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 solutions 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.

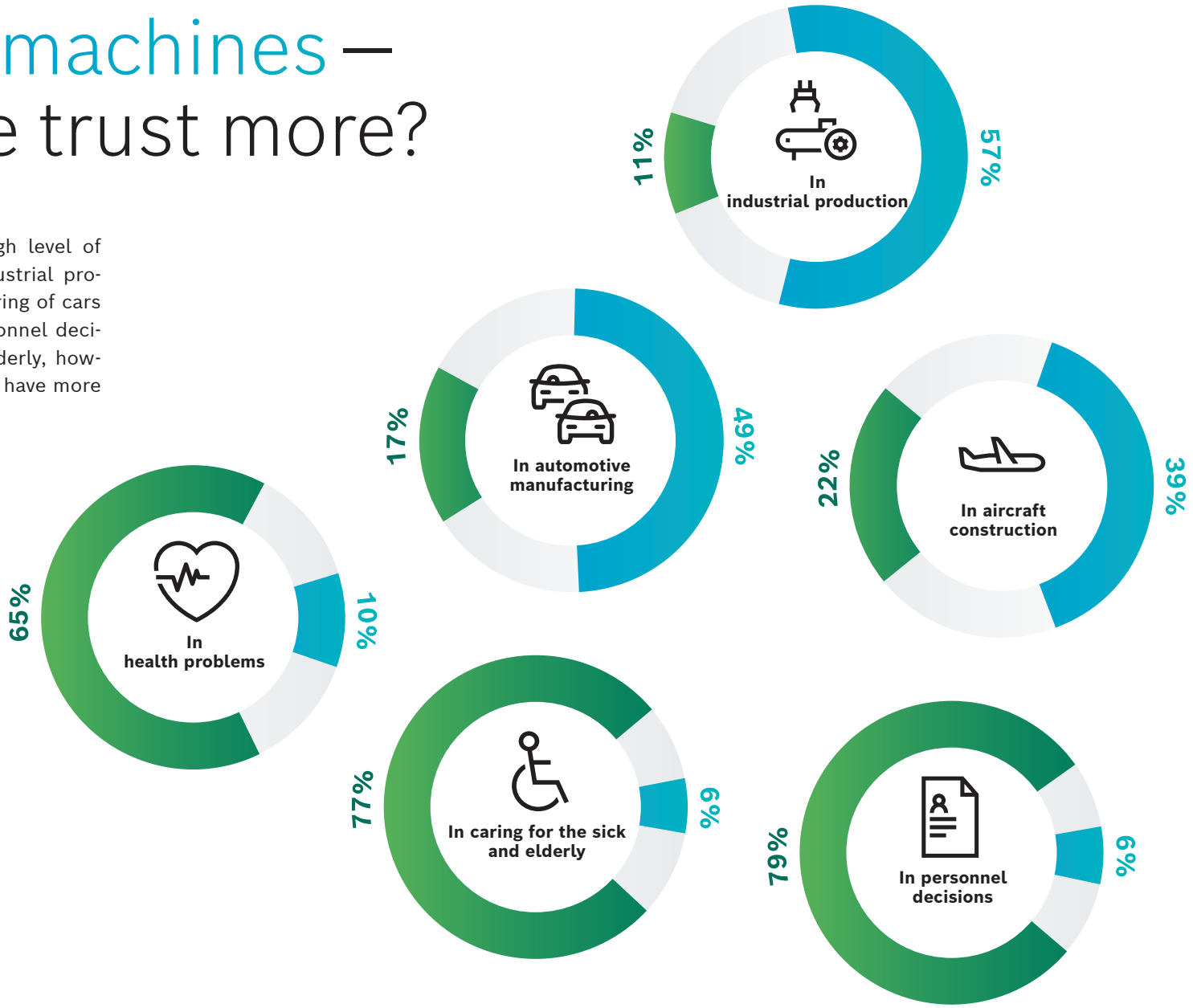
60%

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?

