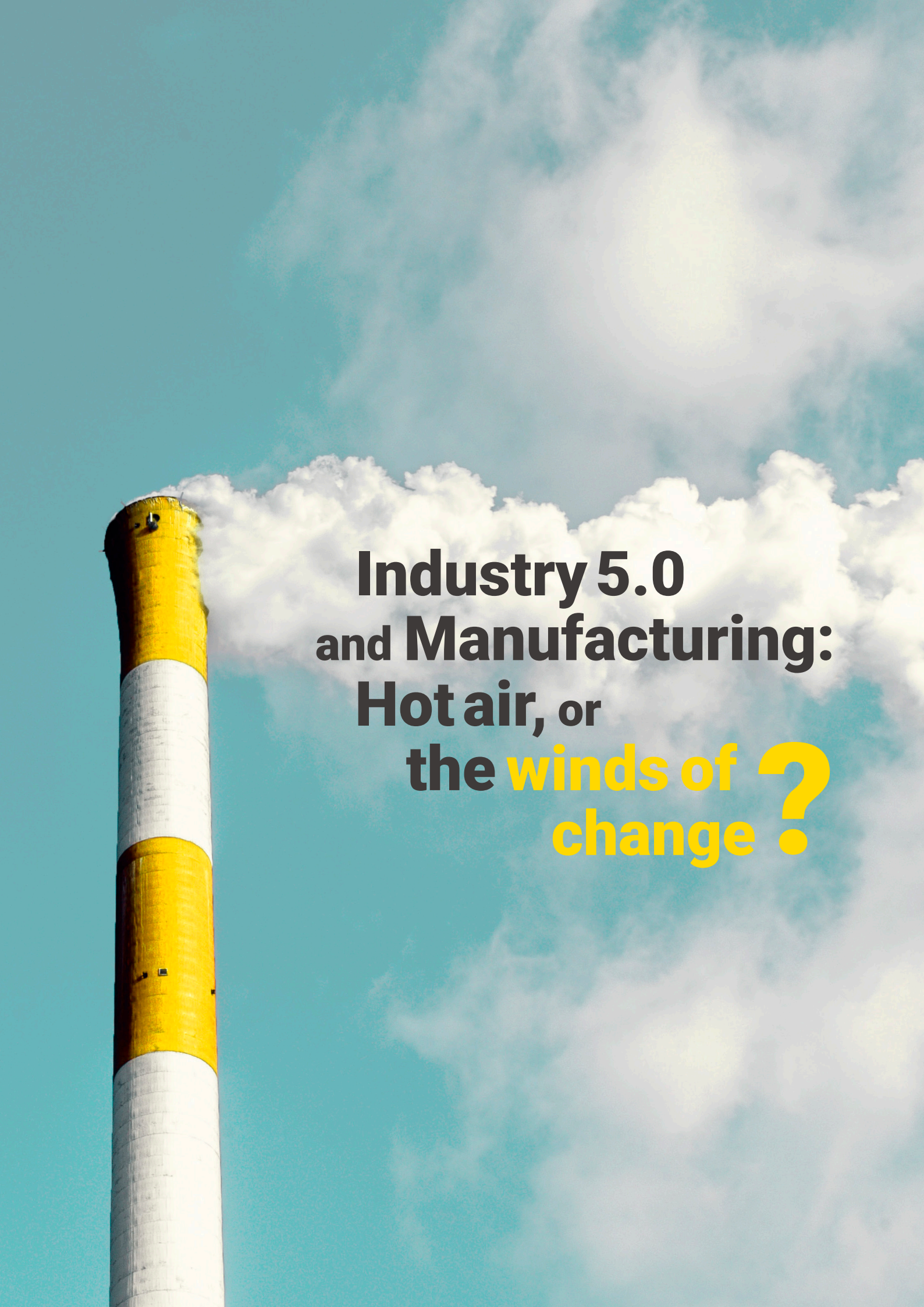
