ARTIFICIAL INTELLIGENCE: FINDING A SIMPLE, EFFECTIVE APPROACH

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The ongoing and pervasive talk about Artificial Intelligence (AI) may leave you with more questions than ever. It's a complex topic addressed from multiple perspectives. One thing that's clear, however, is that AI is becoming an integral part of the smart factory. In fact, your plant will not thrive in the next 10 years if you don't begin adopting a smart factory strategy that uses data analytics and AI practices.

The smart factory evolution, referred to as the Fourth Industrial Revolution (4IR), has raised the stakes in productivity and efficiency. A smart factory builds digitalization into every step, integrating data analytics, the Internet of Things (IoT), and AI into its processes. While this integration may be challenging, the payoff is significant.

A Revolution in Revenue Growth

Use of 4IR innovations will generate $37 trillion in value by 2025, according to McKinsey & Company. The analysis is part of the World Economic Forum's ongoing research project called the Global Lighthouse Network. Leaders in this network are incorporating smart factory technologies into their operations at breakneck speed and shared their lessons learned in research published in January 2020.

These findings reinforce research about how AI boosts industry profits and innovation that was conducted by Accenture and Frontier Economics in 2017. The study predicted that businesses applying AI in 2017 could increase profitability by an average of 38 percent and labor productivity 40 percent by 2035.

The gap between manufacturers who embrace smart factory AI and those who don't will widen exponentially, delineating clear winners and losers. You can take steps to ensure that you're not on the losing side of the gap.

Understanding Artificial Intelligence

Let's start with a clear definition. AI is the creation of human-like intelligence using computer-based algorithms. In other words, AI is intelligence applied by machines, not humans. The Oxford Dictionary identifies AI as the "theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages."

The term was coined in 1956 at the two-month-long conference Dartmouth Summer Research Project on Artificial Intelligence at Dartmouth College in Hanover, New Hampshire. It was the first time Allen Newell, Cliff Shaw, and Herbert Simon presented the proof-of-concept program Logic Theorist, which was designed to mimic the problem-solving skills of a human. The conference launched the study, development, and funding of AI.

While much has been done since then, there is not one established, unifying theory or model that defines AI or guides its research. That has contributed to some of the confusion. Here are five common components, but don't be surprised if you see additions or subtractions on other lists:

- **Machine Learning:** Machine Learning (ML) is at the core of AI. ML enables

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computers to automatically learn from information and then apply that learning. AI systems are based on three types of machine learning: supervised learning, unsupervised learning, and reinforcement learning.

• **Deep Learning:** Deep learning is a form of unsupervised learning. Unlike typical machine learning, it uses artificial neural networks to imitate how humans learn and think. As technology expert Kate Reyes wrote for Simplilearn: "Until recently, neural networks were limited by computing power and thus were limited in complexity. However, advancements in Big Data analytics have permitted larger, sophisticated neural networks, allowing computers to observe, learn, and react to complex situations faster than humans. Deep learning has aided image classification, language translation, speech recognition." Note: According to some, deep learning includes the disciplines of natural language processing (NLP) and cognitive computing; however, others break them out as separate components of AI.

• **Neural Network:** Investopedia's James Chen explains that a neural network is a series of algorithms that tries to recognize underlying relationships in a set of data. The algorithms follow a process that mimics the way the human brain operates. A neural network can adapt to changing input, so it can generate the best possible result without needing to redesign the output criteria.

• **Robotics:** Thanks to movies such as Star Wars and AI, robotics is the first thing people often think when AI comes up. Note: many experts fiercely argue that robotics is a separate technology from AI and should not be considered a subset of AI. Regardless of its ancestry, robotics serves a very distinct role in AI's future. While robots replicate human actions, AI replicates human thought. Combining AI and robotics puts machine learning and deep learning into action, replacing many physical activities done by humans or animals.

• **Computer Vision:** Computer vision is the technology that helps computers to see and understand content in photographic images, videos, and real life. While not yet perfected, it's generating a lot of attention. It's being used in manufacturing to support predictive maintenance and defect reduction.

It All Starts with Data

However you define AI, data is at its roots. Intelligence, whether artificial or biological, needs information to be of value. Chances are you already have a connected factory that is collecting and analyzing data, or you are in the planning process. But you don't need to wait until your factory is fully connected and making the most of big data to begin using AI.

