Using **Computer Vision** to fill **Manufacturing** and **Warehousing** Blind Spots with **Actionable Data**

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Introduction

Manufacturing and warehousing operations have been able to access a wide range of data in a cost-effective manner for many years. With the advent of AI and Industry 4.0 the sources of data have grown exponentially. The sources include:

- **MACHINE TOOLS** – alarms, statuses, overrides, modes, loads, speeds and feeds.
- **CONNECTED SYSTEMS** – application programming interfaces (APIs), enterprise resource planning (ERP), computer assisted manufacturing (CAM), manufacturing execution systems (MES), tooling and maintenance systems.
- **OPERATORS** – equipment operators providing missing data.
- **SENSORS** – wired or IoT measuring power, vibration, temperature, humidity, etc. on both machines and on the shop floor.

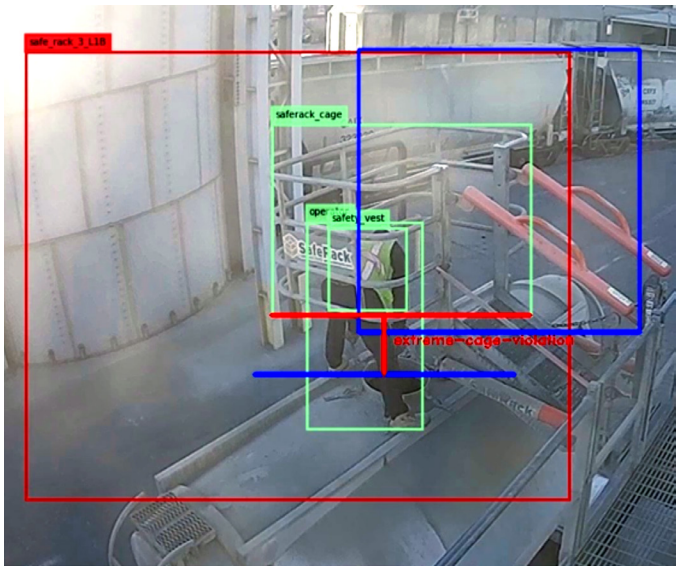
In recent years, the ability to analyze all these sources of data has been simplified with Big Data analytical tools. While all this data is a boon to manufacturing and warehousing, it lacks insights into critical operational issues that hurt efficiency, quality and safety. The issues are around manufacturing blind spots, especially those involving people interacting with equipment, vehicles, and materials they are handling. Only with advanced computer vision using deep learning algorithms is it possible to see how the many moving parts of any operation fit together.

There are several examples of critical blind spots that computer vision can expose and convert into actionable data.

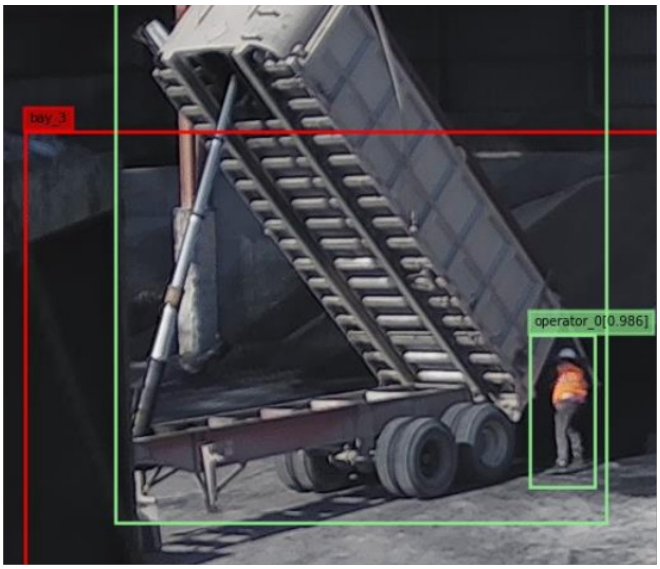
Yard **Safety**

While sensors can detect a variety of operational issues, only computer vision can detect and alert to safety violations involving people interacting with vehicles and equipment. The image below captures the process of loading cement trucks in which the driver stands in a safety cage to open and close the hatch. Without the safety cage the driver could easily fall off the vehicle causing a major injury. The computer vision system sends an alert any time the driver works the hatch outside of the safety cage. With this control in place, accidents have been substantially reduced.

