

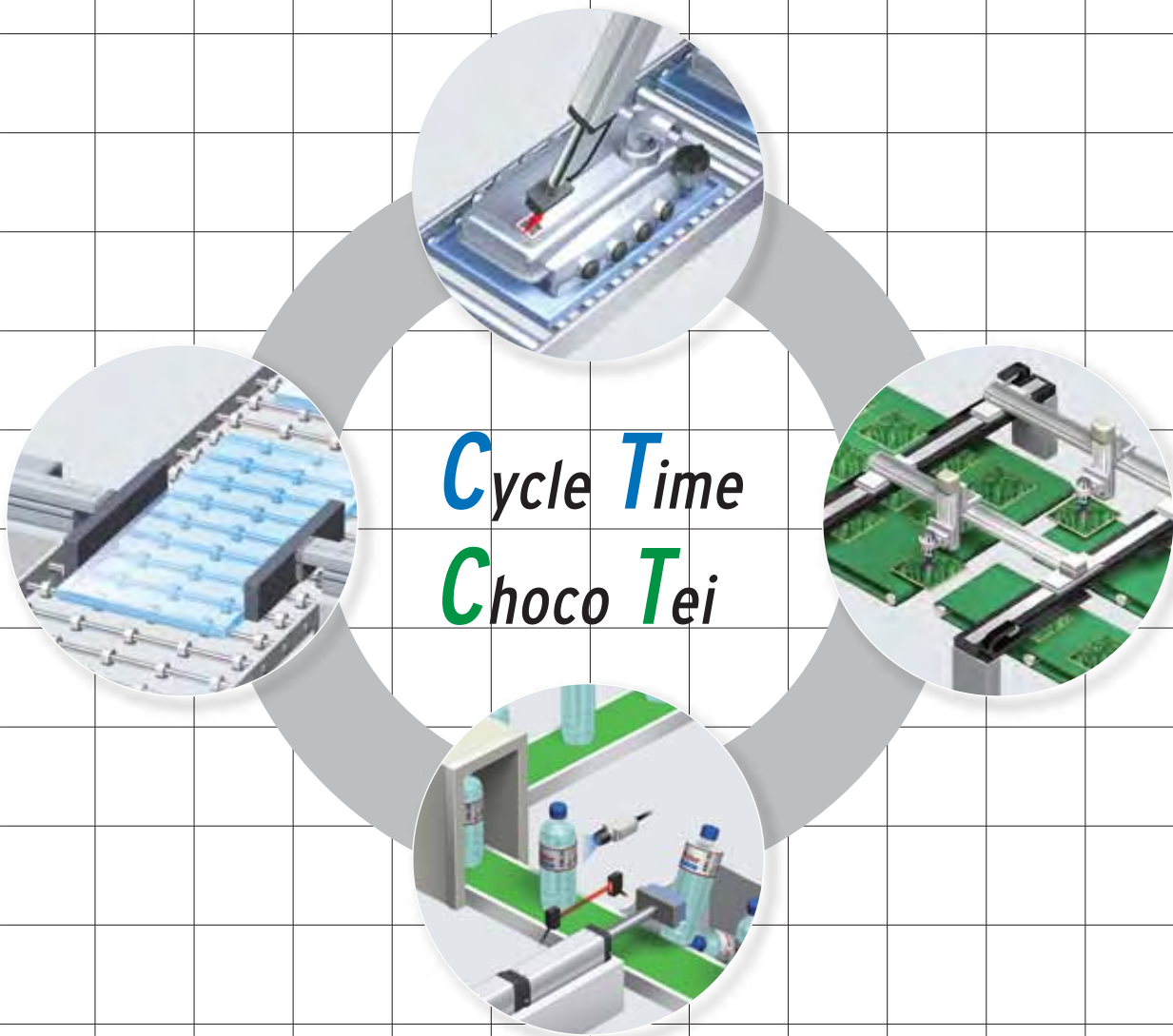


Quality and Innovation

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?



Case 1

Profit of \$261,200 in three years

Reduction of Cycle Time

Overview of the line

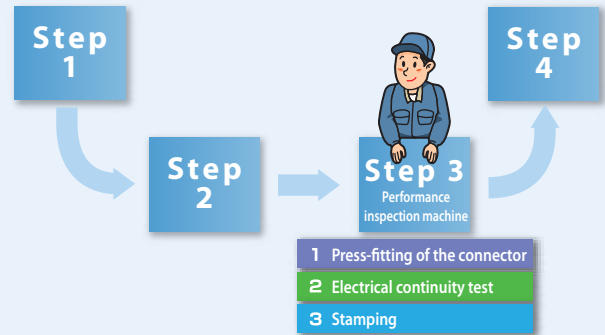


This case example involves onboard assembly and test lines with four steps. The cycle time of Step 3, which was taking the longest among them, was reduced.

