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## Article

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AT A GLANCE

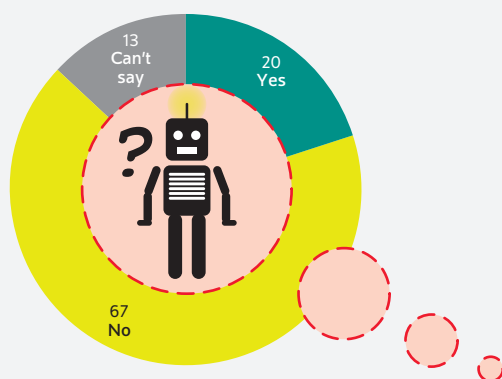
## Artificial intelligence in Germany: employees often unaware they are working with AI-based systems

By Oliver Giering, Alexandra Fedorets, Jule Adriaans, and Stefan Kirchner

- Images of futuristic robots strongly influence public perception of AI, making it so employees are often unaware they are already working with AI-based systems
- When asked if they work with AI, around 20 percent of employees say yes. When asked indirectly about specific systems, around 40 percent say yes
- Human/AI collaboration potential: some tasks are completed with as well as without the assistance of AI-based systems
- Potential human/AI collaboration should be included in the debate about job displacement by AI
- To make the use of AI more transparent and to teach the necessary skills, comprehensive further education for understanding and handling AI is needed

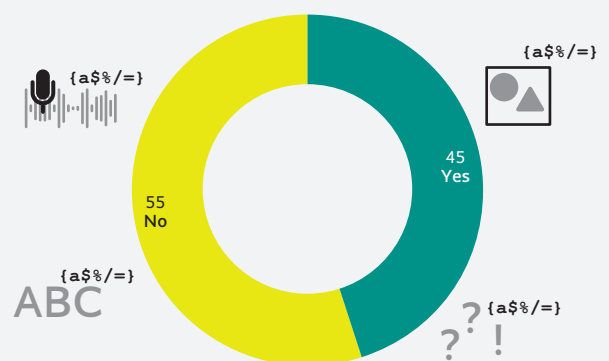
### The power of futuristic ideas: many employees do not know they already work with AI-based systems

Direct measurement:  
"Do you use AI at your workplace?"



Source: SOEP-IS 2019.

Indirect measurement:  
"Do you use digital systems for speech, text, or image recognition or for answering specialized questions?"



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### FROM THE AUTHORS

"The phrase artificial intelligence often makes people think of futuristic robots. Therefore, many people are not aware that AI-based systems are already an everyday part of their work. With a realistic view of AI, many employees could benefit from improved collaboration with digital systems."

— Oliver Giering —

### MEDIA



Audio Interview with A. Fedorets (in German)  
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# Artificial intelligence in Germany: employees often unaware they are working with AI-based systems

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## ABSTRACT

Using a new SOEP-IS data module on digitalization including information on the prevalence of AI use in the workplace, this report shows that the term “artificial intelligence” often remains inscrutable in the day-to-day work of many employees. When asked directly about the use of digital systems with the term “artificial intelligence,” around 20 percent of the working respondents in the sample indicate that they use such systems. When asked indirectly—without using the term AI—almost double the share of respondents indicate that they use at least one of these digital systems on a daily basis. Thus, many employees are already working with AI-based systems without knowing it. This suggests that the current debate about job displacement due to AI (substitution) needs to be expanded to include perspectives on collaboration between humans and machines. As of 2021, many employees still complete certain tasks themselves but also receive assistance from AI-based systems. Training should be offered for the workforce to gain knowledge about AI and strengthen their AI-related skills. With these measures, as many people as possible can shape technological progress in Germany and thus benefit from it.

Artificial intelligence (AI) is often described as a key technology that is significantly influencing the digitalization of the working world and employees’<sup>1</sup> day-to-day life. However, the debates about AI are not limited to the scientific field; they are also present in the public sphere.<sup>2</sup> As a result, “AI” has become a common, everyday term. The debates are dominated by the question of to what extent AI will take over tasks or even replace entire occupations, thus displacing jobs,<sup>3</sup> or, in contrast, to what extent it will create new productivity potentials and jobs, thereby improving the competitiveness of the German economy.<sup>4</sup> Although digitalization and the use of AI are important, topical subjects and far-reaching consequences for the labor market and many occupational profiles are discussed,<sup>5</sup> empirically validated findings on the current consequences of the technological development fall short of the expectations of the debates. This is for various reasons, such as the focus on broad theses or predictions, the ambiguous definition of AI, and the operationalization and embedding of AI, which has limited research overall thus far.<sup>6</sup> The public discourse on AI is shaped by futuristic images of human-like robots performing everyday work without any prerequisites and with significant influence on the work quality. Empirically, however, AI has been

<sup>1</sup> In this context, employee refers to both salaried employees and the self-employed.

