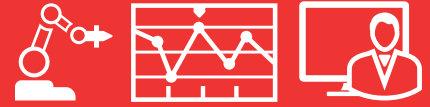


People Still Power Manufacturing

Digital technologies are augmenting —
not replacing — the human workforce





Manufacturing in the U.S. is in the midst of the Fourth Industrial Revolution, in which the real and digital worlds are being blended in unprecedented ways to drive innovation success. That's significant because manufacturing in the U.S. produces 18.2% of the world's goodsⁱ and, taken alone, would be the ninth-largest economy in the world.ⁱⁱ

Through smart manufacturing, digital technologies such as machine learning, artificial intelligence (AI), big data, analytics, and automation are changing the factory floor, and turning your employees into knowledge workers that bring value to your company through the power of their brains, not their brawn.

For manufacturers, the key to surviving and thriving requires learning how to attract, hire, educate, and train the workers of the future – and that means making the most of both the new technologies and the uniquely human qualities of a skilled workforce. According to Deloitte, "In the near future, human workers and machines will work together seamlessly, each complementing the other's efforts in a single loop of productivity. And, in turn, HR organizations will begin developing new strategies and tools for recruiting, managing, and training a hybrid human-machine workforce."ⁱⁱⁱ

But the Deloitte Global Human Capital Trends survey states that only 17% of executives say they are ready to manage a workforce that includes people, robots, and AI working side by side.^{iv} What about your business? Are you prepared for the knowledge workforce?



Making Humans and Machines Inseparable

The key to addressing this knowledge workforce challenge lies, surprisingly, in the same technology that is driving the change. With traditional factory tasks such as repetitive assembly and heavy lifting activities increasingly being taken on by machinery, robots, and automation, human workers are freed up to do what they do best – guide those machines. Today’s workforce can use these technologies to innovate, make judgments, and respond rapidly. Rather than replacing today’s workers, digital technologies are augmenting their efforts.

We all know that humans are pretty good at a lot of things. One of the things is recognizing and overcoming our limitations, and the proper tools can help us do that. Just as a hammer is an extension of an arm, a work tool such as an exosuit (a powered exoskeleton worn by a worker to provide additional stability or strength) or smart glasses like Microsoft’s HoloLens is an extension of the capabilities humans already have.

This shouldn’t be surprising. Augmenting workers with technology is actually something we’ve been doing since the early days of our species – from early tools to the four Industrial Revolutions. It’s part of what makes us human.

In this paper, you’ll get a glimpse of how digital technologies are being used by companies today to supplement their existing workforce and attract the younger, tech-savvy workers that will lead them into a promising future. When your workforce is assisted by the latest digital tools, you’ll be poised to drive your competitive edge forward while creating a better environment for your people to learn and grow.

Creating the Knowledge Workforce in Manufacturing

In the smart factory, innovative technologies increase the visibility of operations, predict downtime and quality issues, and improve agility in the face of the unknown. But those benefits are best applied as tools to address specific business challenges and to aid the workers who remain at the heart of the manufacturing process.

Today’s digital technologies are capable of making your knowledge workers more efficient and effective. By implementing technologies that work alongside your human workforce, you not only assist and support your current employees but future-proof your workforce – addressing the looming skills gap.

These worker-centric benefits of augmentative technology fall into three main categories: agility, quality, and safety.

Some perspective: cost versus benefit

What does it cost to create a digital twin and connect all the shop floor equipment with IoT? The real question is: If production time improves by x percent, what does it mean to the organization’s bottom line, productivity, capacity, growth, employee retention and so on? Leaders in the industry look at what is to be gained and work toward those outcomes.



Digital Use Case: Improving the mobility of first- line workers

A large European manufacturer was struggling to understand why their production line was bottlenecked. Only by visiting the factory floor and watching and talking to workers was a key problem identified.

Here's what they found: Workers were losing valuable production time because they had to walk away from their stations throughout the day to go to a whiteboard that had important data written on it. The workers would use their cellphones to take a photo of the whiteboard, then walk back to their stations, where they would use the data to do their jobs more effectively.

