Manufacturing Management & Technology Institute

Takt Times

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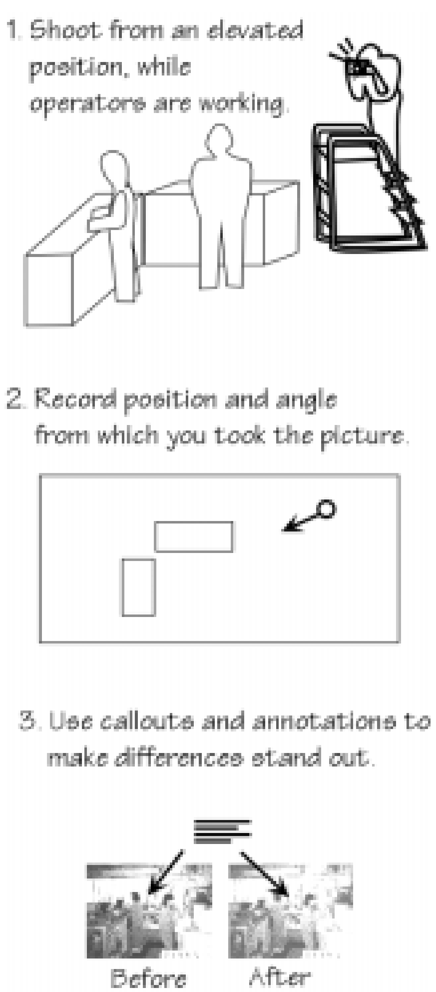

Tips on shop floor photography

As a tool to both drive and document shop floor improvements, photos are a powerful complement to drawings, charts, and videos.

On bulletin board displays of "before-and-after" pictures, however, viewers commonly encounter the following:

- They cannot relate the photographs to the shop floor scene in front of them.
- The changes are less than obvious, and not pointed out.
- The pictures are obviously different, but "after" is not obviously better than "before."
- The pictures are so different that they don't appear to show the same operations.
- The pictures don't show the relevant features.

Before-and-after pictures that work

Photos of cells or workstations should always show people working, and be accompanied by layout diagrams showing the flow of work and callouts indicating where and from which angle the photos were taken.

The "before" and the "after" pictures, should be on the same scale, with photos taken from the same location and angle, to make the differences stand out and to avoid misleading the viewer as to object sizes.

You can mark location and angle on a

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Lean production and "basic" industrial engineering

by Michel Baudin

The fundamentals of cell and line design should be taught in Engineering Schools, but aren't. It stands to reason that these schools should have stopped teaching the 100-year-old methods of Taylor, Gantt and Gilbreth, given that industry has largely abandoned them. But the objectives, methods, and *results* of lean production are different.

Measuring times looks like traditional IE, but addressing the same subject does not mean saying the same things. Time and motion studies in lean production share 99% of their DNA with classical IE, which means that they are as different from it as humans are from chimps.

It is a paradox that explanations of these lean production fundamentals have been best received by those with the most implementation experience. Engineers and managers who are just starting or are not directly involved with implementation, on the other hand, have occasionally given us the feedback that this material was just "basic industrial engineering as taught in college."

We checked out what Stanford University does and what the standard IE textbooks say. To teach IE, Stanford uses "Production & Operations Analysis," by Steven Nahmias. It doesn't have "takt time" in the index. The only reference to lean

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Lean production and "basic" industrial engineering (Cont. from p. 1)

production is a short and simplistic description of the Kanban system, as one of many ways to control flow. If other institutions taught it, we thought that it should have found its way into the most popular references. We checked the following:

- Maynard's "Industrial Engineering Handbook" (4th Edition),
- Walker's "Handbook of Manufacturing Engineering,"
- Salvendy's "Handbook of Human Factors and Ergonomics," and
- Niebel's "Methods, Standards & Work Design."

None of these books says anything about takt time, cell design, or work combination charts.

Time and motion study was the original core of IE and is still what most people think of when they talk about it. In today's textbooks, it is buried among discussions of queueing systems, cost controls, linear programming, or computer simulations. But we can't blame academia for ignoring time and motion studies when industry is doing the same.

In US factories today, stopwatches are almost nowhere to be found. Only the automobile industry seems to pay any attention. It has groups of technicians trained in predetermined time standards methods like MTM or MOST, that are appropriate to anticipate staffing in lines yet to be built but can't match the accuracy of actual measurements in existing lines.