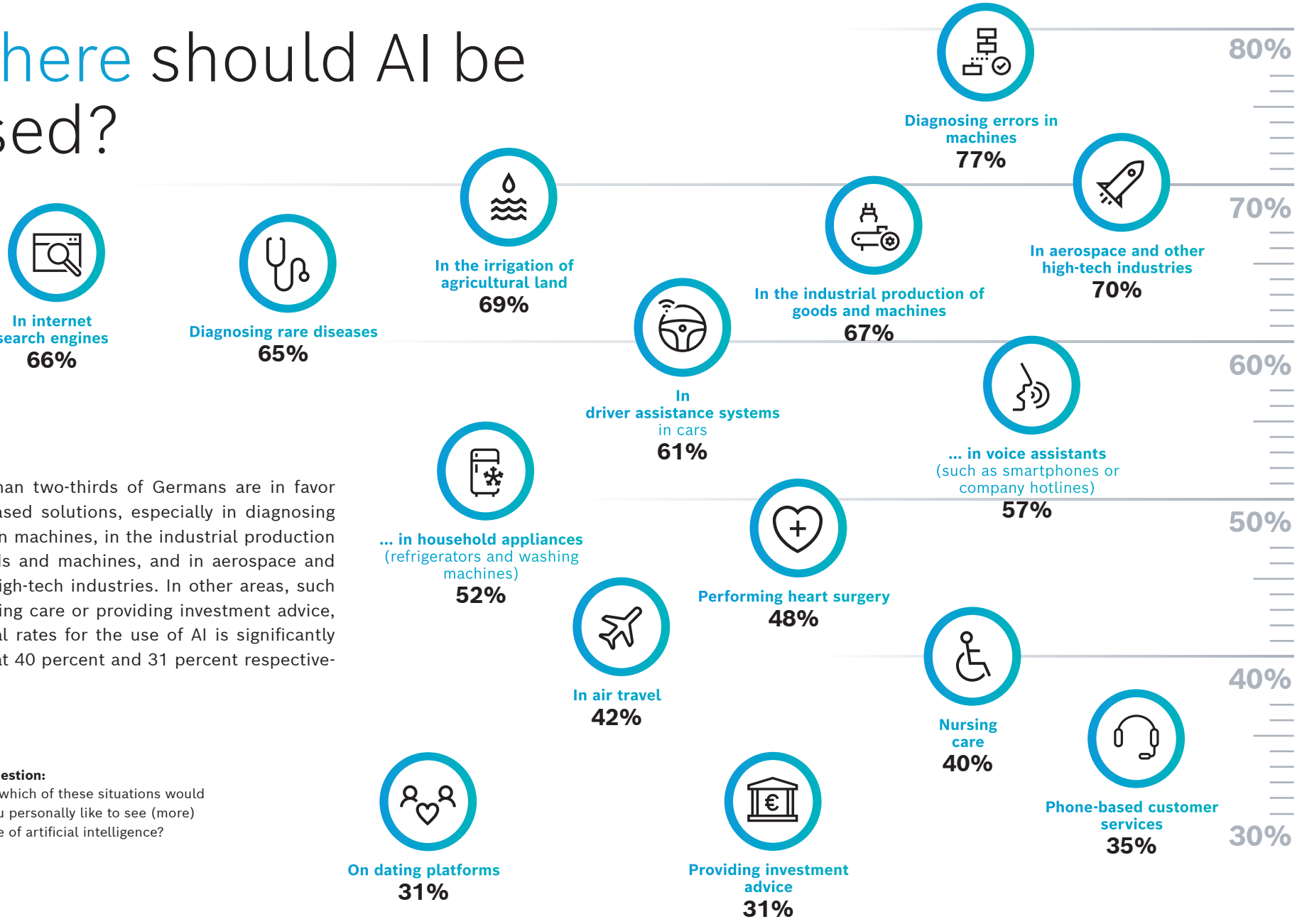


Trust in different use cases:

People

Artificial intelligence

Where should AI be used?