Most experts recommend that you start small, looking for places where AI can be easily implemented and generate real results. Applying AI to make processes more efficient and provide true support to human tasks is where you can find immediate ROI. Taking an incremental approach eliminates the risks of large AI projects that can fail and cost millions of dollars.

Where is AI's Value in Industry?

The value of AI lies in its ability to address business issues, according to the article Artificial Intelligence for the Real World in the January 2018 Harvard Business Review. The authors identify three areas where AI can be effective: automating business processes, gaining insight through data analysis, and engaging customers and employees.

Process automation – automating digital or physical tasks – provides a logical starting point for applying AI to manufacturing. From product design, to online production, to supply chain management, AI can provide significant returns. Here are a few examples of how AI can be applied to improve your manufacturing processes:

• **Descriptive Analytics:** AI can help you understand what happens at each moment in your manufacturing process and identify opportunities for improvement. AI can analyze operational parameters, the environment, and how the conditions impact your product.

• **Predictive Failure Analysis:** By collecting and analyzing data about your products, how they are tested and how they perform, AI can identify the probability of failure and where in your products' design and development additional attention needs to be given.

• **Predictive Maintenance:** Using AI's machine learning, you can help prevent unplanned downtime. With data analytics and statistical models, AI can monitor equipment and predict failures, equipment effectiveness, production quality, and safety risks.

• **Augment Production Design:** You can increase production capacity and reduce material consumption by using AI to make better decisions in production design. AI can also simulate product design to identify multiple areas of improvement.

How to Begin Thinking About AI for Your Company

When and where you adopt AI depends on the unique factors of your plant. Guidance on how to begin can be found in the 2017 research report by Accenture and Frontier Economics. It includes eight strategies for implementing AI.

• **Develop AI strategy that appeals to leadership:** Generating value from AI will require buy-in, recognition, and action from your company's top leadership. Start by developing a road map and identifying tangible benefits for the C-suite.

• **Add HAIR to HR:** Recommend expanding the Chief HR Officer's role beyond managing human employees to include managing human-machine interaction – or Human AI Resources (HAIR).

• **Learn with Machines:** Adopting AI changes the status quo. To absorb the change, adjust the nature of your plant's learning and employee training, particularly in the area of agile skills development.

• **Appoint a chief data supply chain officer:** This leader will provide the oversight needed to effectively construct an integrated, end-to-end supply chain for data.

• **Create an open AI culture:** You can't implement significant change without addressing your organization's culture. For AI to work well, there needs to be trust, openness, and transparency so people can embrace their new relationships with machines.

• **Take the crowd into the cloud:** Begin developing a cloud-based data plan if you haven't already. Combining crowdsourced data in the cloud with AI capabilities is the next phase of innovation.

• **Step beyond automation:** Once your initial AI processes are in place, look beyond automation for opportunities to harness the intelligence of dynamic, self-learning, and self-governing machines.

• **Measure your return on algorithms:** Unlike traditional devices that depreciate over time, AI assets gain value. CFOs will need new financial metrics to properly assess the "Return on AI," which could include the value generated from each algorithm compared to a combination of initial outlay and ongoing costs.

Implementing AI into your operations is an adventure that takes knowledge, planning, strategy and creative thinking. It's an exciting investment and clearly time to jump in. ◆

WHEN LEAN ISN'T ENOUGH, WHAT THEN?

THE KEYSTONE GROUP

Thirty-five years ago, I was part of a grand experiment. I was a first line production supervisor in an automotive assembly plant, implementing this strange new thing called the Toyota Production System (TPS). We were still fighting with the union every day, trying to get employees to show up for work, and dealing with constant quality problems. How could working as a team possibly ever happen, let alone continuous improvement and elimination of waste? It wasn't easy, but it did work. It was an unforgettable transformation – something that would later become Lean Manufacturing.

Decades later, Lean has been adopted as a core strategy at numerous successful companies with excellent results. However, some "Lean" organizations still struggle. Everything looks fine on the surface, with fancy display boards all over the plant, shadow boards where tools are supposed to hang, and a website that brags about continuous improvement, all parts of Lean. Yet quality problems persist, on-time-delivery is poor, and earnings are disappointing.

Lean Obesity

Lean, at its core, is a management philosophy and mindset, supported by a robust set of tools. It streamlines activities around what brings value to the customer, with relentless focus on continuous improvement and elimination of waste. How, then, can Lean become heavy?

