Germany's skills gap: A secondary analysis of demand in the IT sector

April 2026

International
Digital Dialogues
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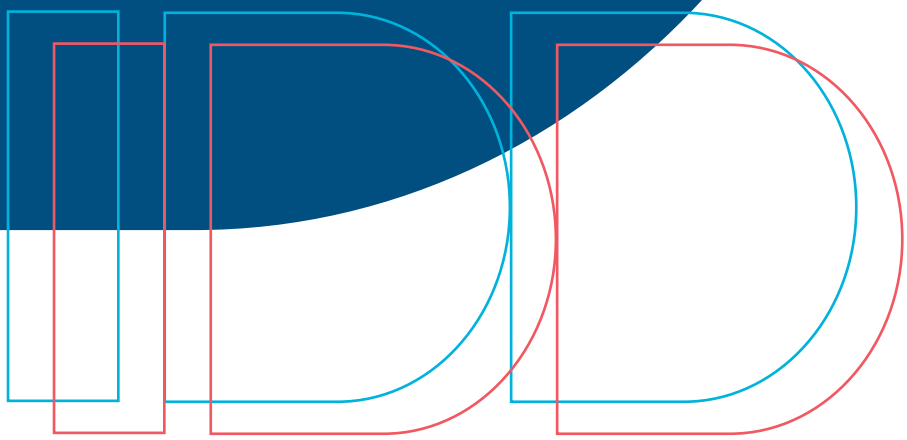


Introduction & Data Foundation

Digitalisation continues to drive demand for IT professionals in Germany. But what will the largest skills gaps be by 2028, and what competencies will be required? Using the labour market projections of the German Economic Institute (IW) and Federal Ministry for Economic Affairs and Climate Action (BMWK), this analysis identifies the digital occupations in which the skills gap is growing most strongly in absolute terms and systematically analyses the corresponding training and qualification profiles. The focus is on three qualification levels: skilled worker, specialist and expert. Using these profiles as a basis, the analysis creates structured profiles (factsheets) of the precise training required and identifies two particularly in-demand skill clusters: applied/practical computer science (software, business IT and systems integration) and technical computer science/automation (electrical engineering, control systems and production/IT-OT). The aim is to provide evidence-based guidance for education and training provision.

The data used to analyse the development of the skills gap in digital occupations comes from the study "Digitalisierung der Wirtschaft in Deutschland - Kompetenzbarometer: Fachkräftesituation in Digitalisierungsberufen Beschäftigungsaufbau und Fachkräftemangel bis 2028" (Burstedde/Tiedemann 2024). Prepared by the IW, it was published by BMWK in December 2024. Despite being published one and a half years ago, it remains the most comprehensive and up-to-date source of data for monitoring developments in Germany.

The BMWK study draws on several official and institutional sources. Extracts from the GENESIS-Online database of the Federal Statistical Office (Destatis) were combined with analyses from the Federal Employment Agency (BA 2025; Flake et al. 2023). This information is continuously incorporated into the skilled labour database of the IW. To smooth out short-term fluctuations, rolling twelve-month averages were employed.

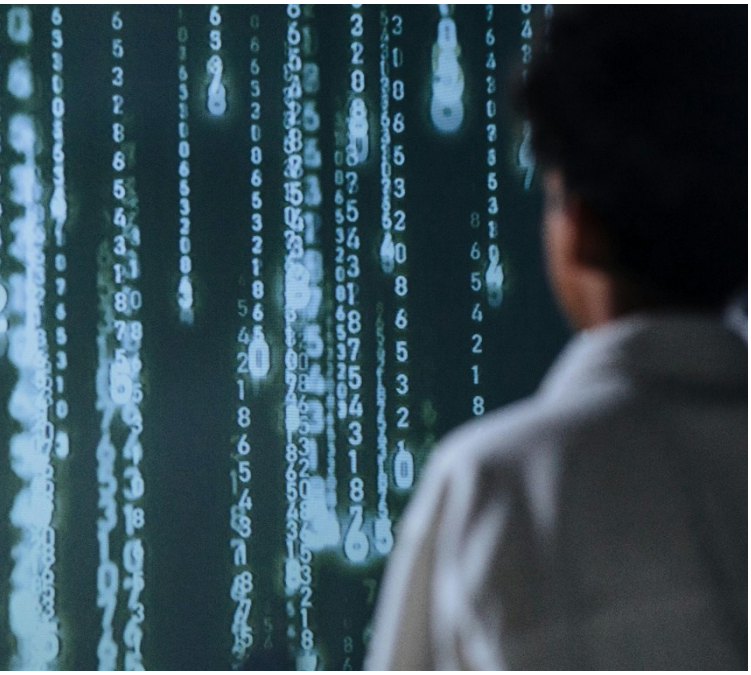
The IW labour market projection method is described in detail by Burstedde (2023). The core element of this method is the separate projection of key labour market indicators, including reported job vacancies, population and age structure, mortality, internal and external migration, labour force participation, unemployment and commuting flows, as well as the distribution of unemployed individuals and occupations. The shortage indicator, referred to as the "skills gap" in the text, is defined as the difference between the number of vacancies and the number of unemployed individuals in the relevant categories. All projections are based exclusively on observed empirical trends; no assumptions about future developments are incorporated. For this reason, the term "labour market projections" is used rather than "forecasts", as no structural shifts in trends are assumed.