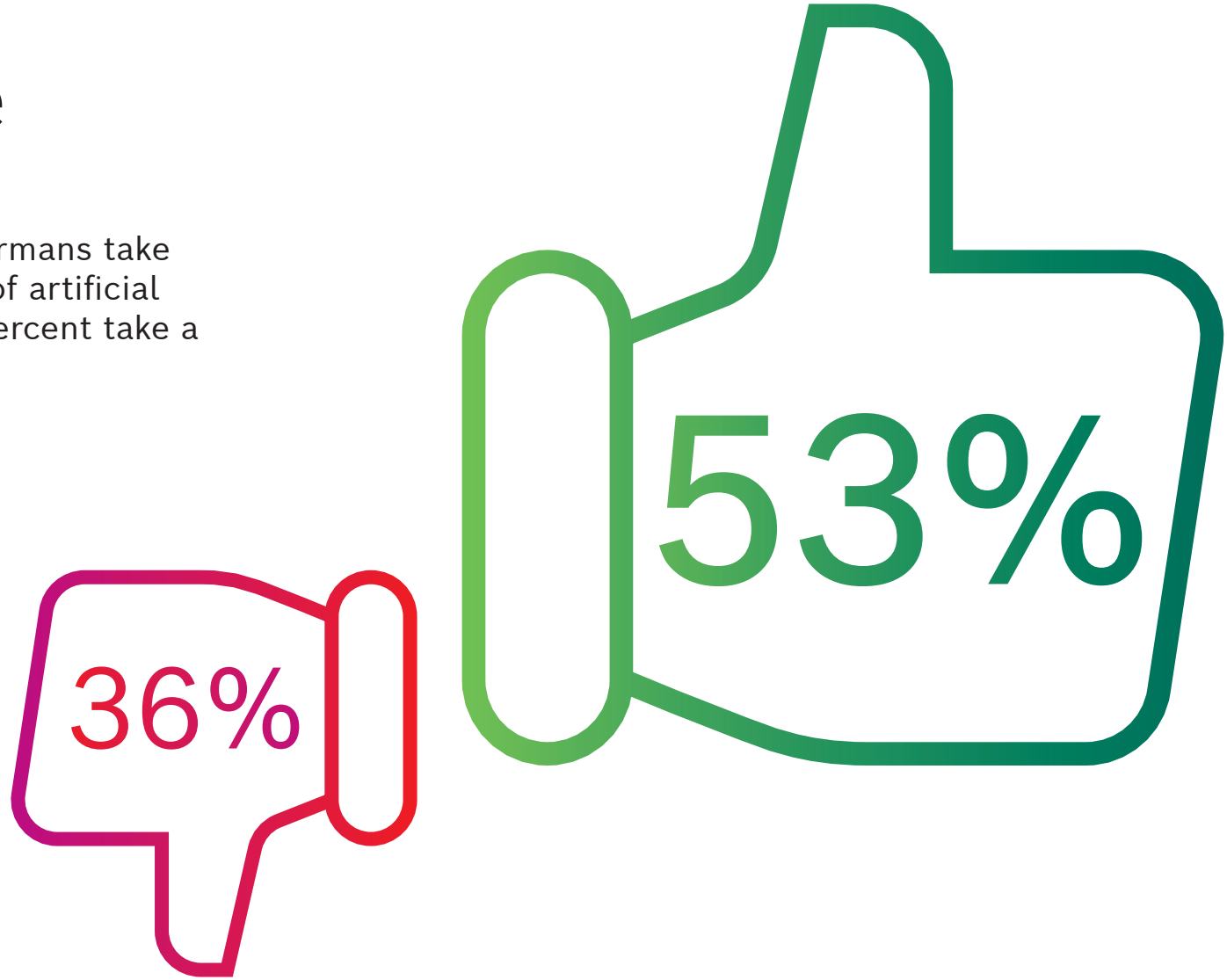


More than two-thirds of Germans are in favor of AI-based solutions, especially in diagnosing errors in machines, in the industrial production of goods and machines, and in aerospace and other high-tech industries. In other areas, such as nursing care or providing investment advice, approval rates for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



