Workshop Report:

Work Standardization at Toyota Auto Body of California

They have the right stuff for standardization here, in process, equipment, and quality conditions. It's an important tool for high-quality product manufacturing with fewer processes.

Bob Dozier

Toyota Auto Body of California (TABC) builds 590 truck beds per day to mount on imported Toyota pick-ups. From the Long Beach installation, truck beds are shipped to eight ports for installation. About two days' supply sits in the yard, marshalling for shipment. Beds in three models and nine colors are built in two shifts, 590 per day in November 1987. The daily rate depends on demand for the month. Present capacity is 500-650 per day. In addition, TABC builds spare parts for truck beds and gas tanks for New United Motors (NUMMI).

Landed, United States Customs applies a 25 percent tariff to pick up trucks. Incomplete (without a bed), the tariff until 1980 was four percent. Because of the original customs decision, Toyota became the only importer building the beds in the U.S; the others shipped beds and trucks separately. Although the Long Beach plant's productivity did not quite equal that of Japan, the facility was kept in production. Now it has a huge cost advantage at the current yen-dollar exchange rate.

When Toyota purchased the Long Beach site ten years ago, personnel from Japan strongly guided early conversion, but now only Mr. Itoh, a press expert, remains as the senior coordinator. (Press stroke rates have increased about 40 percent in three years, and setup times on the largest press lines are in the 15-20 minute range. Single minute die exchanges are common on small presses.)

Design engineering, periodic advice, and 98 percent of the steel come from Japan. Almost everything else is American, including a workforce hailing from over 20 national origins and speaking several different languages in the plant. Some of the challenges are uniquely American.

All 342 TABC employees are called associates. All 280 direct labor associates and lead persons belong to the Teamsters, but relations are friendly and only five grievances were filed in 1987. The workforce is involved in quality circles and improvement activity. TABC has a no-layoff policy. Unit labor productivity is up 60 percent in five years. Annual attrition is only three percent, so the plant maintains an aggressive ongoing search for new work.

Total Elimination of Waste

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Three overall goals guide this philosophy: 1) Good products, 2) satisfied customers, and 3) continued business success. The strategy to achieve these goals is based on "Total Elimination of Waste." (Significantly, Toyota people take time to explain philosophy before any technical discussion.)

The Toyota Production System is alive and well in Long Beach. TABC employs most of the techniques in the literature: SPC, TQC, preventive maintenance, Kanban, setup time reduction, employee improvement, uniform load scheduling, use of andons, and so forth. Thus far, TABC performance has been outstanding in blending these techniques in their overall progress. For instance, of the five reasons given for the Kanban system, which they practice strictly by keeping areas marked and inventories limited, the most important use of Kanban in their opinion is stimulation of quality problem solving. However, two elements of TABC's production system are done so well they merit longer discussion 1) Workplace organization (SS), and 2) standard operations.

Workplace Organization

This practice has become known in the United States as the 5S method because of five Japanese words beginning with S when spelled in English. Actually TABC refers to this as the 4S method: (1) Seiri (sorting), (2) Seiton (arrangement), (3) Seiso (cleaning), and (4) Seiketsu (awareness). The steps:
### Standardized Work Sheet

**PART NAME:** OUTER PANEL (D)  
**PROCESS NAME:** OUTER PANEL SUB-ASSY RESPOT  
**FROM:** SET SIDE PANEL OUTER SUB-ASSY INTO 221-F  
**TO:** SET FRONT POST SUB-ASSY ON TEMPORARY STAND  
**Issue Date:** 10-19-87  
**Section:** BODY ASSEMBLY

