Effects of GenAI on the German labor market

An opportunity to mitigate skilled labor shortages

November 2023
An opportunity to mitigate skilled labor shortages

1 Germany is experiencing skilled labor shortages

2 GenAI can unlock and boost productivity to mitigate these shortages

3 Germany has a promising landscape for GenAI adoption

- Share of businesses affected by skilled labor shortages have increased 5-fold since 2009.
- General open positions have increased 4-fold since 2004
- GenAI has the potential to greatly enhance Germany's competitiveness by boosting productivity growth by an estimated 18%. GenAI can also help address skilled labor shortages through innovation.
- This primarily concerns: Professions in workforce training, STEM, and healthcare that have both the greatest need (represented by the share of job vacancies per share of employment in an occupation group – of >0.9) and greatest GenAI potential (>17 pp) for labor shortage mitigation.
- Greatest profitable effects for a) employees in highly professionalized careers (e.g., legal and business, 36 pp) and b) higher education (e.g., tertiary education, 24 pp), as well as c) high-earning employees (e.g., top earners, 12 pp)
- Germany boasts the highest number of GenAI startups (>500) in the EU private sector.
- Germany holds a top-five global ranking in computing power, academic publications, and patents, demonstrating its competitiveness in tech and research.
- Germany ranks second among OECD countries in AI skill penetration, with 1.7 out of every 100 workers reporting AI skills, only slightly behind the United States.

McKinsey & Company  2
Agenda

The skilled labor shortage in Germany

The potential of GenAI to increase productivity

The GenAI landscape in Germany
At the end of 2022, ~50% of businesses reported they had been affected by skilled labor shortages, marking a 5x increase since 2009.

Share of enterprises affected by skilled labor shortages according to sectors in Germany, Reported to the ifo Institute, percent

Source: ifo Institute, Ifo Konjunkturumfragen
Skilled labor shortage sentiment is corroborated by reported open positions quadrupling between 2004 and 2022

Absolute number of open positions in Germany,
Reported to the Federal Employment Agency in Germany, thousands

Source: Federal Employment Agency (Bundesagentur für Arbeit), labor market in numbers
Agenda

The skilled labor shortage in Germany
The potential of GenAI to increase productivity
The GenAI landscape in Germany
Background: GenAI is the natural evolution of analytical AI, addressing a novel set of challenges to realize large automation potential, thus unlocking meaningful productivity potential.

Analytical AI

Analytical AI algorithms are used to solve analytical tasks faster and more efficiently than humans — e.g., being able to classify, predict, cluster or evaluate data.

Forecasting sales  
Segmenting customers  
Conducting sentiment analyses

Generative AI

GenAI algorithms are used to either create new content on par with humans, or greatly enhance humans’ abilities — e.g., generating audio, code, images, text, and videos.

Designing concepts  
Creating marketing or social media copy  
Generating code
Example: By unlocking productivity potential, GenAI can address skilled labor shortages in manufacturing, resulting in fewer vacancies due to more internal task completion

Illustrative – computer engineer

Sara's current job as a computer engineer
Sara is a computer engineer for a manufacturing company who shifts between 17 unique activities, including testing the performance of electrical equipment and collaborating with technical personnel. Her company is struggling to find skilled personnel.

Sara's company adopts new technologies
Sara's company invests in real-time data analytics and machine-learning software to help monitor the computer systems in the manufacturing plant. The company also purchases several robotics and automation systems to streamline production.

Sara's time rearrangement and productivity gains
With automation, the resulting free time creates increased productivity and innovation: Sara can now operate an adjacent workstation, which is underutilized, as her company has not been able to recruit a suitably skilled new colleague. Moreover, she invents a novel solution to a computer-design problem at the plant.

