

[01] Bosch AI Future Compass: 60 percent of Germans would welcome greater use of artificial intelligence in industrial settings

[02] Bosch AI future compass 2020

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Bosch AI Future Compass: 60 percent of Germans would welcome greater use of artificial intelligence in industrial settings

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Clear majority: AI must always be kept under human control

- Survey of AI acceptance: narrow majority sees artificial intelligence as positive overall.
- More knowledge about AI leads to more willingness to accept it.
- Bosch: AI must serve people, not the other way around.
- Bosch CDO/CTO Dr. Michael Bolle: “AI must become a school subject”.

Stuttgart, Germany, November 10, 2020 – A clear majority of Germans (60 percent) would like to see AI used more in industry, in sectors such as automaking or aircraft-building. In addition, more than two-thirds of Germans would welcome the use of AI to diagnose machine faults and in high-tech areas such as space exploration.

These are some of the findings of the Bosch AI Future Compass, a survey that polled 1,000 Germans aged 18 and over about their attitude to artificial intelligence.

“Germany and Europe have what it takes to be world leaders in industrial AI,” said Dr. Michael Bolle, board of management member and Bosch CDO/CTO, at today’s digital presentation of the Bosch AI Future Compass. More specifically, he added, they have unique specialist and domain knowledge that allows them to use AI in areas such as quality control, energy efficiency, and improving manufacturing efficiency. In this respect, the relatively high level of acceptance for industrial AI revealed in the survey is encouraging: “For the future of Germany and Europe as an industrial location, it is enormously important to have the backing of the general public and of key institutions.”

Trust is essential: need for a clear ethical framework

The acceptance of AI use in other areas of application, such as nursing or investment advice, is significantly lower, at 40 percent and 31 percent respectively. And when it comes to making legal decisions or shortlisting candidates for vacancies, Germans are far more willing to trust a human being than a machine. Across all areas, 53 percent of Germans view the use of AI positively, while 36 percent are more negative.

“AI applications will only win the day if customers and users trust them,” Bolle said. This calls for clear, ethically sound guidelines – not only in Germany, but also at the European level. He added that Bosch already set itself a clear ethical framework at the beginning of this year, when it introduced a code of ethics for AI: “We have made it absolutely clear that AI must serve people, not the other way around. AI must always be kept under human control.”

For two-thirds of the survey participants, it is essential that artificial intelligence be used only in the service of the common good. Similarly, around two-thirds would like to see decisions on legal and ethical standards for the use of AI made multilaterally (38 percent see the need for global action, 27 percent for European action), while only 35 percent advocate a national strategy. Fully 85 percent of the respondents are adamant that people must have the final say wherever artificial intelligence is used.

Users must be able to understand AI decisions

According to the Bosch AI Future Compass, a majority of Germans (53 percent) think that artificial intelligence is vital for remaining competitive internationally. And 42 percent of those surveyed believe that artificial intelligence offers a better way of solving major problems such as disease or climate change.

Irrespective of their fundamental attitude toward AI, respondents largely agree on the opportunities and risks. The benefits most frequently mentioned include “efficiency,” “progress,” and “better (work) results,” while terms such as “surveillance,” “lack of compassion,” and “lack of data privacy” top the list of negatives.

“The Bosch AI Future Compass shows that we need to talk even more about artificial intelligence,” Bolle said, adding: “Customers and users must be able to understand the basis on which an AI makes certain decisions.” This is a discussion that needs to be conducted throughout society, he said, not just in business circles.

Bosch CDO/CTO Bolle: “Objective debate about opportunities and risks”

The Bosch AI Future Compass shows that more knowledge about AI leads to more willingness to accept it. Accordingly, those respondents who consider themselves tech-savvy and feel they have a sound knowledge of the field rate artificial intelligence as fundamentally positive in 81 percent of cases. But among those who consider themselves less technologically minded and state that they know little about AI, the acceptance rate is only 27 percent.

“Any debate about the opportunities and risks of AI, in whatever form, has to be open and objective,” Bolle said. To make this debate constructive and unprejudiced, people have to be given a better idea of how artificial intelligence works. “AI must be included in the school curriculum,” he said, “at least as a voluntary additional subject.”

Bosch is also taking the initiative: over the next two years, the company will make 20,000 associates ready for AI. By 2025, moreover, the aim is for all Bosch products to either contain AI or have been developed or manufactured with it. “This is not about using AI for its own sake, but instead about further increasing the quality and benefits of our solutions for customers and users,” Bolle said.

The Bosch AI Future Compass was prepared by the market researchers Gesellschaft für Innovative Marktforschung mbH (GIM).

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The Bosch Group is a leading global supplier of technology and services. It employs roughly 400,000 associates worldwide (as of December 31, 2019). The company generated sales of 77.7 billion euros in 2019. Its operations are divided into four business sectors: Mobility Solutions, Industrial Technology, Consumer Goods, and Energy and Building Technology. As a leading IoT provider, Bosch offers innovative solutions for smart homes, Industry 4.0, and connected mobility. Bosch is pursuing a vision of mobility that is sustainable, safe, and exciting. It uses its expertise in sensor technology, software, and services, as well as its own IoT cloud, to offer its customers connected, cross-domain solutions from a single source. The Bosch Group’s strategic objective is to facilitate connected living with products and solutions that either contain artificial intelligence (AI) or have been developed or manufactured with its help. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm. In short, Bosch creates technology that is “Invented for life.” The Bosch Group comprises Robert Bosch GmbH and its roughly 440 subsidiary and regional companies in 60 countries. Including sales and service partners, Bosch’s global manufacturing, engineering, and sales network covers nearly every country in the world. The basis for the company’s future growth is its innovative strength. Bosch employs some 72,600 associates in research and development at 126 locations across the globe, as well as roughly 30,000 software engineers.

