LABOUR MARKET SURVEY

3.6 Data monitoring and trend analysis

GINOP-3.1.1-VEKOP-15-2016-00001

Encouraging and supporting cooperation between educational institutions and ICT businesses

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1. Executive summary

The aim of the research is to provide a summary of how to increase knowledge about ICT professions and their labour market needs in the context of the GINOP 3.1.1 - VEKOP-15-2016-0001 project - Encouraging and supporting cooperation between educational institutions and ICT enterprises.

This element of the research **assessed the demand side by analysing job advertisements**. The aim of the activity is to assess labour market needs for IT skills and competences. A key objective is to be able to identify the structure of labour market demand.

In order to monitor the market demand for ICT professionals and analyse trends, we built **a web scraper** to collect job advertisements in a structured format for later analysis. The 7 job portals included in the study are: cvonline.hu, jobline.hu, kellyservices.hu, kozigallas.gov.hu, profession.hu, randstad.hu, workania.hu. For the selection, we tested the traffic data of the largest job portals using Google Trends to select the seven most relevant ones (4 national, one public sector-focused and two consultancy-mediation (head hunter) sites). We also looked at the most important regional job portals in Hungary (5 regional job portals).

We also used **text mining techniques** to analyse the ads. Text mining is the processing and analysis of textual data to uncover new information hidden in the document.

The analysis used **time series analysis** to gain a deeper understanding of the data. The main characteristics of the job advertisements, such as regional data, distribution of typical keywords and job categories, typical job advertising platforms and the language of the advertisement, were included in the analysis.

In **total, 13,023 job ads** were collected by the web scraper between the sixth and thirtieth week of 2020. In the **analysis, we mainly examined the 10,706 job advertisements published between the seventh and the thirtieth week of 2020**,

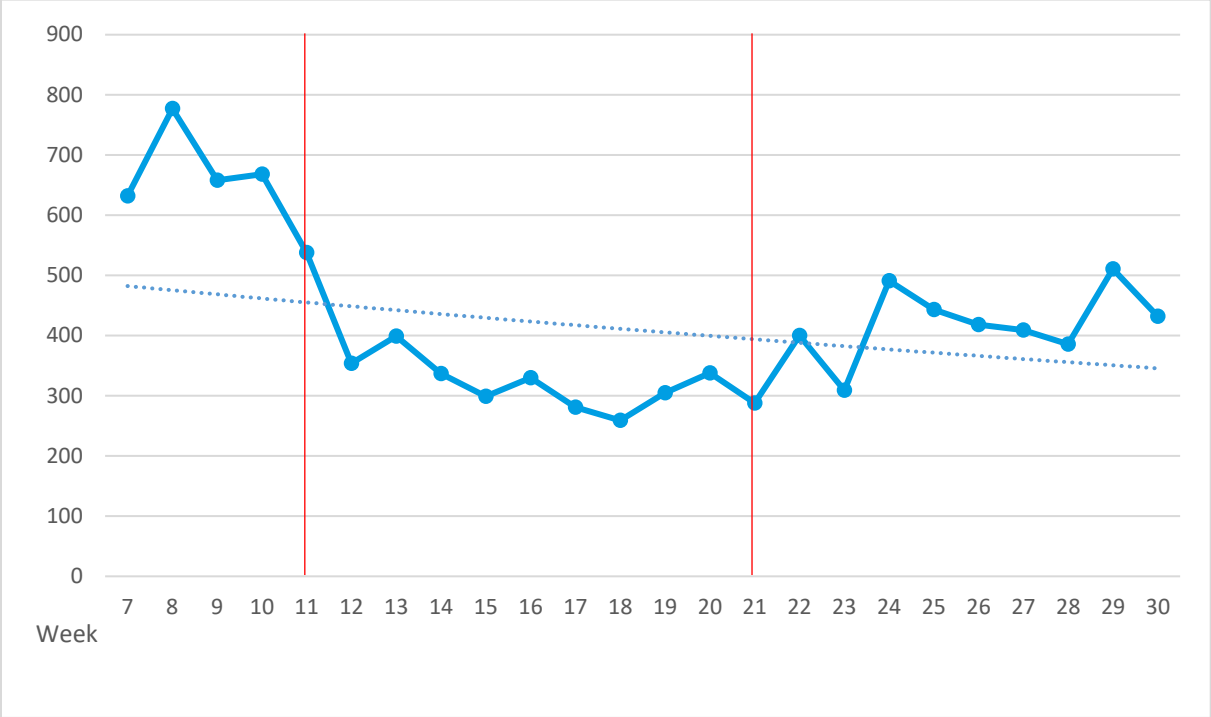
in time series and by job category, as this is the period with the most reliable data in terms of posting time[1].

In addition to the above, we also looked at the top 5 regional job portals. Regional job portals were first ranked by the total number of ads posted, and then the portals with the most ICT-related job ads in the last quarter were selected. Based on these, we chose the sites pecsallas.hu, budapestallas.hu, debrecenallas.hu, kecskemetallas.hu, miskolcallas.hu for the study. This list has been compiled on the basis of the total number of job advertisements on regional job portals, with the most relevant ones in the list. In the case of regional job portals, an almost negligible number of 17 ads appeared on the 5 job sites mentioned above during the period under review.

The number of job advertisements showed **a downward trend during the period under review**. This was mainly due to the epidemic. In the 7th-10th week of the year, there were still over 600 job advertisements per week, but in the 11th-12th week the number of newly posted job advertisements decreased significantly, fluctuating between 250-400 until the **24th week**. **Thereafter**, **growth is still slow**, presumably due to the summer holidays and the continued uncertain period.

[1] The data collection started on week six, so only estimated upload dates are available for job vacancies uploaded earlier. This makes it uncertain how many job advertisements were published in which week, which would increase the uncertainty of the time series analysis.

Figure 1: Trends in the number of IT job ads per week (N=10706)



Overall, the **largest number of job advertisements** appeared on **profession.hu (3,471)** during the period. This was followed by cvonline.hu (2,384), where the most ads appeared in weeks 7-8 and 10. Jobline.hu (1,745) and workania.hu (1,428) are also among the more significant market-based sites.

In addition to the number of ads, traffic figures also confirm the market leaders' position. In accordance with data from SimilarWeb's traffic monitoring service (between January and August 2020), the number of visits to the first-ranked profession.hu averaged 3.4 million people a month, while the number of visits to the second-ranked cvonline.hu was 315.9 thousand, and the number of visits to the third-ranked jobline.hu 207.5 thousand.

The **largest number of job advertisements appeared in Central Hungary** during the period under review. The 9,715 job ads in this macro-region are more than six times the number of online ads in the macro-regions of the Great Plain and North (1,525) or the Transdanubian region (1,378).

71% of the job advertisements, or 9,281 job advertisements in total, were published in Budapest during the period under review. The second most advertised region, the Northern Great Plain (810), accounts for only 6% of all job ads.

The region with the lowest number of job advertisements was the Western Transdanubia region, with only 220, which is less than 2% of all job advertisements.

Rural locations accounted for 30% of the ads in the period under review, but again, the **larger cities** tend to account for a larger share of these ads. One of the reasons for this may be that the infrastructure conditions necessary for IT companies to operate are typically best developed in larger settlements, especially in Budapest. Universities can also play a role in where a large IT company chooses to create jobs, as it is primarily from universities that the next generation of graduates is expected.

In total, nearly 7,300 advertisements mentioned the professional experience required. **Most of the ads were looking for people with 1-3 years' experience (3,401)**. A little over 2000 advertisements were looking for employees with 3-5 years of experience. More job vacancies accepted people with no experience (1,169) than those with more than 5 years' experience (668).

