

# PM Improvements at Toyota Lift Truck Plant

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Georgetown, Ky., is synonymous with Toyota. Each year, manufacturing leaders from across the country – and across industry sectors – make a pilgrimage to this 21,000-resident town to tour the car plant and learn lean principles, efficiency and asset care from the masters.

Considerably fewer plant professionals know that an equally educational Toyota experience exists in the southern Indiana city of Columbus (population 36,000). Toyota Industrial Equipment Manufacturing, or TIEM, may be the best-kept secret in Columbus ... and perhaps all of industry.



“We’re still kind of unknown, even in our own town,” says Fred Williams, the company’s customer center and service training manager. “My vision of a small town is that everyone knows what everyone else is doing. It’s a small community and we are all neighbors.”

However, while wearing his Toyota work shirt around town, Williams says the conversation normally goes something like this:

“Hey, you work for Toyota? Excellent! I have a Camry. I love that car.”

“That’s great. However, I don’t work for the car side. I work for the material handling equipment side. I work for Toyota forklift.”

“Toyota makes forklifts?”

“Yeah, we make forklifts. We’re the No. 1 lift truck manufacturer in the world.”

(Long pause. Blank stare.)

“... We make them in our town. ... We’ve been here since 1990. ... We employ more than 600 people. ... The plant is right off of the highway. ... Big place – 890,000 square feet. ... You can’t miss it.”

“I sure do love my Camry.”

The TIEM plant may produce different vehicles than its car-making cousin, and it may fly a different corporate color (orange vs. red), but that’s where the deviation stops.

“You are at Toyota,” says Williams. “The same principles that drive our engineering, production, and maintenance and reliability performance at Georgetown and other Toyota auto sites ... well, we utilize those, too. This is a close-knit family of companies. We benchmark each other to make sure that we are all at the same level of Toyota quality and performance.”

Like the car plants, the TIEM factory in Indiana is noteworthy for several reasons, including:

- its never-ending efforts to continuously improve its processes and people;
- its all-hands-on-deck approach to maintenance; and,
- its pursuit to efficiently and effectively use every bit of its time and resources.

The examples and comments in this cover story may well change your game plan for preventive maintenance and machinery lubrication. Who knows? It may change the way you look at forklift manufacturing.

“People don’t realize that the forklift industry is pretty cool,” says Williams. “This is a cool industry, and we are a big part of it.”

## The Kaizen Mentality

It’s a cold Monday morning in late December. The skies are gray and snow is in the forecast. But that can’t put a damper on Williams’ day.

“We’re making lift trucks this morning, so it’s a beautiful day,” he says.

His outlook is straight out of the old Mac Davis song, “Oh, Lord, It’s Hard to Be Humble”:

In Williams’ case, his excitement is that TIEM will be a better lift truck maker today than it was yesterday, and opportunities exist to make it even better tomorrow and the next day and the next.

“Our kaizen mentality tells us that we need to continuously improve our products and processes,” he says. “If we keep the focus on continuous improvement, good things will happen for us and our associates.”

This kaizen mind-set is rooted in a couple of Toyota-isms:

1. “If you sit back, complacency sets in. At that point, nothing is good.”
2. “All good is not good.”

The latter is a favorite quote of Toyota managers. If your indexes are showing that you are meeting your goals, perhaps your goals aren’t high enough. It ties in with the two things that are said to occur when a Toyota manager reaches a stretch goal. He or she receives a pat on the back from the boss. The manager then is expected to apologize for not setting the bar high enough.



**Fred Williams (shown in the side-view mirror of a Toyota lift truck) is the customer center and service training manager.**

## How's Your Process?

At Columbus, this isn't hype. It's HYP, an acronym for "How's Your Process?" Every morning at 6:30, each associate (Toyota's term for an employee) fills out a form that asks if issues exist within his or her sphere of influence. If issues exist, the associate provides details. That person's designated team leader has until 10 a.m. to look into the issue and either install a countermeasure or outline the next step toward a solution.

The associate has just as much responsibility and accountability. Each month, he or she is expected to turn in at least two formal continuous improvement ideas (which include full implementation and resolution plans). For December 2009, a total of 449 associates delivered 1,089 ideas.

“The adage is that ‘many voices generate new and better ideas,’” says Wendell Crouch, the plant’s maintenance and production engineering manager. “This is about problem-solving. We want our associates to be quality-minded and continuous improvement-minded individuals.”



**Nearly 30,000 lift trucks come off the assembly line each year at the Columbus, Ind., factory.**

## The Meaning in Maintenance

What does all of this have to do with maintenance and machinery lubrication?

