TECHNOLOGY AND IIOT

Intelligent Poka Yoke: When Lean Manufacturing Meets Deep Learning

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What if human operators on the assembly line had some equivalent of a red, squiggly spellcheck line that highlighted errors as they were made?

Prasad Akella

A few days ago, while working on an earlier draft of this article, I misspelled the word “factory” as “fcatory.” But the editor at *IndustryWeek* never knew it: the instant I made the mistake, a squiggly red line appeared under the misspelled word, and I fixed it.

This happens to each of us, every day. It’s extremely uninteresting—until you consider the act of writing as a form of manufacturing.

In this view, the process of manufacturing the product (this article) began when I started assembling components (words, concepts, citations) in my word processor. I then passed a refined unit (a draft) to an editor, who performed QC: she removed extraneous material, polished rough edges, and ensured that the final piece met the quality standards necessary for distribution to the customer (you).

In that context, the squiggly red line is a *poka yoke* tool. It flags an error at the source, so that the operator (the writer) can eliminate the defect before

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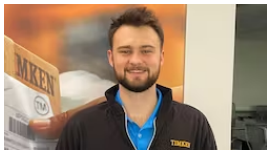

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the piece leaves the station—errors that otherwise might cost me my writing job.

Now, let's make this even more relevant to manufacturing. What if human operators on the assembly line, like magazine writers at their word processor, had some equivalent of a red squiggly line that highlighted errors as they were made?

Introducing Coaching Networks

Gordon Ritter is a founder and general partner at Emergence Capital, one of the earliest investors in Salesforce, Veeva, Box and a number of other successful enterprise software companies. Gordon and his partner, Jason Green, were one of several venture capitalists I met when pitching my company's Series A round.

Of all the new investors I met in that round, Emergence stood out for one reason. After I described to them Drishti's vision of AI that would help operators increase their precision and effectiveness on the assembly line—by observing their activities and flagging issues that an operator should address—they told me that they already had a phrase for just such a system: a "coaching network".

Coaching networks form the basis of Emergence's investment thesis. They define a coaching network as a system that guides workers to doing their jobs

more effectively, even as they're doing it.

Imagine if you had a digital assistant sitting and working with you during a next sales call, offering feedback and advice, calling your attention to the next script you should use, or helping you keep track of your customer's objections.

This is one kind of coaching network. Intelligent *poka yoke* is another.

Emergence, like all of us at Drishti, believes that coaching networks will transform the world. Neither of us sees AI as making humans obsolete, despite the constant negative headlines suggesting this is inevitable. Rather, we see AI as a tool for guiding human attention to the points where our mental cognition and physical agility add the most value to the process.

Will Coaching Networks Make Humans More Relevant?

John Wanamaker was one of the early pioneers of retail in the late 19th century. He's famously quoted as saying, "Half the money I spend on advertising is wasted; the trouble is I don't know which half."

A parallel statement can safely be made in the manufacturing world: half of the effort spent on quality checking is wasted; the trouble is, we don't know which half.

In particular, I've learned from dozens of conversations with plant managers and industrial engineers that something like 33% of line labor is dedicated to

checking the work of upstream associates. These checks and rechecks, these redundant systems and tools, all the money spent on light curtains, touch globes and "traditional" *poka yoke* fixtures—all of it is a reaction to the fact that manufacturers have no other method for directing human attention to the most critical issues and sources of product defects.

Intelligent *poka yoke*—that is, a coaching network that assists line workers—represents an acknowledgement that human attention, properly directed, is potentially more valuable than robots or machines. It combines the flexibility and judgment of a human and the near-perfection of a machine. You can see some examples starting to emerge in the areas of augmented reality:

· Overlaying worker guidance through a screen, such as Google Glass, so that deviations can be highlighted in the worker's field of vision

· Workspace projections

· Light-based work instructions (using projectors to overlay light on the work area)

as well as in computer vision and AI (using cameras to digitally "understand" operator activities and provide feedback as necessary).

The real question then, is the impact on manufacturing jobs.

An illustrative look into the future comes to us from—of all places—the world of spellcheck.

Tools, Quality, Productivity and Jobs

Digital spelling and grammar shortcuts have their detractors. In 2012, the BBC reported that spellcheck was creating an "auto-correct generation." More recently, The Telegraph reported that emojis are perceived to be ruining people's grasp of English.

But studies have shown a net positive effect. Researchers Andrea Lunsford and Karen Lunsford compared student essays from eras before and after the advent of spellcheck, and found that "students in first-year composition classes are, on average, writing longer essays (from an average of 162 words in 1917, to 422 words in 1986, to 1,038 words in 2006), using more complex rhetorical techniques, and making no more errors than those committed by freshman in 1917."

I read this to mean that digital writing tools, by assuming some of the cognitive burden, have resulted in a product of higher quality and with better productivity. These tools flag the lower-level problems so that writers and editors can direct their unique capabilities to the higher-level concerns: coherent arguments, complete thoughts, deeper research, and better logical flow.

I'd expect the same impact, and the same benefits, from preserving and directing human attention from intelligent *poka yoke* in a factory.

In fact, I'd argue that digital assistance for the line worker will change manufacturing as much as spellcheck has changed writing.

A Change to Basic Manufacturing

One hundred years ago, Henry Ford's answer to his frustration with a fleet of craftsmen building one-off cars was to embrace the discipline of mass manufacturing. He wanted—and got—an army of humans acting like automatons. Decades later, lean manufacturing brought back in the human element: empowering the workers with the *andon* cord, for example.

Now, I believe, intelligent *poka yoke*, as an instance of a Coaching Network, has the potential to reorient manufacturing further around the human operator.

(In fact, manufacturing history buffs who have read *The Machine that Changed the World* know that lean manufacturing replaced mass manufacturing over the previous four decades. Perhaps intelligent lean manufacturing is the next?)

One more data point. According to James Bessen of *The Atlantic*, jobs with below-median computer use have grown at a considerably slower rate than than jobs with above-median computer use—by more than a 2-to-1 ratio.

If this pattern holds true, then far from accelerating automation, *intelligent poka yoke*—which brings computational assistance to the assembly line—might be a step towards true human/machine collaboration, and a driver for greater factory employment.

Prasad Akella led the industry/university team that built the world's first collaborative robots at GM. He's the founder and CEO of Drishti, a company deploying AI to collaborate with and enhance humans on the factory floor.

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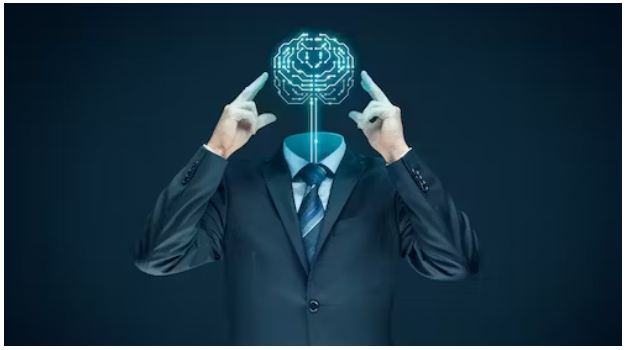

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