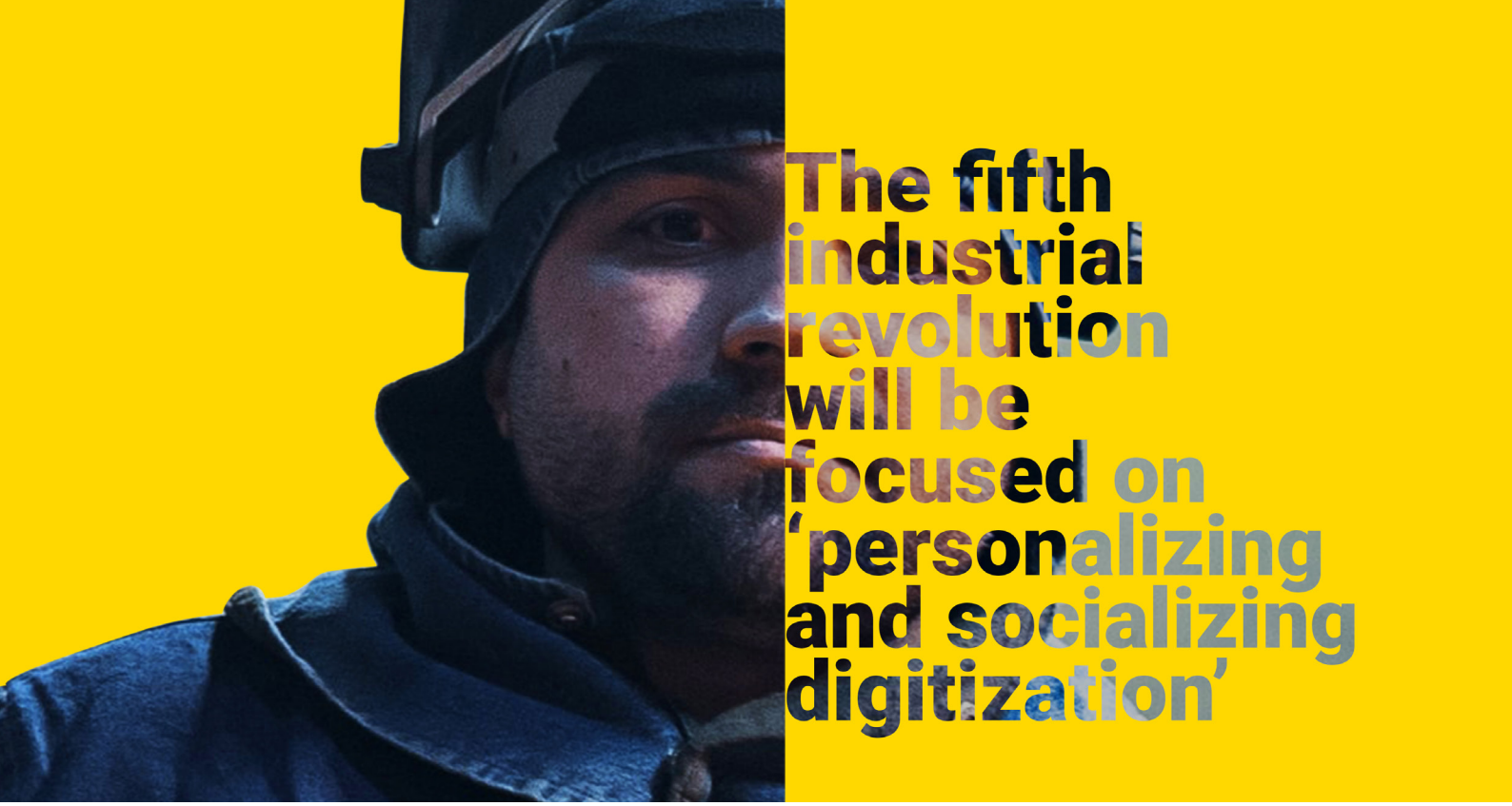