<sup>2</sup> Sarah Fischer and Cornelius Puschmann, *Wie Deutschland über Algorithmen schreibt. Eine Analyse des Mediendiskurses über Algorithmen und Künstliche Intelligenz (2005–2020)*. (Gütersloh: 2021) (in German); Erik Brynjolfsson and Andrew McAfee, *The second machine age: Work, progress, and prosperity in a time of brilliant technologies* (New York: 2014).

<sup>3</sup> David Autor and Anna Salomons, “Is Automation Labor Share—Displacing? Productivity Growth, Employment, and the Labor Share,” *Brookings Papers on Economic Activity* (2018): 1–63; Katharina Dengler and Britta Matthes, “The impacts of digital transformation on the labour market: Substitution potentials of occupations in Germany,” *Technological Forecasting and Social Change* 137, no. 1 (2018): 304–316.

<sup>4</sup> McKinsey, *Smartening up with Artificial Intelligence (AI)—What’s in it for Germany and its Industrial Sector?* (New York: 2017) (available online). Accessed on November 25, 2021. This applies to all other online sources in this report unless indicated otherwise; PricewaterhouseCoopers GmbH Wirtschaftsprüfungsgesellschaft, *Künstliche Intelligenz in Unternehmen. Eine Befragung von 500 Entscheidern deutscher Unternehmen zum Status quo – mit Bewertungen und Handlungsoptionen von PwC* (Frankfurt am Main: 2019) (in German; available online).

<sup>5</sup> Initiative Intelligente Vernetzung, *Künstliche Intelligenz – Impulse zu einem Megatrend* (Berlin: 2019) (in German); Christian Kellermann and Alexander Petring, “Künstliche Intelligenz und Arbeit: Gesellschaftliche Dimensionen einer Technikfolgenabschätzung,” *WISO Direkt* 2019, n. 18 (2019): 1–4 (in German).

<sup>6</sup> Oliver Giering, “Künstliche Intelligenz und Arbeit: Betrachtungen zwischen Prognose und betrieblicher Realität,” *Zeitschrift für Arbeitswissenschaft* (2021) (in German; available online).

## Box

**Data and digitalization research project**

The calculations in this Weekly Report use the SOEP Innovation Sample (SOEP-IS), a representative panel survey that supplements the main SOEP survey using innovative survey and experimental modules.<sup>1</sup>

The authors of this Weekly Report conceived an innovative data module on the topic of digitalization, which was added to the SOEP-IS survey in 2019 following an expert evaluation.<sup>2</sup> The survey was conducted among employed persons in a random sample. The small sample size (N = 785) is also the main limitation for the present analyses, which are intended to serve as an initial indicator of the prevalence of AI as a technology in everyday work. A further limitation involves the broad formulation of the tasks (recognition and processing speech, images, texts, or answering technical questions), which can include applications with varying degrees of potential for digitalization.

The module contains a series of questions on digitalization, especially on the prevalence of AI, the use of digital technologies and corresponding equipment in the workplace, and the spread of the platform economy.<sup>3</sup> This module was also included in the SOEP 2020 survey in a somewhat abbreviated form and will be available for research purposes with the next data release. It includes around 15,000 respondents.

This Weekly Report is a part of the "Employment Risks and Quality of Work during Digital Transformation: Empirical Analyses on AI, Platform Work, and Digitalized Workplace using the SOEP" project by the Federal Ministry of Labor and Social Affairs,<sup>4</sup> a collaboration between the German Institute for Economic Research and the Technical University Berlin.

<sup>1</sup> David Richter and Jürgen Schupp, "The SOEP Innovation Sample (SOEP-IS)," *Schmollers Jahrbuch: Journal of Applied Social Science Studies/Zeitschrift für Wirtschafts- und Sozialwissenschaften* 135, no. 3 (2015): 389–400.

<sup>2</sup> See the information on the dataset on the SOEP website.

