a particular time interval, a warning icon is displayed on the dashboard. Users can modify the "Expected Standby" power and the preferred threshold in the "Device configuration" section of Aquila.

Reviewing and Validating Equipment Performance

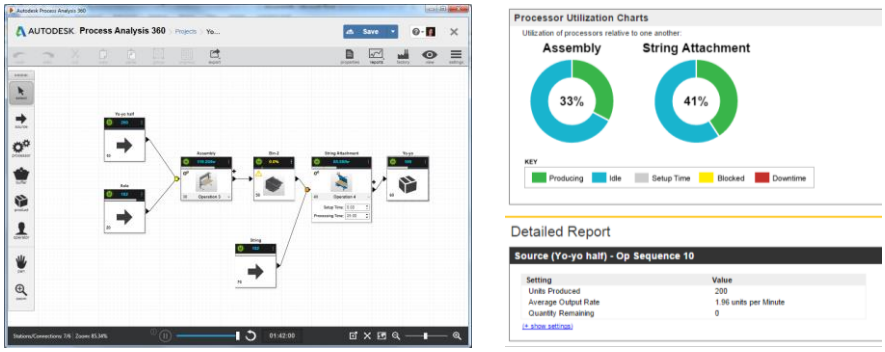
At any point in time throughout the day, the plant manager, industrial engineer, and manufacturing engineer can navigate to the 3D model viewer, click on the time icon, and see the state of the devices in their facility (see the image on the left, below). This view shows three states: off, standby, and operating, and shows the state that the device spent the longest time in over the last one hour.

The Manufacturing Engineer can also see how their production equipment has performed over different time horizons by visiting the "Device Details" page (see the image on the right, below), and compare it to their desired performance. Furthermore, the Industrial Engineer can use these state KPIs to validate the assumptions around equipment utilization in their simulation model of factory operations.



FIGURES 12 (A) AND (B): REVIEWING THE STATE OF DEVICES WITHIN THE FACILITY AND STATE KPIS

There are a multitude of options available for creating the model of factory operations, including the use of discrete event simulation software, such as Autodesk's Process Analysis 360 (PA 360). Once a model is created, the Industrial Engineer can access the utilization charts of the production equipment and compare the "Producing" state of the model to the "Operating" state in Aquila to see if they need to modify any assumptions.



FIGURES 13 (A) AND (B): FACTORY MODEL AND UTILIZATION REPORT FROM PA 360