Industry 5.0 and Manufacturing: Hot air, or the winds of change?

The manufacturing industry is constantly being revolutionized, it seems. We so often hear about new technologies and concepts disrupting the industry, distinguishing the truly impactful from the merely cosmetic becomes difficult.

"Industry 5.0" is no different. With grandiose assertions emerging from business leaders and political institutions, manufacturers can't be blamed if they're unclear about 5.0's potential impact for their businesses.

To help make this clearer, we aim to map out just what Industry 5.0 is, and what it means for manufacturers.



What is "Industry 5.0"?

"Industry 5.0" attempts to characterize a new industrial paradigm where — broadly speaking — humans will be re-centered as the focal point for industrial activity.

Within manufacturing, 5.0 aims to prioritize human-machine collaboration over the 'machines replacing humans' model, and seeks to gear industrial output towards human concerns such as sustainability, as well as profit.

The term "Industry 5.0" indicates a continuation of previous industrial revolutions: The first industrial revolution (1760) described mechanization through steam power. The second (1870) was characterized by the electrification of mass-production. The third, (1969), captured the automation of mass-production (robots in the automotive industry, for example).

The fourth, (2000) focused on digitizing automation. The fifth, it might be said, will be focused on 'personalizing and socializing digitization'.

How is 5.0 different from 4.0?

5.0 isn't a step-change in technological-industrial development, like its predecessors. Instead, it's more of a reconfiguration of how existing technologies will be used.

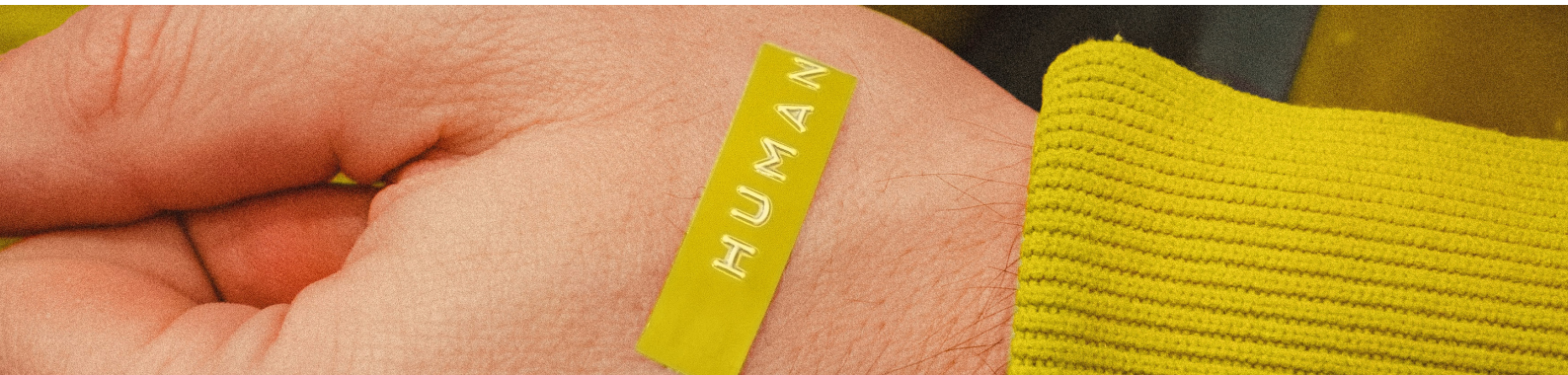
It borrows heavily from its recent (and ongoing) predecessor, "Industry 4.0". **Popularized by the World Economic Forum Founder, Klaus Schwab**, 4.0 describes the massive industrial and social changes instigated by increasing interconnectivity and smart automation.

These technologies have had an enormous impact on manufacturing, with the global production and supply network changing dramatically over the course of the last two decades. Accordingly, **the manufacturing industry and its day-to-day practices have been radically altered** through the use of smart technologies, robotics, large-scale machine-to-machine communication (M2M), and the Internet of Things (IoT).