The image below is of a major safety violation in which the driver leaves his cab to verify that his load is completely emptied. The danger comes from loose material that can easily fall injuring or killing the driver. The computer vision system looks for any instance where a person is detected outside of their vehicle triggering an alert.



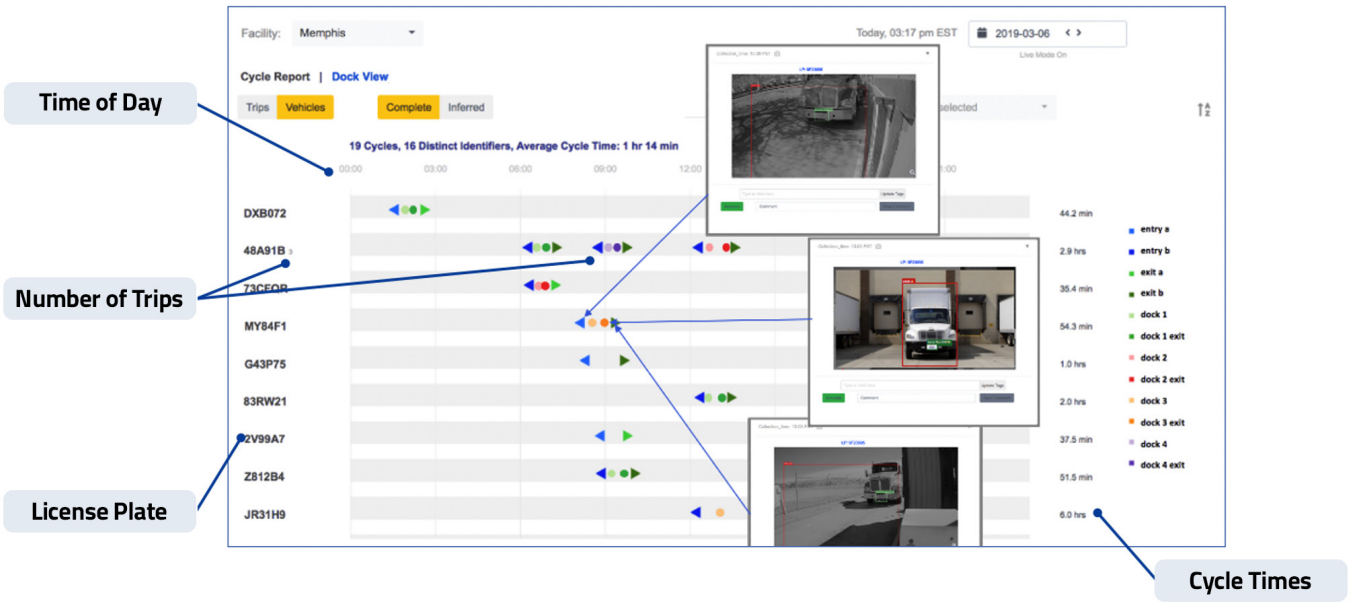
Automatically detects PPE & Other violations



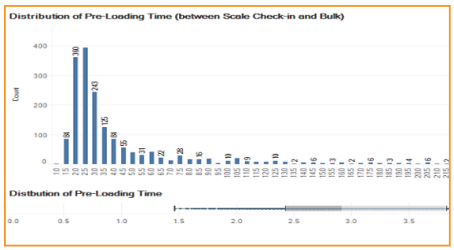
Flagging unsafe behavior in a high risk area