Fewer vacancies and more innovation in 2030
Various workflows have been optimized. Thus, numerous positions are now covered internally where the company had previously struggled to find suitably skilled colleagues. Moreover, Sara's company has implemented various computer-design improvements, which speeds up production.
Example: By unlocking productivity potentials, GenAI can meet skilled labor shortages in workforce training resulting in less vacancies and better apprentice performance and satisfaction

Illustrative – educator and workforce training

01 John’s current job as a workforce trainer
John is a workforce trainer in a vocational school who shifts between 13 unique activities, including frontal teaching, preparing individual work samples, development conversations, and assessing the apprentices’ individual outputs. His organization struggles to find skilled trainers.

02 John’s organization has adopted new technologies
John’s organization invests in educational generative AI software which can analyze the needs, constraints, and preferences of each apprentice, and subsequently offers tailored content and learning styles. Moreover, the new software can create simulation-based and individualized trainings with much less input from John.

03 John’s time rearrangement and productivity gains
With automation, the resulting free time creates increased productivity and innovation: John can now increase the number of apprentices under his supervision from 20 to 30 which is great for the organization, as it has been struggling to recruit another workforce trainer. Moreover, he implemented data-driven informed development conversations and additionally introduced a new innovative course offering individualized remote work simulation.

04 Less vacancies and better apprentice performance and satisfaction in 2030
Various individualized courses and modules have been implemented across the organization’s workforce training portfolio. Hence, now significantly less trainer input is required. Therefore, the average performance of apprentices has increased, and the personal satisfaction of apprentices has improved as they now receive tailored training while having more space for deeper exchange with trainers on a more personal level.
To assess GenAI productivity potentials, we analyzed around 2,100 distinct work activities and ~850 professions.

### Professions

1. Employees in retail and sales
   - Greet customers

2. Employees in food and beverage service
   - Clean and maintain work areas

3. Teachers
   - Demonstrate product features

4. Health practitioners
   - Process sales and transactions

- ... 
- ... 
- ...

~850 professions

~2,100 activities assessed across all professions

### Capability requirements

#### Physical
- Fine motor skills/dexterity
- Gross motor skills
- Navigation
- Mobility

#### Sensory
- Sensory perception

#### Cognitive
- Retrieving information
- Recognizing known patterns/categories (supervised learning)
- Generating novel patterns/categories
- Logical reasoning/problem solving
- Optimizing and planning
- Creativity
- Articulating/display output
- Coordinating with multiple agents

#### Natural language processing (NLP)
- Understanding natural language
- Generating natural language

#### Social
- Social and emotional sensing
- Social and emotional reasoning
- Emotional and social output

Source: National Labor Offices, Occupation Information Network; McKinsey Global Institute analysis
In Germany, GenAI promises greater productivity potential in complex processes, such as decision making and collaboration...

### Overall technical automation potential, comparison by midpoint scenarios, percent

<table>
<thead>
<tr>
<th>Activity groups</th>
<th>With GenAI</th>
<th>Without GenAI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Decision making and collaboration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applying expertise</td>
<td>19</td>
<td>+36 pp</td>
</tr>
<tr>
<td>Managing</td>
<td>16</td>
<td>+34 pp</td>
</tr>
<tr>
<td>Interfacing with stakeholders</td>
<td>25</td>
<td>+25 pp</td>
</tr>
<tr>
<td><strong>Data management</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processing data</td>
<td>75</td>
<td>+17 pp</td>
</tr>
<tr>
<td>Collecting data</td>
<td>65</td>
<td>+14 pp</td>
</tr>
<tr>
<td><strong>Physical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performing unpredictable physical work</td>
<td>34</td>
<td>+1 pp</td>
</tr>
<tr>
<td>Performing predictable physical work</td>
<td>33</td>
<td></td>
</tr>
</tbody>
</table>

Disclaimer: Technical automation potential implies the availability of technological capabilities required to automate a particular work activity, hence, affecting hours spent on that work activity.

Note: Figures may not sum, because of rounding.

