One-Piece Flow: Utilimaster Corporation, Wakarusa, IN

Critical concepts emphasized through management leadership, simulation games.

Keith Syberg

For those of you with a penchant for gambling, the AME workshop at Utilimaster Corporation in Wakarusa, IN was tailor made. We had two tables of noisy players rolling dice and moving chips. We had free food and drinks. We were keeping score to see who had bragging rights for top results. And what's even better, not one person lost money or had to pawn their return airline ticket. No, it wasn't Las Vegas or a riverboat casino.

It was a conference room of manufacturing leaders, hosted by Utilimaster Corporation, and led by Jim Orbik, vice president of operations, where a simulation game was played out to demonstrate the concepts of lean manufacturing and one-piece flow. Jim knows the concepts well and has lived by them for many years. A General Motors Institute (GMI) grad with additional MIT and University of Michigan training, Jim was an early 1970s leader of JIT manufacturing at GM's Delco Remy Division in Anderson, IN. As a divisional manager, he implemented and trained on JIT manufacturing for all 15 plants in the division before leaving in 1987 to consult for Price Waterhouse. After three years on the consulting trail, Orbik joined Harley-Davidson's Holiday Rambler RV Division as vice president of continuous improvement, and then became general manager of the component operations for the company.

Utilimaster Background

Holiday Rambler and its sister company Utilimaster were placed on the market in early 1996. Utilimaster Corporation was purchased by the management team, including Orbik, and a group of outside investors in December of 1996.

Utilimaster employs 1200 people producing all-aluminum, walk-in trucks and delivery vehicles. They are the sole supplier of delivery trucks to Federal Express which honored them with the Supply Chain of the Year Award in 2000 (see Figure 1). They also supply trucks for Budget/Ryder, Purolator, Cintas, and the United States Postal Service. The company grew sales by 70 percent in 2000, a feat largely accomplished by its ability to meet precise, demanding requirements of its customers.

Lean manufacturing — specifically one-piece flow — is a factor in this success, and the simulation game is a critical tool for teaching lean concepts. It is one of seven components in Utilimaster's Quality Leadership Program, an effort to draw the best and brightest from the manufacturing floor.[1] The goal is to have a broad base of manufacturing excellence throughout the company, and to identify those individuals who might provide the talent pool for future promotion.

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Game Playing: Teaching Critical Concepts

Orbik has facilitated the game hundreds of times and is very clear about why he personally leads the effort. "The concepts of lean manufacturing are vital to our business. I want people to know that these concepts are so critical that I insist on teaching the classes," he said.

The Utilimaster executive also believes that a couple of other lessons are important to this hands-on training style by upper management. First, it demonstrates to the employees that senior leadership understands and believes in the concepts. Second, he is able to gauge how quickly and deeply team members internalize the concepts, which then influences the final outcome on the factory floor.

Figure 1. *Utilimaster is the sole supplier of delivery trucks to Federal Express, which honored them with the Supply Chain of the Year Award in 2000. They also manufacture trucks for Budget/Ryder, Purolator, Cintas, and the United States Postal Service.*

Figure 2. *Team players using Utilimaster's simulation game learned how production results were affected by changes in process flow requirements.*

The simulation began (see Figure 2) by dividing the group into two equal teams. Every person on both nine-member teams was given one die and four red poker chips. Each poker chip represented work in process (WIP). Each roll of the die simulated the daily production output, complete with the variations that

come from broken equipment, absent employees, and shortages of raw materials. A roll of one reflected poor production for the day; a roll of six meant things were moving smoothly. Each person rolled 20 times, representing 20 production days in a month. At the beginning, each team had stacks of white chips. These were vendor raw materials at the beginning of the manufacturing process. When the white chips got through all nine people (production process), total throughput was achieved. Both groups would participate in four simulations, tracking both the total number of finished product completed (red chips), and the number of days for throughput (how many rolls before the first white chip completed the production process), and how much WIP remained in the game after 20 rolls. Sounds simple enough. The learning, however, came as a result of changing the process flow requirements in each of the four difference exercises.

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Month 1

The first simulation proceeded with the condition that the plan operate in a batch process. In other words, you could only move your chips to the next person (or process) in groups of four. So if you rolled one with your die, that meant you had completed processing on one part but you couldn't pass it on the next operation. If you rolled four ones in a row, that meant it was four days before you could move product. This wasn't good for throughput, especially if the operation before you had rolled fours, fives, and sixes. Now your queue of incoming work was overflowing, you couldn't send on your own work, and the next station was starved for material. Conversely, if you rolled four sixes in a row, you had excess capacity and not enough product to process. After the first simulation, a batch process, our scores looked like Figure 3.

Month 2

The second simulation operated much the same except that the batch processing, or the requirement that chips only be moved four at a time, was removed. No batching was required. We were now attempting one-piece flow. In other words, if someone rolled a one or two, he or she could move one or two parts to the next station. If a five or six was rolled, and he or she had adequate parts in queue from the preceding station, five or six chips could be moved. The results improved *significantly* compared to round one (see Figure 4).