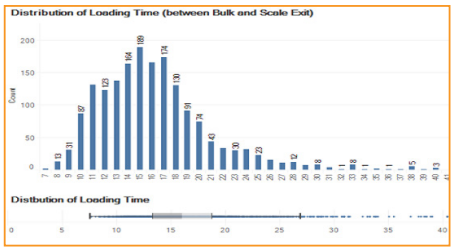
Improving **Yard Cycle Times** and **Eliminating Bottlenecks**

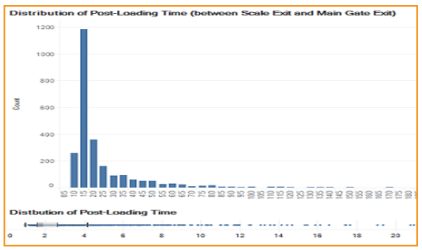
Automatically detect movement of trucks in a yard. The system creates a digital twin of the truck in the system. The detail can include the gate entry, exit and loading times. This type of analysis has helped organizations to better schedule vehicles to avoid bottlenecks throughout the day.



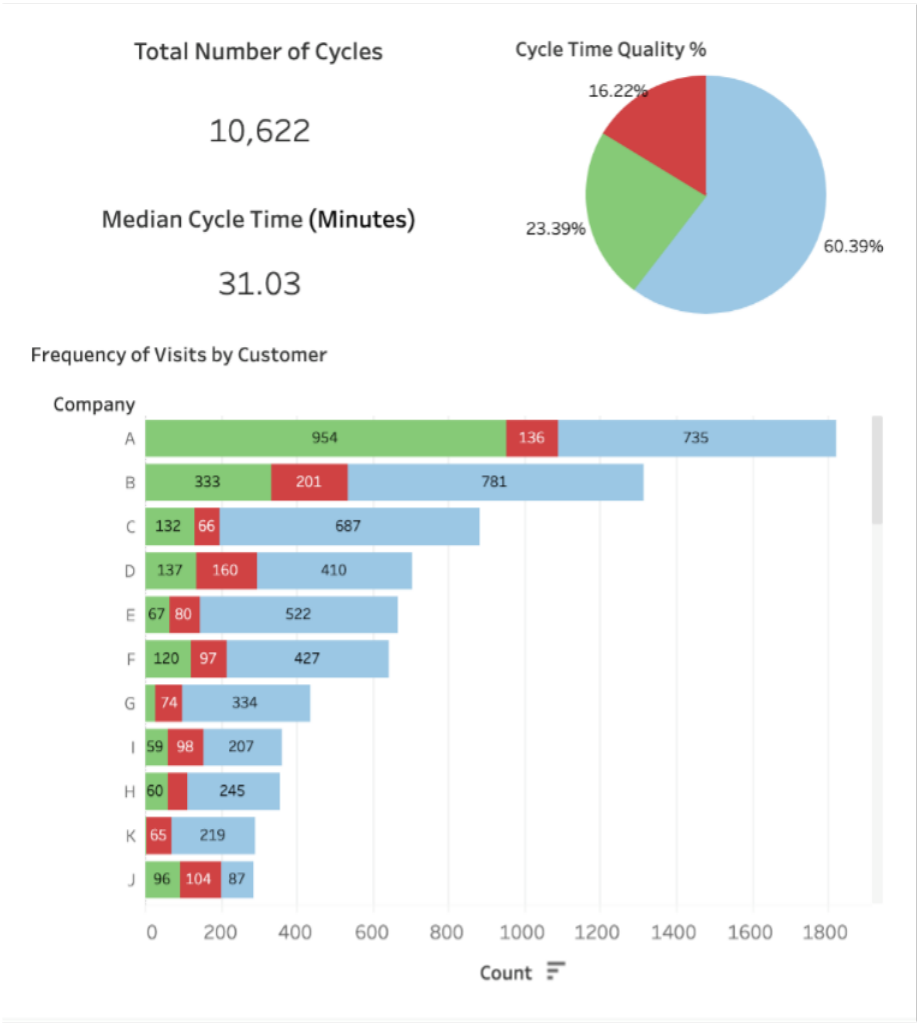
Leveraging computer vision data, the system creates advanced analytics reports to help plant management, sales and safety management make data-informed decisions.