Historically, the efforts of the Taylor/Gantt/Gilbreth school ended in failure, but the idea of measuring how long work takes is about all it has in common with lean production.

Taylor's objective was to put an end to "soldiering" — that is, collusion among workers to curtail output. Taylor's work was done before the advent of the assembly line, in a world where individual effort determined output and where more was always better. Nowhere does he consider the need to match rates in consecutive operations, and his reliance on incentives like differential piece rates reflects a view of human nature that is crude and unsophisticated.

His "scientific management," later renamed IE, was an attempt to wrest control of how the work is done away from the workers into the hands of management, that presumably knew best. The response from workers and organized labor was first to openly oppose it, and then to subvert it by taking advantage of loopholes and fudge factors.

Decades later, the result is rate standards that every operator exceeds by 40%, or jobs so designed that one operator can do the work of two.

The most prevalent practice on America's shop floors is craft control: each operator determines how and with which tools the work is done, with little regard to written specs or to the way *other* operators do the same jobs.

The methods developed informally by the operators are frequently better than the specs, refuting Taylor's belief that workers had nothing to contribute to the design of their own jobs.

Unfortunately, these methods are neither consistent nor shared, and management doesn't know how long the work actually requires. Without that information, we can neither reduce waiting, process or motion waste, nor eliminate the quality defects due to inconsistencies in shop practices. To address these issues, we have to go back to measuring times.

There are, however, subtle differences between the way we go about it and what old-style IEs did, and major differences between the labor force today and 100 years ago.

In the US, the majority of today's operators are not economic refugees from the farms of Sicily or Lithuania, and manufacturing jobs today are not at the bottom of the wage scale. Indeed, they are commonly referred to as "high-paying." With overtime, it is possible today to make more money assembling cars or airplanes with a high school degree than teaching computer science in college with a PhD.

In other sectors, wages may not be high in absolute terms, but they are relative to alternative opportunities for operators. Today's manufacturing wages don't just buy survival, but pay mortgages and college tuitions. The recipients are aware of this, and, as a result, their primary concern is job security.

They also know they're competing against others whose income may be ten times smaller, and must therefore be ten times more productive.

Unlike Taylor, our purpose in doing time studies is not to extract more effort from operators, but instead to avoid wasting it. The wasteful activities on which operators in badly designed jobs fritter away their time are no more restful than useful work and are actually more tedious.

Today's operators frequently use machines with automatic controls, on which their level of physical effort has little or no impact.

In addition, they work as links in a chain, and productivity is achieved by keeping the chain moving at a given takt time with as few operators as possible. The objective is not to maximize the output of each link, as Taylor did, but to synchronize the work of subsequent links involving both people *and* machines.

These differences with the Taylor/Gantt/Gilbreth approach affect both the type of data we need to collect and the use we put it to.

Engineering schools in American universities do not teach this, but they should. They should stop making lean production an item on a menu of approaches and realize the magnitude and depth of what they are dealing with.

Keys to success in smoothing assembly rates

by Tom Berghan

In last month's issue, Tom Berghan described production monitors he developed for Korry Electronics (www.korry.com) and the effect they had. We, however, have seen assembly lines with production monitors installed but ignored. So, we asked Tom to elaborate on what he feels are the key factors for success in implementing this technology.

Many of us have seen assembly lines that, although they use some sort of system for comparing actual production to the goal, do not have smooth production, do not meet daily goals, and have not experienced drops in labor cost. What then is the difference? What did we do to make it work?

For one, the software that John Waite and I have created has numerous features that other display systems do not. These features allow the lines and managers to keep a much tighter control on their production.

I cannot stress enough the power of a visual target. In my experience, people have a very tough time hitting a target they cannot physically see. If we tell an assembly line "Your target is 235 units/day," the odds of them consistently meeting that goal are against them. The line has no idea how many parts they should have produced at, say, 239 minutes into the shift. Therefore, they cannot respond to a crisis until it is *too late.*

But, if we correctly calculate the takt, correctly staff and balance each station of the line to a comfortable and sustainable pace, then place a well designed takt display where all can see it, we will have done a great deal to beat the odds. Now each operator can know what is expected of them at every single moment of the day.

Is that sufficient? No! We must have accountability for each team member. By "each team member," I mean the operators of the assembly line *and* all who sustain and manage that line: supervisors, engineers, production control staff, managers, and senior staff.

