MINT occupations – claims of a skills shortage are often overstated

Analyses from the first BIBB-IAB Qualification and Major Occupational Field Projection

▶ MINT occupations, the umbrella term for job qualifications involving mathematics, information technology, natural sciences and technology, are often cited as a prime example of the imminent skills shortage. This apparent perception of a skills shortage is the subject of the following article. The principal question is whether there is actually any problem with the supply of newly qualified workers. With the help of reference data from official statistics on this occupational field and the first interpretations of the BIBB-IAB Qualification and Major Occupational Field Projections, the article aims to give a more nuanced description of the real situation in this occupational field.

PETER BOTT
Research associate in the "Qualifications, Occupational Integration and Employment" section at BIBB

ROBERT HELMRICH
Head of the "Qualifications, Occupational Integration and Employment" section at BIBB

GERD ZIKA
Research associate at the Institute for Employment Research (IAB) in Nuremberg

Basis of the occupational projections

Research into qualification trends at BIBB follows a stringent logic (cf. Bott 2010) that builds on the results of longer-term labour market and occupational field projections carried out by BIBB in cooperation with the Institute for Employment Research (IAB) (cf. Helmrich/Zika 2010). It takes account of current developments by combining different official employment and education statistics, is verified and validated by means of structured dialogues with industry experts, and is finally analysed in individual projects using a variety of methodological approaches (cf. Abicht et al. 2007). The foundation of the occupational projections are the 54 occupational fields developed by BIBB, which are grouped at the level of the occupational categories (3-digit codes) from the official German classification of occupa-tions KldB 92 (Klassifikation der Berufe 1992) on the basis of comparable job characteristics and branch dominance (cf. Tiemann et al. 2008). Thus, in contrast to the occupational categories of the 1992 classification scheme, they show greater intra-homogeneity and, at the same time, greater inter-heterogeneity. For methodological reasons, the analyses in the following will be confined exclusively to the "Major Occupational Field" (MOF) level.

Overview of MINT occupations

The MINT occupations are grouped under MOF 8, "Technical-scientific occupations". These include the occupational categories listed in Table 1 (p. 10).
As can be seen, the MOF encompasses around 3.2 million employed people (2005) and has expanded by around 400,000 employees (+12.5 %) since 1996,[1] which makes it a distinct growth area in employment terms.
In relation to the number of notified job vacancies, the time taken to fill a reported vacancy (vacancy period) and the number of unemployed, the individual occupations within MOF 8 are very heterogeneous but uniformly and

1 *The sources of data for these discussions are Microcensus data and own calculations by BIBB and IAB.*

Table 1
MINT occupations: Numbers employed in occupation, vacancy period, notified vacancies, number unemployed (2005 and 2007)

Occupational field	Designation of occupational field	Number employed in the occupation	Notified vacancies for normal employees subject to social insurance Total for Germany		Vacancy period (days to fill notified job vacancies)		Total unemployed	
		2005	2005	2007	2005	2007	2005	2007
21	Engineers	1,028,776	7,684	12,037	390	556	59,623	25,611
22	Chemists, physicists, natural scientists	157,569	610	888	124	192	17,134	9,353
23	Technicians	1,033,918	4,185	8,544	378	665	45,697	24,352
24	Technical draftsmen and draftswomen, allied occupations	133,996	896	2,122	38	61	24,336	11,236
25	Surveying	57,084	65	158	45	90	3,878	1,862
26	Specialised technicians	118,313	462	1,043	158	244	9,840	5,709
38	Core IT occupations	679,883	3,927	6,594	57	78	60,214	33,975
	Arithmetical means across all occupational fields		2,823	4,975	288	468	58,815	44,072

Source: Microcensus of the Federal Statistical Office, own calculations; Federal Employment Agency (BA), job vacancy statistics, unemployment statistics, BIBB Arbeitsmarktradar (labour market radar)

recognisably on the increase across all variables in the period 2005 to 2007 (cf. Table 1).

The lengthening of the vacancy period to fill notified job vacancies, particularly for engineers and technicians, indicates an increasingly strained labour market from the companies' viewpoint. It must also be borne in mind that only around 30 % of all job vacancies are notified to the Federal Employment Agency – and the rate is lower still for academic jobs. Figure 1 therefore tends to understate the actual labour market situation as regards skilled workers in the MINT occupations.