The company was set up in Stuttgart in 1886 by Robert Bosch (1861–1942) as “Workshop for Precision Mechanics and Electrical Engineering.” The special ownership structure of Robert Bosch GmbH guarantees the entrepreneurial freedom of the Bosch Group, making it possible for the company to plan over the long term and to undertake significant upfront investments in the safeguarding of its future. Ninety-two percent of the share capital of Robert Bosch GmbH is held by Robert Bosch Stiftung GmbH, a charitable foundation. The majority of voting rights are held by Robert Bosch Industrietreuhand KG, an industrial trust. The entrepreneurial ownership functions are carried out by the trust. The remaining shares are held by the Bosch family and by Robert Bosch GmbH.

Additional information is available online at www.bosch.com, www.iot.bosch.com, www.bosch-press.com, www.twitter.com/BoschPresse.

Liu Ren,
chief scientist for intelligent
HMI technologies and
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Research and Technology
Center

Bosch AI Future Compass 2020

What does Germany think about the key
technology of tomorrow?



BOSCH
Technik fürs Leben

Foreword

Dr. Michael Bolle

Member of the board of management, Robert Bosch GmbH, chief digital officer, chief technology officer



Artificial intelligence (AI) is a key technology for Germany and Europe. It is set to develop into one of the main drivers of our economy and of our prosperity. Unlike at the established major IT providers from the United States or China, for example, the opportunities in Germany and Europe lie not in imitating human behavior with the help of AI, but instead in using AI to optimize interaction between machines and the world of objects. AI allows machines to understand their spatial and functional environments differently than before – and correspondingly lets them respond better. The possibilities include using AI to manufacture physical products and to optimize the way they work.

The European approach to AI is closely related to the internet of things. Companies such as Bosch are looking to use industrial AI to make everyday life safer and more convenient for all of us, improve technologies, and relieve the burden on people, not change them. Bosch AI

makes driving even safer, industrial production even more reliable, the energy management of buildings even more efficient, and homes even cozier.

The Bosch AI Future Compass delivers proof for the very first time that support of AI, especially industrial AI, is high in Germany. However, we also see that there are still many reservations about AI, some of them strong. This skepticism cannot be merely discounted as unreasonable by drawing parallels to the dystopian visions presented in movies. Like all technologies, AI has the potential to be misused. It is for that very reason that we need to understand at all times exactly how AI works and to place limits on its use. To do so, it is also necessary to discuss its benefits and drawbacks – publicly and on a sound factual basis.

Above all, we, the providers and users of AI, need to build trust by voicing our commitment to clear ethical red lines. In its AI code of ethics,

Bosch committed in early 2020 to making sure that Bosch AI is safe, robust, and explainable – and that humans must retain control over all AI-based decisions. We see the fact that 85 percent of Germans agree as clear confirmation of our strategy.

The Bosch AI Future Compass is designed to inspire people to intensively consider and discuss the impact of AI on our society. Now is the time to set the course for our technological future in Germany and Europe. To do so, we need to agree on the direction. I look forward to a lively discussion.

Michael Bolle

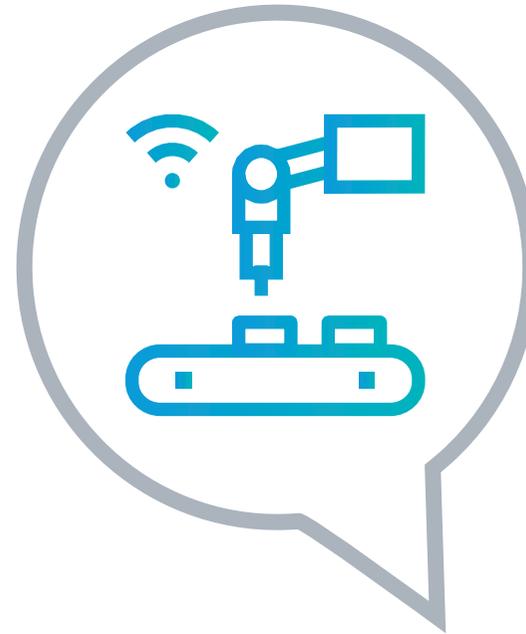
Clear support for industrial AI

Artificial intelligence describes a process in which machines learn to learn. Computer systems imitate human intelligence by simulating intelligent behavior on the basis of programmed or acquired patterns. An AI system is able to perceive its environment through technologies such as cameras and sensors. It uses this information to detect relationships and derive courses of action.

Industrial AI makes it easier for machines to interact with the physical world. It is mainly used in the manufacturing and operation of physical products. Examples include improved quality control in the industrial production of solu-

tions such as self-learning driver assistance systems for improving traffic safety, smart ovens, or efficient energy management in buildings.

According to the “Bosch AI Future Compass,” a majority of Germans would like to see more of this type of AI. As part of a representative survey, 1,000 people aged 18 and up in Germany were asked about their views on artificial intelligence. The findings of the survey, which took place in August 2020, are presented in this brochure.