There must be a set of agreements in place. The agreements are rules that must be strictly enforced by the entire team. The basic rules should be documented and understood by all team players. It is my opinion that these should be documented in the job descriptions. There should be no ambiguity as to what everyone's responsibilities are when the line gets into trouble. I define "trouble" as anything that impedes smooth, predictable production, day after day.

Do your lines have smooth, predictable production? If not, perhaps one or more of the following are true:

- No takt time has been calculated or it was calculated using bad data.
- Assembly line stations are not balanced.
- The assembly line's balance is not checked routinely.
- There are no visual targets.
- Operators do not respond when they are behind the goal.
- Operators do not understand what the indications of trouble are.
- Operators do not call for help when they are in trouble.
- Supervisors, engineers, and managers do not routinely check on the line.
- Supervisors, engineers, and managers do not respond immediately to calls for help.
- People's responsibilities are unclear.
- People are not held accountable when they do not meet their responsibilities.
- People are not rewarded for meeting their responsibilities.

This last item is very important. Fair pay for a job well done is very important but I am not just referring to money. I have conducted surveys and found that most people place friendship, and recognition above money. Every person needs to know that the company is aware of their day-to-day efforts. Recognition and praise is extremely powerful. It need not be "a big deal." When supervisors, engineers and managers drop by often to see how things are going and give praise and handshakes, high-fives, cheers, etc., it means a great deal to the members of an assembly line and its support team. They will know that you care. The opposite is equally true.

Welcome to David Held

David Held is joining us after 10 years at Toyota, where he applied lean principles to parts logistics in support of NUMMI . He designed five consolidation centers, and their current information systems.

In Production Control at NUMMI for two years, he decreased lot sizes, increased delivery frequency, and reduced transportation cost. He helped NUMMI introduce returnable containers to suppliers, and assisted in internal conveyance issues. He also acted as liaison between NUMMI, the consolidation centers, and transportation vendors. He created various EDI and other automated systems for Toyota, NUMMI and other companies.

David is a Chemical Engineer with an MBA from the University of Utah. He received lean training at Toyota in Japan and is fluent in Japanese, which he learned as an exchange student.

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map of the shop floor. Alternatively, you can directly mark the location with a circle on the floor and a focusing target on the machine itself.

Before-and-after pictures of details, such as machine components are taken close up, but pictures of cells or line are best taken from a raised position, otherwise the machines in the front block the view to the rear.

Selecting the right photo equipment

Digital cameras are a popular, high-technology solution, but there are cheaper ways to get *started*. Our colleague Tom Berghan, for example, swears by his Sony Mavica, but he uses it for applications requiring many pictures to be included into computer-generated documents, such as operator instructions.

A top of the line digital camera will at best produce 1/4 of the resolution of film photography, which becomes a problem when you enlarge a small section. Such a camera will cost on the order of $1,000, including neither the computer equipment needed nor the time engineers will spend tweaking the pictures.

For before-and-after pictures on bulletin boards to document improvement projects, we use Polaroids; for visual note-taking on the floor, APS point-and-shoot cameras with zooms.

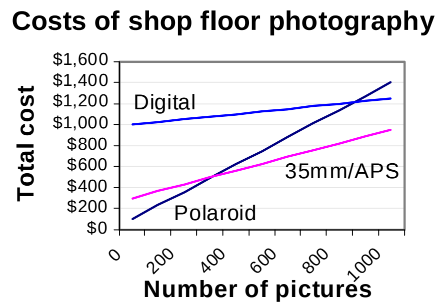
Insurance adjusters use Polaroids, which go for under $100. At $1.30/picture, it is expensive to use, but you would have to take *700 shots* for a high-end digital camera to become more economical.

Instant results, one picture at a time, are a major advantage, but the camera's weak flash makes it unable to shoot broad views of the shop floor.

Film cameras involve batch processing, which delays the availability of the pictures, especially with amateur photographers who are too reluctant to process partially exposed rolls. Film is cheap, and it is more important to have the pictures quickly than to use every frame.

On the shop floor, the recently developed APS format beats 35mm. Its negative is slightly smaller, but the cameras, and particularly the lenses, are *much* smaller, resulting in point-and-shoot zoom lens cameras that fit in a shirt pocket and can be used for note-taking. In addition, the archival and retrieval of APS film is easier than with 35mm.

From a cost standpoint, the different technologies compare roughly as follows:



One last technical point is that the fluorescent lighting of many shop floors gives photographs a yellowish tinge, which you can eliminate with a light-blue filter.

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