<table>
<thead>
<tr>
<th>SEQ #</th>
<th>WORK SEQUENCE</th>
<th>WORK</th>
<th>WALK</th>
<th>TOTAL</th>
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<tr>
<td>1</td>
<td>SET SIDE PANEL OUTER SUB-ASSY INTO 221-F</td>
<td>10&quot;</td>
<td>10&quot;</td>
<td>10&quot;</td>
</tr>
<tr>
<td>2</td>
<td>PUSH AUTO CLAMP BUTTON</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>3</td>
<td>MANUAL SPOTWELD</td>
<td>20&quot;</td>
<td>20&quot;</td>
<td>20&quot;</td>
</tr>
<tr>
<td>4</td>
<td>PUSH AUTO UNCLAMP BUTTON</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>5</td>
<td>OBTAIN FRONT END POST</td>
<td>2&quot;</td>
<td>3&quot;</td>
<td>5&quot;</td>
</tr>
<tr>
<td>6</td>
<td>SET INTO 216-F (FRONT POST FIXTURE)</td>
<td>3&quot;</td>
<td>3&quot;</td>
<td>3&quot;</td>
</tr>
<tr>
<td>7</td>
<td>OBTAIN PATCH AND ROPE HOOK</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>4&quot;</td>
</tr>
<tr>
<td>8</td>
<td>SET INTO 216-F</td>
<td>10&quot;</td>
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<tr>
<td>9</td>
<td>MANUAL SPOT WELD FRONT END POST</td>
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<tr>
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<td>UNLOAD 216-F</td>
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<td>10&quot;</td>
</tr>
<tr>
<td>11</td>
<td>SET FRONT END POST SUB-ASSY ON TEMPORARY STAND</td>
<td>2&quot;</td>
<td>3&quot;</td>
<td>5&quot;</td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>
|       | QUALITY CHECK  
       | SAFETY CHECK  
       | CYCLE TIME  
       | STD. STOCK  
       | TACT TIME  |
| 1     | 3        | 10      | N/A   | 83"   | 83"  |

**Fig. 1.** Actual worksheet example.

**Fig. 2.** The main line status andon board on the weld line is shown above.

1. **Simplification:** Remove from the workplace all items unnecessary for current production.
2. **Organization:** Find a designated place for everything that remains after simplification.
3. **Discipline:** Develop an understanding in all the workforce to simplify, clean, and keep items in their designated place. Make it a habit.
4. **Cleanliness:** Keep all equipment and work areas clean.
5. **Participation:** All employees perform workplace organization and abide by the resulting rules.

TABC believes that workplace organization is the foundation of the Toyota Production System—that commitment of all associates to their
"4S" process is the beginning of the elimination of waste. Things or people out of their normal pattern is the first sign of a quality or production problem which demands immediate attention every day.

At TABC, locations for many items are clearly marked. Item numbers are painted on Kanban squares. Tools are in standard locations. Buzzers and lights call attention to line problems — Jidoka is part of the system. A line downtime clock openly displays the real reasons for line stops. Everything is in place, for instance, to quickly dress the tips of welders which shut down automatically for this process when the weld count reaches a trigger point. Standardized work sheets or operator instruction sheets are displayed at each station. Quality improvement sheets and PM status boards are visible in each department.

Even the small trash cans outside occupy designated locations within yellow lines. Cleanliness and neatness everywhere are impressive. Everything was "spic'n' span," even in the tool and die shop — showing that TABC is committed to "4S" everywhere.

**Standard Operations**

Toyota Auto Body of California is one of the few companies manufacturing in America which gains the benefit of workforce-created standard operations. Most companies understand neither the method nor the full value of it.

Few if any work standards are set by an industrial engineer at TABC. Most of the "Standard Work Sheets" such as the one shown in Fig. 1 are prepared by lead persons or supervisors, and some by operators themselves. TABC does not subscribe to the "philosophy of engineers doing industrial engineering standards." A better idea is training those who work on the shop floor to do it in a way that stimulates them to make improvement. Every work station has a Standard Work Sheet. There are three goals of setting and holding work standards:

1. **Eliminating the waste from the process.** Thinking through
Standardization of Work to a Uniform Load Schedule

The initial contents of this box closely parallel the explanation of standardization in an internal document of Toyota Auto Body of California. Standardization is an important tool to manufacture high quality products with fewer processes. The concentration is on human movement in establishing the best possible sequence for each process.

Three conditions are required to develop standardized work:

1. **Tact time.** Tact time is the maximum time available to complete each process. (Actual work cycles for different parts or models at a work station could vary, but their average should be equal to or less than tact time.) Develop tact time by dividing the volume requirement per month by the total number of shifts per month. The result is the daily shift requirement. Then divide the total working hours per shift by the shift volume requirement to obtain tact time (in hours — can be converted to seconds). See the example below.

2. **Sequence.** Concentrating on human movements, set up each process to enhance sequential work. Strive for easy, repetitive motion. (This concurs with the Toyota policy of using the ability of workers 100 percent while being less concerned with immediate utilization of tools and equipment.)

3. **In-Process Stock.** Establish the minimum/maximum amount of stock for each part at each location.