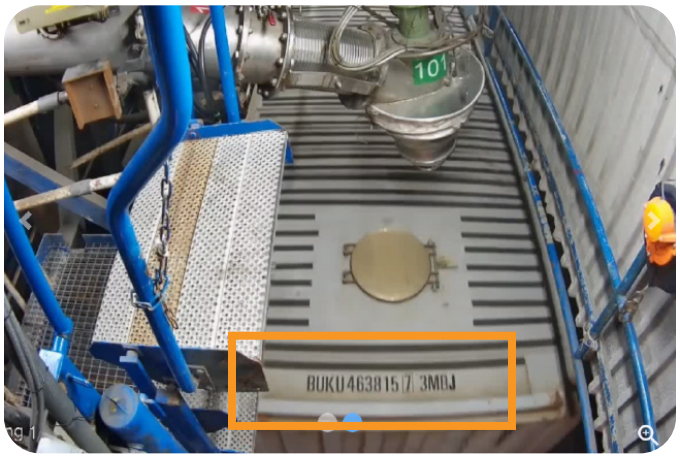


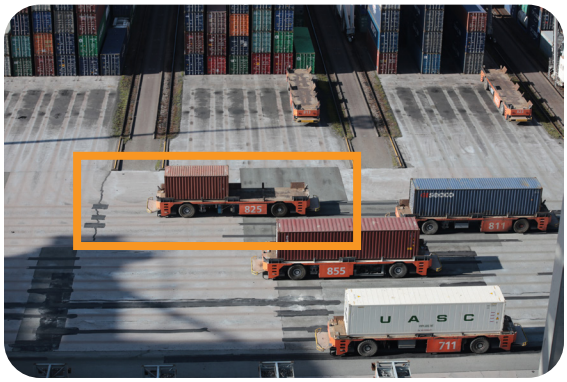
This dashboard shows average cycle times and the number of visits by customer.



The same computer vision technology can also help improve intermodal transporation at ports and rail yards capturing chasis, container, DOT registration, and license plate numbers

Container ID Capture





Gate Activity Capture

Chassis/License Plate Capture

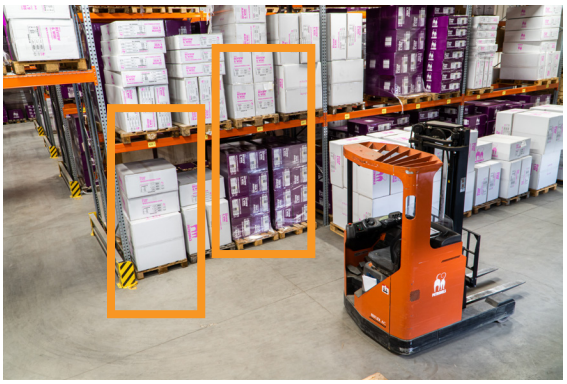
Scale Weight Capture

Automating **Inventory Management**

Computer vision can automate kanbans by signaling when bin levels drop below a predetermined level.