Higher education was the most sought-after qualification in the IT job market in the period under review, according to online job sites. Of the job advertisements, 8,407 stated that the employer required at least a higher education degree. Significantly fewer, a quarter as many job advertisements (2,113) indicated that a secondary education was acceptable for the job. in 749 cases, employers indicated that they require other qualifications (e.g. OKJ).

At the national level, programming skills, engineering technical skills, economics and business skills are generally the skills **most sought** by employers. Universities are the best place for workers to acquire this kind of knowledge.

English language skills are a clear requirement in the IT job market. Of the job advertisements, 9,587 mentioned that some knowledge of this language was required. **Almost 40% of job advertisements were in English**, which also shows the importance of this language. German language skills are expected to a great extent, with 2,795 job advertisements indicating that German language skills are required for the job.

English is the language most expected by businesses in Central Hungary (75%) among the macro-regions, but in all regions it is above 60%. **German is the language most often required by companies in the Great Plain and Northern**

macro-region (37%), but it is also required in a third of job advertisements in the Transdanubian region.

The importance of English is partly due to the fact that **multinational companies make up a significant part of the domestic IT labour market**, where, in addition to professional language use, everyday communication may require the use of English.

In addition to large international companies, the role of **intermediary companies** in the IT labour market is also worth highlighting. These recruitment agencies, such as Randstad (2,070) or Recruit Kft (700), uploaded the most job advertisements on online portals. A significant proportion of IT jobs are therefore advertised through intermediary firms.

Employers may have different expectations for different jobs, so we have looked at these separately.

Figure 2: Main characteristics of the jobs examined

	Software tester	Administrator	IT Manager	Data scientist
Number of ads placed	• 448	• 2620	• 546	• 1960
Language skills	• a foreign language (91%)	• a foreign language (63%)	• a foreign language (68%)	• a foreign language (70%)
Qualifications	• higher education (75%)	• higher education (74%)	• higher education (84%)	• higher education (77%)
Experience	• 1-3 years (56%)	• 1-3 years (32%)	• 1-3 years (40%)	• 1-3 years (38%)

	Database designer	Database developer	Web developer	DevOps Engineer
Number of ads placed	• 2508	• 2468	• 2846	• 3171
Language skills	• a foreign language (66%)	• a foreign language (66%)	• a foreign language (66%)	• a foreign language (65%)
Qualifications	• higher education (74%)	• higher education (74%)	• higher education (71%)	• higher education (70%)
Experience	• 1-3 years (36%)	• 1-3 years (36%)	• 1-3 years (37%)	• 1-3 years (37%)

	Mobile developer	***Software Developer***	***IT sales representative***	***Database Administrator***
Number of ads placed	• 2912	• 3046	• 261	• 2605
Language skills	• a foreign language (66%)	• a foreign language (65%)	• a foreign language (69%)	• a foreign language (62%)
Qualifications	• higher education (72%)	• higher education (76%)	• higher education (80%)	• higher education (74%)
Experience	• 1-3 years (37%)	• 1-3 years (36%)	• not expected	• 1-3 years (33%)

	Customer Service Representative	***Business analyst***	***IT project manager***	***IT systems designer***
Number of ads placed	• 474	• 407	• 904	• 2582
Language skills	• a foreign language (46%)	• a foreign language (55%)	• a foreign language (60%)	• a foreign language (66%)
Qualifications	• higher education (49%)	• higher education (77%)	• higher education (80%)	• higher education (74%)
Experience	• 1-3 years (47%)	• 1-3 years (33%)	• 1-3 years (38%)	• 1-3 years (35%)

From the 7th week of the year to the 30th week of the year, a total of 448 job advertisements were published for **software testers**. A job advertisement was typically open for 27 days during the period studied - the peak period was between weeks 13-15 (31 days). Almost 75% of the job vacancies surveyed require some form of higher education, 13% require intermediate education and 10% require non-formal qualifications (e.g. OKJ, ISTQB). Knowledge of a foreign language is required in 91% of job advertisements. 56% of employers require between 1-3 years of experience for the job, 19% 3-5 years and 3% more than 5 years. Of the 23 professional and other skills surveyed for software tester, employers expect the highest proportions of candidates to have engineering and technical, programming skills (77-77%) and economics and business skills (46%), based on the job advertisements surveyed.

During the period under review, a total of 2,620 job vacancies were advertised for **administrators**. A job advertisement was typically open for 26 days during the period - peaking in week 15 (30 days). Almost 74% of the job vacancies surveyed require some form of higher education, 15% require intermediate education and 3% require non-formal qualifications (e.g. OKJ, ISTQB). Knowledge of a foreign language is required in 63% of job advertisements, of which 62% are in English. For this job, 32% of employers expect 1-3 years of experience, 23% 3-5 years and 8% more than 5 years. Of the skills examined, programming skills were mentioned as an expected competence in nearly 86% of the advertisements. The second most frequently mentioned skill was engineering/technical skills, with 55% of the ads. Knowledge of economics and business is also important, mentioned in 45% of the ads.

During the period under review, a total of 546 job vacancies were advertised for **IT managers**. A job advertisement was typically open for 28 days during the period studied. Almost 84% of the job vacancies surveyed require some form of higher education, 13% require intermediate education and 3% require non-formal

qualifications (e.g. OKJ, ISTQB). Knowledge of a foreign language is required in 68% of job advertisements. 40% of employers require 1-3 years of experience for the job, 30% 3-5 years and 17% more than 5 years. Of the skills tested, 73% of the advertisements mentioned economics and business as an expected competence. In addition, quality assurance (68%) and programming skills (67%) are also mentioned.

A total of 1,960 job advertisements for **data scientist** jobs were published during the period covered by the survey. A job advertisement was typically open for 26 days during the period studied. Almost 77% of the job vacancies surveyed require some form of higher education, 19% require intermediate education and 3% require non-formal qualifications (e.g. OKJ, ISTQB). Knowledge of a foreign language is required in a large proportion of job advertisements. For the job, 38% of employers expect 1-3 years of experience, 31% 3-5 years and 7% more than 5 years. Among the skills tested, programming skills were mentioned as an expected competence in nearly 82% of the advertisements. The second most frequently mentioned skill was engineering/technical, with 72% of the ads. Knowledge of economics and business is also important, mentioned in 65% of the ads.

A total of 2,508 **database designer** job vacancies were published from week 7 to week 30 of 2020. On average, an advertisement for a database designer job was available for 27 days during this period. The vast majority (74%) of advertisers require a higher education degree. Knowledge of English is also dominant in this job category, with 66% of advertisements asking for it. In the period, 36% of job vacancies required 1-3 years of experience and a quarter required 3-5 years of professional experience. Employers most often mentioned programming skills as an expected competency in their advertisements (93% of advertisements). The second most sought-after skill is engineering/technical, in 60% of the ads. Business and economics skills were also significant, appearing in 49% of the ads.

During the period under review, 2,468 **database developer** jobs were published, which were available for an average of 27 days. 74% of the job vacancies were for professionals with a tertiary education. As regards language skills, 66% of the ads asked for English. In the period, 36% of job vacancies required 1-3 years of experience and a quarter required 3-5 years of professional experience. Of the skills surveyed, 93% of the advertisements most frequently cited programming skills as a

job requirement. In database development jobs, engineering/technical skills (60%) and business/economics skills (48%) are the most important.