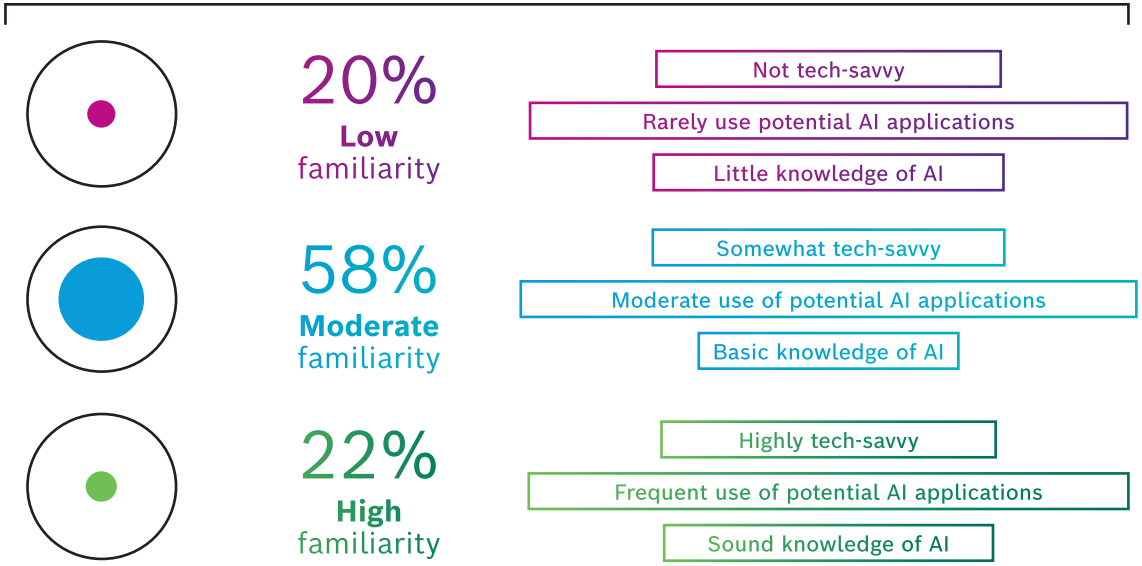
Question:
What kind of feeling do you get when you think of the term “artificial intelligence”?

More information – more trust

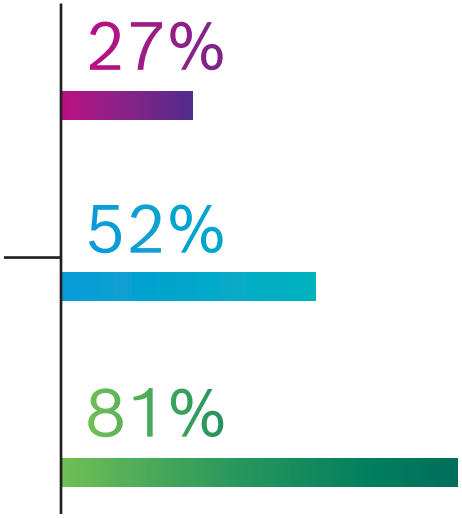
People take a more positive view of using artificial intelligence the more knowledgeable and familiar they are with the technology.

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.

Familiarity with artificial intelligence



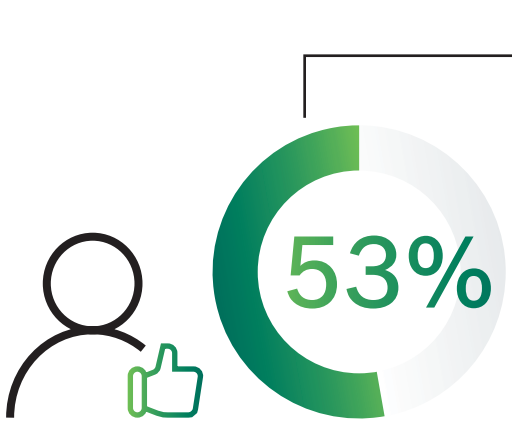
Positive opinion of artificial intelligence by level of knowledge



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?



Positive attitude toward artificial intelligence

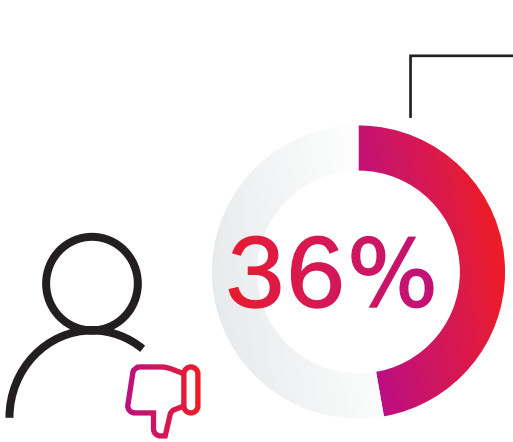
Hopes

- Efficiency 86%
- Progress 85%
- Better outcomes 77%
- Safety/security 74%
- More freedom for people 72%
- Better educational opportunities 66%
- Stronger economic growth 61%
- Less work for people 58%
- Fairness 51%
- Human optimization 33%

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?