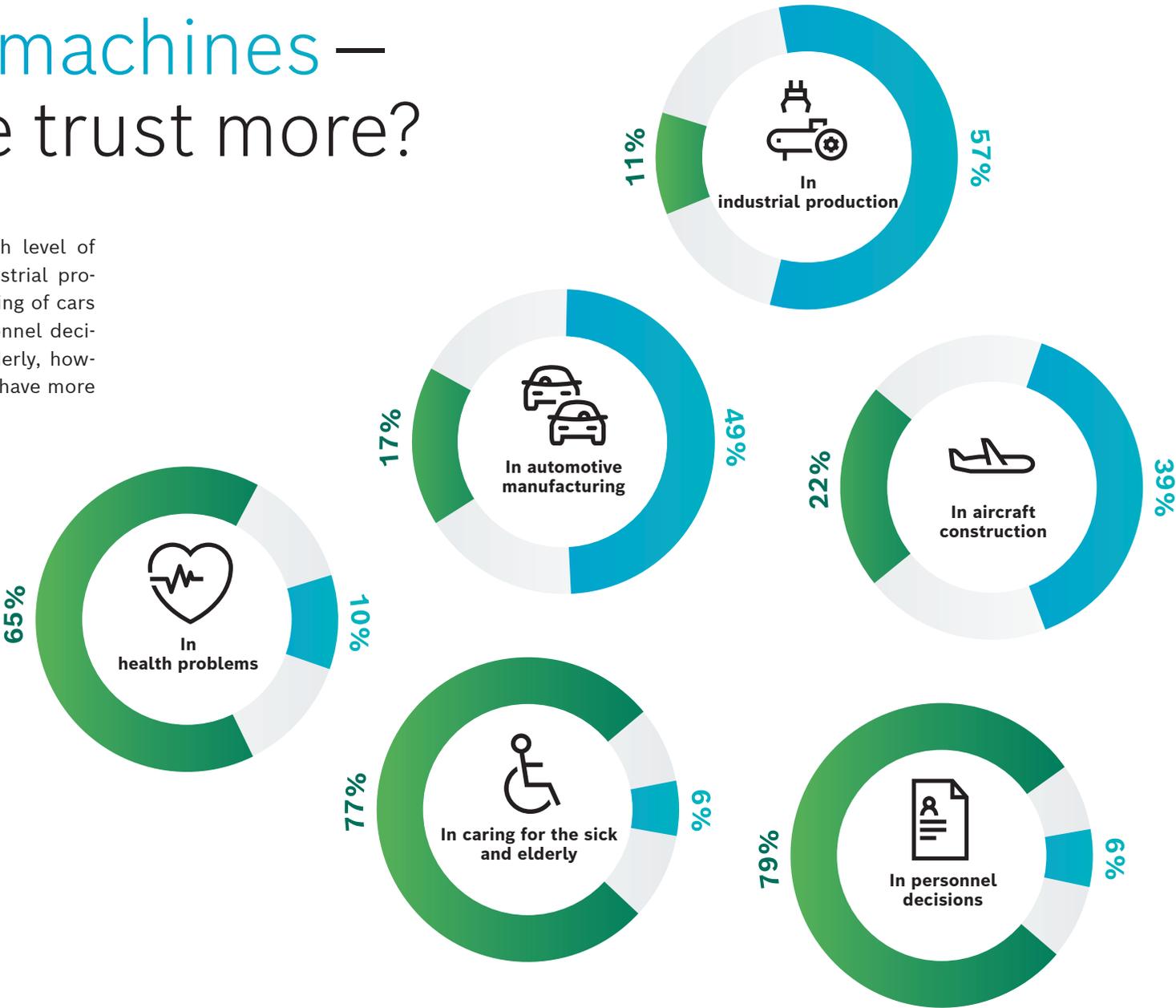
60%

A clear majority of Germans would like to see industrial AI used more often.

People or machines – who do we trust more?

Respondents have a particularly high level of trust in artificial intelligence in industrial production, especially in the manufacturing of cars and aircraft. When it comes to personnel decisions and caring for the sick and elderly, however, a large majority of respondents have more faith in people.

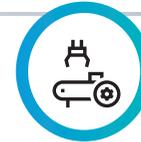
“ Question:
In the following situations, what do you trust more: people or artificial intelligence?



i Trust in different use cases:

- ▶ People
- ▶ Artificial intelligence

Where should AI be used?