During the period covered by the survey, 2,846 job advertisements for **web developer** jobs were published, which were open for an average of 27 days. In 71% of the job advertisements surveyed, advertisers require a higher education qualification. Advertisements typically require knowledge of a foreign language. English is the language considered most important, with 86% of ads requesting it. The experience most often sought by employers in the jobs shown is 1-3 years (37%), and in a quarter of the advertisements it is between 3-5 years. Of the skills surveyed, 92% of the job advertisements most frequently cited programming skills as a job-related competency. For web development jobs, engineering/technical skills (60%) and business/economics skills (49%) are the most important.

From week 7 to week 30 of the year, a total of 3,171 job advertisements were posted looking for **DevOps engineers** and employees who can perform both IT development and operations tasks. During this period, an ad was open for an average of 27 days. 70% of the advertisements in the sample expect their employees to have some form of higher education. On average, the advertisements published require knowledge of one foreign language, with employers in the Transdanubian region more often preferring knowledge of two foreign languages. English is the most important language, expected in 85% of job advertisements, and German in 21%. The experience most often sought by employers in the jobs shown is 1-3 years (37%), and in a quarter of the advertisements it is between 3-5 years. Of the 23 professional and other competences surveyed, employers expect the highest proportions of DevOps engineers to have programming (89%), engineering and technical (63%) and economics and business (57%) skills, according to the job advertisements surveyed.

The number of job advertisements for **mobile development** in the period under review was 2,912. The average lifetime of these job ads was 27 days. The most sought-after qualification is a degree at tertiary level, which is expected by 72% of job advertisements. 66% of mobile development job vacancies require English language skills. Employers are looking for people with 1-3 years of experience. Among the skills surveyed, employers expect the highest proportions of mobile developers to

have programming (92%), engineering and technical (61%) and economics and business (49%) skills, according to the job advertisements surveyed.

In the period under review, 3,046 job advertisements were published for **software developer** jobs. The ads were open for 27 days on average. 76% of the advertisements surveyed require a higher education degree to fill the job. 64% of the ads require English language skills, with German being the second most common (20%). 36% of the ads are looking for people with 1-3 years of experience and 25% are looking for people with 3-5 years of experience. For software developers, employers expect the highest proportions of applicants to have programming (90%), engineering and technical (61%) and economics and business (49%) skills among the skills surveyed, according to the job advertisements examined.

During the period covered by the survey, 261 job advertisements for **IT sales** jobs were published. The overwhelming majority of advertisements mention jobs in Budapest (84%). On average, the ads were open for 26 days. In terms of educational qualifications, the highest level of education required by advertisers is tertiary education (80%). English also seems to be an important language for this job, with 87% of advertisements asking for knowledge of the language. 40% of the job advertisements surveyed did not mention any professional experience or highlighted that they would hire without sales experience. Of the skills surveyed, employers expect the highest proportions of IT sales assistant candidates to have programming (75%), quality assurance (69%) and economics and business skills (63%), according to the job advertisements surveyed.

A total of 2,605 job advertisements for **database administrator, operator** were published in the period under review. Typically, the job vacancies were open for 26 days. Almost 74% of the job vacancies surveyed require applicants to have a higher education qualification. 61% of the advertisements ask for knowledge of English. In terms of professional experience, people with 1-3 years (33%) and 3-5 years (23%) of experience are generally sought. Of the skills surveyed, database administrator employers most often expect candidates to have programming (86%), engineering and technical (56%) and economics and business (45%) skills, according to the job advertisements surveyed.

During the period under review, a total of 474 job vacancies were advertised for **basic or intermediate level customer service** staff. The region of Central Hungary is the most popular for this type of job (72%). The average lifetime of job ads in this category was 30 days between weeks 7 and 30 of the year. For customer service representative, half (49%) of the job vacancies surveyed require applicants to have some form of higher education qualification, such as a degree in IT, engineering or a university degree. A third (34%) of job advertisements consider a secondary education to be sufficient. In terms of language skills, the data is mixed: 46% of ads ask for one language and 40% of ads ask for two. English only is requested by 43% of the ads. The highest proportion (47%) of jobseekers expect 1-3 years of experience, and the second highest proportion (21%) expect no experience. For customer service representative, employers expect the highest proportions of candidates to have economic and business (60%), engineering and technical skills and practical experience (51-51%) of the skills tested, based on the job advertisements surveyed.

There were 407 job advertisements for **Business Analyst** jobs in the survey period, 2/3 of which were in Budapest. A job advertisement was typically open for 23 days. 77% of job vacancies require candidates to have a higher education qualification. The advertisements published typically require knowledge of one language, with the exception of the Transdanubian region, where knowledge of two languages is more common. English is required in 96% of job advertisements. For the job, employers typically expect at least 1-3 years (33%) or 3-5 years of experience (26%). Of the skills surveyed, employers expected the highest proportions of candidates to have economics and business skills (57%), quality assurance skills (49%) and programming skills (46%).

From the 7th week of the year to the 30th week of the year, a total of 904 job advertisements were placed looking for **IT project managers** or employees with the skills to perform such tasks. Looking at the lifespan of job advertisements, a job was typically open for 28 days. 80% of the job vacancies examined require applicants to have a higher education qualification. One foreign language is required in 60% of job advertisements (typically English), with a further 31% requiring two languages. Of the experience requirements, 1-3 years of experience is the most common (38%), but 3-5 years is not far behind (30%). Of the 23 skills, professional and other skills

surveyed, the need for economic and legal skills (72%), engineering and technical skills (66%) and practical experience (57%) are the most frequently mentioned in the advertisements.

A total of 2,582 job vacancies for **IT systems designer** were published in 2020. A job advertisement was typically open for 27 days. In 74% of the job advertisements surveyed, advertisers require a higher education qualification. A large proportion of job advertisements (84%) expect employees to have a good command of English. The experience most often sought by employers in the jobs shown is between 1-3 years (35%), and between three and five years in a quarter of the advertisements. Employers expect the highest proportions of candidates to have programming (92%), engineering and technical (58%) and economics and business (49%) skills for IT systems designer jobs, based on the job advertisements surveyed.

2. Short summary of the project

The aim of the research is to provide a summary of how to increase knowledge about ICT professions and their labour market needs in the context of the GINOP 3.1.1 - VEKOP-15-2016-0001 project - Encouraging and supporting cooperation between educational institutions and ICT enterprises. The project will survey all the areas concerned:

- Demand side from businesses
- Supply side from professionals
- Output page from training institutions
- Expectations on output from companies and students

The aim of the data monitoring and trend analysis is to provide a detailed, regionally disaggregated picture of the market for ICT professionals. It is also crucial to understand the skills and qualifications needed in the domestic ICT labour market. The main reason for the need for the survey is that the labour market is undergoing a dynamic change which, due to its speed and its extension beyond the traditional ICT domains, official statistics are not able to capture and provide decision-makers with up-to-date and relevant information. The survey will help to identify which ICT jobs are most affected by the general shortage of labour in the field and what employers expect from jobseekers in these jobs, and will help to identify, for example, the types of training that need to be promoted to reduce the ICT shortage as much as possible.

The research will address the following questions:

- trend analysis of advertisements for available and public ICT-related jobs
- the IT skills, qualifications and language skills needed in each geographical area and the volume of jobs advertised
- the research will also examine previous research on the subject and produce data suitable for time-series comparison
- the research is adapted to the European Skills/Competences, Qualifications and Occupation (ESCO) classification system.

3. Presentation of available data and information

3.1. Literature review

László Csonka examined the situation of SMEs in the Hungarian ICT sector. The empirical study was based on an online questionnaire survey (summer 2009) and company interviews, complemented by the findings of expert roundtable discussions organised during the research. These show that services, including telecoms and software/information technology services, account for the largest slice of the European ICT sector (together they account for more than 60% of the market), with hardware and other equipment manufacturing being much smaller. Export orientation is an important feature of the Hungarian ICT sector as a whole. The role of foreign-owned enterprises in the sector, which have settled in Hungary mainly because of the positive conditions for the workforce here, may play a role in this.