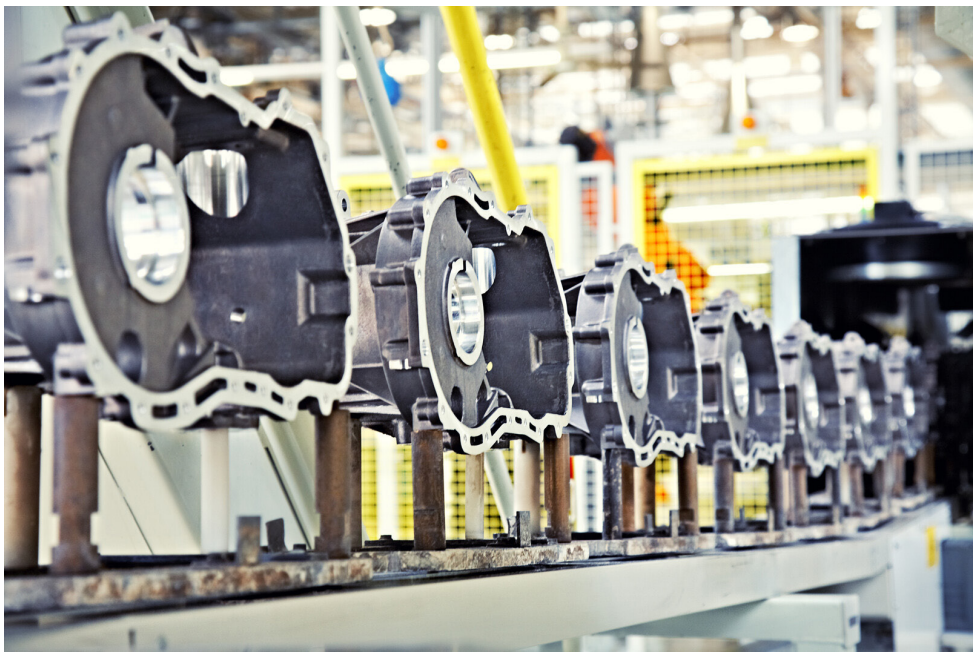
Consider a factory that starts each shift with crew meetings, reviewing six visual display boards created by the last Lean task force. People nod their heads when the supervisor talks, but their eyes are glazed over with all the information – none of which leads to any actions or helps them do their jobs better. Two operators raise their hand to say, "Our machines are down because we're waiting on work orders from Scheduling," but they're told to be patient. The person responsible for distributing the work orders also updates all the displays, and he's so busy updating the displays that work orders sometimes fall through the cracks. He gets in big trouble if the displays don't look nice, but no one seems to notice if a couple of machines are down. Somehow, process and appearance just became more important than results.

This is just one example of how Lean processes and meetings, in excess, can become burdensome. It's important to balance the resources required to maintain each process with the benefits obtained. Every now and then, one should audit all Lean processes and modify/prune those that don't have impact. One should also avoid using every tool in the Lean toolbox, when all that's needed is a pliers and a screwdriver. Lastly, remember that Lean enables results, but isn't the result in and of itself. Keep Lean lean.

Continuous Improvement – Discontinuously!

Think about the underlying meaning of the word lean, and ask yourself, "What's more effective, a diet/exercise burst every January, or a healthy lifestyle every day?" Dr. Deming, the father of Kaizen (Continuous Improvement) instilled the principle that the one-time efforts would just fade away if they were not maintained. Some companies hold "Kaizen Events" once or twice a year, advertise them widely, and assume Kaizen is alive and well. However, the underlying fabric of continuous improvement, the intrinsic belief that "We can change things for the better," every day, gets lost. Benefits don't hit the bottom line.

Picture a big, complicated machine that makes paper. For over a year, the production team has been unable to increase volume, in spite of great speeches and several Kaizen initiatives. Production is mad at maintenance for not fixing the machine. Maintenance is mad at production because they don't provide the information or time needed to find the root cause and fix it. Then, management implements a novel approach. Every time the machine breaks down, the operator documents exactly what happened and communicates with maintenance. Maintenance analyzes the data and works with the operators to find the root cause. Management provides reinforcement as well as machine time and money to fix the problems. The machine starts running more reliably, day-in, day-out. Next, the team focuses on speed. When the machine tops out at 600 ft/min, they ask why it can't run faster. They try a new starch formula which increases speeds to 615, then to 630 and 650 ft/min. Day after day, the little improvements in uptime



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and speed add up. Everyone gets pizza when a new production record is set, and management is spending lots of money on pizza. Maintenance and production now eat at the same table. Earnings start going through the roof, and so does morale.

