Transforming Manufacturing by CT Effects

The key to reducing production costs is found in CT effects. You may be able to further reduce the costs if you look closely at the CT effects.

So what exactly are CT effects?

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Overview of the line

This case example involves onboard assembly and test lines with four steps. The cycle time of Step 3, which was taking the longest among them, was reduced.

System specifications

- Number of air cylinders = **8 units**
- Product types supported = **10 types** (25 types can be supported with 3 lines.)
- Cycle time = **14.0 seconds**

Onboard sensor performance inspection machine

Using air cylinders

Step 1 Press-fitting of the connector
Step 2 Electrical continuity test
Step 3 Stamping

Positioning of the system in the line

Onboard sensor assembly line

The system is semi-automated and requires one operator per line.

Overview of the system

It is a simple semi-automatic system that conducts a performance test of onboard sensors.

When the operator sets the work part and presses the start switch, the work table moves forward toward the back of the system.

Once steps 1, press-fitting of the connector (assembly): 2, electrical continuity test: and 3, stamping (PASS stamp) are completed, the table comes back to the forward position.
Significant Improvement of Production Efficiency through Motorization

**Improvement 1**

**Cycle time reduction for "work part setting table" operation**

With the air cylinder system, the work table could not be operated faster because it would have increased the shock upon stopping. With the ROBO Cylinder system, on the other hand, the maximum speed can be increased because the actuator stops without generating shock. In addition, the ROBO Cylinder system starts quicker than the air cylinder system, which enabled significant reduction of the cycle time.

**v-t diagram**

- **Maximum speed is higher!**
- Work table operation takes 1.8 seconds less.

**Improvement 2**

**Cycle time reduction for "connector press-fitting" operation**

With the air cylinder system, an automatic switch was used to determine whether the work part had been pressed to the specified position, which made the operation unstable and required 4 seconds for the press-fitting action to ensure quality. With the ROBO Cylinder system, on the other hand, push-motion operation can be performed using the zone function and consequently the press-fitting time was successfully reduced by 2 seconds.

- Quickly approaches the work part.
- Performs push-motion operation at low speed.
- Pushes the work part reliably into the area set by zone signals.
- Push-motion operation takes 2 seconds less.
Increased Profits through Motorization

- **Year 1**
  - Equipment cost: Reduced from 3 to 2 lines
  - Labor cost: Reduced from 3 to 2 operators
  - Equipment cost: $55,600 x 3 lines – $61,100 x 2 lines = $166,800 – $122,200 = $44,600
  - Labor cost: $72,200 x (3 - 2 operators) = $72,200 x 1 = $72,200
  - Sub-total: $116,800

- **Year 2**
  - Labor cost: Reduced from 3 to 2 operators
  - $72,200

- **Year 3**
  - Labor cost: Reduced from 3 to 2 operators
  - $72,200

3-year total: $261,200

As illustrated above, the reduction of cycle time through the motorization of the air cylinder system yielded a profit of $116,800 for the first year, and $72,200 for the second and subsequent years, resulting in a 3-year total of $261,200.
Reduction of Choco Tei

A minor stoppage, or “Choco Tei” in Japanese, is an “intermittent, short stop of a production line.” To be more specific, it is a stoppage of a production line caused by a minor failure of a machine part or electrical component of an automated machine. It can be repaired in a short time and the line can be recovered quickly.

If it had to be translated into English, it could be:

- Ceased Time
- Frequent Stop
- Short Stoppage
- Temporarily Ceasing

What is “Choco Tei”?

A motorized cylinder will not have a “Choco Tei” caused by any of these.