In addition, a study on the situation of the Hungarian ICT sector was commissioned by the Association of Telecommunications and Information Science in Hungarian. Their study focuses on an international comparison of domestic SMEs in the ICT sector: the situation of the telecommunications sector, the quality of domestic IT services and the importance of the sector, its role in the Hungarian economy, and the main findings that can be drawn from these are presented: the applications are known. Among the summary findings is the fact that the companies operating in the sector cannot be treated in a uniform manner, and to overcome this, it is proposed to set up a group of experts with expertise in the ICT sector, which would be able to coordinate the sector's operations, support the increase of the competitiveness and added value of the domestic ICT sector, help in the development of international relations and assist in the process of tendering for innovation.[2]

Trends in supply and demand on the labour market in general, are dealt with in the volume Trends and Forecasts - Labour Market Forecasting, Structural Change on the Labour Market, edited by the Institute of Economics of the Hungarian Academy of Sciences. Among other things, it describes the labour market forecasting system developed by MTA KRTI KTI, the primary aim of which is to match supply and

[2] Source: Schmicom Ltd.: Opportunities to strengthen R&D and innovation activities of SMEs in the ICT sector, based on the identification of barriers. Working Paper, News Releases and Information Science Association. 2006.

demand on the labour market. The modelling system predicts labour demand and labour supply based on a 10-sector macro model predicting sectoral GDP. The supply model predicts the population's educational attainment, the proportion of active and inactive people by gender and age groups, while the demand model takes into account the forecast of employment rates in industries. It also takes into account international trends in labour demand, sectoral forecasts, the role of the SME sector and large firms in employment, estimates of the share of black and grey employment, atypical employment, changes in employment rates in the EU and labour market dynamics, using complementary models.[3]

On the basis of our literature review, we can say that there is little domestic experience with similar research designs, so it is worth looking for foreign and international examples.

Sobhi and Son (2009)[4] examined online job advertisements in their study of O.R. (operational research) using content analysis. In the study, they compared different content analysis methods used previously and then presented their own method. A keyword search was used, and then a "dictionary" was created in which words were hierarchically categorised, the method of which is described in detail in the paper. The categorical variables generated were analysed in several ways, using univariate, bivariate and multivariate methods, with frequencies, cross-tabulations and Spearman rank correlation. They believe that their method can be used for a comparative analysis of several areas and for monitoring changes in trends.

Omar et al. (2012)[5] examined the job placement skills of Malaysian jobseekers based on online job advertisements. They did their research on jobstreet.com.my, with ads heavily filtered. The qualitative data were quantified using a simple checklist. They then looked at, among other things, the qualifications, work experience and soft skills

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[3] Source: Bakó T., Cseres-Gergely Zs., Galasi P.: The Labour Market Forecasting System of the MTA KRTK KTI. In: Institute of Economics edited by Trends and Forecasts - Labour Market Forecasting, Structural Change in the Labour Market (Ed: Fazekas K. – Varga J.). 2013

[4] Sodhi, M.S. & Son, B-G. (2010) Content analysis of OR jobs advertisements to infer required skills. Journal of Operational Research, 61, 1315-1327. https://orsociety.tandfonline.com/doi/abs/10.1057/jors.2009.80 Last download: 03/12/2019

[5] Omar, N. H., Manaf, A. A., Mohd, R. H., Kassim, A. C., & Aziz, K. A. (2012). Graduates' employability skills based on current job demand through electronic advertisement. *Asian Social Science*, *8*(9), 103. https://pdfs.semanticscholar.org/855b/eae513dab019794dbbfc8f2a97e36254e2a8.pdf?_ga=2.39829347.1338182201.1575282531-14900526.1574932939 Last download: 03/12/2019

expected of new entrants. In their study, they concluded that young people are in need of development mainly in soft skills. In addition to soft skills, a university degree is important, but the degree qualification plays a negligible role in the selection process. The most important soft skills include good communication and interpersonal skills, knowledge of foreign languages and the ability to work in a team - important for problem solving, negotiating, learning and multitasking. The main reason for this is the horizontal and vertical communication within the company. In addition, good reading and writing skills are important, as well as a good presentation style. In addition to Malay, English and Mandarin are the main language skills required - which is often a problem due to the lack of English.

The study identifies the reduction in graduate unemployment as a result of the development of such soft skills, in which higher education institutions play a major role. One solution is to forge closer links between universities and businesses in the industry, professional organisations and society as a whole. This cooperation could take the form of professional, practical opportunities, joint seminars, student mobility and other development programmes. In addition, the development needs of the sector could be linked to the research directions of universities.

Ark van, B. (2015)[6] researched the impact of the ICT sector on the European and US economies since the 1990s. He has also researched workforce training and organisational innovation as part of economic competences. His research was carried out by analysing secondary data. The research found that Europe has been less able to take advantage of the opportunities offered by digitalisation in economic terms, despite the fact that there is no economic reason for its failure: it is one of the world's largest single markets, with a high GDP, high income and productivity, and a high level of innovation. The fact that services are the continent's largest sector could be an additional advantage in the field of digitalisation. The digitalisation of the market enables more efficient operations, helping successful companies, start-ups

[6] van Ark, B. (2015). Productivity and Digitilization in Europe: Paving the Road to Faster Growth. DIGIWORLD ECONOMIC JOURNAL, no. 100, 4th quarter. 2015, p. 107. https://ssrn.com/abstract=2845368 Last download: 02/12/2019

and other innovative SMEs to grow. In this context, it is important that the Single Market places greater emphasis on supporting the ICT sector.

Hong (2015)[7] used content analysis to investigate online job advertisements focusing on geographic information systems (GIS) professionals (analysts, programmers, engineers). The author collected 1,000 advertisements from several US websites and then categorised the jobs. He then collected the skills mentioned in the advertisements, which he also categorised, and also carried out a cluster analysis. He also observed trends over the period and found that there is a growing demand for technical knowledge and soft skills. Although different skills were the most important for different job categories, soft skills appeared in the list of most important competences in all cases. Of the 31 skills tested, communication skills came out on top, ahead of many of the skills related to the profession. In addition, the development and maintenance of appropriate contacts also plays an important role in employment. This confirms that workers in the field use general skills such as time management, writing, critical thinking much more than technical skills. Recently, this trend has become more and more pronounced: not only communication and interpersonal skills are now often mentioned in job advertisements, but also problem-solving skills and project management skills - an increasing proportion of the general knowledge expected from employees. The right employee can articulate and communicate information well, can see problems and find solutions, can manage professional projects - and has the right level of technical knowledge. The study lists several options to help those looking for work in the sector. To acquire the right technical knowledge, it is important to develop database development and query skills, and to learn programming languages. The development of generic skills can be achieved if they are also embedded in general, vocational courses. Such related good practices include:

- writing and presenting papers;
- courses to prepare for public speaking;
- teamwork during lessons;
- project-based tasks.

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[7] Jung Eun Hong (2016) Identifying Skill Requirements for GIS Positions: A Content Analysis of Job Advertisements, Journal of Geography, 115:4, 147-158 https://doi.org/10.1080/00221341.2015.1085588 Last downloaded: 03/12/2019

These will help students develop their writing, presentation, networking, negotiation and project management skills - in line with their technical knowledge.

Katarina Pažur Aničić and co-authors (2016)[8] conducted a meta-analysis of 761 studies at the summary level and 155 additional studies at the in-depth level, examining the ICT sector workforce competences and changes in market needs. In addition to increasing knowledge base, taking advantage of internship opportunities and alumni network can also contribute significantly to a successful job search.