Stock Out Alerts

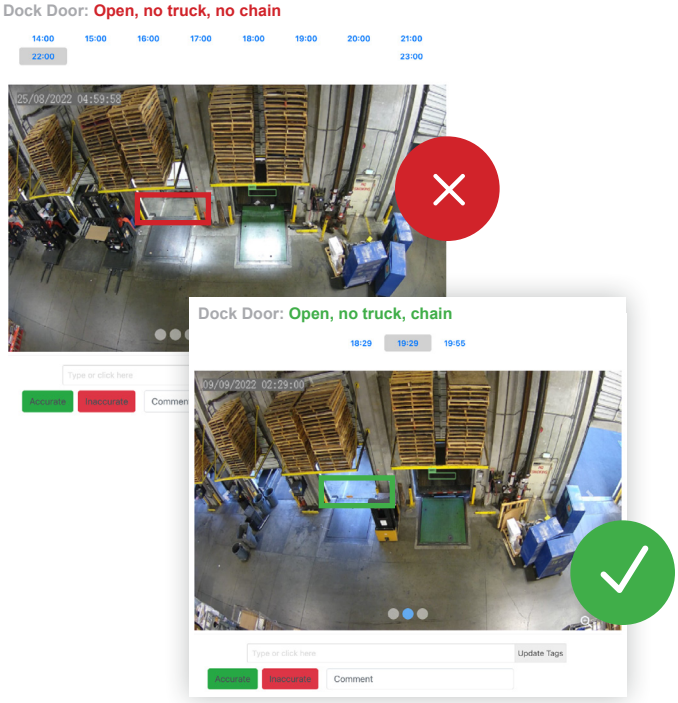
Kanban Level Monitoring



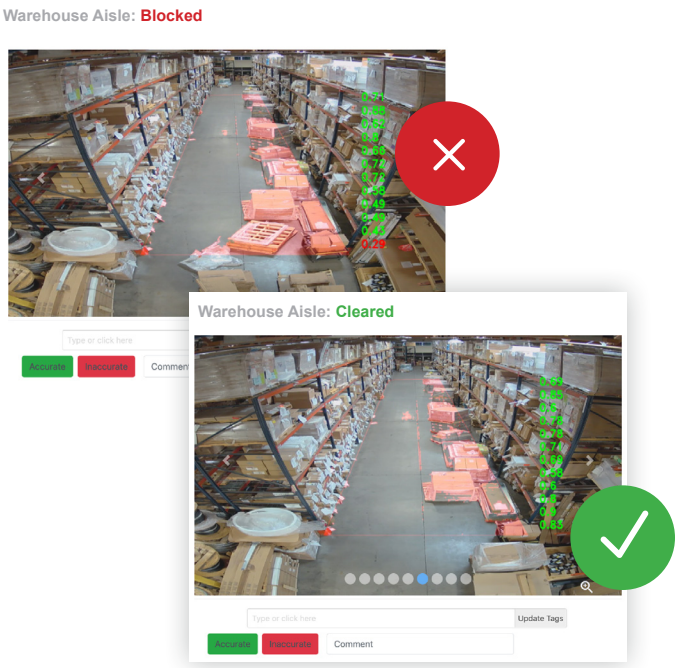
Automating **Warehouse Management**

Computer vision can enforce how the shop floor is laid out and managed. Keeping designated areas clear helps to reduce accidents and injuries while improving material flows.