Positioning of the system in the line

Onboard sensor assembly line

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



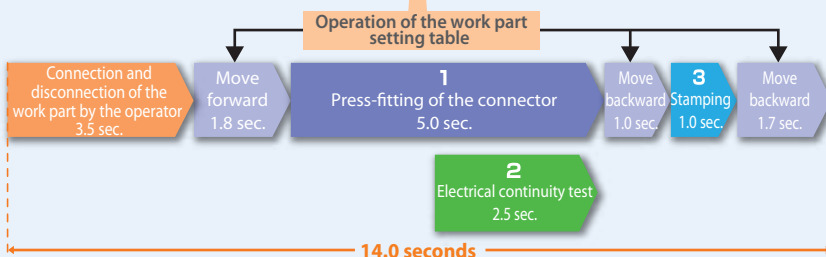
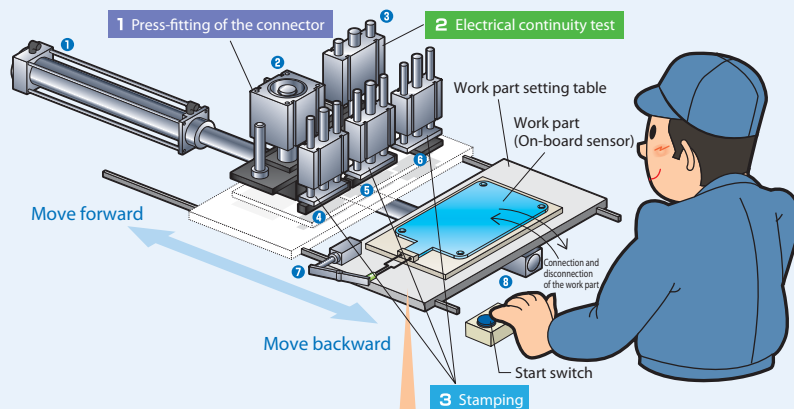
System specifications

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

- 1 Moving of the work table
- 2 Press-fitting of the connector
- 3 Electric continuity test
- 4 · 5 · 6 Stamping
- 7 Connection of wires for inspection
- 8 Stopping of the work table at the midpoint

Onboard sensor performance inspection machine

Using air cylinders



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.

Cycle Time



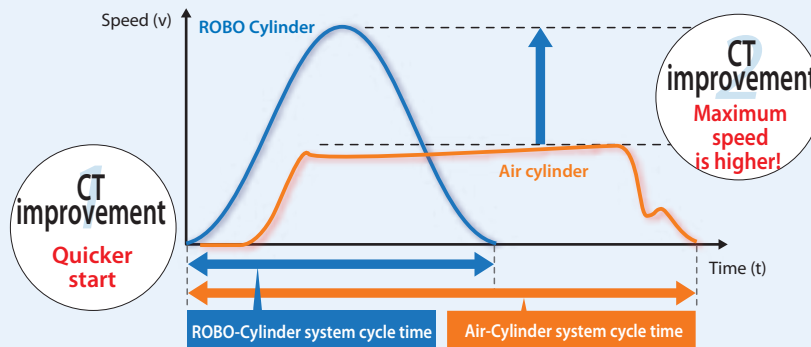
Significant Improvement of Production Efficiency through Motorization

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



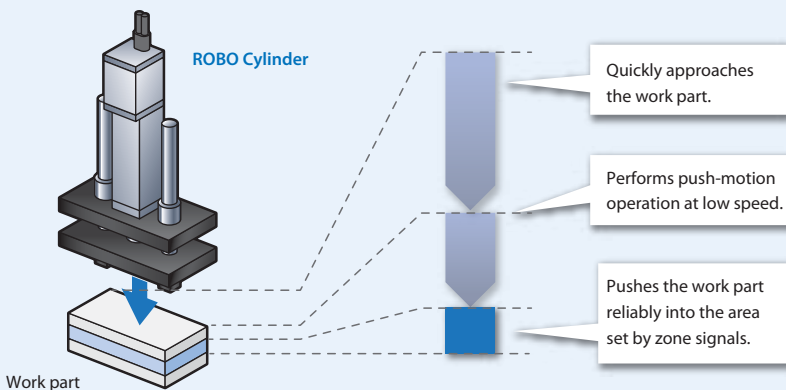
Work table operation takes **1.8 seconds less.**