Messum et al. (2016)[9] examined previous research using content analysis of online job advertisements to inform university curriculum developers. They wanted to know what difficulties and opportunities had been identified in previous studies. The objectives, data collection methods and analysis methods of the studies were summarised and compared. It was suggested that it would be necessary to work with larger data sets to increase reliability, and that it would be useful to use cluster analysis alongside frequency tables to obtain more relevant and practical information.

Gardiner et al (2018)[10] examined online job advertisements that included the term big data in their title. Job-related skills were analysed using a computer-assisted content analysis method and systematized using the consensus pile-sort protocol (CPSP). A significant part of the paper is devoted to the description of the data collection and the three-phase CPSP methodology and its application to the data under study. The paper also refers to a more detailed description of the CPSP method. At the end of their research, they included a summary table of skills requirements for big data jobs. The table shows that the job is varied, but that development skills are typically required.

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[8] Aničić, K.P. (2016). Preparing ICT Graduates for Real-World Challenges: Results of a Meta-Analysis. https://ieeexplore.ieee.org/abstract/document/7795180 Last download: 03/12/2019

[9] Messum, D., Wilkes, L., Peters, K., & Jackson, D. (2016). Content analysis of vacancy advertisements for employability skills: Challenges and opportunities for informing curriculum development. Journal of Teaching and Learning for Graduate Employability, 6 (1), 72-86. https://pdfs.semanticscholar.org/142f/6e9f0f229fcf1509a5b8fd89bac310cf36dd.pdf Last download: 03/12/2019

[10] Adrian Gardiner, Cheryl Aasheim, Paige Rutner & Susan Williams (2018) Skill Requirements in Big Data: A Content Analysis of Job Advertisements, Journal of Computer Information Systems, 58:4, 374-384 https://doi.org/10.1080/08874417.2017.1289354 Last download: 03/12/2019

Brooks et al (2018) examined online job advertisements for IT security professionals at[11]. They used four keywords in their 30-day search and then used NVivo qualitative analytics software to visualise the most common items. These were grouped into four categories based on the so-called "consensus pile-sort protocol" used by the Gardiners. Anomaly analysis was used to filter out the erroneous data, and then the multi-word phrases were analysed and filtered against a compiled word list. They then looked at the frequency with which the terms occur. They also found that soft skills are important for IT security professionals, and that education and qualifications play an important role. A significant proportion of the advertisements, 98%, mentioned professional experience as a requirement - the proportion of junior jobs was very low - suggesting that security is not an entry level position in the sector. In terms of the names of the positions, security engineers are in first place, followed by security analysts and then application developers. In total, the research identified six categories of soft skills: teamwork, communication, literacy, planning, travel and motivation - with teamwork skills being the most common. This is followed by communication and literacy, with motivation coming last. In addition to the skills mentioned above, education played an important role in the advertisements surveyed, with 83% of positions requiring a bachelor's degree or higher.

Peng Dongcheng, in his research (2018)[12], wanted to invent a more efficient and faster way to collect data than he had ever known before. Based on this analysis, two methods for targeted data collection were tested in the labour market: the Python standard libraries and the Scrapy crawl framework, the latter of which proved to be more effective.

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[11] Nita G. Brooks, Timothy H. Greer & Steven A. Morris (2018) Information systems security job advertisement analysis: Skills review and implications for information systems curriculum, Journal of Education for Business, 93:5, 213-221 https://doi.org/10.1080/08832323.2018.1446893 Last download: 03/12/2019

[12] Dongcheng, P. (2018). Research on Information Collection Method of Shipping Job Hunting Based on Web Crawler.http://eds.b.ebscohost.com/eds/detail/detail?vid=0&sid=4d9e8f10-6b1c-446f-9e80-9132c3234478@pdc-v-sessmgr03&bdata=Jmxhbmc9aHUmc2l0ZT1lZHMtbGl2ZQ==#AN=edseee.8426183&db=edseee Last download: 03/12/2019

Verma et al (2019)[13] examined job advertisements for BI analyst, business analyst, data scientist and data analyst on Indeed.com. The job descriptions were collected using a web scraper. Their content was grouped according to a predefined system of categories, and then the skills and qualifications required for each job were compared by frequency. The job ads collected were grouped into four main categories: business analyst, BI analyst, data analyst and data scientist. Within each position, the main skills were identified and five categories were identified. These include decision-making experience, data management, organisational knowledge, communication, statistical knowledge and programming. There are also 5-5 skills within each category. The business analyst position required the least technical knowledge, but a higher level of economics. In comparison, the BI analyst position was advertised more for data analysis and statistical skills. Compared to data analyst jobs, data scientist jobs required a higher level of statistical and programming skills in the advertisements. Soft skills were also important in each of these positions.

3.2. Definition and delimitation

The concepts followed in the previous element of the research were used in the data collection. Three methods were used to select the relevant jobs:

- for one third of the large sample survey on Theme 1 (N=856 completed interviews), data collection was stopped and the most relevant IT jobs in the ICT and non-ICT sectors in terms of prevalence and number of interviews were identified from the current data.
- to validate this, we also used actual scraping data: we looked at the most important IT jobs based on job advertisements.
- the results of the large sample survey and scraping were validated and finalised by a team of ICT experts, researchers and HR staff.

[13] Amit Verma, Kirill M. Yurov, Peggy L. Lane & Yuliya V. Yurova (2019) An investigation of skill requirements for business and data analytics positions: A content analysis of job advertisements, Journal of Education for Business, 94:4, 243-250 https://doi.org/10.1080/08832323.2018.1520685 Last download: 03/12/2019

Along these lines, the following jobs were considered as IT jobs:

IT, telecommunications manager

IT, telecommunications manager, project manager	IT, telecommunications manager
	IT project manager

Telecommunications expert

Telecommunications expert, engineer	Telecommunications expert, engineer

IT sales representative, sales consultant

IT sales, IT sales consultant	IT sales representative

System designer, consultant, business analyst, software developer, project manager

System designer, architect, business analyst (expert, consultant, systems engineer, agile/SCRUM expert)	AI expert, artificial intelligence expert
	IT systems designer, IT architect
	System integration engineer
	IT consultant, IT consultant
	Business analyst, Business analyst
	IT systems engineer, Systems engineer
	Embedded System Designer
	Integration systems engineer, System integration engineer
	Customer experience analyst, User experience analyst
	Cloud technology expert, Cloud architect
	Business management, teamwork system expert (ERP, SAP, CRM, Exchange, Sharepoint)
	Agile professional
	SCRUM Master
Software developer, software engineer (designer, programmer, mobile developer, industrial and IoT, game, UI developer, DevOps	User interface (UI) developer
	Software developer
	Software engineer, Software development engineer
	Software architect, Software designer
	Business Application Developer
	Mobile developer
	Industrial application developer, IoT developer
	Industrial robot programmer
	Game developer
	Embedded system developer

engineer)	DevOps Engineer (Development and Systems Engineer)
Web and multimedia developers, search engine optimisation SEO specialists	SEO (search engine optimisation) expert
	Web developer
	Web Content Manager
Software tester, quality assurance specialist	Quality assurance specialist
	Software tester

Database designers and developers, Data experts and analysts

Database and data warehouse designer, developer, administrator	Database Administrator
	Database developer
	Database integrator, Data engineer
	Database designer, Data architect
	Data warehouse architect, Data warehouse architect
Data Analyst, Data Scientist, Data science, Business Intelligence	Data analyst, Data scientist
	Business intelligence developer, BI developer
	Business Intelligence Analyst, BI analyst