Monitoring Dock Door Safety Procedures

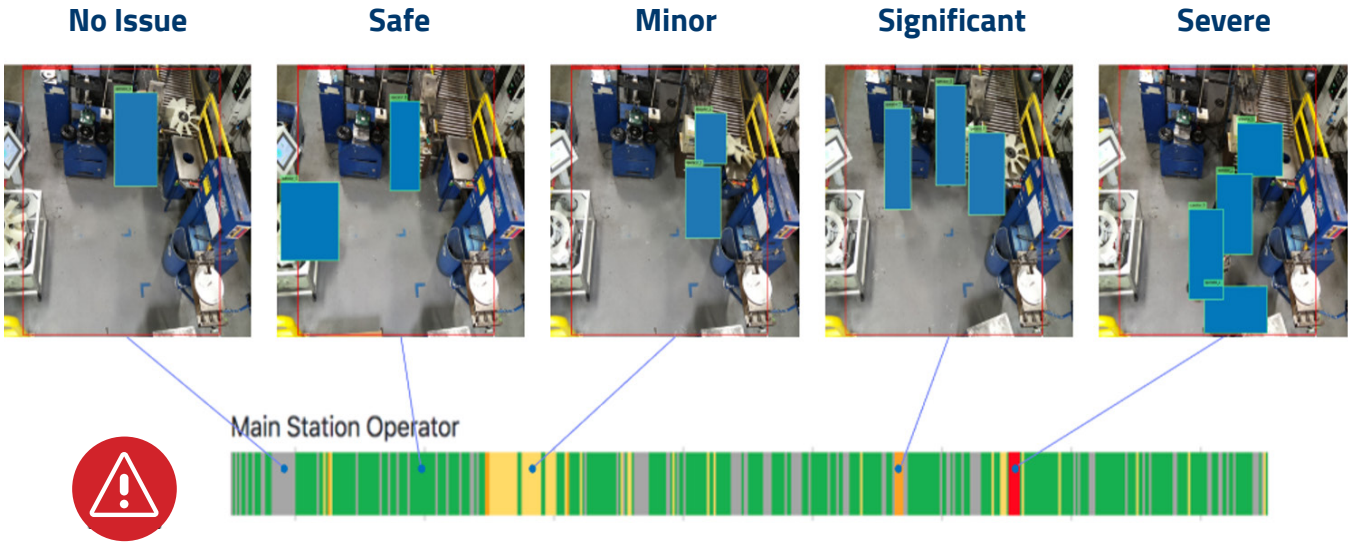


Enforcing designated areas are kept open for safety



Enforcing Social and **Safety** Distancing **Requirements**

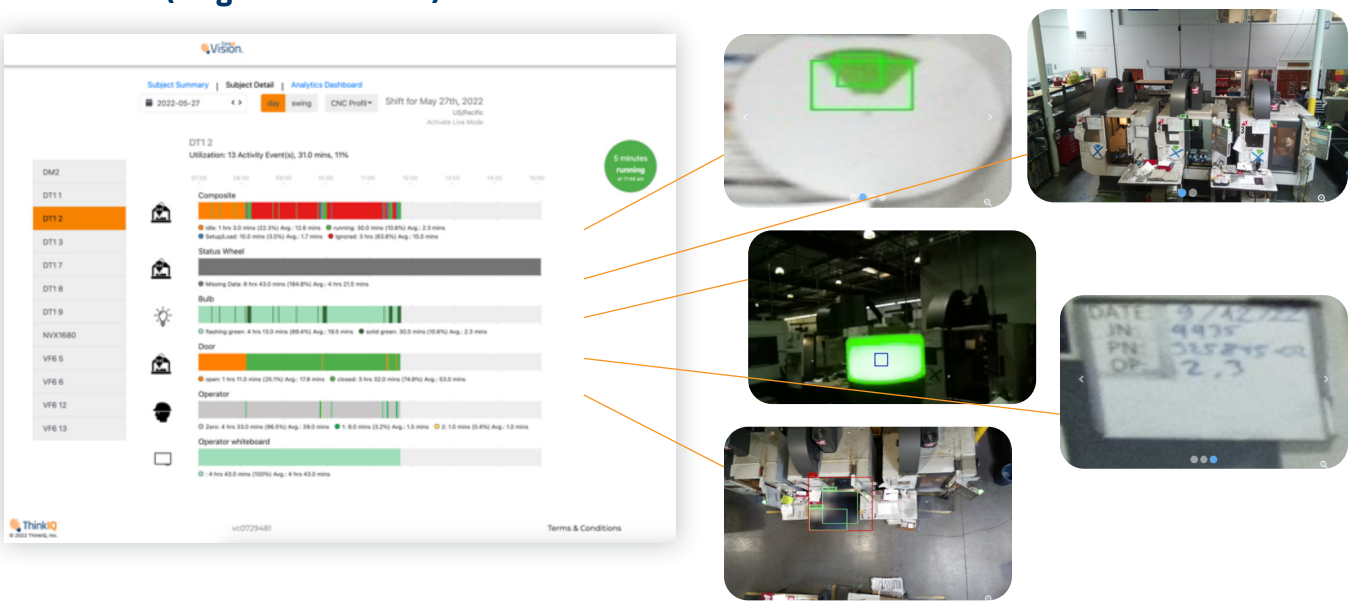
There is no viable alternative to computer vision in enforcing distancing between people on the shop and warehouse floor. The image on the right shows not only a social distancing problem but a potential hazard with so many people standing next to machinery that is running. Privacy protection is assured by masking individual identities.