Yes, this sounds like a fairy tale, but it's not. It starts with a continuous improvement mindset, one that never settles for status quo and thrives on the desire to get better every day. It takes persistence and problem-solving discipline (the Plan-Do-Check-Act cycle in Lean). It also recognizes the small wins that turn into big victories. As the old saying goes, "The best way to eat an elephant is one bite at a time."

Simply Lean

Lean manufacturing, at its core, is not complicated. Especially in the early days of TPS, we were amazed with how much of it was actually common sense. Visual displays and Kanban replaced complicated reports. People on the production floor worked alongside engineers to solve problems. Intense focus was placed on training, recognizing that capable people, working together, could accomplish anything. Over the years, though, Lean has evolved into more and more tools and a variety of "brands," each with its own flavor. It has become complicated, albeit unintentionally.

Picture the following situation: A manufacturing plant has been getting quality complaints from angry customers for the past year. The quality control department does a great job creating a defect tracking process and applying the latest statistical techniques. Reports are generated and control charts posted, but months later, customer complaints continue. The General Manager decides to go back to Lean basics. Every time a bad part comes back from a customer, it goes on the "Quality Focus" table in the lunchroom for everyone to see. Within three days, the operator is involved in root cause analysis and corrective action is taken and publicized on the table. The inspection sheets used at the start of every job are simplified from 46 check items to the 15 responsible for 99 percent of the defects. And, the GM walks the floor periodically and personally does quality checks, congratulating operators for doing a good job. Within weeks, quality complaints are rare.

Visibility, accountability, timely corrective action, leadership by example, recognition. Simple, eh? The key is to recognize that simple, well executed, wins the day every time.

Gumby Gemba

Gemba is a Lean principle that means "the actual place." It refers to management going to the source, to see for oneself where it really happens. In manufacturing, that usually means the plant floor. Gemba is a fundamental building block of Lean leadership that makes Lean real, makes it personal. It's the leader that walks the plant floor and stops to talk with operators, and even the person who cleans the restrooms. He listens more than talks, and always observes. Instead of trusting hearsay or reports, he goes to see for himself. He's in touch with reality.

While this is the goal, Gemba sometimes loses its original intent. Let's look a story that brings the point home. The plant leadership team in a factory goes on a Gemba walk every morning at 7:45. They walk around the plant as a group and look at the machines running. However, instead of listening to operators they mostly talk to each other. On top of that, the crews know when the bosses are coming by and have their props ready, making sure everything looks perfect. The managers check off "daily rounds" on their personal to-do list and go back to the office. After a long day of emails and meetings, they go home exhausted. Ever happen to you?

THERE ARE NO EASY ANSWERS WHEN IT COMES TO "RIGHT PEOPLE, RIGHT JOBS, RIGHT SITUATIONS." IT STARTS WITH HIRING THE RIGHT PEOPLE IN THE FIRST PLACE, AND RELENTLESS FOCUS ON DEVELOPING THOSE YOU ALREADY HAVE.

Think back (if you're old enough) on the animated clay figure Gumby. He was fun to watch, but he wasn't real. If we aren't careful, Gemba can become Gumby. We have to go to the actual place, but in a way that makes what we see real. That means connecting with people, removing the filters, acting on what we see, and following up with the same people the next time around.