The BMWK study categorises occupations into three groups according to level of qualification: skilled workers (individuals with vocational training); specialists (individuals with a bachelor's degree or advanced training following vocational education); and experts (individuals with a master's degree).

Method

The first step was to draw on Table 4-1, "Top-20-Fachkräftelücken in Digitalisierungsberufen", from the BMWK study. A skills gap indicates the number of qualified employees lacking in a region to meet existing demand. This is based on the assumption that companies will initially fill vacancies with suitably qualified unemployed individuals available within the region. Any remaining unfilled demand is defined as the skills gap. Its value is never negative: a value above zero indicates a shortage of qualified workers.

Only those occupations for which an increase in the skills gap is expected by 2028 were considered; those with a high current gap but a decline in employment forecast for the future were excluded. The number of additional vacancies expected to arise by 2028 was then calculated based on the difference between the current and projected gap, and the occupations were ranked in descending order according to this increase. Due to low case numbers, the profiles surveying (expert), computer science (skilled worker) and leadership in IT networks (expert) were not considered further. The resulting list is as follows:



1. **Computer Science – Expert**: 18,655 vacancies, with an additional 2,611
2. **Electrical Engineering – Expert**: 15,394 vacancies, +2,498 additional vacancies
3. **Business Information Systems – Expert**: 5,955 vacancies, +1,356 additional vacancies
4. Technical production planning and control – Expert (Master's level): 5,955 vacancies, +1,022 additional vacancies
5. IT system administration – Specialist (Bachelor's level): 4,038 vacancies, +2,107 additional vacancies
6. Automation engineering – Skilled Worker (vocational training): 2,952 vacancies, +282 additional vacancies
7. IT application consulting – Expert (Master's level): 2,733 vacancies, with an additional 1,222.

The respective occupations were identified in BERUFENET (BA n.d.a) based on the ranked list, and the corresponding training and qualification pathways were determined. The occupations are renamed according to their respective training titles. The required competency profiles were then derived from the occupational profiles and supplemented by additional desk research, and median salaries were determined using the BA's Salary Atlas (BA n.d.b).

Results

1. Computer Scientist – Expert

Skills gap 2028	18,655 vacancies, +2,611 additional vacancies
Description	- Development of IT infrastructures, software and database solutions, as well as user interfaces - Customisation of standard software to meet company-specific requirements - Use of programming languages to translate project concepts into practical software architectures
Skill set	- Software engineering: proficiency in algorithms and data structures; object-oriented and procedural programming in Python, Java and C/C++; testing, debugging and documentation - Systems analysis and specification: as-is/to-be/feasibility analyses, functional specifications and requirements documentation - Structured problem-solving, as well as expertise in architecture and modelling
Type of training	Advanced higher education degree (Master's in computer science), also available as a dual study programme with integrated practical experience in a company
Entry requirements	Completed undergraduate degree in computer science
Duration of training	4+2 years
Median salary	EUR 6478

2. Electrical Engineer – Specialist

Skills gap 2028	15,394 vacancies, +2,498 additional vacancies
Description	- Planning, installation, commissioning, maintenance and troubleshooting of electrical systems in the fields of energy supply, communications technology, automotive engineering or automation - Understanding of automation and control engineering (e.g. PLCs, pneumatics/hydraulics, sensor systems) - Design and testing of new components, systems and manufacturing processes
Skill set	- Understanding of failure mode and effects analysis (FMEA) and reliability engineering - In-depth knowledge of energy systems, information technology, automation engineering and microelectronics - Expertise in circuit and system design for power electronics Proficiency in programmable logic controllers (PLCs) - Knowledge of industrial communication and simulation software (MATLAB/Simulink), including field simulation - Basic knowledge of cybersecurity in the Industrial Internet of Things (IIoT)
Type of training	Advanced higher education degree (Master's in electrical engineering), also available as a dual study programme with integrated practical experience in a company
Entry requirements	Completed undergraduate degree in electrical engineering
Duration of training	4+2 years
Median salary	EUR 6940