These changes precipitated several acres' worth of literature on the idea that machines would replace humans in all aspects of industry. However, although automation has many clear advantages over non-automated processes, it's too-thorough application leaves much to be desired:

1. Although robots and automated processes are highly efficient in creating products, they are less reliable when it comes to issues of creativity – despite advances in AI and machine learning. Therefore, humans have to remain involved in the process.
2. Consumer demand for personalized products has increased. This means automated processes require human input to create highly individualized products at scale.
3. Political and social concerns are increasingly impacting business, meaning sustainability has to be factored into business models. This means adjusting and refining existing automated processes to be more sustainable, and to do so requires human intervention and feedback.
4. With much talk of replacing humans with machines, there is an imperative to upskill people, and retain jobs.

As a result, the 5.0 paradigm reintroduces human beings back into the nexus of increasingly independent and communicative technologies. In doing so, it also hopes to fulfil the European Commission's statement: Innovation should be aimed at "increasing prosperity for all involved: investors, workers, consumers, society, and the environment."



Humans need to be recentered in Industry: it allows us to direct these machines more closely to do what **you** want

Is it *really* so Important for Humans to be Re-centered in Industry?

With the advent of Industry 4.0, manufacturing achieved efficiencies through automation which were previously unimaginable. Smart technologies and the IoT helped to create more effective manufacturing processes – improvements we've witnessed first hand at **KNIME, with some of our manufacturing customers building solutions that reduced 6 months of work down to 20 minutes**.

And as recently as 2020, manufacturing leaders felt that the changes brought about by 4.0 **increased productivity by 88% and product quality 48%**.

However, while Industry 4.0 radically improved manufacturing processes, it also demonstrated the downsides to leaving them entirely (or nearly entirely) to machines. Namely, these processes could leave little room for human intervention or redesign.

When humans are involved in processes from the viewpoints of process improvement and product design, they can work with machines to steer and adjust automated processes to suit different goals. Machines in return benefit humans by doing repetitive, difficult or dangerous tasks.

These changes are illustrated by two concepts, **Personalization and the Human in the Loop**. They also demonstrate why it's important to **recenter** humans in industry.

This kind of approach will also conceivably shift from a purely B2C arena, to a B2B one, where bespoke machines can be produced at scale to suit an individual business' needs.

This Time it's Personal: Personalization

83% of US consumers expect to be able to buy personalized products regularly by 2030. They're also willing to pay more for these products. Needless to say, the consumer shift to personalized products will be a driver for change in manufacturing.

So what is personalization? According to Gartner, it's a "**process that creates a relevant, individualized interaction between two parties designed to enhance the experience of the recipient**."

In relation to manufacturing, Accenture comments that in **5.0, mass-produced products will be made as close to individual customer specifications** as possible. This is different from customization. Where customization allows consumers to configure the details of a product from a list of options, **personalization creates truly unique products suited to individual tastes or needs**.

For example, when it comes to health products and cosmetics, consumers have been able to customize products for some time. Now however, companies are beginning to offer extremely personalized cosmetics which are ideally suited to consumers' individual needs.

Rather than a customized 'mix-and-match' product, they're now able to buy a product which is ideally suited to their skin's PH level, condition (whether they have wrinkles, for example), complexion, allergies, UV exposure and so on.

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To achieve personalization across verticals, manufacturers will have to adopt a **Goldilocks approach to their operations, sizing them "just right"**. They will have to transition to a more agile supply chain and make their own processes leaner. What's more, personalization will require greater involvement from humans, including from customers when offering up more personal data.

To utilize this data and process customer insights across the supply chain, manufacturers will have to adopt unified data management systems that are usable for all business users.

This is the only way to make personalization a reality.

The ‘Human in the Loop’

In the context of Machine Learning, Human-in-the-Loop (HITL) is a framework for integrating human feedback into accurate prediction model training. According to **Ge Wang of Stanford University**, HITL harnesses the best of human and machine abilities: It envisions processes that use the efficiency of intelligent automation while remaining amenable to human input.

Until recently, we’ve generally seen Machine Learning presented as an autonomous system, where algorithms improve their predictions over time by training on historical data. Although this gets the core concept of ML correct, it assumes that a machine will have complete and sufficient data to train on.