Issues and ideas can and do relate to oil, grease, coolant, hydraulic fluid, etc. But, bring it back a level. Continuous improvement starts with the employee.

TIEM’s maintenance structure is built around generalists. No one is hired as an electrician or a mechanic or a lubrication technician. Every associate is brought into the maintenance department at the same pay grade and base skill level. Each person goes through a rigorous training program to develop skills and knowledge.

“There is no continuous improvement without training, without learning,” says Williams.

It takes approximately three years to complete the four education modules. Lubrication concepts are covered in each of them. Classes are four hours long, once per week, and are held during non-shift time. The modules and course components are as follows:

- Electric (basic electricity, electrical wiring fundamentals, electrical circuits, and motors and controls), 26 weeks, 104 hours
- Hydraulic/Pneumatic (hydraulics and pneumatics), 24 weeks, 96 hours
- Skill I (machining fundamentals – levels 1 and 2, industrial plumbing, and welding), 28 weeks, 112 hours
- Skill II (PLCs, machine rigging and installation, mechanical/electrical troubleshooting, and CNC and robotics programming), 26 weeks, 104 hours

Associates also receive training in Toyota-based lean concepts – from the well-known Total Productive Maintenance and five-whys to the lesser-known genchi genbutsu and yokoten (see terms in sidebar found below).

Genchi genbutsu embraces the notion that rather than to simply hear or read about a problem and make a suggestion for improvement, one should actually go to its direct location and experience the situation first hand. Yokoten involves applying lessons learned to similar situations. If downtime occurs on a conveyor as the result of a particular lubrication issue (under-lubrication, over-lubrication, wrong lubricant, etc.), details of the issue and the countermeasure are communicated plant wide (and to Toyota forklift plants in Japan, France and China). That way, follow-up work can determine if like conditions exist elsewhere. If so, the countermeasure can be implemented.

Armed with this knowledge and the Toyota/lean mentality of “seeing things differently”, associates are able to amass meaningful continuous improvement ideas.

One recent idea addressed lubrication issues with a turntable.

“A guard previously had been retrofitted and installed so that the operator could run a part into it,” says Crouch. “However, the guard covered up the grease zerk. If a zerk is unseen or inaccessible, the machine isn’t going to get the grease it needs.

An idea led to a modification of the guard. There's now access to the grease zerk and the operator can still run a part into it."

Another idea led to greater accessibility to lubricant sumps and streamlined procedures for draining them.

"No kaizen is too small," says Williams. "We would rather have 100 small, incremental kaizens than one big home run. All of those individual kaizens create a stable platform for our products and procedures."

Improvement ideas are not static creatures. They can be regularly revisited, refined and revamped.

"We may find that another plant at a different company has a better solution than our solution," says Crouch. "We aren't against taking the best practices from other places and painting them TIEM orange."



**TPM specialist Bill Mings checks out preventive maintenance work orders on his Motorola Pocket PC handheld device.**

## Team-Based Method for PMs

TIEM considers its approach to preventive maintenance to be a best practice ... and the focus of continuous improvement efforts.

Manufacturing and maintenance personnel jointly perform approximately 4,500 preventive maintenance (PM) tasks for the plant's 2,900 pieces of equipment. Manufacturing associates actually perform the lion's share of the PMs. Since the



maintenance department has just 19 associates, it comes down to necessity and simple mathematics.

“There are a host of surveys that show 85 percent of all equipment downtime is due to cleaning, lubricating and tightening,” says Crouch. “There are a whole lot more manufacturing associates than maintenance associates. Therefore, I gear my daily operator tasks and autonomous maintenance tasks toward these three activities. This way, you can make detailed, more complex preventive and predictive maintenance activities to cover the other 15 percent of the downtime, thus allowing 19 maintenance associates to cover almost 3,000 assets.”

Operators perform their PM tasks at the start and completion of the first shift (the day’s only production shift). Since machine stoppages are rare and to be avoided at all costs, maintenance handles its PM tasks during the third shift.

The dividing line for coverage is generally that machine operators handle PMs that take 10 minutes or less to complete and are less than monthly in frequency. There are other caveats.

“If it takes equipment (a ladder, a lift, etc.) to get to what needs to be greased or lubricated, then that would be a maintenance task,” says Crouch. “What is the potential for doing it wrong? The higher the risk, the more that it is going to go to maintenance. If electrical is involved, that goes to maintenance. Some of the supervisors and team leaders are authorized lockout/tagout users out there, but most of the operators are not.”

Operators and manufacturing team leaders have received training on proper lubricating and greasing practices from the maintenance group and the plant’s production engineer.

While the plant is set on this joint approach to completing PMs, it is continually tinkering. The maintenance organization is currently working to change the frequency of PM tasks from a calendar basis to an hourly or run time basis. It also consistently explores PM effectiveness.