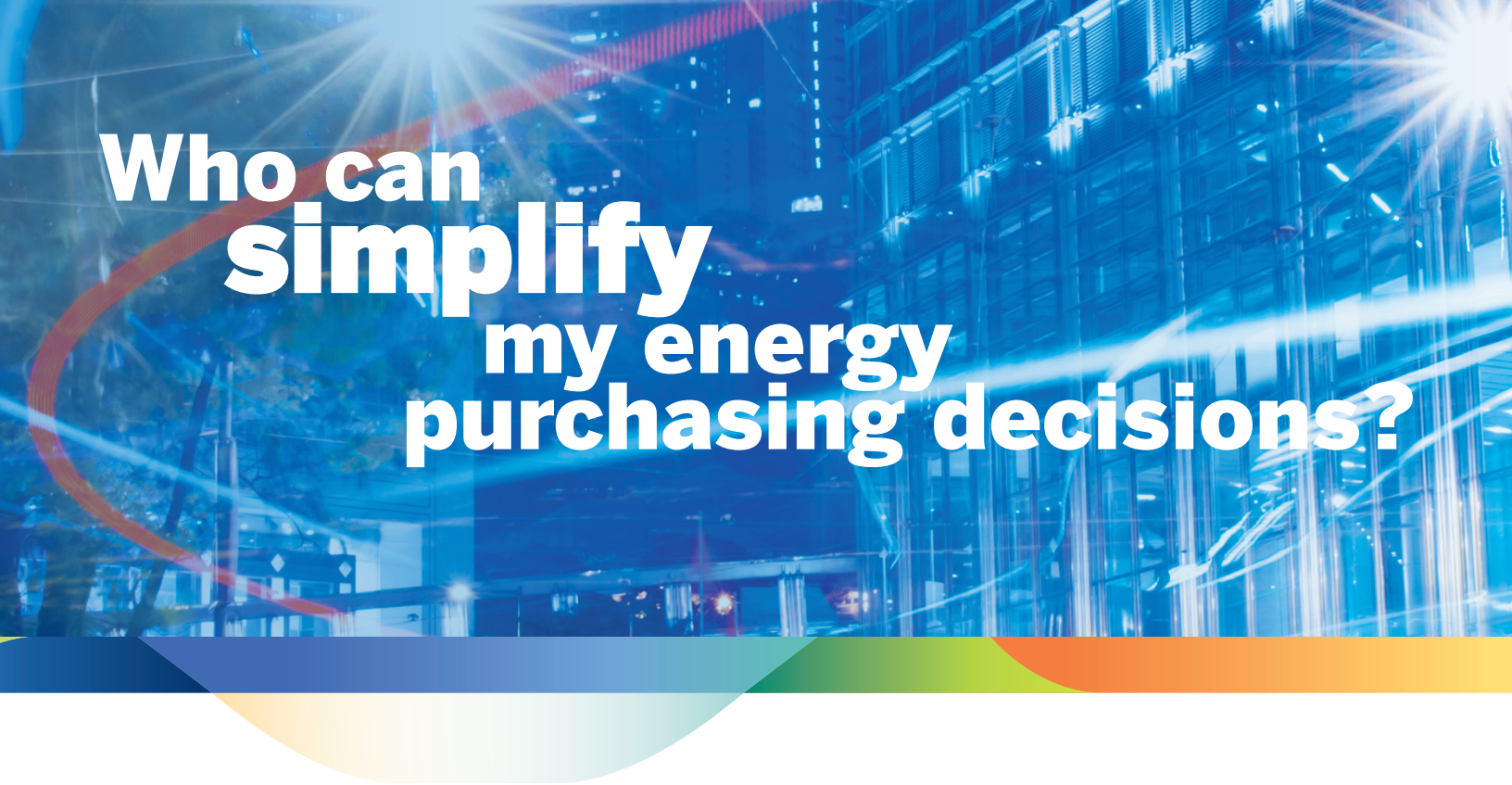
Right People, Right Jobs, Right Situations

Let's face it. Getting the right people in the right jobs is one of the hardest challenges leaders face. It's equally difficult to tell if it's the person, or an untenable situation that causes a problem. Lean, when implemented correctly, does a great job of addressing the situation part, setting people up for success. At the end of the day, though, when the wrong people are still in the wrong jobs, Lean may not be enough.

Picture a factory that suffers from Lean Obesity and Discontinuous Improvement. Employee turnover and ongoing machine problems make production totally unreliable. The scheduler is blamed for missed due dates and he's about to get fired. He's actually the third scheduler in the last year – the prior two left for other jobs. The plant manager, an able administrator with an authoritarian style, spends most of his day in the office. He is quick to blame others, and hence people are reluctant to bring problems forward, let alone take corrective action. In short, they don't trust him. Two simple questions: What are the odds that continuous improvement and teamwork will prosper with that leader? On the other hand, can any scheduler succeed in this situation?

There are no easy answers when it comes to "Right People, Right Jobs, Right Situations." It starts with hiring the right people in the first place, and relentless focus on developing those you already have. It also means creating a winning culture, with processes and systems that enable the right people to succeed. The journey is never ending, a continuous improvement effort in and of itself.

Lean remains a superior management philosophy, provided the pitfalls are avoided. Periodic reflection and assessment is critical, whether it's done internally or with the help of an objective outside resource. Keeping Lean lean, simple, real, and continuously improving with the right people is the key. ◆



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