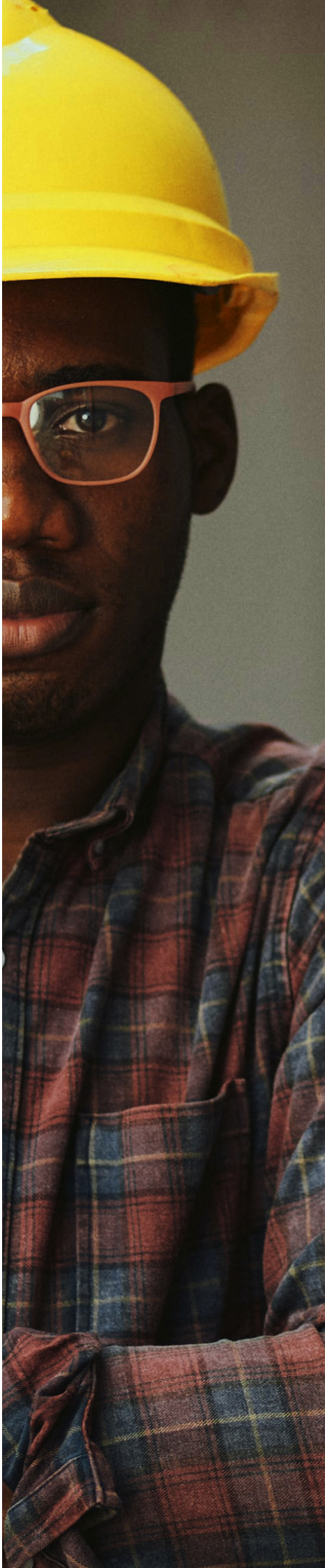
In reality, there’s hardly ever the ideal dataset: Either it’s incomplete, or insufficient. So what do you do? Rather than wait for the holy grail of datasets to arrive, humans can work productively with machines to train them on existing, incomplete datasets.

As the machine trains on the data, the human provides feedback and input, correcting the machine when it’s made an error. In this way, the human refines the algorithm by taking on the burden of decision-making for some of the time, and also, the machine learns quicker in working with the human, meaning the method is also cost-effective.

Selective inclusion of human feedback also allows humans to direct the model towards different goals. **Humans can assess the quality of the algorithm, and adjust it as the model trains**. For example, if the model is thought to produce accurate but environmentally unfriendly results, it can be adjusted.

The framework sets up a mutually-beneficial relationship: Human input in machine learning will allow these systems to produce more interesting results geared towards human needs; and they in turn will offset the need for human beings to complete repetitive or labor-intensive tasks.

HITL is particularly useful in the areas of quality control and error detection. In these cases, the humans in the loop are experts of all kinds: Data experts, Quality Analysts, and Machine Learning engineers.



Take QA and QC, for example: Humans assess the quality and safety of products already checked by the model. Even if the model deemed the products to be safe, an expert double-checks, and provides feedback to the model where necessary.

A human is capable of spotting subtle, problematic errors, and dealing with edge cases far better than machines. Since manufacturers want to ensure the quality of their products, detecting errors through a collaborative approach between humans and machines is highly effective.

Smart Factories, Smarter Workers, Cobots and Collaboration

Industry 5.0 also seeks to extend the capabilities of individual workers, floor workers, and managers alike.