Improvement 2

Cycle time reduction for "connector press-fitting" operation

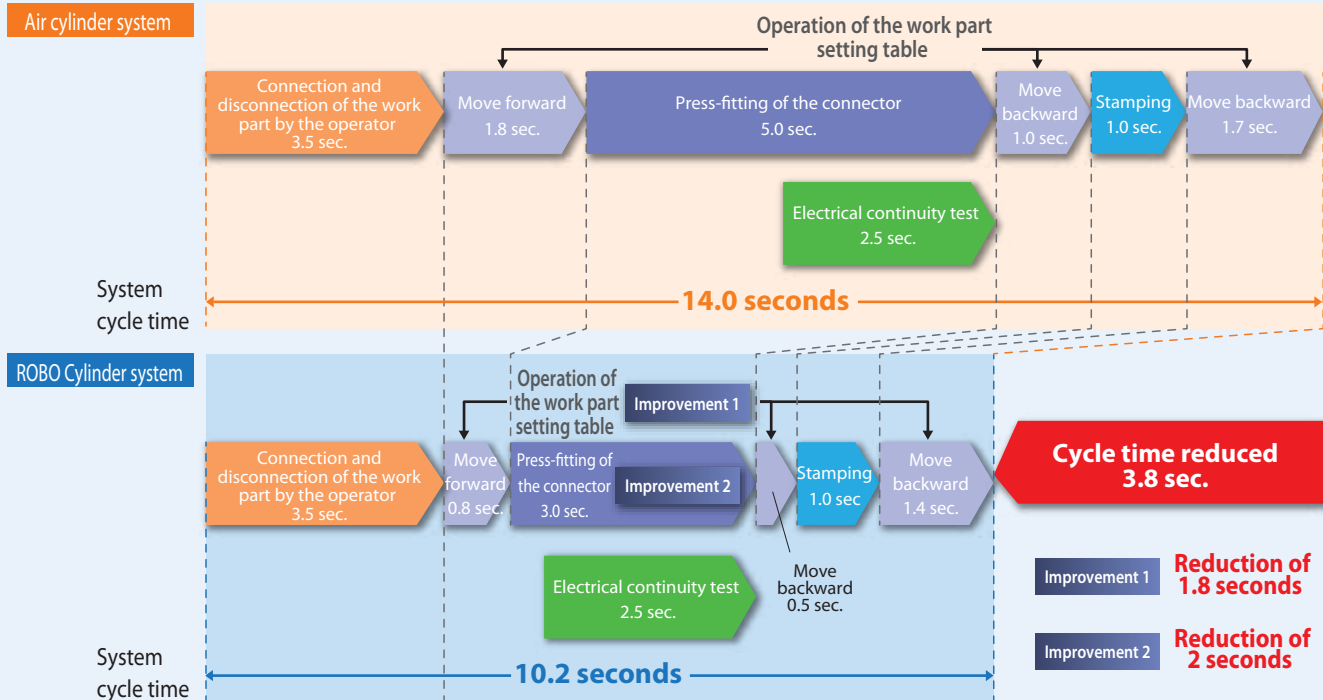
With the air cylinder system, an automatic switch was used to determine whether the work part had been pressed to the specified position, which made the operation unstable and required 4 seconds for the press-fitting action to ensure quality. With the ROBO Cylinder system, on the other hand, push-motion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



Push-motion operation takes **2 seconds less.**



Improvement 1 & Improvement 2 reduced the cycle time by 3.8 seconds.



Number of lines and operators required to produce 5,000 pieces in one 7.5-hour day (27,000 sec.)

	Air cylinder system	ROBO Cylinder system
Cycle time	14.0 sec.	10.2 sec.
Number of work parts that can be produced per line in one 7.5-hr day (27,000 seconds)	27,000 seconds / 14.0 seconds = 1,929 pcs	27,000 seconds / 10.2 seconds = 2,647 pcs
Number of lines required	5,000 pcs / 1,929 pcs = 2.6 → 3 lines	5,000 pcs / 2,647 pcs = 1.9 → 2 lines
Number of operators required (one operator per line)	1 operator x 3 lines = 3 operators	1 operator x 2 lines = 2 operators

Other conditions

Air cylinder equipment cost for one unit	\$55,600
ROBO Cylinder equipment cost for one unit	\$61,100
Labor cost for one person	\$72,200/year

Increased Profits through Motorization

Year 1	● Equipment cost: Reduced from 3 to 2 lines	$\$55,600 \times 3 \text{ lines} - \$61,100 \times 2 \text{ lines} = \$166,800 - \$122,200 = \$44,600$
	● Labor cost: Reduced from 3 to 2 operators	$\$72,200 \times (3 - 2 \text{ operators}) = \$72,200 \times 1 = \$72,200$
		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.**

Case 2

Profit of \$877,700 in three years

Reduction of Choco Tei

What is "Choco Tei" ?