<sup>3</sup> Carsten Schröder et al., "The economic potentials of the German Socio-Economic Panel Study," *German Economic Review* 21, no. 3 (2020): 335–371.

<sup>4</sup> German title: "Beschäftigungsrisiken und Arbeitsqualität in der digitalen Transformation: Empirische Analysen zu KI, Plattformarbeit und digitalen Arbeitsplätzen mit dem SOEP". The project's grant number is DK1.00.00014.20.

shown to have only a superficial influence on work quality. Furthermore, correlations between certain digital work tools and professional positions can be found, which is crucial for the use as well as the impact of AI.<sup>7</sup>

Although these futuristic images of autonomous, near-human robots do not exist even in technologically advanced environments, they dominate the public perception of AI. In light of these influential narratives, we must question to what extent the use of new technologies can be reliably measured. Using a data module on digitalization that is part of the SOEP Innovation Sample (SOEP-IS), this report illustrates the issue and compares the respondents' directly reported use of AI at the workplace with their indirectly measured actual use (Box). In doing so, the indirect measurement of AI use relies on the functionalities that AI-based systems currently provide.

**AI: a common yet ambiguous term**

There is still no comprehensive or standardized definition of AI, even in the scientific community. AI is a field in computer science whose core idea is that machines should be enabled to perform certain tasks in an intelligent manner. However, the term AI does not clarify which technologies are

meant or what intelligence means in this context.<sup>8</sup> For example, AI includes automated searching, sorting, learning, and decision-making.<sup>9</sup> In some areas, even a simple automated query is considered AI, whereas in others the requirements for AI are much higher.

Therefore, a conceptual distinction is made between strong and weak AI. Strong AI describes a machine that has its own consciousness and is superior to humans in every way. As of 2021, strong AI remains an unrealistic, futuristic vision.<sup>10</sup> Thus, without exception, existing AI technologies can be described as weak AI, computer-controlled systems that imitate certain human abilities and complete individual tasks.<sup>11</sup> Here, it is important to understand that weak AI can only imitate human actions, as it lacks human characteristics such as creativity, spontaneity, or emotional intelligence. Thus, AI achieves similar goals but uses fundamentally different

<sup>7</sup> Oliver Giering and Stefan Kirchner, "Künstliche Intelligenz am Arbeitsplatz. Forschungsstand, Konzepte und empirische Zusammenhänge zu Autonomie," *Soziale Welt* (forthcoming, 2021) (in German).

<sup>8</sup> Inga Döbel et al., *Maschinelles Lernen. Eine Analyse zu Kompetenzen, Forschung und Anwendung* (Munich: 2018) (in German).

<sup>9</sup> Stuart J. Russel and Peter Norvig, *Künstliche Intelligenz: ein moderner Ansatz* (Munich: 2012) (in German).

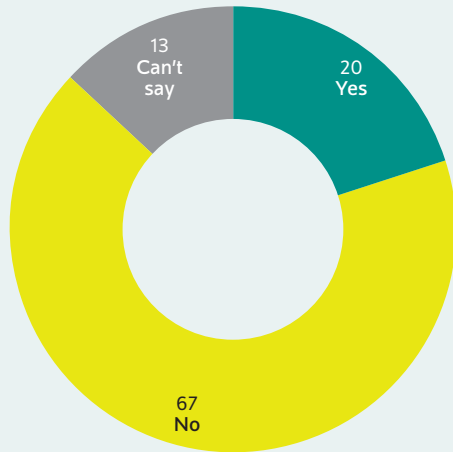
<sup>10</sup> Bundesverband Informationswirtschaft, Telekommunikation und neue Medien & Deutsches Forschungszentrum für Künstliche Intelligenz, *Künstliche Intelligenz. Wirtschaftliche Bedeutung, gesellschaftliche Herausforderungen, menschliche Verantwortung* (Berlin and Kaiserslautern: 2017) (in German; available online).

<sup>11</sup> German Federal Government, *Strategie Künstliche Intelligenz der Bundesregierung* (Berlin: 2018) (in German; available online).

Figure 1

**Direct measurement: Employees who indicate they regularly use AI-based systems**

Share in percent



Note: Numbers are weighted.

Source: SOEP-IS 2019.

