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**I S S U E**

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# The Jobs That Artificial Intelligence Will Create

A global study finds several new categories of human jobs emerging, requiring skills and training that will take many companies by surprise.

## [WORKFORCE PLANNING]

# The Jobs That Artificial Intelligence Will Create

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BY H. JAMES WILSON, PAUL R. DAUGHERTY, AND NICOLA MORINI-BIANZINO

**T**he threat that automation will eliminate a broad swath of jobs across the world economy is now well established. As artificial intelligence (AI) systems become ever more sophisticated, another wave of job displacement will almost certainly occur.

It can be a distressing picture.

But here's what we've been overlooking: Many new jobs will also be created — jobs that look nothing like those that exist today.

In Accenture PLC's global study of more than 1,000 large companies already using or testing AI and machine-learning systems, we identified the emergence of entire categories of new, uniquely human jobs. These roles are not replacing old ones. They are novel, requiring skills and training that have no precedents. (Accenture's study, "How Companies are Reimagining Business Processes with IT," will be published this summer.)

More specifically, our research reveals three new categories of AI-driven business and technology jobs. We label them trainers, explainers, and sustainers. Humans in these roles will complement the tasks performed by cognitive technology, ensuring that the work of machines is both effective and responsible — that it is fair, transparent, and auditable.

## Trainers

This first category of new jobs will need human workers to teach AI systems how

they should perform — and it is emerging rapidly. At one end of the spectrum, trainers help natural-language processors and language translators make fewer errors. At the other end, they teach AI algorithms how to mimic human behaviors.

Customer service chatbots, for example, need to be trained to detect the complexities and subtleties of human communication. Yahoo Inc. is trying to teach its language processing system that people do not always literally mean what they say. Thus far, Yahoo engineers have developed an algorithm that can detect sarcasm on social media and websites with an accuracy of at least 80%.

Consider, then, the job of "empathy trainer" — individuals who will teach AI systems to show compassion. The New York-based startup Kemoko Inc., d/b/a Koko, which sprung from the MIT Media Lab, has developed a machine-learning system that can help digital assistants such as Apple's Siri and Amazon's Alexa address

people's questions with sympathy and depth. Humans are now training the Koko algorithm to respond more empathetically to people who, for example, are frustrated that their luggage has been lost, that a product they've bought is defective, or that their cable service keeps going on the blink even after repeated attempts to fix it. The goal is for the system to be able to talk people through a problem or difficult situation using the appropriate amount of understanding, compassion, and maybe even humor. Whenever Koko responds inappropriately, a human trainer helps correct that action — and over time, the machine-learning algorithm gets better at determining the best response.

Without an empathy trainer, Alexa might respond to a user's anxieties with canned, repetitive responses such as, "I'm sorry to hear that" or "Sometimes talking to a friend can help." With the right training, Alexa becomes much more helpful. The following is a verbatim transcription of how Alexa with Koko responds to a person who says he's worried that he'll fail an upcoming exam: "Exams are really stressful, but a little anxiety can help us succeed. It sharpens our minds. ... It's your body's way to prepare itself for action. It's actually a really good thing. I wonder if you could think of your nerves as your secret weapon. Easier said than done, I know. But I think you will do much better than you think."

## Explainers

The second category of new jobs — explainers — will bridge the gap between technologists and business leaders. Explainers will help provide clarity, which is becoming all the more important as AI systems' opaqueness increases. Many executives are uneasy with the "black box" nature of sophisticated machine-learning algorithms, especially when the systems they power recommend actions that go against the grain of

conventional wisdom. Indeed, governments have already been considering regulations in this area. For example, the European Union's new General Data Protection Regulation, which is slated to take effect in 2018, will effectively create a "right to explanation," allowing consumers to question and fight any decision made purely on an algorithmic basis that affects them.

Companies that deploy advanced AI systems will need a cadre of employees who can explain the inner workings of complex algorithms to nontechnical professionals. For example, algorithm forensics analysts would be responsible for holding any algorithm accountable for its results. When a system makes a mistake or when

changes to the input variables and observes how they alter that decision. With that information, the algorithm forensics analyst can pinpoint the data that led to a particular result.

So, for instance, if an expert recruiting system has identified the best candidate for a research and development job, the analyst using LIME could identify the variables that led to that conclusion (such as education and deep expertise in a particular, narrow field) as well as the evidence against it (such as inexperience in working on collaborative teams). Using such techniques, the forensics analyst can explain why someone was hired or passed over for promotion. In other situations, the analyst can help demystify why

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its decisions lead to unintended negative consequences, the forensics analyst would be expected to conduct an "autopsy" on the event to understand the causes of that behavior, allowing it to be corrected. Certain types of algorithms, like decision trees, are relatively straightforward to explain. Others, like machine-learning bots, are more complicated. Nevertheless, the forensics analyst needs to have the proper training and skills to perform detailed autopsies and explain their results.