Source: McKinsey Global Institute analysis

---

1. Previous assessment of work automation before the rise of GenAI, including analytical AI, machine learning, and deep learning
2. Applying expertise to decision making, planning, and creative tasks
3. Managing and developing people
4. Performing physical activities and operating machinery in unpredictable environments
5. Performing physical activities and operating machinery in predictable environments
...thus, GenAI makes it possible to contribute significantly to Germany's competitiveness

### Productivity impact from automation by scenario, 2022-40, CAGR, \(^1\) percent

#### Developed economies

<table>
<thead>
<tr>
<th>Country</th>
<th>Early (With GenAI)</th>
<th>Late (With GenAI)</th>
<th>Early (Without GenAI)</th>
<th>Late (Without GenAI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>3.6</td>
<td>0.7</td>
<td>2.9</td>
<td>0.6</td>
</tr>
<tr>
<td>France</td>
<td>3.7</td>
<td>0.7</td>
<td>3.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Austria</td>
<td>3.7</td>
<td>0.8</td>
<td>3.1</td>
<td>0.9</td>
</tr>
<tr>
<td>Global</td>
<td>3.3</td>
<td></td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>3.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Emerging economies

<table>
<thead>
<tr>
<th>Country</th>
<th>Early (With GenAI)</th>
<th>Late (With GenAI)</th>
<th>Early (Without GenAI)</th>
<th>Late (Without GenAI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>3.8</td>
<td>0.6</td>
<td>3.2</td>
<td>0.8</td>
</tr>
<tr>
<td>India</td>
<td>2.3</td>
<td>0.8</td>
<td>2.9</td>
<td>0.6</td>
</tr>
<tr>
<td>Mexico</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Based on the assumption that automated work hours are reintegrated into work at today’s productivity level
2. Previous assessment of work automation before the rise of GenAI
3. Based on 47 countries, representing about 80% of global employment
4. Automation scenarios (early: early adoption of GenAI technology capabilities; late: late adoption of GenAI technology capabilities, expert based)

### Key implications for Germany

- Early (vs. late) adoption of automation potential will lead to an additional ~EUR 2,600bn in GDP by 2040
- Early additional adoption of GenAI alone can increase Germany’s GDP by ~EUR 585bn (13%) by 2040
- GenAI can increase automation impact on productivity growth by ~18%, significantly advancing Germany’s competitive position

Source: Oxford Economics; The Conference Board Total Economy Database; McKinsey Global Institute analysis
Education: Greatest labor shortage mitigation potential for tertiary education level while societally for high school education level

### Impact of GenAI on technical automation potential in midpoint scenario, 2023, percent

<table>
<thead>
<tr>
<th>Education level</th>
<th>Overall technical automation potential, comparison²</th>
<th>Additional automation potential,² pp</th>
<th>Share of population, %</th>
<th>Population-weighted skilled labor shortage mitigation potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tertiary education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Bachelor and above)</td>
<td>[60 (With GenAI)]</td>
<td>[36 (Without GenAI)]</td>
<td>[24 (Share of population)]</td>
<td>[19 (Medium)]</td>
</tr>
<tr>
<td>High school</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Diploma or equivalent)</td>
<td>[64 (With GenAI)]</td>
<td>[51 (Without GenAI)]</td>
<td>[13 (Share of population)]</td>
<td>[56 (Large)]</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(No degree)</td>
<td>[63 (With GenAI)]</td>
<td>[54 (Without GenAI)]</td>
<td>[9 (Share of population)]</td>
<td>[25 (Small)]</td>
</tr>
</tbody>
</table>

1. Previous assessment of work automation before the rise of GenAI
2. Based on US extrapolation

**Source:** Statistisches Bundesamt (Destatis); McKinsey Global Institute analysis

---

**Key implications for Germany**

- Additional impact of GenAI is expected to be **highest for those with tertiary-level education** (24 pp)
- Example: Computer engineers (STEM) like Sara or workforce trainers like John
- The **population-weighted skilled labor shortage mitigation potential** is highest for high-school-degree holders (55.9% population share)
- Example: Community health care worker or pharmacy technician
**Professions: GenAI holds the greatest opportunities for workforce training, business and legal, and STEM**