Negative attitude toward artificial intelligence

Concerns

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%

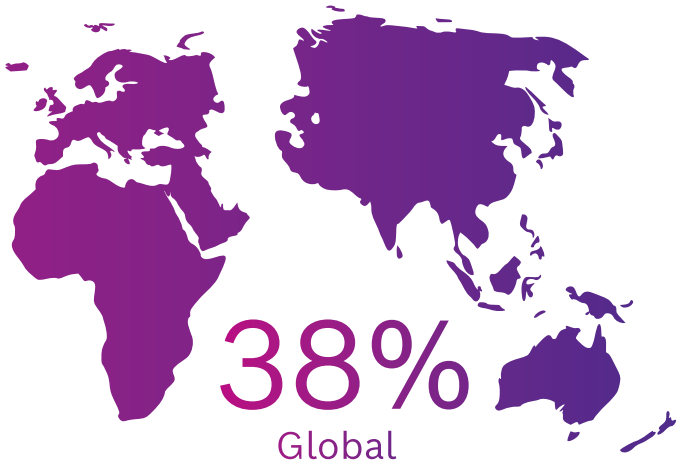
People should always have the ability to correct the decisions made by artificial intelligence.

On what level should AI be regulated?

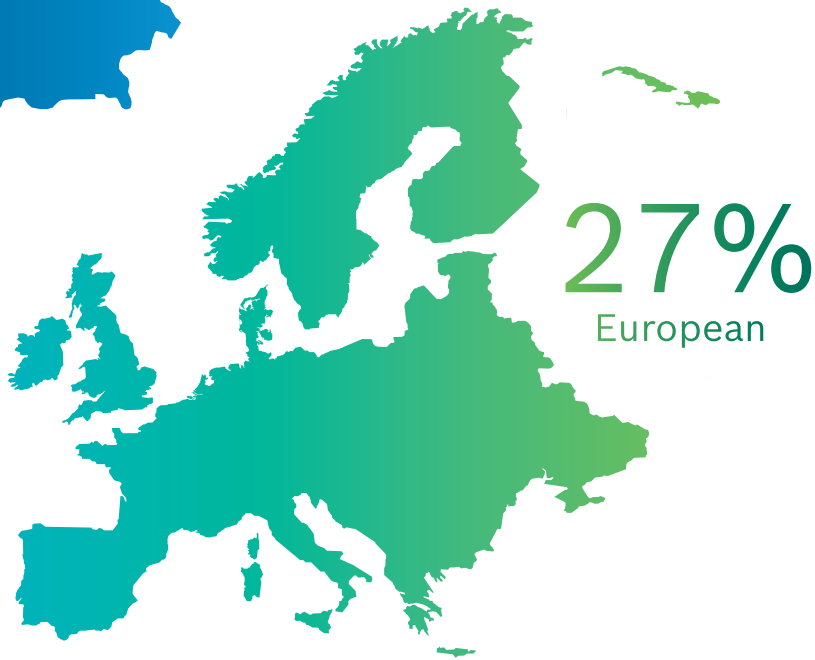
Two-thirds of respondents want decisions regarding the legal and ethical standards for the use of AI to be made on an international level (38 percent globally, 27 percent on a European level). Only 35 percent would like to see a national strategy.

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

35%
National



38%
Global



27%
European

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.

34% The **fans**

- Positive attitude toward AI
- Very tech-savvy early adopters
- Good understanding and own experiences

18% The **open-minded**

- Generally positive attitude toward AI as a helper for people
- Rather low level of familiarity with AI applications