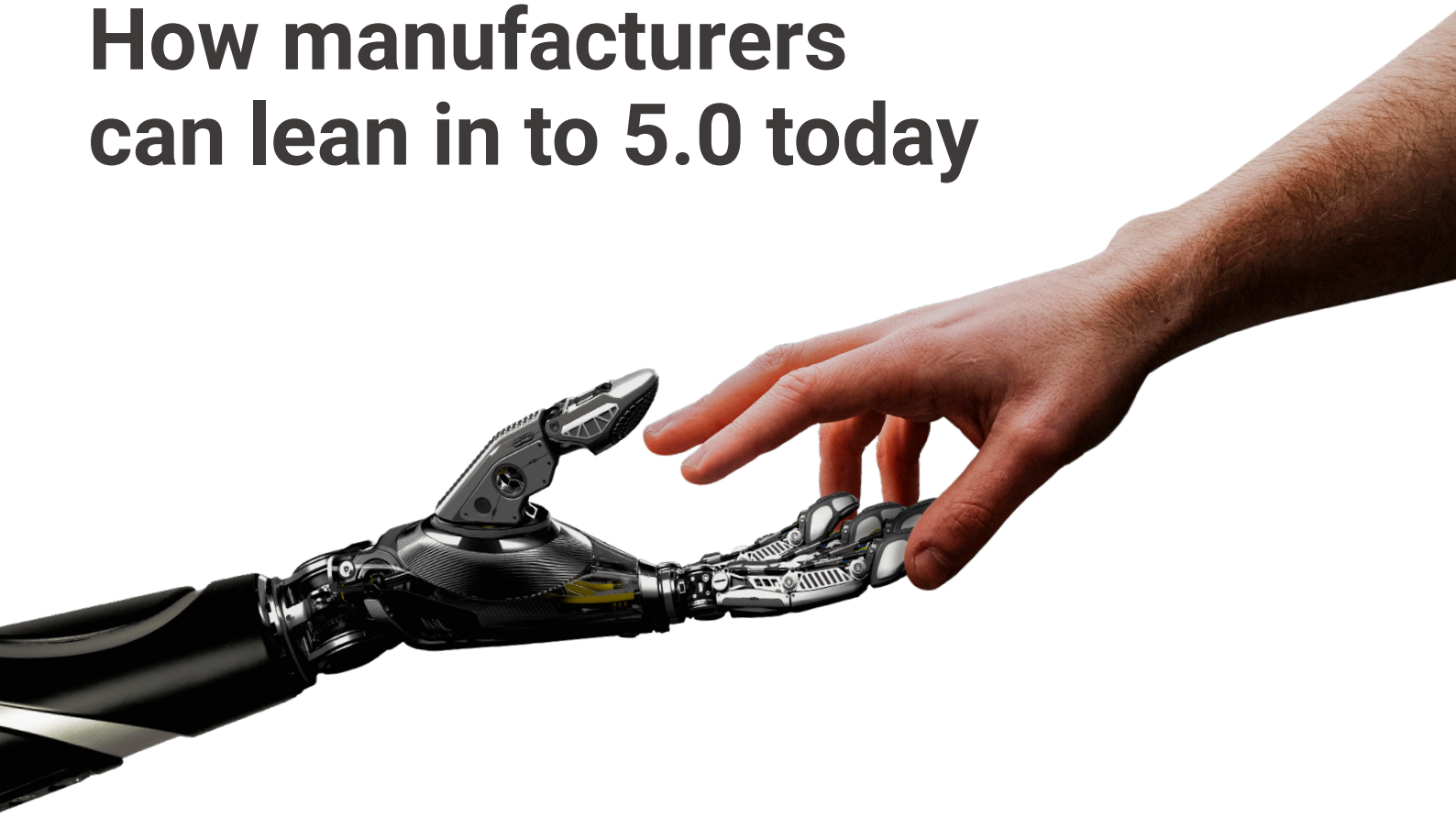
Since the concept of 5.0 is about centering business processes around human concerns (whether that's the environmental impact of the business, or the nature of the jobs involved), 5.0 aims at expanding the capabilities of the industry worker with innovative technological means.

The idea of workers working alongside robots collaboratively — what have been termed 'cobots' — has been around for a while, but **EIT Manufacturing has developed 8 future projections of extended operators to showcase the range of collaboration**: From workers wearing mechanical exoskeletons to perform their jobs, to workers being informed by smart assistants on how to best perform tasks, to workers using Big Data analytics in real-time to make changes to processes if they need.

Other developments suggest that Digital Twin Systems will proliferate. A Digital Twin system is a virtual replica of a physical system (such as a production plant) which IT specialists can use not only to monitor the plant but also to run simulations in real-time and perform crucial changes before the actual changes are implemented and deployed.