3. Business IT Specialist – Expert

Skills gap 2028	5,955 vacancies, +1,356 additional vacancies
Description	- Conducting cost-benefit analyses - Acting as an interface between business and IT: designing processes and systems to be economically efficient, effective and secure - Assessing existing IT systems in terms of effectiveness, security and cost-efficiency - Customising standard software to meet new requirements or developing new applications - Leading planning and advisory discussions with clients and specialists to identify solutions - Testing new or adapted applications with end users in practice-oriented scenarios - Coordinating programming, integration, support and maintenance following system decisions
Skill set	- Cost-benefit analysis, business case development and economic evaluation - Process analysis (actual/target), requirements analysis and specification (functional/non-functional) - IT system evaluation and risk analysis (technology, data protection, information security), as well as interface and integration assessment - Customisation of standard software Experience in database management (e.g. MySQL), including data modelling and administration - Fundamental knowledge of IT security and data protection requirements (roles/authorisations, compliance)
Type of training	Advanced higher education degree (Master's in business information systems), also available as a dual study programme with integrated practical experience in a company
Entry requirements	Completed undergraduate degree in business information systems
Duration of training	4+2 years
Median salary	EUR 5961

4. Production Technician – Expert

Skills gap 2028	5,504 vacancies, +1,022 additional vacancies
Description	- Planning, controlling, monitoring and optimising production processes - Conducting digital simulations and adapting production software - Calculating and coordinating the use of materials, machinery and personnel - Continuously improving production processes, for example through networked systems (cobots) or additive manufacturing (3D printing)
Skill set	- Proficient use of systems for automating manufacturing processes (e.g. MES or ERP) - Basic knowledge of software for computer-aided manufacturing (CAM) and design for manufacturing (DfM) - Fundamental knowledge of programmable logic controllers (PLCs) - Production planning and control - Discrete-event simulation modelling (e.g. AnyLogic or FlexSim)
Type of training	Advanced higher education degree (Master's) in production engineering, electrical engineering, civil engineering, automation engineering, mechanical engineering or mechanics
Entry requirements	Completed undergraduate degree in production engineering, electrical engineering, civil engineering, automation engineering, mechanical engineering or mechanics
Duration of training	4+2 years
Median salary	EUR 7084

5. Systems Integration and Networking Specialist – Specialist

Skills gap 2028	4,038 vacancies, +2,107 additional vacancies
Description	- Planning, integrating and commissioning networked IT systems (e.g. industrial production systems, transport infrastructures) - Selecting components of cyber-physical systems and designing their integration - Implementing communication protocols for data exchange and machine control - Commissioning and testing systems; ensuring operational reliability - Developing recovery concepts for component or system failures Analysing process, operational and sensor data; developing solutions for deviations from target values Incorporating - IT security considerations: assessing risks (e.g. during migrations) and developing security concepts - Supporting project management, e.g. by taking responsibility for subprojects or contributing to effort estimation
Skill set	- Project coordination and risk management Knowledge of compliance and data security - Network monitoring using the Simple Network Management Protocol - Experience with orchestration and monitoring tools (e.g. Ansible or Grafana) - Experience with security measures such as network segmentation, system hardening and intrusion detection systems - Ability to assess and implement security and recovery concepts
Type of training	Advanced vocational training as an IT specialist (“Berufsspezialist”), with the option to subsequently obtain a Bachelor Professional in IT
Entry requirements	Admission to the certification examination typically requires completion of a recognised vocational qualification in information and communication technology. Access is also possible with a qualification in another recognised occupation and at least one year of relevant professional experience, or with at least 60 ECTS credits from a degree programme and a minimum of two years of relevant professional experience. Alternatively, candidates with at least four years of professional experience with substantial relevance to IT consulting tasks may be admitted.
Duration of training	6 to 12 months of self-study, typically combined with project work within a company
Median salary	EUR 5331