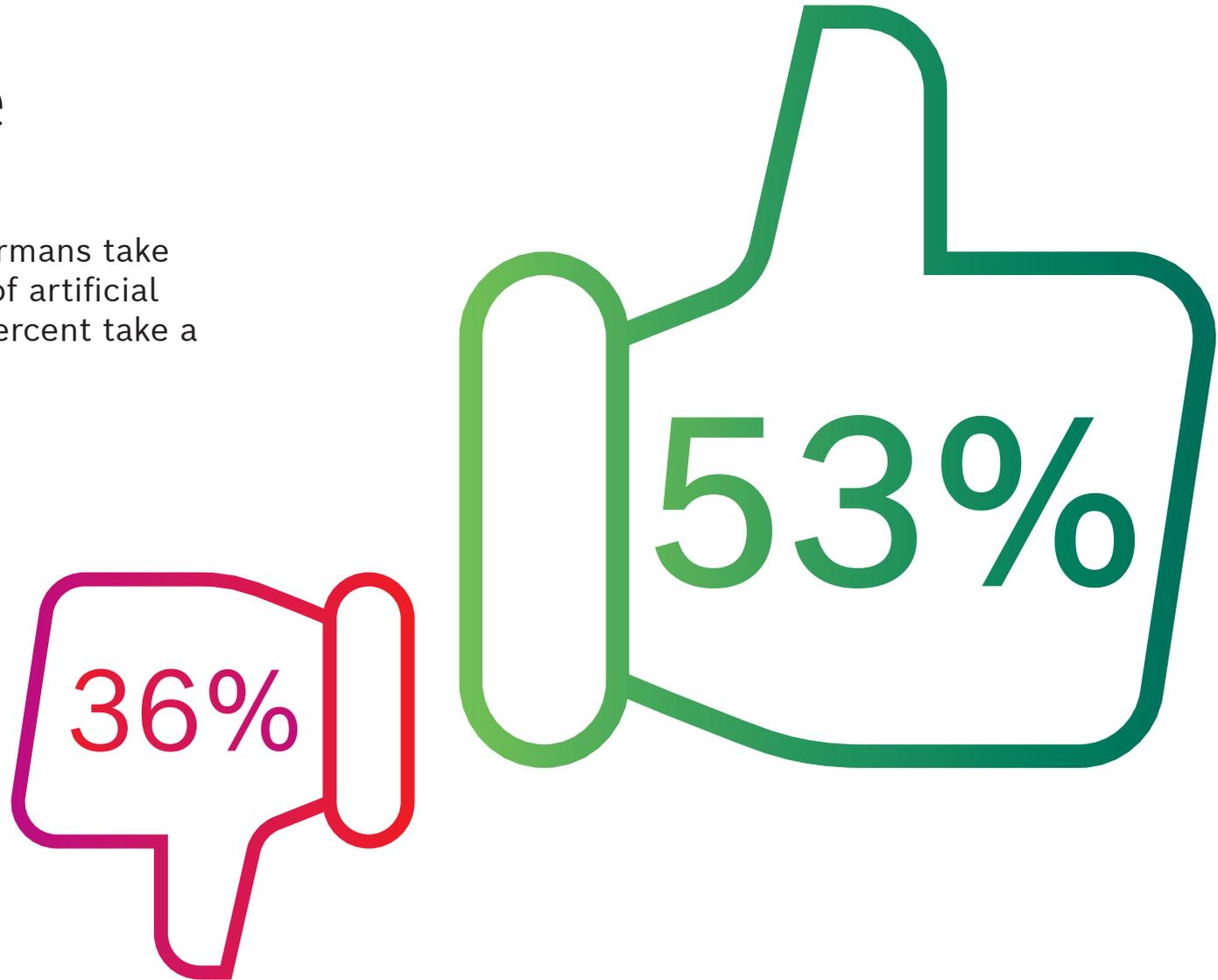


More than two-thirds of Germans are in favor of AI-based solutions, especially in diagnosing errors in machines, in the industrial production of goods and machines, and in aerospace and other high-tech industries. In other areas, such as nursing care or providing investment advice, approval rates for the use of AI is significantly lower, at 40 percent and 31 percent respectively.

“ Question:
In which of these situations would you personally like to see (more) use of artificial intelligence?

Majority for artificial intelligence

All in all, 53 percent of Germans take a positive view of the use of artificial intelligence, whereas 36 percent take a more negative view.

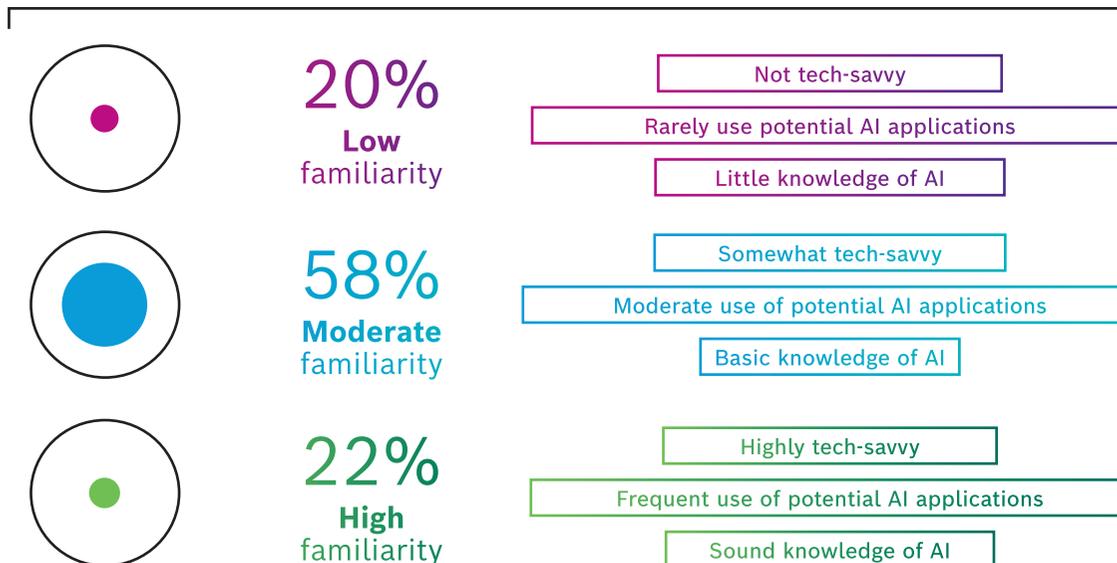


“ **Question:**
What kind of feeling do you get when you think of the term “artificial intelligence”?

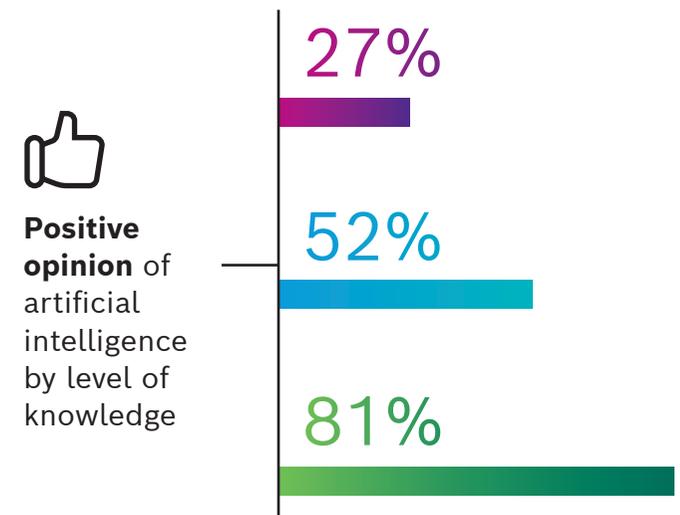
More information – more trust

People take a more positive view of using artificial intelligence the more knowledgeable and familiar they are with the technology.