Administrators, infrastructure managers

System Administrator, General System Administrator	System Administrator, General Network Hardware Software Administrator

Network engineers and IT security professionals

Network designer, network systems engineer	Network designer
	Network systems engineer, Network engineer
IT security consultant, manager, expert, auditor, ethical hacker	IT security administrator
	IT security manager
	IT security advisor
	IT Security Manager
	Ethical hacker, Penetration tester
	Digital forensics expert

Operational technicians, support staff, customer service

Database administrator, operator	Database administrator, operator
Customer Service, Support, Helpdesk, Level 1-2 support	Basic customer service/support associate, helpdesk, level 1 support
	Mid-level customer service/support associate, level 2 support
General administrator technician, network builder, operations support	General administrator technician
	Networking technician
	Technical technician
Web server operator, Internet administrator	Internet administrator, web server administrator

Mechanics, technicians, repairers

IT and telecommunications technician, fitter	Information technology / telecommunications technician, fitter

3.3. Theoretical and practical relevance

The priorities of the Operational Programme for Economic Development and Innovation (GINOP) and the Operational Programme for Competitive Central Hungary (VEKOP) aim at improving labour supply by supporting skills development and training, and at improving the training system in line with economic needs. The research is of particular importance as the international and domestic labour market demand for professionals related to the IT and digital economy is dynamically growing - despite this, the number of people applying for and completing IT training has been steadily declining over the past decade, and has only shown moderate growth in recent years. The development of the digital economy depends on a skilled workforce, the lack of which is already having an impact today and will increasingly hamper competitiveness in the coming years, both at the national economy and at the enterprise level.

Interventions are needed to reduce labour shortages in the IT sector - to increase the number of applicants to higher education courses in IT, and to update the content of higher education IT courses to meet the real needs of the market for graduates.

Increasing the number and quality of people with IT skills can boost both economic output and employment.

This will include a detailed analysis of the market demand for ICT professionals, broken down by region. The aim is to find out what skills and qualifications are needed in the domestic ICT labour market. The monitoring system set up along these lines should be able to summarise demand on job portals and forecast the resulting trends.

3.4. Methodology

In order to monitor the market demand for ICT professionals and analyse trends, we built a web scraper to collect internet job advertisements in the field in a structured format for later analysis. The 7 job portals included in the study are: cvonline.hu, jobline.hu, kellyservices.hu, kozigallas.gov.hu, profession.hu, randstad.hu, workania.hu. For the selection, we tested the traffic data of the largest job portals using Google Trends and selected the 7 most relevant ones[14]. The database collected by the scraper, which operated between 30/01/2020 and 28/07/2020, contains a record of 13,023 job advertisements. The data included in the analysis are from 10/02/2020 to 26/07/2020 (weeks 7 to 30 of 2020), representing a total of 10,706 records.

We also looked at the most important regional job portals in the country. Regional job portals were first ranked by the total number of ads posted, and then the portals with the most ICT-related job ads in the last quarter were selected. Based on these, we chose the sites pecsallas.hu, budapestallas.hu, debrecenallas.hu, kecskemetallas.hu, miskolcallas.hu for the study. This list has been compiled on the basis of the total number of job advertisements on regional job portals, with the most relevant ones in the list. In the case of the regional job portals, the number of advertisements was almost negligible, with a total of 17 in the period under review.

The portals do not have a uniform structure and different data content, so it was necessary to filter duplicates based on the URLs of the ads, to reorganise the data into a uniform structure and to address data gaps before starting the analysis. Data

[14] In the case of the national job portals, 5 primary and 2 back-up job portals were selected on the basis of preliminary risk management criteria.

gaps occurred mainly in the date fields, which are essential for time-series analysis, and estimation was used to deal with them.

Several methods were used to estimate the activity time of job advertisements based on the date fields, and the most appropriate method for the database was selected later. One such estimation method was the Random Forest (RF) algorithm. A Random Forest is a machine learning algorithm that aggregates the outputs of several different decision trees after constructing them. The result is a decision forest that can estimate what missing values can take based on existing variables. The result of the algorithm is a non-integer number, rounded to the nearest integer in each case according to the rounding rules. The variables used for imputation are: 'platform', 'language', 'County', 'Region', 'Macroregion', 'first_appearance'.[15]

The next estimation method used was KMeans (K-means). KMeans is an algorithm that creates a predefined number of groups and places all points into one of them. This was used to estimate the group to which each job belongs, based on existing variables, and then impute the missing values by the group average. The result of the algorithm is a non-integer number, rounded to the nearest integer in each case according to the rounding rules. The variables used for imputation are: 'platform', 'language', 'County', 'Region', 'Macroregion', 'first_appearance'.

The third method used is the K Nearest Neighbor (KNN) algorithm. K Nearest Neighbor is a machine learning algorithm that determines the five closest (in this case, Euclidean distance) other jobs to a given job based on various variables, and imputes their average *job_open* (the duration of job advertisement activity in days). The result of the algorithm is a non-integer number, rounded to the nearest integer in each case according to the rounding rules. The variables used for imputation are: 'platform', 'language', 'County', 'Region', 'Macroregion', 'first_appearance'.

After reviewing the results, we decided to use the KNN method, as the distribution of results estimated by this method best matched the distributions of the original database in terms of date fields.

We also used text mining techniques to analyse the ads. Text mining is the processing and analysis of textual data to uncover new information hidden in the

[15] A description of the variant names referred to can be found in the Annex

document. In doing so, it draws primarily on the methods of computational linguistics and language technology. During the research, the variables for the analysis were created by examining the text body (description) of the advertisements and the keywords provided in the advertisements using Python code.[16]

The analysis uses time series analysis to gain a deeper understanding of the data. The main characteristics of the job advertisements, such as regional data, distribution of typical keywords and job categories, typical job advertising platforms and the language of the advertisement, were included in the analysis. In addition, the length of time a job advertisement is active, i.e. the time elapsed between its publication and its inactivity, is an important analytical criterion.

When examining job competences, we created 4 knowledge groups based on the nature of the competences. The first group is general professional skills, including programming skills, database management skills, knowledge of artificial intelligence (AI) applications and IT security skills. The second group is the contextual knowledge group, which includes engineering and technical knowledge, economics and business knowledge, general legal knowledge, industry knowledge and mathematical knowledge. The third group is methodological skills, which includes practical knowledge of agile methodologies, project management skills, quality assurance skills and knowledge of business intelligence (BI) tools. The skills group is the largest, and includes practical experience, structured thinking, teamwork, presentation skills, creativity, communication skills, empathy, problem-solving, time management and the ability to work independently.

Other job-specific competences for each job are not considered in this analysis.

[16] The way in which the variables are constructed can be found in the Annex.