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When asked directly about artificial intelligence, only 20 percent of employees indicated that they regularly use AI-based applications at work.

methods of sensing and processing.<sup>12</sup> Machine learning (ML) is a subfield of AI that is particularly significant at present. ML involves computer programs that are able to learn by processing large amounts of data and gradually improve their performance through training. ML technologies are already used for tasks such as automatic language, image, or text processing as well as in medical diagnostics.<sup>13</sup> However, access to a large amount of existing data is necessary to make this learning process possible.<sup>14</sup> Some simple applications of machine learning, such as personalized advertisements, automated posting of incoming and outgoing payments, or automated responses to inquiries/complaints, are already widely used, although advanced applications remain the exception.<sup>15</sup> Thus, the existing AI-based applications in everyday work are found in automated algorithms or integrated software functions, for example in the use of search, email, or translation services, which are not necessarily recognized by users as AI-based systems.<sup>16</sup>

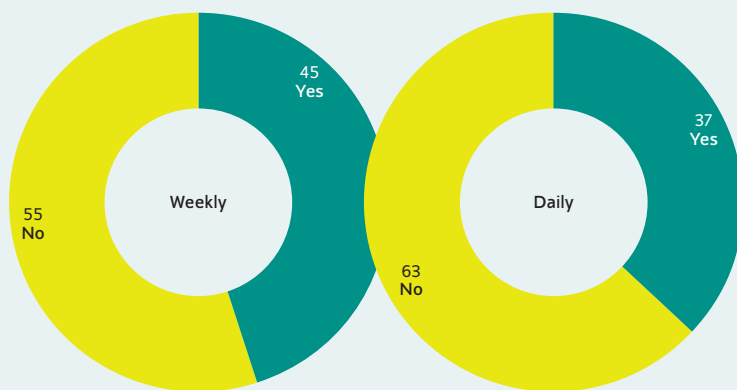
**Employees' subjective perception of the use of AI differs from its actual prevalence**

The major difference between the public's futuristic perception of AI and its actual existing applications makes it difficult to survey the use of AI-based systems. With regard to surveys of employed and self-employed persons, it is also important to note that many do not know in detail which technologies are included in the technical devices and software applications they use.

Figure 2

**Indirect measurement: Employees who regularly complete tasks with assistance from AI-based systems**

Share in percent



Note: Numbers are weighted.

Source: SOEP-IS 2019.

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When not asked directly about artificial intelligence in general and instead asked indirectly about specific tasks that are completed with the assistance of digital systems, 45 percent of the respondents indicate that they use them at least once a week.

Using the new data module in SOEP-IS 2019, two approaches to capturing the use of AI-based systems can be compared: direct and indirect measurement. First, a direct question is asked: "Do you think that you work with digital systems at your workplace that use artificial intelligence or machine learning?" The majority of the respondents (67 percent) answered no. However, 20 percent did indicate they work with AI- or ML-based digital systems and 13 percent were not sure. These results could possibly indicate that many employees have a more extensive idea of AI, thus making their response behavior more reserved (Figure 1).

Next, an indirect question is posed, focusing on implicit use of AI by asking about common ML technologies that automate certain activities. This indirect questioning intentionally does not use the term AI: "Some of these tasks are also being executed by digital systems. How often do you personally work with digital systems that ..."

<sup>12</sup> Norbert Huchler, "KI in der Arbeitswelt – und der Mensch?" ansätze – *ESG-Nachrichten* 1–3 (2020): 13–17 (in German).

<sup>13</sup> Initiative Intelligente Vernetzung, *Künstliche Intelligenz*.

<sup>14</sup> Inga Döbel et al., *Machinelles Lernen*.

<sup>15</sup> Bundesverband Informationswirtschaft, Telekommunikation und neue Medien, *Künstliche Intelligenz. Einsatz und Forschung in Deutschland* (Berlin: 2020) (in German; available online).

<sup>16</sup> Florian Butollo, "Automatisierungsdividende und gesellschaftliche Teilhabe," *Regierungsforschung.de – Wissenschaftliches Online-Magazin der NRW School of Governance* (2017): 3–8 (in German).