Primary causes of “Choco Tei” and corresponding descriptions

<table>
<thead>
<tr>
<th>Causes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faulty auto switch</td>
<td>The position at which the auto switch turns ON changes due to the following:</td>
</tr>
<tr>
<td></td>
<td>✔ Shifting of the position: The fastening plate of the auto switch shifts due to an impact of the Air-Cylinder operation.</td>
</tr>
<tr>
<td></td>
<td>✔ Unstable sensitivity: The position where the switch turns ON varies depending on the operating environment, etc.</td>
</tr>
<tr>
<td>Unstable air supply pressure</td>
<td>The speed, cycle time, operation timing, thrust, etc. varies depending on the change in the air pressure.</td>
</tr>
<tr>
<td>Deteriorated seal/gasket</td>
<td>The air cylinder operating characteristics gradually change as the rubber seal performance declines due to aged deterioration.</td>
</tr>
<tr>
<td>Impact</td>
<td>A work part may fall, tip over, get damaged, etc. due to the acceleration or stopping impact.</td>
</tr>
</tbody>
</table>

Analysis of the causes of “Choco Tei” due to air cylinders

- Faulty auto switch: 22%
- Unstable air supply pressure: 18%
- Deteriorated seal/gasket: 14%
- Impact: 14%
- Foreign matter/drain: 12%
- Malfunction: 9%
- System problem: 8%
- Other: 15%

(Results of research by IAI)

This case example involves a system to manufacture office supply parts, previously with an air cylinder. The number of “choco tei” occurrences was reduced through motorization and the system operating rate rose from 70% to 90%. Consequently, the number of lines required was reduced by one, which yielded a profit of $588,900 for the first year and $144,400 per year for the second and subsequent years.
Adjustment became easy. It now takes 2 weeks, instead of 3 weeks, before we can conduct a test run of the entire line.

Compared to when we had the air facility, sensor and cable stocks have been minimized.

**Equipment and labor cost comparison**

<table>
<thead>
<tr>
<th></th>
<th>Air cylinder line</th>
<th>Motorized cylinder line (with a partial use of an air cylinder)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production capacity</td>
<td>10,000 pcs/line</td>
<td>10,000 pcs/line</td>
</tr>
<tr>
<td>Equipment operating rate</td>
<td>70%</td>
<td>90%</td>
</tr>
<tr>
<td>Actual production quantity</td>
<td>7,000 pcs/line</td>
<td>9,000 pcs/line</td>
</tr>
<tr>
<td>Target production quantity</td>
<td>26,000 pcs/day</td>
<td>26,000 pcs/day</td>
</tr>
<tr>
<td>Number of lines required</td>
<td>26,000 / 7,000 = 3.7 → 4 lines</td>
<td>26,000 / 9,000 = 2.8 → 3 lines</td>
</tr>
<tr>
<td>Equipment unit cost</td>
<td>$1,111,100/line</td>
<td>$1,333,300/line</td>
</tr>
<tr>
<td>Total equipment cost</td>
<td>4 lines x $1,111,100 = $4,444,400</td>
<td>3 lines x $1,333,300 = $3,999,900</td>
</tr>
<tr>
<td>Labor cost</td>
<td>4 operators x $72,200 = $288,800/year</td>
<td>2 operators (Note) x $72,200 = $144,400/year</td>
</tr>
</tbody>
</table>

(Note) The number of operators was reduced from 4 to 2 as a result of the reduction of the number of lines and “Choco Tei.”

**Increased Profits through Motorization**

- **Year 1**
  - Equipment cost: $4,444,400 – $3,999,900 = $444,500
  - Labor cost: Reduced from 4 to 2 operators
    - $72,200 x (4 - 2 operators) = $72,200 x 2 = $144,400
    - Sub-total: $588,900

- **Year 2**
  - Labor cost: Reduced from 4 to 2 operators
    - $144,400

- **Year 3**
  - Labor cost: Reduced from 4 to 2 operators
    - $144,400

3-year total: $877,700

As illustrated above, the reduction of Choco Tei through the motorization of the air cylinder system yielded a profit of **$588,900** for the first year, and **$144,400** for the second and subsequent years, resulting in a 3-year total of **$877,700**.