**Impact of GenAI on automation potential sorted by additional GenAI potential, percent**

<table>
<thead>
<tr>
<th>Professions</th>
<th>Overall technical automation potential, comparison by midpoint scenarios, 2023, %</th>
<th>Automation potential shift, pp</th>
<th>Share of German employment</th>
<th>Employment-weighted skilled labor shortage mitigation potential</th>
<th>World automation potential shift, pp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educator and workforce training</td>
<td>40</td>
<td></td>
<td></td>
<td>Medium</td>
<td>110</td>
</tr>
<tr>
<td>Business/legal professionals</td>
<td>36</td>
<td></td>
<td></td>
<td>High</td>
<td>100</td>
</tr>
<tr>
<td>Creatives and arts management</td>
<td>29</td>
<td></td>
<td></td>
<td>High</td>
<td>91</td>
</tr>
<tr>
<td>STEM professionals</td>
<td>29</td>
<td></td>
<td></td>
<td>High</td>
<td>82</td>
</tr>
<tr>
<td>Office support</td>
<td>22</td>
<td></td>
<td></td>
<td>High</td>
<td>73</td>
</tr>
<tr>
<td>Community services</td>
<td>22</td>
<td></td>
<td></td>
<td>High</td>
<td>64</td>
</tr>
<tr>
<td>Managers</td>
<td>20</td>
<td></td>
<td></td>
<td>Medium</td>
<td>55</td>
</tr>
<tr>
<td>Health professionals</td>
<td>17</td>
<td></td>
<td></td>
<td>Medium</td>
<td>46</td>
</tr>
<tr>
<td>Customer service and sales</td>
<td>10</td>
<td></td>
<td></td>
<td>Medium</td>
<td>37</td>
</tr>
<tr>
<td>Production work</td>
<td>8</td>
<td></td>
<td></td>
<td>Medium</td>
<td>28</td>
</tr>
<tr>
<td>Property maintenance</td>
<td>7</td>
<td></td>
<td></td>
<td>Low</td>
<td>19</td>
</tr>
<tr>
<td>Transportation services</td>
<td>6</td>
<td></td>
<td></td>
<td>Low</td>
<td>10</td>
</tr>
<tr>
<td>Health aides, technicians, and wellness</td>
<td>6</td>
<td></td>
<td></td>
<td>Medium</td>
<td>9</td>
</tr>
<tr>
<td>Builders</td>
<td>5</td>
<td></td>
<td></td>
<td>Low</td>
<td>4</td>
</tr>
<tr>
<td>Food services</td>
<td>5</td>
<td></td>
<td></td>
<td>Low</td>
<td>8</td>
</tr>
<tr>
<td>Mechanical installation and repair</td>
<td>5</td>
<td></td>
<td></td>
<td>Low</td>
<td>6</td>
</tr>
<tr>
<td>Agriculture</td>
<td>4</td>
<td></td>
<td></td>
<td>Low</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

1. Previous assessment of work automation before the rise of GenAI. | Note: Figures may not sum, because of rounding.

Source: McKinsey Global Institute analysis

**Key implications for Germany**

Greatest skilled labor shortage mitigation potential in Germany in the areas of workforce training (40 pp), business and legal (36 pp), and STEM (29 pp)

Employment-weighted labor shortage mitigation potential in Germany is largest for business and legal, STEM, office support, and community services

Based on relative employment in Germany and the world, STEM and community services might profit more in Germany, while workforce training and customer service might profit less than the global average
Profession: GenAI has greatest labor shortage mitigation potentials in high job vacancy concentration areas, such as educator training, STEM, and Health