The main concentrations of employment (2007)[2] are in the industry branches "Provision of business services" (12 %) followed by "Data processing and databases" (11.1 %) and "Mechanical engineering" (8.5 %). Ten years earlier (1996) the main concentrations were in "Construction industry" (11.1 %), "Mechanical engineering" (10.0 %) and "Provision of business services" (9.3 %).

MINT occupations in the future[3]

According to the projection of workforce needs compiled with the IAB/INFORGE model,[4] the "Services for companies" sector among the MINT occupations will be the only one to rise substantially by 2025, and will form the most important branch of industry for this Major Occupational Field (MOF). Other branches that will remain significant are "Public administration" and "Construction industry", although these will show a slightly declining trend on average. The numbers employed in public administration will decrease from 3.0 million to around 2.4 million. A slightly modified picture, but following a similar trajectory, is seen in the construction industry with a downturn from 3.1 million to 2.0 million employees. The other significant industry branches for MINT occupations are remaining at a relatively constant level over time.

Until now, labour market projections have only been calculated on the level of a small set of qualification-stages (Bund-Länder Commission for Educational Planning and Research Promotion (BLK) 1996, 2002) or career stages (Bonin et al. 2007; Prognos 2008) or abstract job characteristics (IAB-Prognos 1998; cf. Dostal 2002), and have yielded only demand-side results, for the most part. One reason for this is that, until now, either the data sources have lacked complete information on employment and on qualifications attained (Federal Employment Agency statistics on employees subject to social insurance), or else the data on qualifications attained was not recorded in conjunction with the specific occupation.

Since 2005, Microcensus data has captured the highest vocational qualification plus the specialisation of initial vocational training for all economically active individuals, which BIBB has subsequently translated into the system of occupational classification. This forms the data basis for the projection of both supply and demand (cf. Bott et al. 2010). This measure of the highest vocational qualification, i. e. proficiency in a recognised occupation, represents the level of qualification produced by the education system, which can then be set against labour market demand on the balance sheet. A net difference between

2 The following presentations of the projections are based on Microcensus data from the year 2005, while structural data on current labour market trends is from the year 2007.

3 The data basis used in the BIBB-IAB Qualification and Major Occupational Field Projections is the Microcensus. This is the official representative statistical data from the Federal Statistical Office on the population and labour market, in which one per cent of all German households participate every year (continuous household sampling).

4 The INFORGE model is an econometric forecasting model that is deeply disaggregated by production sectors and product groups for the Federal Republic of Germany. Detailed model descriptions are found in: Schnur et al. 2009; Meyer et al. 2007.

these two values can reflect a possible mismatch between demand and suitably qualified supply.
A striking finding about the MINT occupations is that although the supply of persons trained in a relevant occupation declines in the period from 2005 to 2025, it is still very markedly higher than the demand, which rises only slightly (cf. Figure 1).

Starting from the long-term trend of a continuous increase in tertiary skills, particularly in knowledge-intensive occupations (cf. TIEMANN 2010), the projection shows a continuous expansion of the supply of persons with an academic qualification in a MINT occupation (ISCED 5A, 6). In proportional terms, this is primarily at the expense of the middle-grade specialist and management level (Master Craftsman, Technical Engineer, advanced technical school and healthcare school qualifications, ISCED 5B). On the other hand, the proportion of skilled workers (ISCED 3B, 4) will only decrease slightly over this period (cf. Figure 2).

Ultimate employment of individuals with MINT qualifications

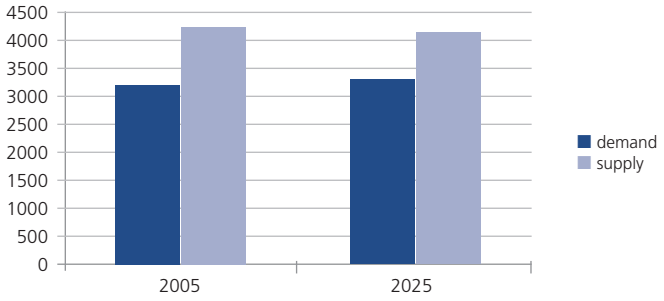
A flexibility matrix has been compiled for the year 2005[5] which shows how many economically active people who trained in MINT occupations are actually working in MINT occupations, or have migrated to other occupational fields. The matrix also shows in which other occupational fields those now working in MINT occupations were originally trained. Using this matrix, it is possible to incorporate changes of occupation and hence an empirically verifiable flexibility into the balance sheet, and thereby simulate a possible adaptation scenario.