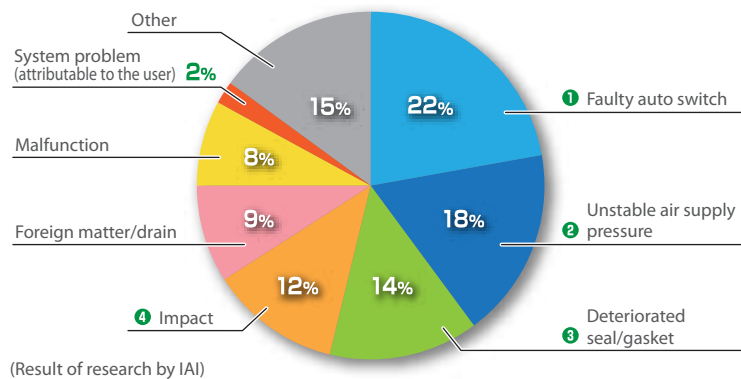
A minor stoppage, or "Choco Tei" in Japanese, is an "intermittent, short stop of a production line." To be more specific, it is a stoppage of a production line caused by a minor failure of a machine part or electrical component of an automated machine. It can be repaired in a short time and the line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

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

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

Primary causes of "Choco Tei" and corresponding descriptions

● Analysis of the causes of "Choco Tei" due to air cylinders



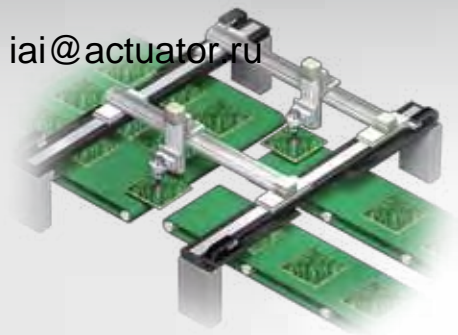
Causes	Description
1 Faulty auto switch	The position at which the auto switch turns ON changes due to the following: <ul style="list-style-type: none"> ● Shifting of the position: The fastening plate of the auto switch shifts due to an impact of the Air-Cylinder operation. ● Unstable sensitivity: The position where the switch turns ON varies depending on the operating environment, etc.
2 Unstable air supply pressure	The speed, cycle time, operation timing, thrust, etc. varies depending on the change in the air pressure.
3 Deteriorated seal/gasket	The air cylinder operating characteristics gradually change as the rubber seal performance declines due to aged deterioration.
4 Impact	A work part may fall, tip over, get damaged, etc. due to the acceleration or stopping impact.

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



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.

ChocoTei



Elimination of Sensors and Numerical Control

Motorized cylinders allow for "simpler actuator design" and contribute to elimination of sensors from production facilities.

Other Feedback from Customers

- **Shorter startup time**
"Adjustment became easy. It now takes 2 weeks, instead of 3 weeks, before we can conduct a test run of the entire line."
- **Less frequent stops of the line due to sensors**
"Compared to when we had the air facility, sensor and cable stocks have been minimized."

Equipment and labor cost comparison

	Air cylinder line	Motorized cylinder line (with a partial use of an air cylinder)
Production capacity	10,000 pcs/line	10,000 pcs/line
Equipment operating rate	70%	90%
Actual production quantity	7,000 pcs/line	9,000 pcs/line
Target production quantity	26,000 pcs/day	
Number of lines required	26,000 / 7,000 = 3.7 → <b style="color: #008000;">4 lines	26,000 / 9,000 = 2.8 → <b style="color: #008000;">3 lines
Equipment unit cost	\$1,111,100/line	\$1,333,300/line
Total equipment cost	4 lines x \$1,111,100 = \$4,444,400	3 lines x \$1,333,300 = \$3,999,900
Labor cost	4 operators x \$72,200 = \$288,800/year	2 operators (Note) x \$72,200 = \$144,400/year

(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	<ul style="list-style-type: none"> ● Equipment cost: \$4,444,400 - \$3,999,900 = \$444,500 ● Labor cost: Reduced from 4 to 2 operators $\\$72,200 \times (4 - 2 \text{ operators}) = \\$72,200 \times 2 = \\$144,400$ <p style="text-align: right;">Sub-total: \$588,900</p>
Year 2	<ul style="list-style-type: none"> ● Labor cost: Reduced from 4 to 2 operators \$144,400
Year 3	<ul style="list-style-type: none"> ● 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**.