“We look at the success of the PM,” says maintenance supervisor Brian Weber. “Is the PM adding value? Is it preventing downtime? Based on several factors and metrics (downtime, cost, etc.), is it being done too frequently, not enough or just right?”

Lubrication PMs are always under review. A task may call for the oil on a machine to be changed every six months. However, oil analysis and an examination of machine performance and run hours may alter the policy to a much less frequent change-out schedule. Needless to say, TIEM’s Infor 7i computerized maintenance management system gets a workout. Since 2006, more than 5,000 PM changes have been submitted. This can involve anything from changing frequency, adding steps to a task, adding part numbers, changing lubricant type or creating a whole new PM.



**Maintenance supervisor Brian Weber (left) goes over metrics with maintenance and production engineering manager Wendell Crouch.**

## Going Paperless for PMs

Another more recent change is in how PMs are delivered. Starting in June 2009, maintenance began using Motorola Pocket PC handheld devices. The units link with the CMMS, allowing planners and schedulers to send PM work orders (and repair work orders) electronically to maintenance associates on the floor. An

electronic work order includes instructions and safety notes, and has the capability to store pictures and graphics. The PM can be opened, accessed and closed out – all without a voluminous paper trail.

“We used to print out 2,500 to 3,000 pages of PM tasks every month,” says TPM specialist Bill Mings. “We aren’t doing that now. The third-shift leader doesn’t have to make paper piles to hand out. And, it has smoothed out communication between departments because everyone can know the status of a job. Anyone can access it over the intranet.”

While maintenance associates are the only ones carrying around the handhelds for PM tasks, manufacturing team leaders may get their own within the next year or two. That way, they can relay tasks to operators and make the PM process completely paperless.

In the near future, maintenance also will be able to take advantage of the Motorola Pocket PC’s bar-code-reading functionality. Every production machine currently has an asset tag that details its unique number and date of purchase. That and additional information could be infused into a bar-code-based tag.

“If there is a bar code on the machine, the associate can walk up, scan it and see the outstanding work orders and PMs on that machine,” says Mings.



**TIEM president Kazue Sasaki (second from left) is a big proponent of the maintenance work that has taken place.**

## Made to Specification

Another significant way that TIEM maximizes its time and resources is with Early Equipment Product Management. This is a structured process that seeks to reduce the complexity associated with the operation and maintenance of equipment. It brings lean principles to equipment design and manufacturing.

“Very often, you can find the root cause of a breakdown in something you did or didn’t do when you bought the equipment,” says Crouch. “We want to address everything before that piece of equipment is brought to the plant floor, installed and put into production.”

The strategy consists of three elements:

- Design for quality assurance
- Design for maintainability
- Life cycle costing

Working together, these elements provide Toyota with a program to create equipment ideal for its production environment – equipment that is easy to operate, easy to maintain and “right-sized” to aid in establishing flow.

When TIEM places an equipment order, it includes a four-page list of equipment specifications. Lubrication-related references may encompass items such as:

- Final documentation shall include (among other things) lubrication drawings and instructions, and a recommended preventive maintenance schedule.
- Lubrication label must be attached (manufacturer, type) by a metal tag with black letters. Attach by screw or rivet. Lubrication shall be Mobil Oil product – exceptions must be approved in writing.
- Reservoir for oil, coolant, etc., shall have sight glass visible from the outside of the machine to check level (no cover must be removed to see sight glass).
- Reservoir sight glass for oil, coolant, etc., shall have operating zone marked in with green paint.
- All lubrication points shall be below 1,600 millimeters (63 inches) in height.

TIEM also specifies what happens when the machine is put into service. This includes regulations on how training is performed for lubrication and other preventive maintenance tasks.

## Lifting the Bar Higher

So TIEM, how's your process for maintenance and machinery lubrication?

Crouch rates overall performance at a 7 to 7.5 on a 1-to-10 scale (10 being optimum). In true kaizen spirit, he states, "We are a whole lot better than what we were, but there is still much more that we can do."

Uptime on critical equipment exceeds 97 percent. For December 2009, uptime in main assembly was 99.76 percent, equating to an average of one minute per day of downtime.

The department has logged a 27.8 percent reduction in repair costs over the past three years.

And, with the focus on preventive and proactive work, just five maintenance associates are assigned each day to handle firefighting calls, a great improvement over a decade ago.

On the lubrication side, Crouch says, "We are at around a 7 for wet lubricants and a 5 for greasing. The numerical grade is not based on the effectiveness of the program. It is the result of it not being fully integrated. For greasing, I haven't moved that process to the manufacturing associate level as thoroughly across the board as I have the wet lubricants. Maintenance is still very responsible for greasing. Again, with only 19 maintenance associates, I need somebody else to do the greasing."