Here, techniques like Local Interpretable Model-Agnostic Explanations (LIME), which explains the underlying rationale and trustworthiness of a machine prediction, can be extremely useful. LIME doesn't care about the actual AI algorithms used. In fact, it doesn't need to know anything about the inner workings. To perform an autopsy of any result, it makes slight

an AI-driven manufacturing process was halted or why a marketing campaign targeted only a subset of consumers.

## Sustainers

The final category of new jobs our research identified — sustainers — will help ensure that AI systems are operating as designed and that unintended consequences are addressed with the appropriate urgency. In our survey, we found that less than one-third of companies have a high degree of confidence in the fairness and auditability of their AI systems, and less than half have similar confidence in the safety of those systems. Clearly, those statistics indicate fundamental issues that need to be resolved for the continued usage of AI technologies, and that's where sustainers will play a crucial role.

One of the most important functions will be the ethics compliance manager.

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**REPRESENTATIVE ROLES CREATED BY AI**

Accenture's global study of more than 1,000 large companies identified the emergence of three new categories of uniquely human jobs.

<b>TRAINERS</b>	<b>Customer-language tone and meaning trainer</b>	Teaches AI systems to look beyond the literal meaning of a communication by, for example, detecting sarcasm.
	<b>Smart-machine interaction modeler</b>	Models machine behavior after employee behavior so that, for example, an AI system can learn from an accountant's actions how to automatically match payments to invoices.
	<b>Worldview trainer</b>	Trains AI systems to develop a global perspective so that various cultural perspectives are considered when determining, for example, whether an algorithm is "fair."
<b>EXPLAINERS</b>	<b>Context designer</b>	Designs smart decisions based on business context, process task, and individual, professional, and cultural factors.
	<b>Transparency analyst</b>	Classifies the different types of opacity (and corresponding effects on the business) of the AI algorithms used and maintains an inventory of that information.
	<b>AI usefulness strategist</b>	Determines whether to deploy AI (versus traditional rules engines and scripts) for specific applications.
<b>SUSTAINERS</b>	<b>Automation ethicist</b>	Evaluates the noneconomic impact of smart machines, both the upside and downside.
	<b>Automation economist</b>	Evaluates the cost of poor machine performance.
	<b>Machine relations manager</b>	"Promotes" algorithms that perform well to greater scale in the business and "demotes" algorithms with poor performance.

Individuals in this role will act as a kind of watchdog and ombudsman for upholding norms of human values and morals — intervening if, for example, an AI system for credit approval was discriminating against people in certain professions or specific geographic areas. Other biases might be subtler — for example, a search algorithm that responds with images of only white women when someone queries "loving grandmother." The ethics compliance manager could work with an algorithm forensics analyst to uncover the underlying reasons for such results and then implement the appropriate fixes.

In the future, AI may become more self-governing. Mark O. Riedl and Brent Harrison, researchers at the School of Interactive Computing at Georgia Institute of Technology, have developed an AI prototype named Quixote, which can learn about ethics by reading simple stories. According to Riedl and Harrison, the system is able to reverse-engineer human values through stories about how humans interact with one another. Quixote has learned, for instance, why stealing is not a good idea and that striving for efficiency

is fine except when it conflicts with other important considerations. But even given such innovations, human ethics compliance managers will play a critical role in monitoring and helping to ensure the proper operation of advanced systems.

The types of jobs we describe here are unprecedented and will be required at scale across industries. (For additional examples, see "Representative Roles Created by AI.") This shift will put a huge amount of pressure on organizations' training and development operations. It may also lead us to question many assumptions we have made about traditional educational requirements for professional roles.

Empathy trainers, for example, may not need a college degree. Individuals with a high school education and who are inherently empathetic (a characteristic that's measurable) could be taught the necessary skills in an in-house training program. In fact, the effect of many of these new positions may be the rise of a "no-collar" workforce that slowly replaces traditional blue-collar jobs in manufacturing and other professions. But where and how these workers will be trained remain open

questions. In our view, the answers need to begin with an organization's own learning and development operations.

On the other hand, a number of new jobs — ethics compliance manager, for example — are likely to require advanced degrees and highly specialized skill sets. So, just as organizations must address the need to train one part of the workforce for emerging no-collar roles, they must reimagine their human resources processes to better attract, train, and retain highly educated professionals whose talents will be in very high demand. As with so many technology transformations, the challenges are often more human than technical.

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