Once that simple productivity issue was identified, the company developed an elegant solution – in this case, a digitized whiteboard that instantly supplies up-to-date data to every workstation along the production line. The result? A six-to-one return on investment in one year and a multimillion-dollar increase in productivity and output capacity.

Four Ways to Increase Agility

1. Maximize the value of your current workforce. Digital tools allow you to make the most of your current workforce. You don't have to hire expert workers if you can give your existing workers the guidance they need as they step through a process. This also provides stability and career growth for workers.

"I'm not sure that most people understand that further skills development is not only good for the company, but also good for the individual," said Dan Davis, from the International Fabrications & Manufacturers Association. "It keeps them more relevant in the job that they currently have and more marketable when that job suddenly ends, by the individual's or the employer's choice."^v

2. Attract high-quality new workers. Young job-seekers entering the workforce today already have technical fluency in social media, online communities, education, and gaming. While a traditional factory job is not likely to appeal to this population, when your factory uses modern, digital work tools, it becomes a high-tech environment that can attract the workers with those skills. In short, factory jobs can become challenging and fun.

Some of the cool tools that are in use today include exosuits that allow the wearer to lift enormous weights effortlessly or hover safely in mid-air to work on top of a utility pole. Other tools include mixed-reality systems that can superimpose a 3-D building plan onto an empty lot and allow the user to "walk through" the proposed building. As one technology educator described his students, "... they don't care if they jump on the automated system and they're terrible at it. It's fun for them. It's like a video game. You learn from it, and you do better the next time."^{vi}

3. Plug the brain drain. Digital work tools can tap into the knowledge and expertise of skilled, trained workers to provide the data that makes an augmented environment work. For example, augmentative technologies can capture the skills and knowledge of your expert workers to train new workers. When your expert workers retire, their knowledge and expertise remains with the company and keeps your workforce agile.

4. Increase worker mobility. Today, 80% of workers don't have desks – these "first-line workers" need to be able to access the data and information required to do their jobs wherever they are, in the field or on the factory floor.^{vii} Tools such as digital smart glasses use machine learning-based information to continually assess and assist human actions, directing workers to the component or tool they need, when they need it.



Three Steps to Improved Quality

The benefits of improved product quality are obvious – with fewer product returns, higher customer satisfaction, and an enhanced reputation compared to competitors, you stand to reap real financial rewards and brand accolades. Smart manufacturing, and augmentative technology in particular, contribute to manufacturing quality in a number of ways:

1. Mistake-proof your operations. With the right technology, workers have the benefit of real-time guidance that not only teaches them the right way to do things but prevents them from doing things wrong. This improves the quality of products and reduces waste and safety incidents.

One study compared the performance of a technician using the company's current process to wire a wind turbine's control box with his performance of the same task while assisted by line-of-sight instructions overlaid on the job by an augmented reality (AR) headset. Even though this was his first time using the device, it improved his performance by 34%. With mistake-proofing, it's easier for workers to make good decisions, improving your company's bottom line while improving workers' throughput and satisfaction with their work.

2. Address individualized demand. With customers demanding a growing variety of product options, robots are unable to handle the level of endless customization required – a demand that trained people can address with ease. This has led to a new trend emerging in the manufacturing sphere: humans being brought back to work side by side with, and even replace, robots.

Mercedes Benz announced that it was bringing human operators back to the factory floor to deal with this increasing degree of individualization. The automaker, along with Audi, BMW and Toyota, is experimenting with replacing large autonomous robots with human operators working along smaller, more collaborative robots.^{viii} It seems that, as good as robots are at performing repetitive tasks, they are no match for the trained human mind. Manufacturers that employ highly skilled people assisted by digital technologies can deliver better results than with the technologies alone.

3. Train workers faster and more effectively. When you capture and refine the skills and knowledge of your expert workers, you can build a knowledge base of best practices to use for training. These best practices can continue to be available on an interactive basis as workers execute the tasks.