- Recognize and process language or language commands?
- Recognize and process pictures and photos?
- Recognize and process handwriting, texts, and numbers?
- Answer questions about specialized knowledge?\*

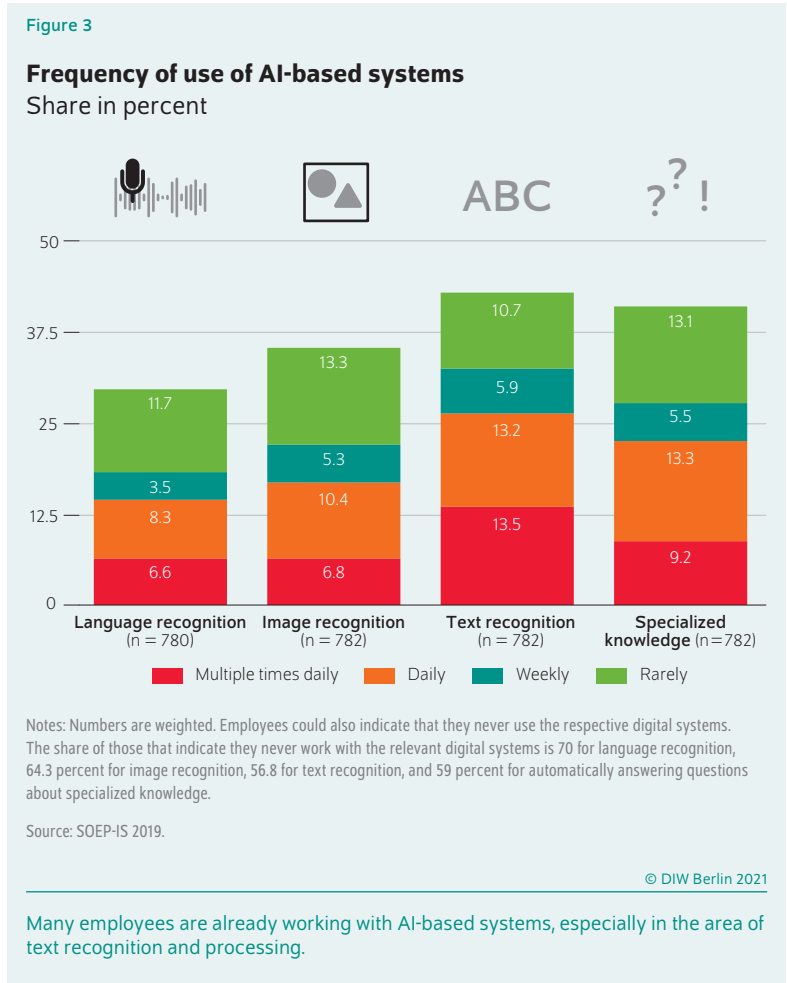
The results show that around 45 percent of the respondents use at least one of these four AI-based systems at least weekly while 55 percent use these digital systems less frequently or never. This means that as of 2021, almost half of employees are already working with AI-based digital systems to complete certain tasks at least once a week. When categorizing responses by daily use, it appears that about 37 percent of employees still use at least one AI-based system at least once daily. This indicates that these AI technologies are already present in the working world to a large extent (Figure 2).

Different AI-based systems are used with varying frequency. The AI-based system most frequently used is the type that automatically recognizes and processes text. Almost 27 percent of the respondents use such a digital system once or multiple times daily. The second most frequently used type, the digital expert system, answers questions automatically and is used by 22.5 percent of the respondents once or more daily. Digital image and photo recognition systems are the third most common, used by around 17 percent of respondents once or multiple times daily. Digital speech recognition systems are somewhat less widespread; only around 15 percent of the respondents use them at least once daily.

When comparing the results of the direct and indirect questions about the use of AI-based systems, it can be seen that in many cases, employees use them without perceiving them as AI technologies, which may be due their perception of the everyday nature of AI-based applications. Moreover, when integrated into software, AI technologies do not necessarily stand out as a separate component. This could also mean that the indirect question underestimates the true prevalence of AI technologies (Figure 3).

**Employees still completing tasks that AI-based systems could potentially complete automatically**

As relevant technologies are developed further, the prevalence of AI-based systems completing tasks will pick up speed. However, these tasks were previously completed by humans and as of 2021, there are numerous areas in which humans continue to perform the same tasks that AI-based systems are potentially capable of completing automatically. Thus, an additional question asks if employees perform tasks such as recognizing and processing language, visual material, and texts or answering technical questions. The question is: “Please think of your main professional occupation. Please tell me how often you perform one of the following tasks at work.” The answers show that humans still frequently complete tasks that AI-based systems are also potentially capable of completing (Figure 4). The most frequent



task is text recognition and processing; around 60 percent of the respondents indicate they perform this task once or multiple times daily. Similarly widespread is answering questions that require specialized knowledge: over half of the respondents do this once or multiple times daily. A little over 40 percent of the respondents indicate they recognize and process language and language commands once or multiple times daily as a part of their work. Around one third of the respondents perform image or photo recognition and processing once or multiple times daily.