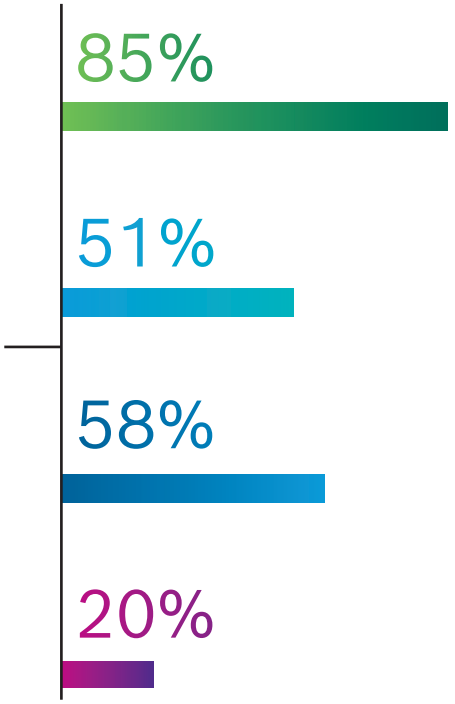
34% The **undecided**

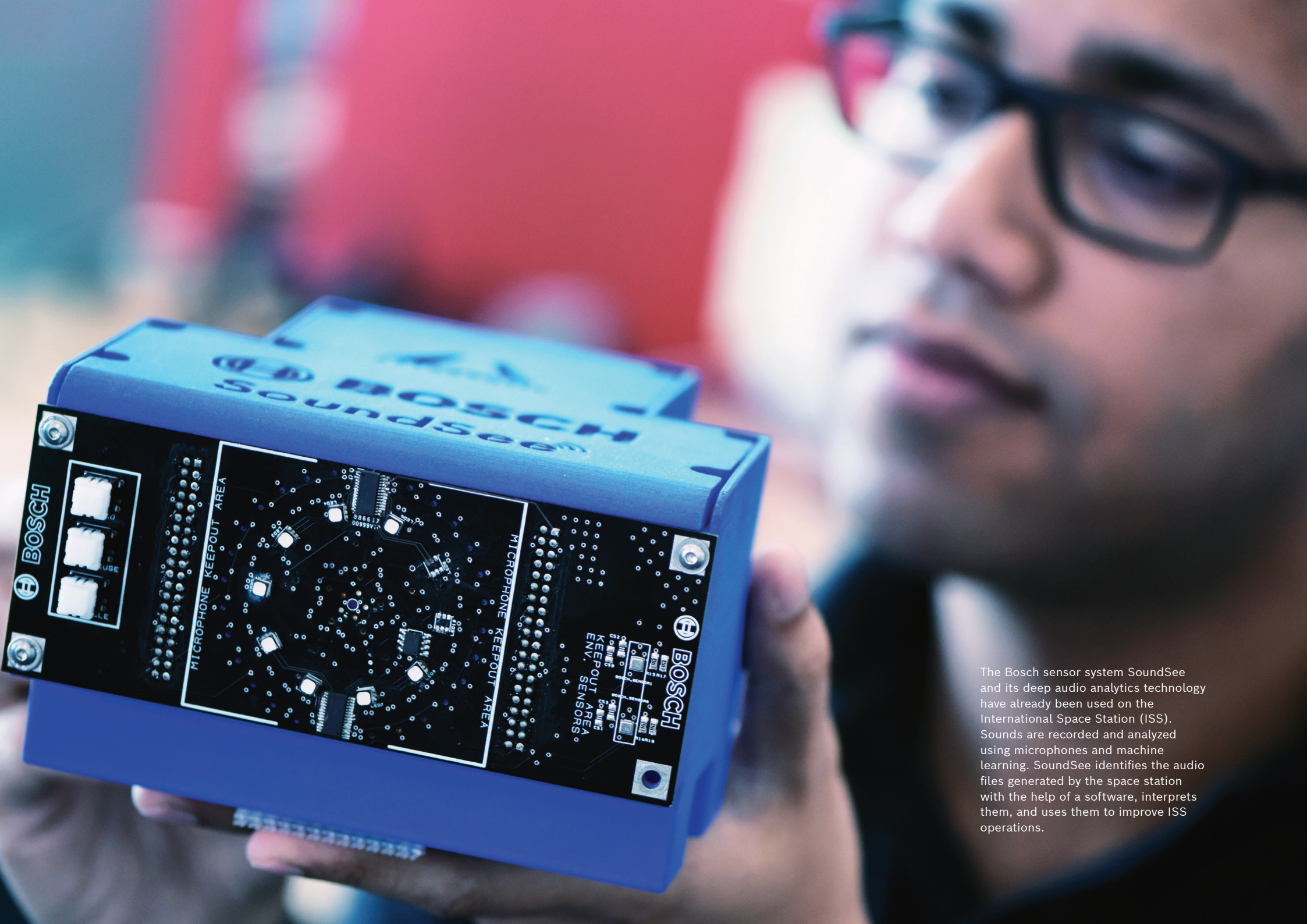
- See advantages mainly in industrial applications that make life easier for people
- AI is not believed to have emotional or social intelligence

14% The **opponents**

- Clear rejection of AI
- AI is mostly associated with concerns, risks, and dangers rather than with opportunities

Support of industrial AI by AI personality





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.

July 16 – July 17, 2020

August 21 – August 28, 2020

Qualitative pre-stage

Quantitative survey

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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