Next, considering that only around 52 % of economically active people in MINT occupations remain within the MOF in which they were trained, and around 36 % of individuals now working in this area are skilled workers from different fields of specialisation (cf. HELMRICH/ZIKA 2010), the result from Figure 1 is relativised. For in the long term, assuming that the distribution remains as in 2005, initially the rising demand can only be met by those trained in other specialisations, taking account of movements out of the MOF (cf. Figure 3). In the long term, however, a shortage will set in for demographic reasons.

The high level of migration out of this MOF applies to all the occupational fields associated with it. 55 % of engineers and 57 % of specialists in the core IT occupations remain in their original training occupations; the figure for all other technical and scientific occupations is less than 30 %

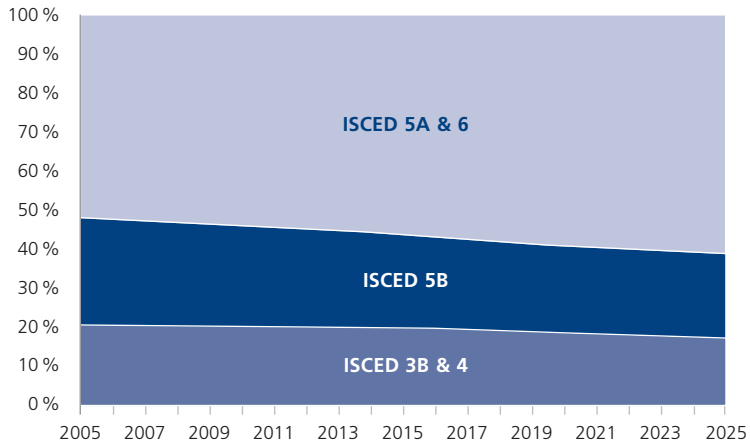
5 *Data for the following years (2006-2008) was still being processed at the time of original publication.*

Figure 1 **Numbers economically active / gainfully employed in MOF 8: "Technical-scientific occupations" – without flexibility (thousands)**



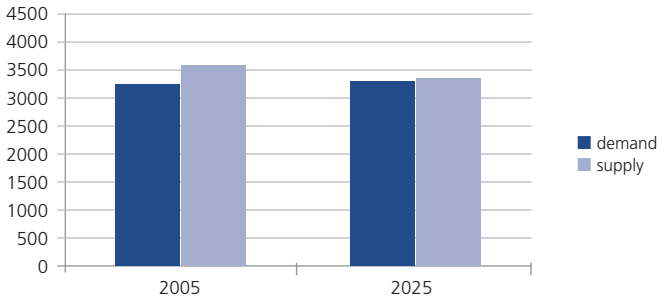
Source: Microcensus of the Federal Statistical Office; own calculations

Figure 2 **MOF 8 "Technical-scientific occupations": Composition of economically active population by qualification tiers – before occupational flexibility**



Source: Microcensus of the Federal Statistical Office; own calculations

Figure 3 **Numbers economically active / gainfully employed in MOF 8: "Technical-scientific occupations" – including flexibility (thousands)**



Source: Microcensus of the Federal Statistical Office; own calculations

Table 2 **Flexibility matrix for MINT occupations on the level of MOFs**

	Present working occupation	Orig. training occupation		
		21	**23**	**38**
7	Metal, plant and sheet metal construction, installation, assembly workers	0.8 %	4.4 %	0.2 %
8	Industrial and tools mechanics	0.5 %	5.2 %	0.3 %
9	Vehicle and aircraft construction, servicing occupations	0.1 %	6.6 %	0.1 %
11	Electrical occupations	0.7 %	6.7 %	0.5 %
18	Construction occupations, wood and plastic working and processing	0.7 %	2.0 %	0.1 %
21	Engineers	54.8 %	5.2 %	4.5 %
23	Technicians	4.2 %	27.8 %	4.1 %
28	Wholesale and retail clerks	1.3 %	2.0 %	1.1 %
30	Other clerical occupations (except wholesale, retailing, banking)	1.9 %	2.0 %	1.2 %
32	Transport occupations	0.7 %	2.5 %	0.7 %
35	Business management, auditing, business consulting	9.6 %	5.4 %	6.5 %
36	Public administration occupations	1.9 %	1.3 %	1.8 %
37	Finance, accounting, cost-accounting	1.0 %	0.8 %	1.6 %
38	Core IT occupations	4.4 %	2.0 %	56.9 %
39	Clerical office occupations	3.1 %	3.5 %	6.0 %
43	Safety and security occupations	0.9 %	1.4 %	1.2 %
50	Teachers	2.8 %	1.6 %	2.1 %
51	Publishing, librarianship, translation and associated research occupations	1.3 %	0.3 %	1.7 %
	Column percentages	**90.7 %**	**80.7 %**	**90.6 %**