Familiarity with artificial intelligence



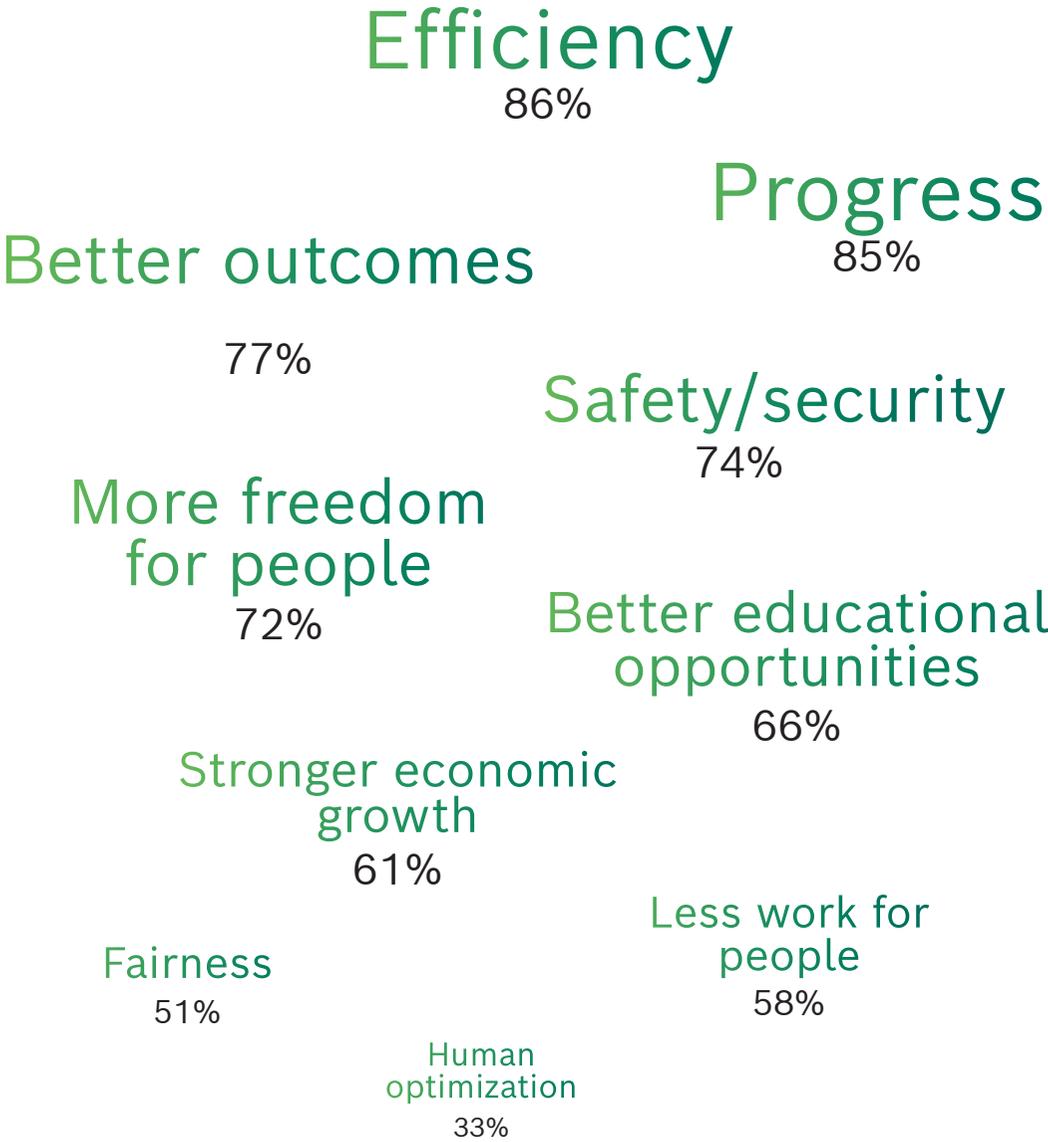
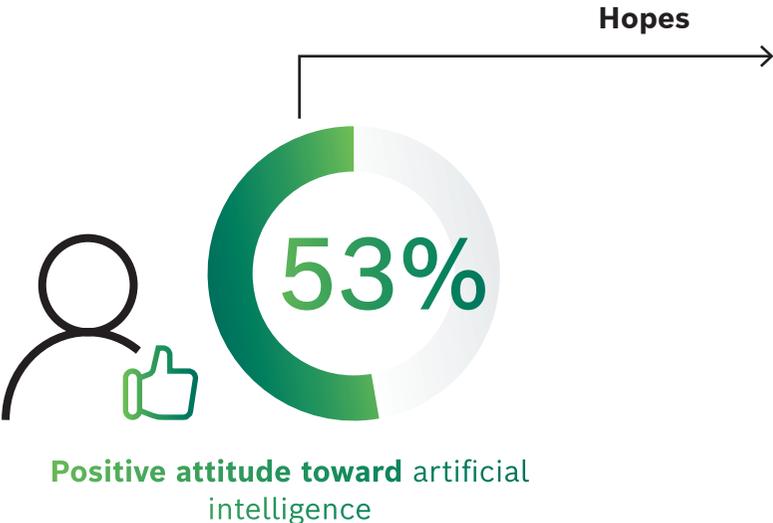
Of all respondents who describe themselves as tech-savvy and informed, 81 percent generally have a positive opinion of artificial intelligence. By contrast, that figure stands at 27 percent among those who consider themselves less interested in technology and less informed.



What is driving hopes?

More than four out of five respondents who have a positive opinion of artificial intelligence associate AI with progress and innovation. More than three-quarters of people hope it will result in more efficiency (86 percent) and better outcomes (77 percent). In addition, 74 percent expect AI to increase safety and security.

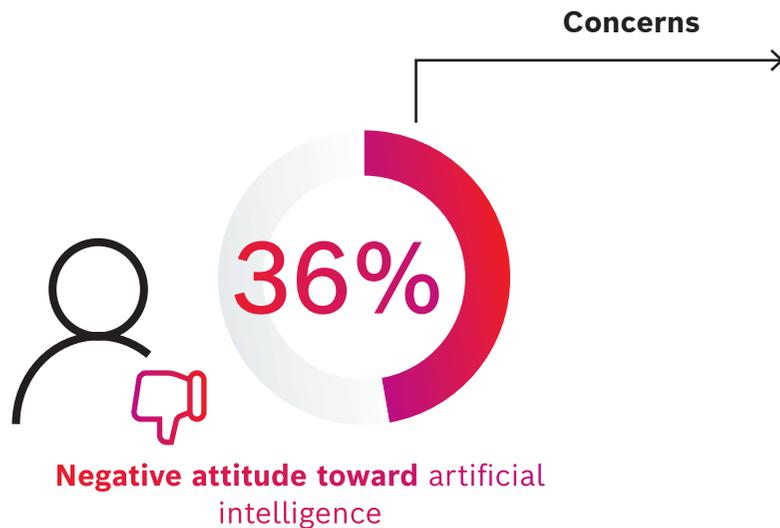
“ Question:
What are your specific hopes regarding the use of artificial intelligence?