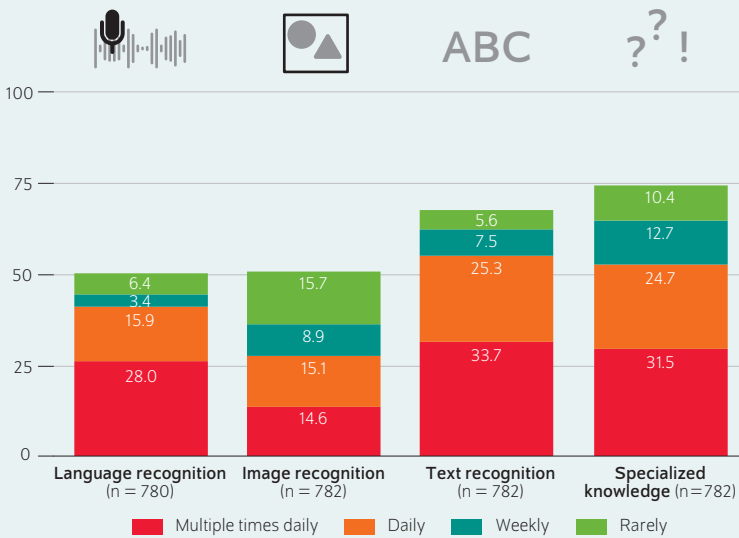
Comparing the evaluations of the prevalence of the use of AI-based systems (Figure 3) with the frequency with which people perform tasks without AI assistance (Figure 4) suggests that AI technologies are currently only partially used for tasks they are capable of. On the one hand, this can be explained by the prices of AI technologies, which do not make the relevant applications economically viable in every sector. On the other, it is likely that social, (labor) political, technical, legal, and ethical reasons will also ensure that work processes are not fully automatized. For example, the know-how and expertise of employees also play significant roles.<sup>17</sup>

<sup>17</sup> Hartmut Hirsch-Kreinsen, “Digitalisierung von Arbeit: Folgen, Grenzen und Perspektiven,” *Soziologisches Arbeitspapier*, no. 43 (2015) (in German); Norbert Huchler, “Grenzen der Digitalisierung von Arbeit – Die Nicht-Digitalisierbarkeit und Notwendigkeit impliziten Erfahrungswissens und informellen Handelns,” *Zeitschrift für Arbeitswissenschaft* 71, no. 4 (2017): 215–223 (in German).

Figure 4

**Shares of employees who complete tasks without technical assistance that could potentially be performed by AI-based systems**

In percent



Notes: Numbers are weighted. Employees could also indicate that they never complete the respective tasks themselves. The share of those who indicate that they never complete the respective task themselves is 46.3 percent for language recognition, 45.8 percent for image recognition, 28.0 percent for text recognition, and 20.7 percent for answering technical questions.

Source: SOEP-IS 2019.

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Humans continue to frequently complete tasks independently that could potentially be performed by AI-based systems.

**AI technologies offer the potential to complement human work**

As shown above, certain tasks are performed both by humans and computers. There are clear overlaps here, meaning that employees report completing certain tasks independently but also report working with AI-based systems that perform similar tasks automatically. For example, around 13 percent of the respondents engage in speech recognition and processing tasks at least once a day, both independently as well as with assistance from AI-based systems. Around 12 percent of the respondents perform image and photo recognition and processing tasks, both with and without assistance from AI-based systems. Furthermore, around 26 percent of the respondents perform text recognition and processing tasks and around 19 percent answer questions requiring specialized knowledge.

The results indicate that there are areas in which AI-based systems can complement humans in recognizing and processing speech, images, and texts or in answering questions that require specialized knowledge. It also shows that as of 2021, only a small share of employees exclusively uses AI-based systems to complete these tasks.