4. Presentation of general trends

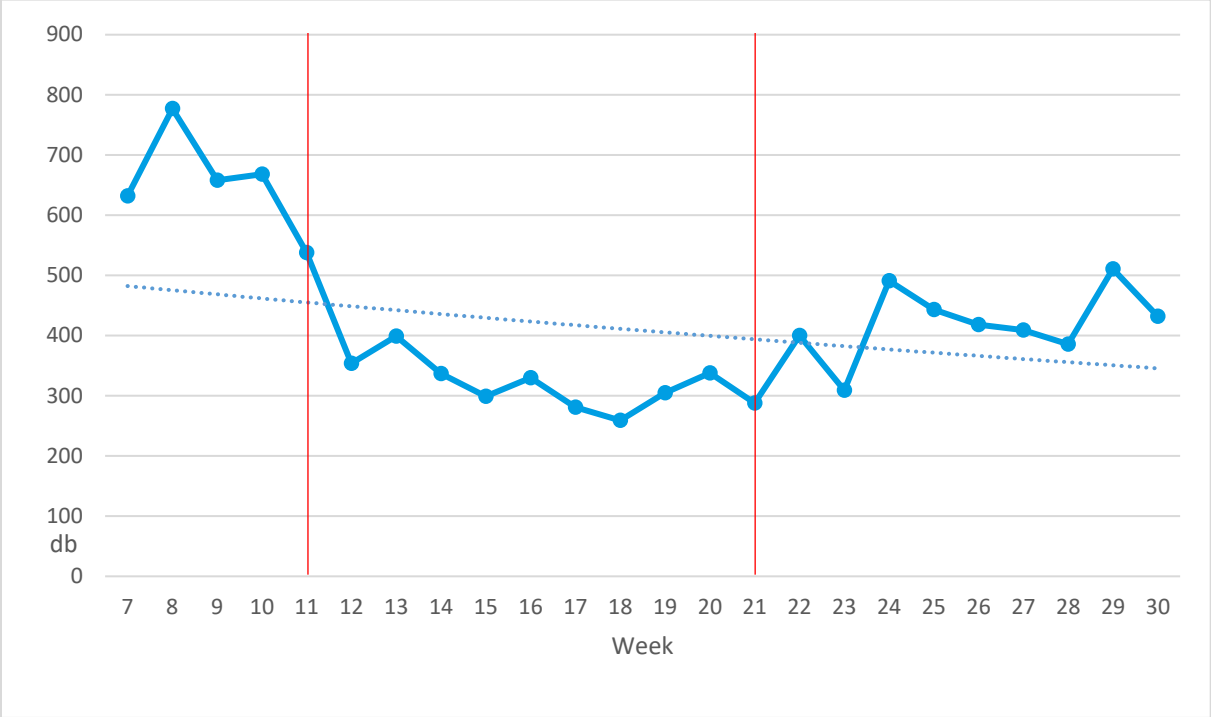
4.1. Trends in the number of job ads on the portals surveyed

During the survey, a total of 13,023 job advertisements were collected by web scraper from the job portals cvonline.hu, jobline.hu, kelly services, kozigallas.gov.hu, profession.hu, randstad.hu and workania.hu. In the analysis, we mainly examined job advertisements (10,706) published between the seventh and the thirtieth week of 2020, in time series and by job category, as this period provides the most reliable data in terms of posting time.

Due to the cyclical nature of the labour market and the COVID-19 epidemic situation in the data collection, the trends presented should be treated with caution. The period of the epidemic from the first measures to the peak is marked by red lines on the graphs. The data are presented by week, with one data point representing one week of new job advertisements. Although the number of advertisements in the period under review is lower than in the normal period, the spatial proportions and the typical skills required are not expected to have changed significantly during the epidemic. We suspect that this may be because IT firms were able to operate during the epidemic, albeit at reduced capacity, due to the nature of their work. Businesses are unlikely to have moved during the period so presumably the spatial proportions have not changed significantly. The tasks to be carried out are unlikely to have changed much, so we do not expect significant changes in the expected competences. There are differences in working conditions, so it is possible that companies expect more autonomy from workers.

The number of job advertisements showed a downward trend during the period under review. This was probably mainly due to the epidemic situation. In the 7th-10th week of the year, there were still over 600 job advertisements per week, but in the 11th-12th week the number of newly posted job advertisements decreased significantly, fluctuating between 250-400 until the 24th week. Thereafter, growth is still slow, presumably due to the summer holidays and the continued uncertain period.

Figure 3: Trends in the number of IT job ads per week (N=10706)



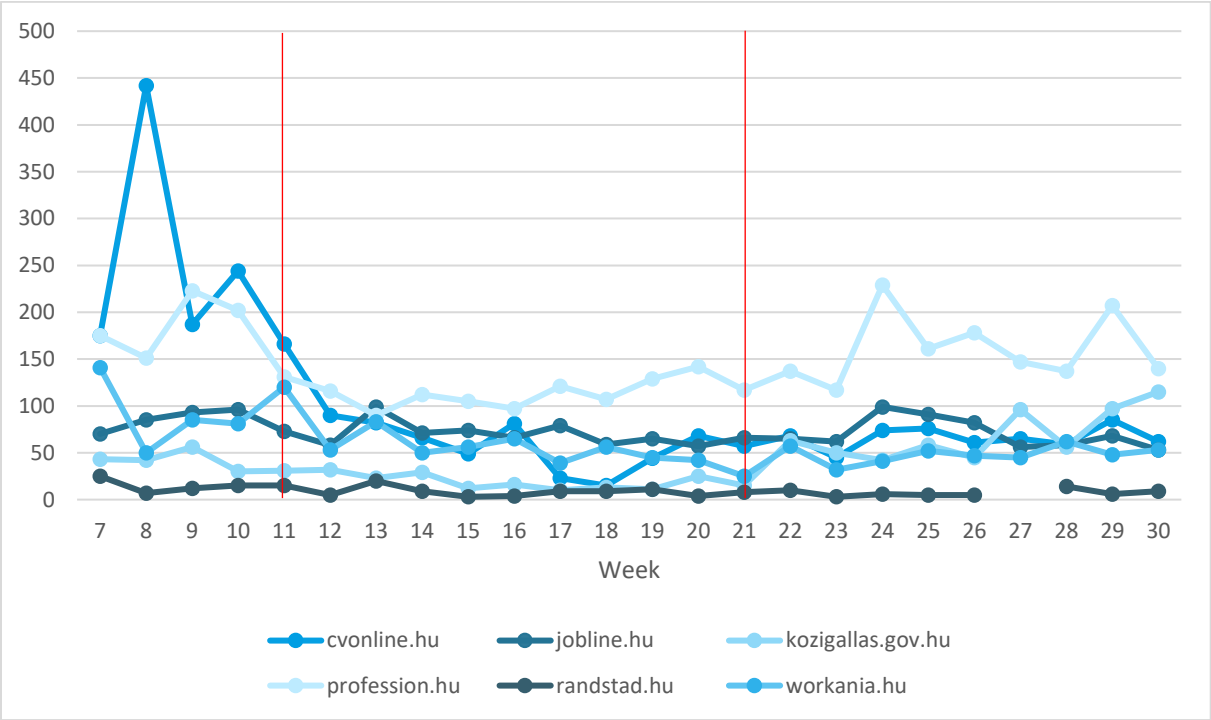
Overall, the largest number of job advertisements appeared on profession.hu (3,471) during the period. This was followed by cvonline.hu (2,384), where the most ads appeared in weeks 7-8 and 10. Jobline.hu (1,745) and workania.hu (1,428) are also among the more significant market-based sites. The number of administrative jobs was also considerable, with more than 1,000 vacancies advertised during this period. The fewest job vacancies were published by job agencies, with 214 jobs at randstad.hu and only 35 at kellyservices.hu.

The web scraper ad detection time[17] did not differ significantly between job portals. Typically, it takes on average 1-2 days after the upload time to find the job advertisements you are looking for. The kellyservices.hu site took the longest to find, with an average of 4 days, but also had few results overall. A few job portals also had larger fluctuations. On cvonline.hu, the detection time increased to 21 and 14 days in weeks 18-19. In addition, on randstad.hu, there was an outlier in week 16 (8 days). The fastest downloading web scraper was from kozigallas.gov.hu, where it took on average less than a day to find a job advertisement. On profession.hu and workania.hu the scraper also found the job ads quickly, in just over 1 day after

[17] The time elapsed before the ad was noticed. The number of days between the time the ad first appeared in the database and the time it was uploaded.

uploading. The delay between the uploading and the downloading of the job advertisement by the scraper depends on the authorisation procedures of each job portal, so the time between the uploading and the validation and the activation of the job advertisement may be longer than 1 day, for some job portals, hours or days.