Why are people skeptical?

Among those respondents with a negative opinion of AI, skepticism toward artificial intelligence is driven largely by concerns regarding potential surveillance, a lack of emotion, poor data protection, and loss of control (more than 80 percent each).

“ Question:
What are your specific concerns regarding the use of artificial intelligence?



Surveillance
82%

Lack of emotion
82%

Loss of control
81%

Poor data protection
81%

Unethical decisions
79%

Loss of safety/security
75%

Less work for people
61%

Weaker economic growth
25%



The Bosch multi-purpose camera takes automotive camera technology to a new level. Vehicles equipped with this camera can perceive their surroundings much more reliably – a key requirement for automated driving. The camera combines image-processing algorithms with AI methods.

Humans should retain control

Two-thirds of Germans say that artificial intelligence should only be used for the greater good. An overwhelming majority of Germans (85 percent) believe that people should always have the ability to correct the decisions made by artificial intelligence.

“ Question:
How far do you agree with the following statements?

68%

Artificial intelligence should only be used for the greater good.



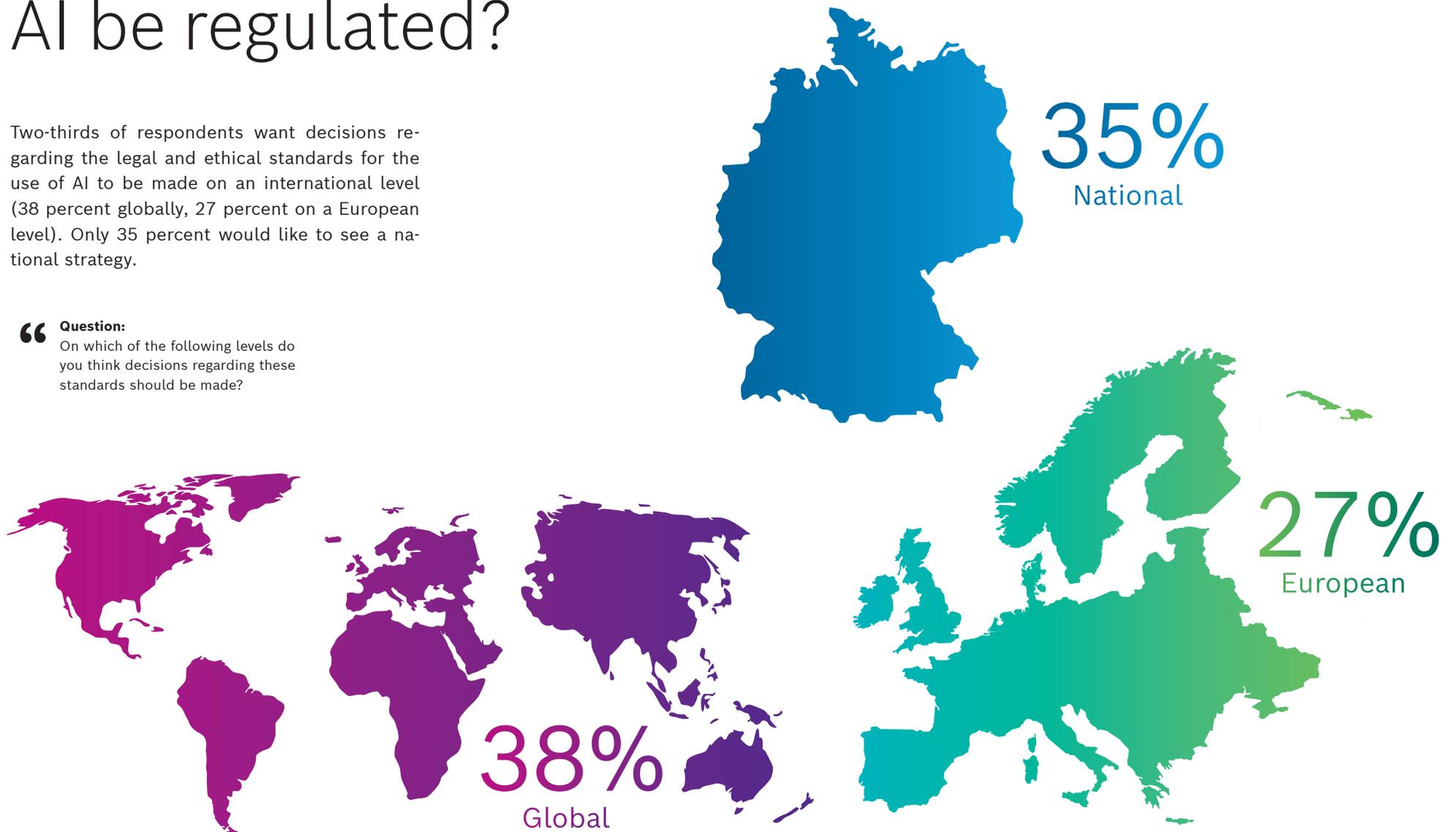
85%

People should always have the ability to correct the decisions made by artificial intelligence.

On what level should AI be regulated?

Two-thirds of respondents want decisions regarding the legal and ethical standards for the use of AI to be made on an international level (38 percent globally, 27 percent on a European level). Only 35 percent would like to see a national strategy.

“ Question:
On which of the following levels do you think decisions regarding these standards should be made?



Artificial intelligence as a competitive advantage

A majority of Germans (53 percent) thinks that the use of artificial intelligence is necessary for companies to remain competitive on the global stage.

“ Question:
How far do you agree with the following statement:
“Artificial intelligence is necessary for companies to remain competitive on the global stage.”

53%



Using AI to fight global pandemics

Of the respondents, 63 percent say that artificial intelligence should be used to predict and combat pandemics.

“ **Question:**
In which of these situations would you like to see (more) use of artificial intelligence?