Job-vacancy concentration\(^2\) and corresponding automation shift in Germany

<table>
<thead>
<tr>
<th>Additional technical automation potential, pp</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
</tr>
<tr>
<td>35</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>25</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>0.1</td>
</tr>
<tr>
<td>0.2</td>
</tr>
<tr>
<td>0.3</td>
</tr>
<tr>
<td>0.4</td>
</tr>
<tr>
<td>0.5</td>
</tr>
<tr>
<td>0.6</td>
</tr>
<tr>
<td>0.7</td>
</tr>
<tr>
<td>0.8</td>
</tr>
<tr>
<td>0.9</td>
</tr>
<tr>
<td>1.0</td>
</tr>
<tr>
<td>1.1</td>
</tr>
<tr>
<td>1.2</td>
</tr>
<tr>
<td>1.3</td>
</tr>
<tr>
<td>1.4</td>
</tr>
<tr>
<td>1.5</td>
</tr>
<tr>
<td>1.6</td>
</tr>
<tr>
<td>1.7</td>
</tr>
<tr>
<td>1.8</td>
</tr>
<tr>
<td>1.9</td>
</tr>
<tr>
<td>2.0</td>
</tr>
<tr>
<td>2.1</td>
</tr>
<tr>
<td>2.2</td>
</tr>
</tbody>
</table>

Share of job vacancies per share of employment in an occupation group\(^2\)

Note: Figures may not sum because of rounding

1. Previous assessment of work automation before the rise of GenAI. | 2. Share of job vacancies divided by the share of employment within an occupation group indicating the concentration of open job positions per actual employment

Key implications for Germany

- Highest need (≥0.9) and potential for GenAI for skilled labor shortage mitigation in workforce training (40 pp), STEM (29 pp), and health professions (17 pp)
- This applies to workforce trainers like John or computer engineers (STEM) like Sara
- High potential (≥20 pp) but medium need for business, creatives, or office support, and high needs but limited potential (≤10 pp) for builders
## Wages: GenAI is expected to have the biggest labor shortage mitigating impact in areas with high wages

Additional GenAI automation adoption vs. without GenAI per wage group, 2030, percentage points

### Developed economies
- **USA**:
  - Lower: 5%, 6%
  - Mid: 9%, 12%
  - Upper mid: 12%, 13%
  - Upper: 10%, 11%

- **France**:
  - Lower: 3%
  - Mid: 4%
  - Upper mid: 8%
  - Upper: 11%

- **Austria**:
  - Lower: 3%
  - Mid: 5%
  - Upper mid: 6%
  - Upper: 14%, 15%

### Emerging economies
- **China**:
  - Lower: 2%
  - Mid: 4%
  - Upper mid: 7%
  - Upper: 7%

- **India**:
  - Lower: 1%
  - Mid: 2%
  - Upper mid: 7%
  - Upper: 7%

- **Mexico**:
  - Lower: 2%
  - Mid: 3%
  - Upper mid: 3%
  - Upper: 8%

### Germany
- **USA**: 5%, 6%
- **France**: 3%, 4%
- **Austria**: 3%, 5%
- **Germany**: 12%, 12%

### Key implications for Germany
- In Germany, the highest wage group (quintile) will experience the greatest additional automation potential (12 pp) and the corresponding labor shortage mitigation potential from GenAI.

### Additional GenAI automation adoption vs. without GenAI
- Largest increase in automation adoption from GenAI
- Largest automation adoption without GenAI

1. Previous assessment of work automation before the rise of GenAI
2. Difference between automation potential without GenAI and additional automation potential with GenAI

Source: McKinsey Global Institute analysis
Upskilling and attracting the right tech talent is the core task of public and private organizations in mitigating labor shortages

1. **Upskilling/ reskilling for AI roles**
   - Developing requirements for the building and leadership development of GenAI core competencies
   - Determining the cohorts with upskilling needs
   - Establishing a boot camp approach to GenAI training

2. **Training and coaching**
   - Implementing improvements for the training program based on early findings

3. **Establishing a ‘learning culture’**
   - Involving senior management to ensure support is provided
   - Defining the behavioral and mindset changes required for a learning culture
   - Designing of competency building initiatives (e.g., on feedback, coaching)

