Conceptual Design Review of Workcells

Sigma Cell

3-23-05
Requirements

- Create two workcells which effectively demonstrate the concept of SMED.
- Utilize “pick-and-place” design.
- Contrast the efficiencies of both cells.
Overall Workcell Design

Cell A: Lean Design
Cell B: Standard Design
Operator Interface Design

1/2 \(\rightarrow\) Selects which cell is active
MAN/AUTO \(\rightarrow\) Selects between manual and auto mode
ACTUATOR \(\rightarrow\) Manually extend both axes of the actuator
GRIP \(\rightarrow\) Manually close the grip
GATE \(\rightarrow\) Manually raise the gate
START \(\rightarrow\) Start auto mode
STOP \(\rightarrow\) Stop auto mode
HOME \(\rightarrow\) Brings system to home position and enters STOP mode
E-STOP \(\rightarrow\) Stops both workcells and conveyor
Product A vs B

- Variation in size/shape
  - Requires changeover of gripper
- Variation in position on palette
  - Requires alignment changes of workcell
Affected Components

- Changeover of gripper
  - Remove/install mounting screws
  - Remove/install adapter plates.
  - Remove/install pneumatic hoses
  - Remove/install wiring

- Alignment of workcell
  - Adjust position of “Limiting Means”
  - Adjust proximity switch positions

Note: Grippers will require different hose sizes. This mandates that hoses will need changing every time a gripper changeover occurs.
SMED Concepts
To Be Demonstrated

- Internal → External
- Quick Change Components
- Quick Adjust Components
- Commonality of Components
- Location of Components
SMED Concepts

Internal → External

Lean Workcell
- Pull pneumatic hoses for Product B gripper while workcell is operating with Product A.
- Assemble Product B gripper while workcell is operating with Product A.
- Mount Product B gripper onto its adapter plate while workcell is operating with Product A.

Standard Workcell
- Pull pneumatic hoses for Product B gripper after Product A gripper hoses have been removed.
- Assemble Product B gripper after Product A gripper has been removed.
- Mount Product B gripper onto its adapter plate after Product A gripper and adapter plate have been removed.
## SMED Concepts
### Quick Change Components

<table>
<thead>
<tr>
<th>Lean Workcell</th>
<th>Standard Workcell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use machined screws (no nut needed)</td>
<td>Use bolts w/ nuts.</td>
</tr>
<tr>
<td>Use short screws</td>
<td>Use long bolts</td>
</tr>
<tr>
<td>Pneumatic connections made via quick connects.</td>
<td>Use bolts of different size and type.</td>
</tr>
<tr>
<td>Electrical connection made via snap connector.</td>
<td>Pneumatic connections made via hose barbs with clamps.</td>
</tr>
<tr>
<td>Hose routing through hangars.</td>
<td>Electrical connection made via terminal blocks.</td>
</tr>
<tr>
<td></td>
<td>Hose routing through conduit.</td>
</tr>
</tbody>
</table>
SMED Concepts
Quick Change Component Examples

Lean Workcell
- Quick connect hose coupler

Standard Workcell
- Hose barb

- Snap-style electrical connector
- Terminal Blocks
SMED Concepts
Quick Adjust Components

Lean Workcell
- Use stop collars.

Standard Workcell
- Use fine-threaded stop screws.
SMED Concepts
Quick Adjust Components

**Lean Workcell**
- Adjust position using a “pinch screw”

**Standard Workcell**
- Adjust position by turning fine-threaded barrel housing.

Drill, tap, and install screw
SMED Concepts
Commonality of Components

**Lean Workcell**
- Use screws of same size and type.
- Electrical connector for Product A gripper same as electrical connector for Product B gripper.

**Standard Workcell**
- Use bolts of different size and type.
Gripper Changeover
Location of Components

Lean Workcell
- Electrical connection made at workcell. No wire routing required.
- DC Enclosure pneumatic connections made outside of box. Connections are easily accessible.
- Hose routing is short distance to DC enclosure.

Standard Workcell
- Electrical connection made inside DC enclosure. Wire routing through conduit required.
- DC enclosure pneumatic connections made inside the box. Connections are awkward.
- Hose and wire routing is long distance to DC enclosure.
## Cost Estimate

<table>
<thead>
<tr>
<th><strong>EXISTING PURCHASES</strong></th>
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<tbody>
<tr>
<td>RS500 PLC software</td>
<td>$175</td>
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<tr>
<td>USB/DH485 converter</td>
<td>$155</td>
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<tr>
<td>Misc</td>
<td>$30</td>
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<td>$360</td>
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<table>
<thead>
<tr>
<th><strong>FUTURE PURCHASES</strong></th>
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<tbody>
<tr>
<td>Grippers</td>
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<tr>
<td>Electrical enclosures</td>
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<tr>
<td>Buttons/Switches/Relays/Terminal blocks</td>
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<tr>
<td>Wiring/Cable/Connectors</td>
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<tr>
<td>Pneumatic valves/equipment</td>
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<tr>
<td>Misc</td>
<td>$100</td>
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<td>$1025</td>
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| **TOTAL + buffer**     | $1500   |

Note: cost does not include AC portion of the project.
## Schedule

<table>
<thead>
<tr>
<th>PHASE</th>
<th>DURATION</th>
<th>START</th>
<th>FINISH</th>
<th>% Complete</th>
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</thead>
<tbody>
<tr>
<td>PHASE 1 - Project Scoping</td>
<td>15 days</td>
<td>11/9/2004</td>
<td>12/10/2004</td>
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<tr>
<td>PHASE 2 - Conceptual Power Design</td>
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<td>PHASE 3 - Preliminary Power Design</td>
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<td>PHASE 4 - Detailed Power Design</td>
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<td>PHASE 7 - Detail Cell Design</td>
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<td>PHASE 8 - Cell Fabrication/Assembly</td>
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<td>PHASE 9 - Overall System Testing</td>
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<td>PHASE 10 - Delivery</td>
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Problems and Challenges

- Power and air to the conveyor
- Struts for building actuator mounting assembly
- Palettes might need to be purchased
- Scheduled for completion in June
Questions?