* Shows only vocational fields in which one of the original training occupations accounts for 1 % or more.

Guide to interpretation: e. g. see grey-shaded cell: 9.6 % of those originally trained in the occupation of "Engineer" are working as managing directors, auditors, business consultants or similar in 2005.

Source: Microcensus of the Federal Statistical Office; own calculations

(cf. Table 2, which shows the original occupations of greatest numerical significance: engineers, technicians, core IT occupations). Working individuals trained in an occupation within this MOF have a particular propensity to switch into MOF 2 "Working, processing and repairing occupations", MOF 7 "Office and clerical service occupations" and MOF 9 "Legal, management and economic occupations".

There can be a host of reasons leading to a change of occupation. They are both gender and age-dependent. What exactly these reasons are cannot be set out here in detail. People may switch occupations out of personal motives or due to career-related constraints (cf. Maier et al. 2010; Hall 2010).

There are, however, limitations to the projection of labour force supply and demand, which need to be borne in mind when interpreting the results. The supply and demand projections compared side-by-side for the labour market analyses give an indication of which future scenarios might be anticipated in the given labour market segment. In reality, labour market scenarios in which demand cannot be satisfied are bound to cause reactions on the demand side (e. g. company owners may alter production processes) and/or on the supply side (e. g. expansion of the volume of supplied working time).

Analyses on qualification trends in individual occupations and branches

Substantive in-depth analyses on questions of detail concerning individual occupations (e. g. current qualification requirements in certain occupations) or comparative breakdowns of different training courses in the labour market cannot be accomplished by means of relatively broad-brush projections (from a birds-eye perspective, so to speak) but require the use of elaborated and validated methods in individual projects. Thus, while there is still a great deal of debate and speculation over the range of positions suitable for graduates of the new, phased degree programmes and the recruitment behaviour of companies for middle management positions, to date no really robust empirical studies exist from which solid conclusions can be drawn. For example, the expertise prepared by IW Köln, the Cologne Institute for Economic Research (cf. Hollmann et al. 2008) does not elaborate on the selection of study courses for analysis, and looks at university of applied sciences graduates in place of Bachelor programme graduates. BIBB's current research project on "Impacts of the new phased degree programmes on qualifications in initial and further vocational training" also focuses on the occupational group of IT specialists as representative of the MINT occupations, not least because this has been one of the programmes with the highest numbers of graduates from universities of applied sciences and universities since 2003. Targeted surveys of companies that have notified vacancies for IT workers to the Federal Employment Agency are undertaken to investigate the recruitment practices used by companies recruiting to fill positions for mid-level specialist and management staff. Thus sub-aspects of MINT occupations, e. g. the possible competition in the labour market between graduate recruits and skilled workers with dual-system qualifications at apprenticeship and continuing vocational education levels, are analysed in greater detail than the projection findings revealed.

At the start of the year 2010, the German Physical Society (DPG 2010) stressed the following point:
"The shortage of skilled workers in the MINT areas (mathematics, IT, natural sciences and technology) has unleashed an intensive debate in the recent past. In particular, heated discussion surrounds measures and initiatives to improve the situation. The knowledge that the future of our country and particularly the general state of the labour market depends most essentially on junior MINT staff, has rallied the associations and politicians and ensured that the problem is raised for thorough public debate." (DPG 2010, p. 3).

On the basis of the BIBB-IAB projections of qualifications and occupational fields, the articulated fears of an impending shortage of skilled workers in the MINT occupations appear to be far less dramatic in reality. For the time being, there is still sufficient latent potential in the form of well-trained skilled workers who are migrating into other occupational fields or have already done so.