Three conditions are required to maintain standardized work:

1. **Process.** The work process must be a set of easily repeated motions. Concentrate on human movement. (A major responsibility of lead persons and supervisors is to see that standard work methods are adhered to, and to check the reasons if they are not.)

2. **Equipment.** The tooling and equipment must run with a minimum of problems to enable standard work. Frequent stops make control of a sequential process difficult. The excess time allows operators to build as they wish, thus deviating from the predetermined sequence.

3. **Quality.** Uniform quality is vital. Each following process is dependent on each preceding process to enable consistent flow and repetition (not interruptions for re-work or problem solving.)

Example of calculating a tact time:

- **Monthly requirement:** 11,800 truck beds (known exactly because the trucks are either on the water or have almost finished production)
- **Work days in month:** 20 (two shifts each day), 40 shifts
- **Work time per shift:** 460 minutes, or 27,600 seconds, which allows 72 minutes per shift for eating, breaks, and other (such as Jidoka downtime)
- **Shift requirement:** 11,800/40 = 295 units
- **Tact time:** 27,600/295 = 94 sec.

Suppose one part for a truck bed has a monthly spare parts requirement of 1500. That is about 37 per shift added to the 295 per shift needed for assembled truck beds. The tact time for this operation is:

27,600/(295 + 37) = 83.1 sec.

If synchronized to the line, the operator would build slightly ahead of the line, but set every tenth part aside on a rack for the spare parts department to pick up. TABC has operations working this way.

Calculation of tact times for different parts going into different models in mixed model assembly is slightly more complex. Calculate the tact time of each model by the same basic approach, only using the monthly requirement for each model.

The calculation of tact times does not have to be based on a monthly requirement. Select a schedule cycle that best matches market demand with production capability to make a tact time change.

The concentration is on human movement in establishing the best possible sequence for each process.

- development of work methods for a standard sheet encourages people to look for waste — waste doing the operation itself, wasted motion, waste of delays, waste of poor layout, waste of inferior tooling, and on and on. This methods study concentrates on human movement. A sequence of operations should be designed to be easily and consistently repeated.

2. **Balancing operations at different output rates.** Each month a “tact time” is calculated based on production requirements for the month. “Tact time” is the time between completions of truck beds necessary to meet the requirement, or tact time could be the time between completions of parts.

Tact time is the maximum average time allowable for each operation at each station. Actual work time can be less than that, but then the difference between tact time and the work cycle time is idle worker time — not a desirable condition.

If monthly requirements change very much, tact times for every work station in the plant could change. Then the work cycles of every work station would have to be restudied and reset. That is an opportunity as well as a big task. For a plant...
industrial engineer, the task is insurmountable. Distributed among lead persons, supervisors and workers, it is not overwhelming—provided they are trained to handle it.

Of course, changing work hours is also a way to adjust the total output of the plant. Increasing tact times (decreasing line rates) takes fewer people and decreasing tact times takes more—in total. At parent Toyota, as with many Japanese companies, assembly tact times are adjustable ± 15–20 percent from the mid-range. TABC has never really tested this capability, but is developing it.

3. Capping the amount of possible work-in-process inventory.

Specifying the standard amount of stock at each station limits the work-in-process. The rule is not to permit any more than the standard level of stock at each station. This practice supports the Kanban objective of discipline over the total number of cards, containers, or spaces available to authorize holding stock. In November 1987, TABC’s tact time on the truck bed line was 83 seconds.

A production status board in assembly compares target completions with actual performance. In November, every 83 seconds the clock on this sign added one more to the daily total of truck beds that should be complete. A counter at the end of the line incremented the total actually completed. At any time during the day, the two numbers could be compared to see if the line is staying “linear to schedule.” Most of the assembly line is paced by the bed carrier speed, but some operations are completely worker controlled. The day is not done—barring disaster—until the actual complete equals the target complete.

Standardization and the standard work sheets are a critical basic of JIT. They couple the possibility of flexible production with a discipline to regularly review the operations for waste, and they are a prime vehicle of employee participation in improvement. In Japanese JIT companies, experienced workers usually complete the work sheets themselves. TABC has now finished training all supervisors and lead persons. Worker training is next.

Toyota Auto Body of California hosted a workshop for the Western Region of AME on November 5–6, 1987. Although they have done very well, General Manager Don Haller and his team reviewed the suggestions from the workshop and are busy working on many of them. Another workshop is planned for early 1989.

Photos: Hank Eide, manufacturing engineering manager, Schrader Bellows.

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