For manufacturers, this would mean substantial savings in making changes to their production processes, as any significant alterations could be modeled and visualized beforehand.

How manufacturers can lean in to 5.0 today



Safety and Efficiency through Sensors

There are also some ways in which Industry 5.0 is already underway. Take anomaly detection, for example, where **manufacturers use sensors to make their factories** more efficient through early problem detection.

Optimally, a factory's machinery must operate at peak performance for as long as possible, without interruption. Critical machinery needs to be constantly monitored for proper functionality, with sensors providing data at regular intervals.

In order for companies to ensure that maintenance occurs at exactly the right time, they must know about impending issues far enough in advance in order to take action. Anomalies can be detected at the earliest possible stage thanks to KNIME.

Based on readings taken from sensors while parts are functioning correctly, a model is trained to detect anomalous data, thereby predicting impending breakdowns. This data is read into a KNIME workflow which is automatically executed daily on KNIME Server.

In the case of an anomaly, the model determines whether a first or second level alert should be activated. Next steps can then be quickly taken by the company, data experts, and workforce to address the anomaly.

By using data management tools like KNIME, manufacturers can already insert humans into their processes, and begin to identify ways to make their businesses more sustainable, work-friendly, and safer.

Process Mining: Mapping out all Business Processes

One of the biggest challenges manufacturers have in understanding their processes is due to the complexity and wide range of manufacturing mechanisms and systems.

On top of that, the data making up this complexity comes from multiple and varying sources. Finding a way to manage all these different data types and data sources while creating efficiencies, and at the same time ensuring consistency across all applications is extremely difficult.

By making use of log files, manufacturers can already find out the weak points in their businesses: Across manufacturing business processes, IT applications create log files. These register events across the process: Who has done what, and what event has taken place for every step in the process.

An event log can be used to visualize the process while it's taking place – also known as the 'as-is process'.

What's more, various data sources and types **can also be blended for use in KNIME** so that data can be tracked throughout a process. The as-is process enables experts to see where the bottlenecks and friction points in the process are.

By using data management tools like KNIME, manufacturers can already insert humans into their processes, and begin to identify ways to make their businesses more sustainable, work-friendly, and safer.

Industry 5.0: How big will it be?

With so much noise around 5.0, it's inevitable that some of it will be hyperbole. Much of the current information underplays the fact that Industry 5.0 is not a true technological revolution in the mold of previous revolutions. Rather, it's a way of reconfiguring or rethinking existing technologies to suit different goals.

As this is the case, some of the more vaunted benefits would only come about as a result of massive political action. Manufacturers might not adjust their sustainability goals as a matter of course: They will need persuading, demonstration that it is good for business, or legal reasons to do so.

Nevertheless, there's no doubt that there's a need to get humans and machines to collaborate in the workplace. There are already ways manufacturers can lean in to this, and develop safer, more creative workplaces.

To facilitate this transition, it will be incumbent on business leaders to prepare for Industry 5.0. They can do this by initiating wide-ranging upskilling programs to train workers to use robotics and reading basic data outputs. What's more, managers should upskill themselves for greater data literacy to lean in to 5.0's changes.

While some of its more sweeping changes might be overhyped, the concept of 5.0 at least sets forward a positive vision for innovation while also respecting environmental boundaries. What's more, it provides a vision for how manufacturing jobs could be done, using technologies to make factories safer.

If workers are more broadly upskilled for data literacy and robotics to work collaboratively with machines, that will already have knock-on benefits for businesses, and allow them to take advantage of potential changes early.

Smarter machines will produce smarter workers.

About KNIME

KNIME is a global company that provides data analytics tools for customers across verticals. It enables manufacturing businesses, specifically, to be responsive to changes in business processes and build self-service analytical applications and automation tools in an intuitive environment. KNIME software is embraced by manufacturing staff because all processes are verifiable, secure, and easily shared within teams. Send an email to **sales@knime.com** if you are interested to find out more

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