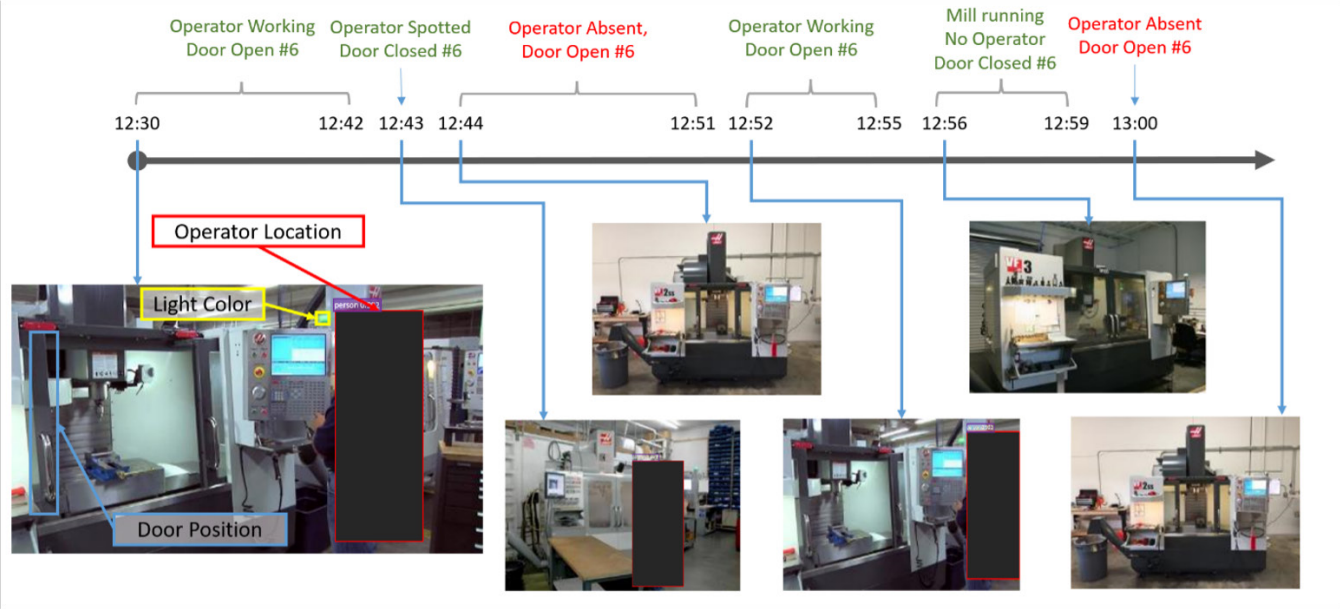
Improving **Work Center Utilization** and **Eliminating Bottlenecks**

As noted earlier, machine tools, connected systems, sensors, and operators collectively provide a great deal of operational data. Their major blind spot is the interaction between people, machines or vehicles, and the materials they are handling. The image below is a good example of the unique role computer vision plays in providing actionable insights in how to improve utilization in all types of work centers

Detail view (single workstation)



The sequence of images below captures the end-to-end processes of a machining process, the type of temporal data that is ideal for continuous improvement efforts.



Conclusion

While manufacturing and warehousing have utilized several sources of analog and digital data to evaluate and improve operations for years, many critical blind spots remained. The major shortfall was a lack of visibility into the human aspects of operations. A global view of factory and warehouse operations was also lacking.

The beauty of today's computer vision is its utilization of low-cost cameras feeding imagery into machine learning and AI programs running on edge computers. The technology is following Moore's Law so that the power doubles roughly every two years without any increase in costs. The result is a digital twin of physical operations, the key element in Industry 4.0 and Smart Manufacturing, that transforms discrete and process manufacturing, distribution, and warehousing. In this eBook we have provided some examples of the major benefits computer vision brings to operations of all types, sizes, and complexities.

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