

Factory Floor Map

This map is oriented toward the ERC, but should be able to accommodate a moderately sized factory floor. It is meant to give operators a context for the status of the current machine. Even in reconfigurable situations, locality is important – nearby errors may have an impact on the current machine, and visa versa.

To aid transitional understanding, this map follows the convention of low detail floor, which were observed at Daimler-Chrysler. The difference is that it uses lower contrast colors to keep it away from the center of attention.

The current cell is highlighted on the map, and is show with slightly more contrast, aiding in picking it out. However, this would be more of an issue with larger systems.

One of the open design questions is how much can and should be represented here. What is the maximum area that can be usefully represented here? Do operators need to see the entire floor, a local region, or their duty zone?

Cell Diagram

In this view, the central screen element is the diagram of the current cell. To aid orientation, each element in the cell is diagrammatically represented in a recognizable way, which includes orientation.

The cell diagram is visually separated into the primary operational chunks: CNC machines, robot, conveyor, and conveyor stop. This is an operational level of granularity; both operators and technicians appeared to think of each machine as an independent unit grouped into a functional cell.

Faults are indicated by coloring the background of the cell red (fault) or yellow (warning.) This avoids the legibility problems of coloring the machines themselves a particular color.

An open issue has been how much to show in this display. Should several cells for which an operator is responsible be displayed, or should it maintain focus by showing a single cell? What is the correct balance of scale between this display and the overall map display?

Cell Status

The stacked/overlaid bar graph is meant to show production progress for the current cell.

The background is a stacked bar graph.

- The light gray represents the daily quota for the current cell.
- The darker gray is continuously updated and represents the current goal for meeting the daily quota.
- The segmented bar is continuously updated and represents the actual production. It is colored red or green depending on whether it is less or more than the current goal.

The three colors were selected to stack by intensity, presenting the most immediate information in the most intense color, followed by less immediate information in less intense values.

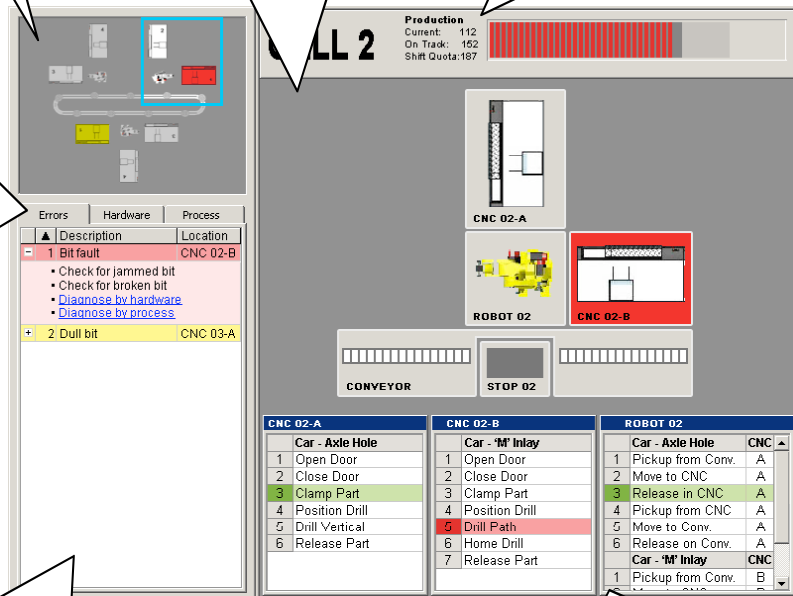
To aid understanding and trust, raw numbers are presented to the left of the bar graph.

Status Views

More detailed status information for the area represented on the map is accessible through three facets:

- **Errors:** Shows a prioritized list of the current errors. This meant for use by operators and is tied to the current view in the right pane.
- **Hardware:** Shows a hierarchical view of the machinery on the floor, allowing drilldown to specific machines and machine parts.
- **Process:** Shows a hierarchical view of the processes being performed in the factory, allowing a drilldown to specific actions.

The Hardware and Process facets are meant for use by electricians. When selected, a set of diagnostic tools appears in the right pane.



Error Messages

Error messages are shown as an automatically prioritized list. Red background indicates fault, while yellow represents a warning. The list can be re-ordered by description or location in order to aid discovery of common sets of errors.

Each error message is expandable to show common solutions, and a link to diagnostics by hardware or process. The links are meant for use by electricians, and lead to a view that includes automatically generated visualizations that the systems predicts to be appropriate for the given error.

Process Status

The process status list shows the programmed operations and current operation for the CNC machines and the robot. The current process is highlighted according to whether it is correctly executing (green) warning (yellow) or in fault (red.) The robot process list also shows the CNC machine that it is currently servicing.

This was one of the last items we added to the visualization. A diagrammatic or abstract process view may be more valuable, but would have required more time than we had to develop.