**Conclusion: collaborative perspective on AI needs to be strengthened and further training on transparency and use established**

Comparing the different lines of questioning on AI among employees shows clear differences. One difference involves comparing the direct and indirect questions regarding the use of AI-based systems. When asked indirectly about the use of common AI technologies without using the term AI, respondents indicate they use such technologies twice as much compared to when asked directly about AI.

The second difference involves the overlap of the use of AI-based systems for specific tasks and humans performing similar tasks independently. The evaluation shows that tasks that AI-based systems tend to also be able to complete are still more often completed by humans without computer assistance. At the same time, there are also areas in which employees complete tasks, such as language, image, and text recognition and processing or answering questions that require specialized knowledge, both with AI assistance as well as without.

The survey results indicate that AI-based systems are already used significantly more often than the employees realize. The reason for this is that the AI-based systems currently in use are far from the popular idea of futuristic, humanoid robots. Some of these systems are even used daily. At the same time, it must be noted that a large share of employees is already working with AI-based systems and is neither being displaced by the technology nor noticing a radical change in everyday work. Therefore, in addition to studies on job loss due to AI, more research on AI/human collaboration—that is, humans and machines working together at the workplace—is necessary.

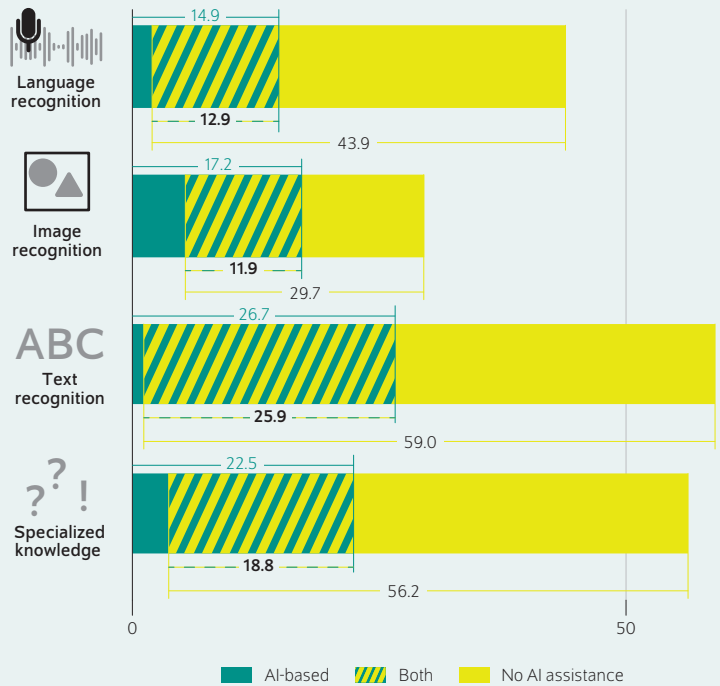
The use of AI technologies is further limited, as it is not always reasonable or profitable to use such technologies for all tasks they are capable of. Therefore, mere feasibility of a technological solution does not automatically imply its prevalence or impact. Nevertheless, it seems likely that AI-based systems will displace some jobs and change numerous other job descriptions in the future. At the same time, however, new jobs will be created. To ensure this balance is positive and that as much of the workforce as possible benefits from AI technologies, areas of successful AI/human collaboration should be investigated in more detail to more precisely identify future training needs.

The results of this report make it possible to draw initial conclusions on AI. First, the public idea of AI—for example, human-like robots—appears exaggerated and distorts the public’s perception of technological progress. Many people are already working with AI-based systems on a daily basis without recognizing them as such. Thus, AI in the workplace seems to be an opaque topic for many in practice. The use of AI technologies as software components may be much more extensive than employees realize and thus more

extensive than can be measured in this analysis. Limitations in the perception of the use of AI should be considered in the relevant surveys. Second, there are signs of potential for broader applications of AI, but these are limited by the feasibility of the purpose, labor policy, technological possibilities, and economic viability. Far too often in public discussions, it is not concretely described what AI means in practice. For the planned digitalization campaign by political decision makers to succeed, it is necessary to make AI and its uses transparent for employees. Continued education and training in the use of modern technologies are two methods of achieving this goal.

Figure 5

**Share of employees who regularly complete tasks independently as well as with AI-based system assistance**  
In percent



Note: Numbers are weighted.

Source: SOEP-IS 2019

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For some of the employees, tasks performed by AI-based systems and tasks that are still performed independently complement each other.

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## LEGAL AND EDITORIAL DETAILS

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