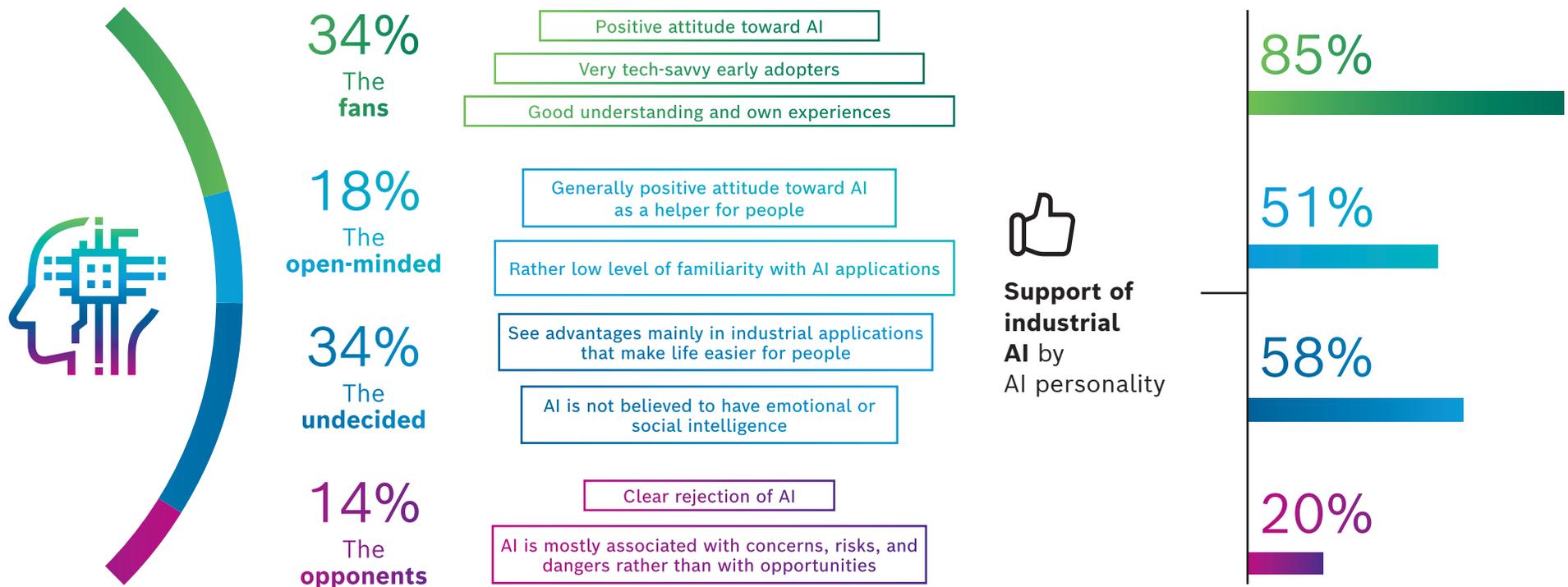
63%

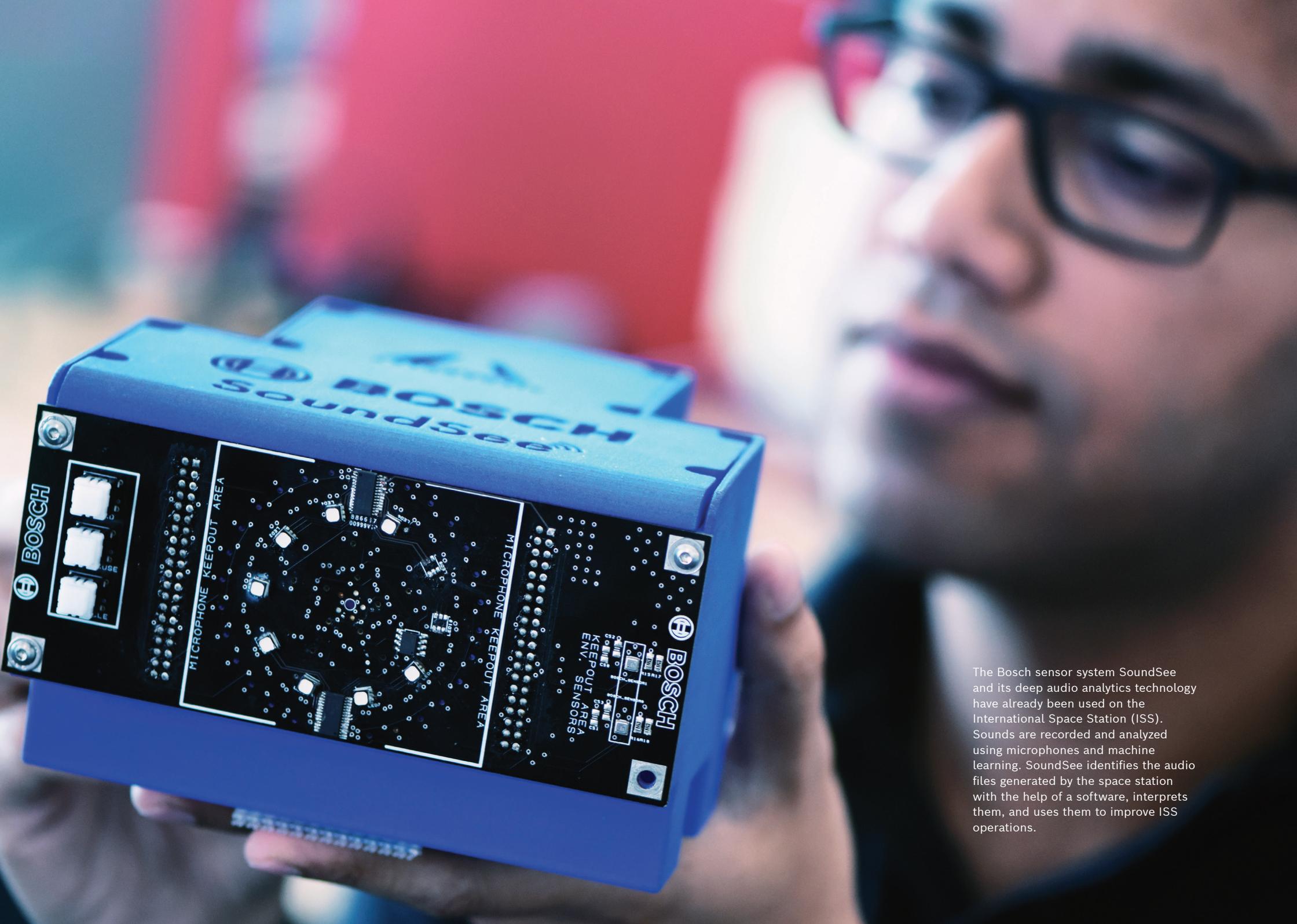
Artificial intelligence should be used in the fight against global pandemics in the future.