Thought should be given to ways in which skilled workers might be retained in their original training occupations, for in the long term even the MINT sector will be no exception to the demographic trend. ■

Literature

Abicht, L. et al. (eds.): Auf der Suche nach neuen Qualifikationen. Methoden der Früherkennung von Qualifikationsentwicklungen. Bielefeld 2007

Bonin, H. et al.: Zukunft von Bildung und Arbeit – Perspektiven von Arbeitskräftebedarf und -angebot bis 2020. IZA Research Report No. 9. Bonn 2007

Bott, P. et al.: Qualifikations- und Berufsfeldprojektionen: Datengrundlagen, Systematisierungen und Bilanzierung. In: Helmrich, R.; Zika, G.: Qualifikation und Beruf in der Zukunft. Bonn 2010

Bott, P.: Qualifikationsentwicklungsforschung – von der Arbeitsmarkt- und Qualifikationsprojektion zur berufsfeldbezogenen Erfassung von Qualkifikationsentwicklungen. In: Becker, M.; Fischer, M.; Spöttl, G. (eds.): Von der Arbeitsanalyse zur Diagnose beruflicher Kompetenzen. Frankfurt am Main 2010, pp. 29-35

Bund-Länder Commission for Educational Planning and Research Promotion (BLK): Beschäftigungsperspektiven der Absolventen des Bildungswesens, No. 45. Bonn 1995

Bund-Länder Commission for Educational Planning and Research Promotion (BLK): Zukunft von Bildung und Arbeit – Perspektiven von Arbeitskräftebedarf und -angebot bis 2015. Bericht der BLK an die Regierungschefs von Bund und Ländern, No. 104. Bonn 2002

Deutsche Physikalische Gesellschaft (DPG): Physikerinnen und Physiker im Beruf – Arbeitsmarktentwicklung, Einsatzmöglichkeiten und Demografie. Cologne 2010

Dostal, W.; Reinberg, A.; Schnur, P.: Tätigkeits- und Qualifikationsprojektionen – der IAB/Prognos-Ansatz. In: Kleinhenz, G. (ed.): IAB-Kompendium Arbeitsmarkt- und Berufsforschung. Beiträge zur Arbeitsmarkt- und Berufsforschung. BeitrAB 250, 2002, pp. 547-556

Hall, A.: Wechsel des erlernten Berufs. Theoretische Relevanz, Messprobleme und Einkommenseffekte. In: ZBW Special issue 24, 2010, pp. 157-173

Helmrich, R.; Zika, G.: Beruf und Qualifikation in der Zukunft. Bonn 2010

Hollmann, Ch.; Schmidt, J.; Werner, D.: Wie entwickeln sich angesichts des Strukturwandels zur Wissensgesellschaft und der Einführung der Bachelorstudiengänge die Chancen für duale Ausbildungsberufe und das duale System? Abschlussbericht eines Gutachtens für das Bundesministerium für Wirtschaft und Technologie. Cologne 2008

Maier, T.; Schandock, M.; Zopf, S.: Flexibilität zwischen erlerntem und ausgeübtem Beruf. In: Helmrich, R.; Zika, G. (eds.): Qualifikation und Beruf in der Zukunft. Bonn 2010

Meyer, B. et al.: National economic policy simulations with global interdependencies. A sensitivity analysis for Germany. In: Economic systems research (2007), Vol. 19, No. 1, pp. 37-55

Prognos AG: Arbeitslandschaft 2030. Projektion von Arbeitskräfteangebot und -nachfrage nach Tätigkeiten und Qualifikationsniveau. Munich 2008

Schnur, P; Zika, G. (eds): Das IAB/INFORGE-Modell, IAB-Bibliothek [IAB Library] 31. 2009

Tiemann, M. et al.: Berufsfeld-Definitionen des BIBB auf der Basis der Klassifikation der Berufe 1992. (BIBB Academic Research Discussion Paper series, No. 105) Bonn 2008 – URL: www.bibb.de/veroeffentlichungen/de/publication/show/id/2080 (retrieved 10.04.2010)

Tiemann, M.: Wissensintensive Berufe. (BIBB Academic Research Discussion Paper series, No. 114) Bonn 2010 – URL: www.bibb.de/veroeffentlichungen/de/publication/show/id/6176 (retrieved 10.04.2010)