The Blue Team, using one-piece flow, showed a 16 percent increase in finished product, a 25 percent improvement in throughput, and a four percent increase in WIP. The Red Team, however, showed leapfrog improvements. They achieved a 38 percent increase in finished product, a 33 percent throughput improvement, and a phenomenal 45 percent *reduction* in WIP. They got more product to customers, in less time, with fewer resources needed for inventory. As you might imagine, a few "light bulbs" started going off around the table, something that Orbik looks for in every simulation.

Month 3

The third round was an attempt to achieve even further improvement. The new condition was simple. The customers wanted 70 finished parts that month. Not an unreasonable request. We all have customers who expect certain shipments, not just what we get around to sending. But, even with the change to one-piece flow and its dramatic improvement, the Blue and Red teams were only able to produce 51 and 54 parts, respectively. How to improve again? The answer, or new condition, was to allow overtime.

The use of overtime is a critical decision for any plant, primarily because of the increase in labor costs through overtime pay. Simulation number three was no different, with the exception that this time *extra* rolls of the dice were allowed to signify overtime work of an entire second and/or third shift. However, each roll was done at a 50 percent labor cost premium over simulations one and two. See Figure 5 for the results.

Again, for both teams, improvements continued. Throughput improved for both teams. WIP continued to improve, particularly for the Blue Team. From the first simulation to the third, the Blue Team saw a 50 percent improvement in throughput and a 71 percent improvement in WIP. The Red Team saw a 45 percent improvement in throughput and a 50 percent WIP improvement. Both groups hit their production requirement of 70. But, the cost of scheduling overtime meant a decrease in profitability, a critical learning point.

	Blue Team	Red Team
Monthly finished product	44	39
Days for total throughput	15	16
WIP remaining	65	64

Figure 3.

	Blue Team Batch/OPF*	Red Team Batch/OPF*
Monthly finished product	44/51	39/54
Days for total throughput	15/12	16/12
WIP remaining	65/68	64/44

Figure 4. **One-piece flow.*

	Blue Team Batch/OPF/ OPF+OT	Red Team Batch/OPF/ OPF+OT
Monthly finished product	44/51/70	39/54/70
Days for total throughput	15/12/10	16/12/11
WIP remaining	65/68/38	64/44/32

Figure 5.

Another "light bulb" went off in game number three. Because a specific production number of 70 was required, the participants quickly determined where the 70th product was in the process. That chip became the focal point for determining plant overtime. No more or no less overtime was scheduled than what was needed to get the 70th chip around to the last player. The other critical result was that even though material costs went up (more production) and labor costs went up (overtime), unit cost continued to go down through higher output and reduced WIP.

Month 4

The final simulation, number four, proceeded with the same conditions as numbers two and three: one-piece flow was allowed, as was overtime. Changes, however, reduced variation in the process. A roll of one, two, or three meant moving three chips from one station to the next. A roll of four, five, or six meant moving four chips at a time. The same labor rate multiple of 1.5 still applied for overtime, but now overtime could be flexibly scheduled to attack key bottlenecks at individual stations, not the entire plant, to push through the 70th completed product. Another lesson: by flexibly focusing on the material flow, the teams could schedule strategic overtime at any time instead of waiting until the last few, frantic days of the month. For the final results, see Figure 6.

By the end of the fourth simulation, both groups had dramatically improved shipped product, throughput, and WIP, while keeping overtime to a manageable, flexible level. Both groups had achieved stable levels upon which further improvements could later be made.

Simple, Powerful Example

While most of the participants had some idea about the benefits that this simulation emphasized, this simple yet powerful example made a strong impression on all who participated. It reinforced that a lack of parts in a batch process leads to expensive downtime. Schedules are hard to meet.

WIP numbers are higher than needed, hiding quality problems and driving up material costs, both of which drive up unit cost and make you less competitive in the marketplace. Additionally, we documented that reducing batch sizes will reduce leadtimes, selective overtime can control shortages, and reduced process variability will improve flow while reducing leadtimes.

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The event ended with an excellent tour of the Utilimaster facility. One manufacturing manager from Ford was so impressed with the event that he was going to return home and sign up 20 of his employees for AME membership. With results like that, I can only say, "Thanks" to everyone at Utilimaster who made this educational event possible, and, "When can we schedule the next event?"

1. Components of Utilimaster's Quality Leadership Program include SPC, human resources, quality management, manufacturing systems, communication, facilitation, and lean manufacturing; all are one-two day training programs.

	Blue Team Batch/OPF/OPF+OT/ OPF+FOT+RV*	Red Team Batch/OPF/OPF+OT/ OPF+FOT+RV*
Monthly finished product	44/51/70/64	39/54/70/66
Days for total throughput	15/12/10/11	16/12/11/10
WIP remaining	65/68/38/32	64/44/32/34

Figure 6. **One-piece flow, flexible overtime, and reduce variability.*

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