6. Electrical Engineer specialising in Automation Technology – Skilled Worker

Skills gap 2028	2,952 vacancies, +282 additional vacancies
Description	- Analysing functional relationships and process sequences in automated systems - Designing modifications and extensions to automated systems Installing and calibrating electrical, hydraulic and pneumatic drive systems - Installing measurement, control and regulation technology Assembling sensor, control, bus and network systems - Conducting test runs, handing over systems and instructing users in their operation - Monitoring, maintaining and servicing automation systems
Skill set	- Experience with programmable logic controllers (PLCs) and control engineering - Knowledge of sensors and actuators, as well as hydraulics and pneumatics - Experience in the implementation, operation and maintenance of industrial robots (e.g. cobots) - Ability to identify, analyse and resolve faults using testing software and diagnostic systems
Type of training	Dual vocational training
Entry requirements	Access to dual vocational training requires a training contract with a company. Training providers select trainees according to their own criteria (e.g. prior school education).
Duration of training	3,5 years
Median salary	EUR 4358

7. IT Applications Consultant – Expert

Skills gap 2028	2,733 vacancies, +1,222 additional vacancies
Description	- Developing digitalisation strategies and concepts for companies, organisations and public authorities, in close coordination with clients - Analysing IT structures as well as business, operational and value creation processes for digitalisation potential - Assessing problem situations and reviewing infrastructural requirements and economic conditions - Supporting the implementation of innovative technologies, including providing technical expertise, training materials and coaching
Skill set	- Experience in requirements analysis and specification, as well as process mapping (e.g. as-is analysis) - Preparation of fit-gap analyses, market assessments and cost-benefit evaluations - Experience in database management (e.g. MySQL), including data modelling and administration
Type of training	Completed advanced higher education degree (Master's) in business administration, engineering or computer science
Entry requirements	Completed undergraduate degree in business administration, engineering or computer science
Duration of training	4+2 years
Median salary	EUR 5712

Conclusion

The analysis shows that the largest additional skills gaps by 2028 are expected in the fields of computer science and electrical engineering, with an increase of 2,611 and 2,498 respectively at the expert level. Moderate increases are observed in IT system administration at a specialist level (+2,107), business information systems at an expert level (+1,356) and IT application consulting at an expert level (+1,222). Overall, growth in shortages is concentrated in highly qualified digital and electrical engineering roles, as well as business-facing IT roles. Meanwhile, purely vocational skilled worker roles, such as automation engineering, show only moderate growth (+282).

This has two key implications: First, there is a significant shift in demand towards Master's-level or expert profiles, supported by specialised Bachelor's-level or specialist roles in system administration. Accordingly, long-term funding and training measures aimed at closing the skills gap should prioritise Master's-level qualifications and establish bridging programmes from Bachelor's or specialist level to expert-level roles.

Second, the most in-demand competencies fall into two skill clusters. The first cluster comprises roles in practical and applied computer science. These roles include computer scientists, business information systems specialists, IT application consultants, and system integration specialists. The second cluster covers technical computer science roles with a strong electrical engineering focus, such as production engineers and electrical engineers at expert and skilled worker levels.

The applied/practical computer science skill cluster covers a broad spectrum of the software lifecycle and the interface between business and IT. Core competencies include software and IT engineering, including algorithms and data structures, object-oriented and procedural programming in languages such as Python, Java and C/C++, software architecture, specifications, testing and debugging, and documentation. In addition, there is a strong focus on business IT and process design, including systematic process and requirements analysis, cost–benefit evaluation, business case development, fit–gap analysis, system selection and integration, and customising standard software (e.g. ERP, CRM and DMS), while taking into account governance, compliance, data protection and IT security. At the platform level, this includes database management and modelling (e.g. MySQL), cloud

and operating models, and automation and orchestration tools (e.g. Ansible and Grafana), as well as recovery and resilience concepts.

In contrast, the technical computer science/automation skill cluster focuses on integrating electrical engineering, control engineering, and networked production. Key competencies in electrical engineering include circuit and system design, signal integrity, power engineering, microelectronics and reliability engineering. These competencies also encompass the programming and commissioning of programmable logic controllers (PLCs), control systems, sensors and actuators, and hydraulic and pneumatic drive systems. Experience with cobots may also be relevant. To ensure the security of industrial communication, it is essential to have knowledge of network security (segmentation and hardening), compliance and data security. The use of simulation software also plays an important role. This requires expertise in MATLAB/Simulink, manufacturing simulation (e.g. ANSYS) and discrete-event production simulation (e.g. AnyLogic/FlexSim). For electrical engineering roles at a skilled worker level, the focus is on operating and maintaining machinery, conducting test runs, systematically diagnosing faults, and implementing security and recovery concepts.

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Imprint

Publisher:
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

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Berlin, Germany
April 2026

The German Federal Ministry for Digital Transformation and Government Modernisation (BMDS) commissioned the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH to support the implementation of the International Digital Dialogues.