---

**Recruiting of new tech talent**

- Analyzing the skills and competence profiles of current employees and existing open positions that cannot be recruited from the labor market
- Establishing employer branding and targeted recruiting to attract best-in-class talent
- Identifying the remaining necessary qualifications
- Creating a short-term hiring target for recruiting the required role profiles
- Developing a mid-term road-map for strategic recruiting
Agenda

The skilled labor shortage in Germany
The potential of GenAI to increase productivity
The GenAI landscape in Germany
Public and private actors must work toward a scenario with both the right operating environment and the availability of skills

Ensuring availability of skills

Key implications for Germany

The two key enablers for making use of GenAI in Germany are:

- The right operating environment
- The availability of relevant skills

As they both have a reinforcing effect towards the respective counterpart they must be pursued simultaneously.

Providing the right environment

Private sector

- R&D collaboration
- Procurement

Academia

- Data for GenAI
- Supports

German Government

- Creates and enforces

Public policy (Germany/EU)

Skills

Quantitative deep dive on every stakeholder (group) on the following pages

1. We apply a GenAI focus to this framework because GenAI builds on the workforce, skillsets, and capabilities, which grew the AI market

Source: Oxford Publication
Germany is an entrepreneurial but underfunded country with great potential to becoming a European leader.

Germany’s expenditure on R&D is increasing, whereas its contribution to AI projects has stagnated for years

Gross domestic expenditure on R&D, % of GDP

Number of AI projects by global comparison, % total AI projects

Number of AI projects (i.e., AI-related GitHub "repositories") as a fractional count based on the share of contributions (i.e., "commits") by country and over time

Source: Eurostat; November 2022; GitHub; Preqin; oecd.ai
Germany is a leader in technology, but only keeping up with equally large countries in investments

Global perspective – relating to both AI and GenAI in 2022

<table>
<thead>
<tr>
<th>Technology and research¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding positioned</td>
</tr>
<tr>
<td>Spain</td>
</tr>
<tr>
<td>Sweden</td>
</tr>
<tr>
<td>Singapore</td>
</tr>
<tr>
<td>Austria</td>
</tr>
<tr>
<td>Mexico</td>
</tr>
<tr>
<td>Uganda</td>
</tr>
<tr>
<td>Aspirational</td>
</tr>
<tr>
<td>Finland</td>
</tr>
<tr>
<td>Russia</td>
</tr>
<tr>
<td>Technology skilled</td>
</tr>
<tr>
<td>The Netherlands</td>
</tr>
<tr>
<td>Australia</td>
</tr>
<tr>
<td>Canada</td>
</tr>
<tr>
<td>South Korea</td>
</tr>
<tr>
<td>Italy</td>
</tr>
<tr>
<td>US</td>
</tr>
<tr>
<td>China</td>
</tr>
<tr>
<td>Germany</td>
</tr>
</tbody>
</table>

¹ Technology and research contains country ranks by theoretical peak computer performance, number of processing cores, number of supercomputers, and maximal LINPACK performance achieved; the country ranks for the number of conference papers and journal papers; and the country rank for the number of patents

Source: Brookings, 2022
Germany has a high proportion of self-reported AI capabilities compared to the OECD average, trailing only the US

Germany has the 2nd second highest AI skill penetration (1.5) in its workforce, which is only surpassed by the US with a penetration factor of 2.2

German workers are 1.7x likely to report AI skills than workers in the OECD benchmark

Germany is thus in the group of leading AI nations, like the US, Israel, Canada, and the UK

---

**AI skill penetration of workforce**

Prevalence of workers with AI skills as self-reported by LinkedIn members from 2015-2022 by country¹

1. A Country's AI skills penetration of 1.5 means that workers in that country are 1.5X more likely to report AI skills than workers in the benchmark

Source: Data from LinkedIn 2015-2022 accessed on Sep 20, 2023; self-reported; OECD.AI (2023)