Monitoring and prompting workers' movements, for example during an assembly process, makes it possible to coach workers through a change in the process in a more agile way—learning on the job without sacrificing quality or efficiency. In fact, according to Venture Beat, augmented reality is the future of training due to its great potential for streamlining the training process and reducing the cost of getting workers up to speed.^{ix}

Digital Use Case: Transferring expert skills with technology

Daikin, a leading global air conditioning manufacturer, needed to improve productivity, quality, and the transfer of important skills to new employees. A key part of the air-conditioner assembly process is a skill called brazing, in which copper pipes are carefully joined. Daikin turned its attention to how it could better train workers worldwide and ensure that they attained the high level of skill and absolute consistency required for the task. It was here – in the training of workers – that the company realized it could employ digital technologies as a tool to support its skill transfer and solve a critical workplace challenge.

To improve the efficiency of training and skill transfer, Daikin and Hitachi developed the Brazing Skills Training Support System. This system uses cameras and sensors to collect and digitize time-series data on how expert workers (meisters) perform brazing. That data is then used to create a virtual display that shows how the work of trainees differs from that of the meisters. Is the trainee holding the torch at the wrong angle? Are they feeding the wires correctly?

The meisters use the differences revealed by the training system to help their trainees improve their skills more quickly. In addition, the training support system achieves uniform quality across Daikin's global facilities and accelerates skill transfer by enabling meisters to provide training at worldwide plants without needing to be there in person.

Three Methods to Ensure Safer Environments

Workplace injuries and accidents that cause employees to miss six or more days of work cost U.S. employers nearly \$62 billion.^x With technology that can detect and mitigate worker actions, bringing it to the factory floor makes good business sense. An augmented workforce is a safer workforce:



1 Reduce repetitive motion and stress injuries.

Injuries from overexertion by workers costs employers \$15 billion a year in compensation.^{xi} The mistake-proofing built into many technologies guides workers' motions in ergonomic directions and provides mechanical support to allow them to perform their tasks without injury. For example, a construction exosuit can support a heavy power tool and keep a worker's arms aligned for minimum muscle strain when he or she is working overhead.



2 Automatically detect and prevent dangerous situations.

Intrusion detection systems using video can detect when a person is in a restricted zone and may be vulnerable to injury. The detection system can send an alert or even automatically suspend nearby machine activity until a safe environment is restored. These systems can also detect and alert workers to abnormal movement of machinery, such as a forklift that is about to drop its unstable load.



3 Reduce human error in safety spot checks.

On today's busy, complex factory floors, safety spot checks are crucial to make sure workers have the correct safety gear for the tasks they are assigned to. Until now this has been performed manually by safety officers or co-workers, leaving room for human error. But new technologies bring together real-time video analysis with machine learning to ensure that workers are correctly equipped with the hard hats, protective gloves and eyewear, and other PPE (personal protective equipment) required when they enter a work area. The pre-set rules and location of the system at entry and exit points both expedites and mistake-proofs the spot check process, resulting in a safer, more efficient work environment.^{xii}

The People-Driven Future of Manufacturing

According to Accenture, “The very concept of work is being redefined as different generations enter and exit the workforce amidst a rapidly changing technological landscape. Responsive and responsible leaders must act to harness the power of the Fourth Industrial Revolution for long-term advantage and shareholder value. Mindful to put their people first, at the center of change, the new leadership imperative is clear: Create the future workforce – now.”^{xiii}

As the Fourth Industrial Revolution progresses, your workers’ skills will continue to change – they will rely less on their muscles and more on their minds. And their efforts will increasingly be guided and supported by robotics, big data analytics, augmented reality, IoT, and other digital innovations. Capturing the knowledge of the employees you have now, and attracting the tech-savvy workers you want, requires a commitment to supporting your workforce in new and inventive ways.

Close to 15 million new jobs will be created in the U.S. over the next decade as a direct result of automation and AI, equivalent to 10% of the workforce.^{xiv} In the factory of the future, the interests of these knowledge workers will directly intersect with the interests of the companies they work for as never before. By bringing augmentative technologies to your workforce now, you can build more efficient and productive facilities and remain competitive well into the future.

Many manufacturers are transforming operations with the help of digital technologies. Find out more about how your company can navigate this dynamic environment and generate positive outcomes at social-innovation.hitachi/us/think-ahead/manufacturing/.

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