OK, it doesn't manufacture cars and pickup trucks. And, it isn't held to the same reverence as Georgetown. But by continually improving its processes and people, establishing a team-based approach to maintenance and lubrication, and developing strategies to best use its time and resources, Toyota's lift truck plant in Columbus, Ind., is worthy of notice (and a benchmarking tour).

TIEM is making the forklift industry seem, well ... pretty cool.

## Time for TIEM

**Company:** Toyota Industrial Equipment Manufacturing Inc., the lift truck manufacturing division of Toyota Material Handling USA.

**Plant:** TIEM in Columbus, Ind., a town of 36,000 located in southern Indiana. Site development began in 1988 and production began in 1990. The facility has undergone 11 expansions since 1990.

**Plant size:** 890,000 square feet.

**Plant employment:** The site employs 620 workers, including 26 in maintenance.

**Products:** The plant currently makes 63 lift truck products, including diesel tow tractors, sit-down electric forklifts, sit-down internal combustion tire units and sit-down internal combustion pneumatic tire units. This product line spans units with lifting capabilities of 2,000 pounds to 17,500 pounds. An average of 100 lift trucks are produced on a daily basis; nearly 30,000 are produced annually. TIEM also makes the DC/AC inverter assembly for Toyota Tacoma pickup trucks.

**FYI:** Toyota is the world's No. 1 supplier of lift trucks. ... Most of the Toyota lift trucks sold in the U.S. are manufactured at TIEM. ... The plant produced its 350,000th lift truck in November 2009. ... The site has been a zero-landfill facility since 2004.

## Toyota Production System Concepts of Particular Use to Maintenance Organizations

Here is how Toyota defines some of the maintenance-pertinent concepts of its Toyota Production System. TPS is the basis of operation at the company's plants around the world, including the TIEM plant in Columbus, Ind.

**Kaizen:** Continuous improvement. Muda (waste) exists everywhere. Kaizen refers to the series of activities whereby instances of muda are eliminated one by one at minimal cost by workers pooling their wisdom and increasing efficiency in a timely manner.

**Jishuken:** Management-driven kaizen activity where management members identify areas in need of continuous improvement and spread information through the organization to stimulate kaizen activity.

**Nemawashi:** Preliminary work to involve other departments in discussions to seek input, information and/or support for a proposal or change (process, policy, etc.) that would affect them.

**Monozukuri:** Having the spirit to produce excellent products and the ability to constantly improve a production system and process.

**Mu-Jun:** Try everything first in kaizen activities. As Taiichi Ohno (the “father” of the Toyota Production System) stated, “Making sense is important, but in kaizen, it’s better to try first and think later.”

## How the TIEM Plant Stores and Manages Bulk Lubricants

TIEM’s maintenance organization stores and manages lubricants in the plant’s hazardous materials room.

Inventory, as you expect from a Toyota plant, is kept to a minimum. A storage and dispensing rack holds drum cubes that contain the 12 most-used oils in the facility. There is very little backup stock since the plant’s lubricant supplier can deliver it on a just-in-time basis.

Third-shift maintenance team leader Brian Napier inventories

the supply of oils and greases every Friday. Minimum quantity levels trigger a reorder point.

Manufacturing team leaders dispense directly into transfer containers on carts and bring them out to associates at the point of use. Containers are tagged for easy identification by the operators.

At the end of each year, the maintenance department performs a survey to determine the total amount of lubricant (by product) purchased and consumed by the facility. The data helps to identify trends and pinpoint lubricants that may be consolidated or completely eliminated.

## Oil Analysis Points Out Necessary Work During Shutdowns

The Toyota Industrial Equipment Manufacturing plant in Columbus, Ind., has been doing oil analysis since 1998, working primarily with Mobil's Signum program.

Oil analysis is performed every six months on major pieces of equipment. Sampling takes place four to six weeks prior to a plant shutdown.

Maintenance associates take samples under the supervision of the plant's third-shift maintenance team leader, Brian Napier. All involved have undergone proper training from Mobil technical representatives.

Napier receives the results from Signum. After conferring with maintenance supervisor Brian Weber and maintenance and production engineering manager Wendell Crouch (and perhaps Mobil representatives), necessary actions are scheduled for the upcoming shutdown.

Oil analysis results are a key component of the department's



shift to a more condition-based strategy.

“An example would be a PM (preventive maintenance task) for a 500-ton press,” says Crouch. “When it comes to changing the hydraulic fluid, the PM will spell out, ‘Only do this if the analysis from Mobil recommends changing.’”