The four AI personalities and how they view industrial AI

Within the populace, there are four distinct groups that each take a different view of AI. Among the fans of artificial intelligence, 85 percent want to see stronger use of industrial AI. That figure stands at 58 percent for the undecided, and still reaches 51 percent for the open-minded. Among the opponents, only 20 percent support the use of industrial AI.

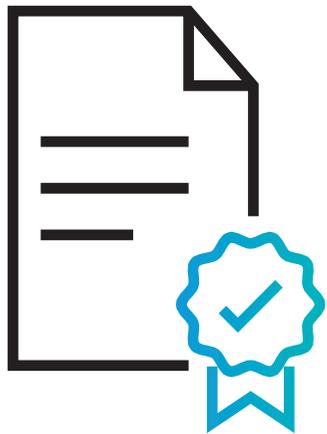




The Bosch sensor system SoundSee and its deep audio analytics technology have already been used on the International Space Station (ISS). Sounds are recorded and analyzed using microphones and machine learning. SoundSee identifies the audio files generated by the space station with the help of a software, interprets them, and uses them to improve ISS operations.

The Bosch AI code of ethics at a glance

In early 2020, Bosch developed a clear ethical framework: the AI code of ethics. According to the code, Bosch AI needs to serve people, and not the other way around. Humans must always retain control.



 Find out more about the Bosch AI code of ethics online:

1. All Bosch AI products should reflect our “**Invented for life**” ethos, which combines a quest for innovation with a sense of social responsibility.
2. AI decisions that affect people should not be made without a human arbiter. Instead, **AI should be a tool for people.**
3. We want to develop **safe, robust, and explainable AI products.**
4. Trust is one of our company’s fundamental values. We want to develop **trustworthy AI products.**
5. When developing AI products, we observe **legal requirements** and **orient to ethical principles.**

AI at Bosch: trust as a sign of quality

Artificial intelligence (AI) plays an increasingly important role for Bosch. By 2025, the aim is for all Bosch products to either contain AI or have been developed or manufactured with its help. The company wants its AI-based products and services to be safe, robust, and explainable, which is why Bosch has imposed ethical checks on artificial intelligence in its own AI code of ethics. At the heart of it is a simple goal: humans must retain control over all AI-based decisions. Artificial intelligence should serve people, not the other way around. The AI code of ethics provides Bosch associates with clear guidance regarding the development of intelligent products. The code of ethics is based on Bosch's "Invented for life" ethos, which combines a quest for innovation with a sense of social responsibility.

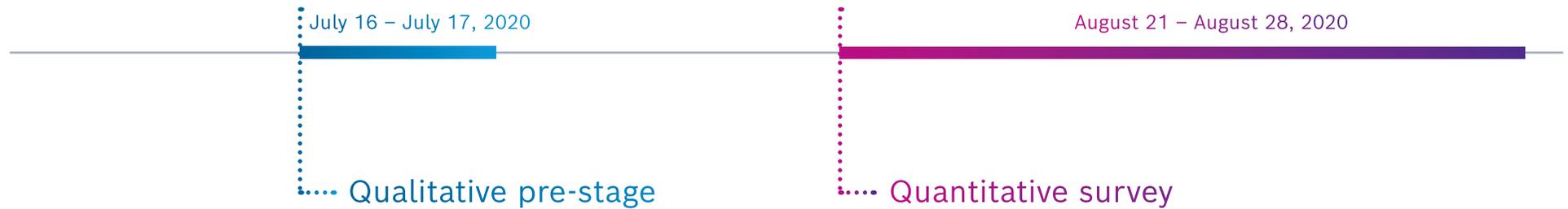
Over the next two years, Bosch also plans to train 20,000 of its associates in the use of AI. Bosch's AI code of ethics governing the responsible use of this technology will be part of this training program.

User acceptance will determine the extent to which AI is used. It will take more than just technical know-how to establish trust in intelligent systems – there is also a need for close dialogue among policymakers, the scientific community, and the general public. This is why Bosch has additionally signed up to the High-Level Expert Group on Artificial Intelligence, a body appointed by the European Commission to examine issues such as the ethical dimension of AI. In addition, Bosch established its own center of

competence for artificial intelligence, the Bosch Center for Artificial Intelligence, in 2017. The company plans to invest 300 million euros to expand the BCAI by 2021. In a global network currently comprising roughly seven locations, and in collaboration with the University of Amsterdam and Carnegie Mellon University (Pittsburgh, USA), Bosch is working to develop AI applications that are safer and more trustworthy. As a founding member of the Cyber Valley research alliance in Baden-Württemberg, Bosch is investing in the construction of an AI campus, where some 700 Bosch experts will soon be working side by side with external researchers and start-up associates.

Methods

For the Bosch AI Future Compass, Gesellschaft für Innovative Marktforschung mbH (GIM) performed a representative online survey of 1,000 Germans aged 18 and up in August 2020 on behalf of Robert Bosch GmbH.



Method	Focus group discussions	Representative online survey
Strata	Informed public (tech-savvy cross-section)	Age (18 and up), gender, region, employment status, marital status, level of educational attainment
Sample size	N=12 (3 groups of 4 participants each)	N=1,000
Survey length	2 hours	20 minutes

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