Figure 4: Evolution of the number of job ads on each job portal (N=10706)



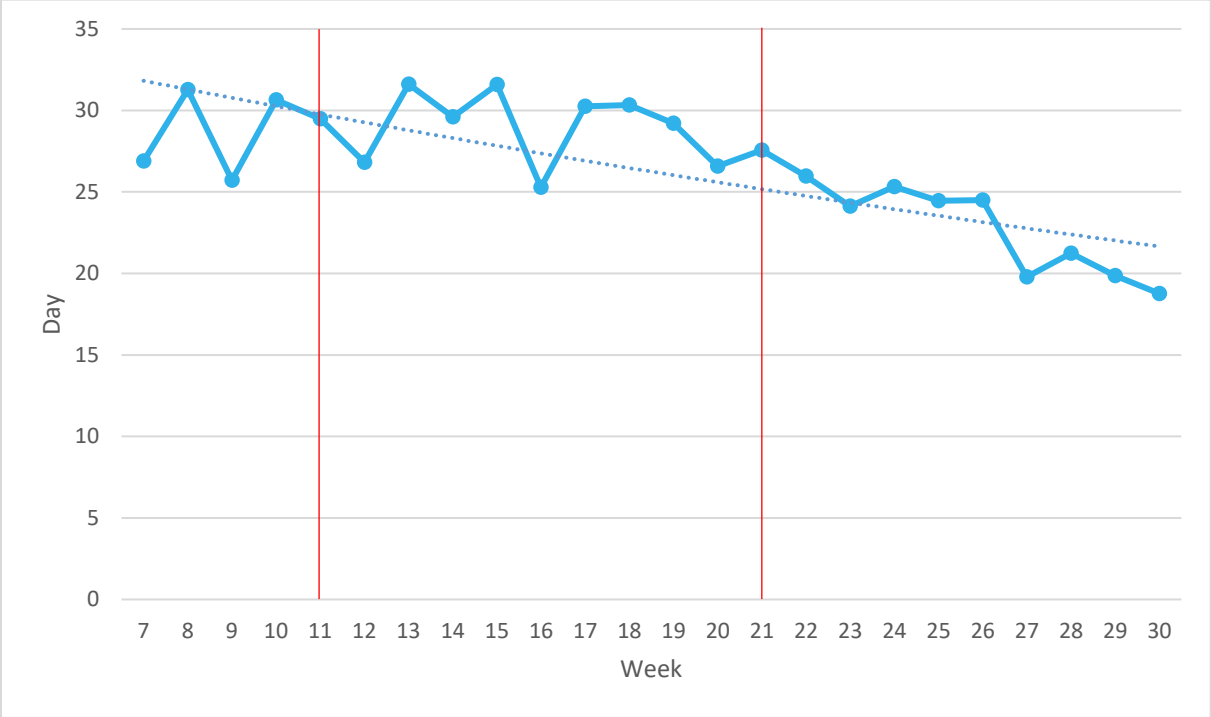
The biggest job portal is profession.hu, which publishes 1-2 thousand more IT jobs than its competitors. For those looking for a job in the IT job market, profession.hu offers the widest range of jobs, so IT jobseekers are most likely to find a job on this site.

4.1.1. The lifetime of job advertisements and its evolution

The lifetime of a job ad is the time from the time it is uploaded to the time it is taken down, measured in days. In cases where there was no data on the time for which ads were uploaded, an estimate was used to fill the data gap.

For a significant part of the period under review, from week 7 to week 22, the average number of days the ads were open was 26-31. After week 22, this time started to decrease. For job advertisements posted in week 30, the advertised position has been removed in as little as 20 days, according to the data.

Figure 5: Lifetime of IT job advertisements published in the period under review (N=10706)



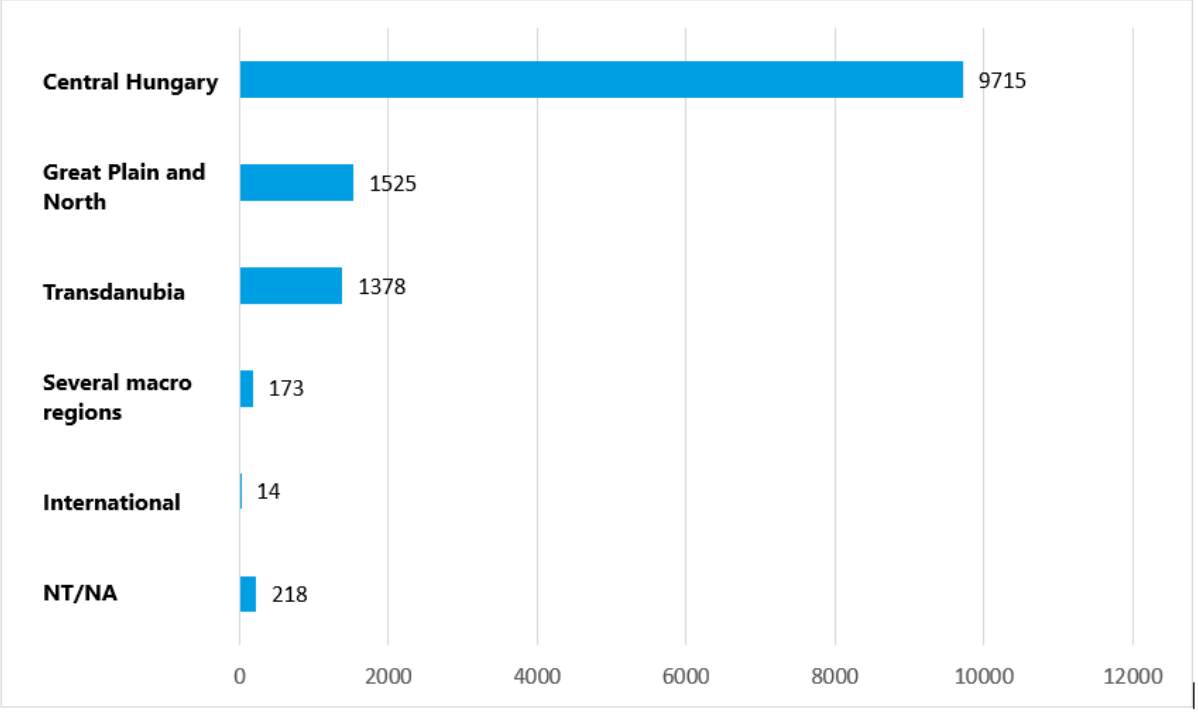
We can therefore conclude that the number of job advertisements has been on a downward trend over the period under review, but the market has started to recover somewhat as the epidemic has subsided. A look at the lifespan of job advertisements shows that businesses are filling vacancies faster and faster.

4.2. Territorial distribution of job advertisements

An important element of the presentation of the IT job market in Hungary is the analysis of the regional distribution. Throughout the chapter, we will move from the larger regions to the smaller units. In this section, we use the data collected by all web scrapers and show in total how many job ads appeared in which part of the country during the period of collection.

First, we looked at the macro-regional division. The macro-regions are the Central Hungary, Great Plain, North and Transdanubia regions, in addition to which there were job advertisements in which several job vacancies in different regions appeared at the same time. In this case, these advertisements have been grouped into the multi-macro category. In addition, there were a few advertisements that mentioned a foreign location and several that did not include a work location.

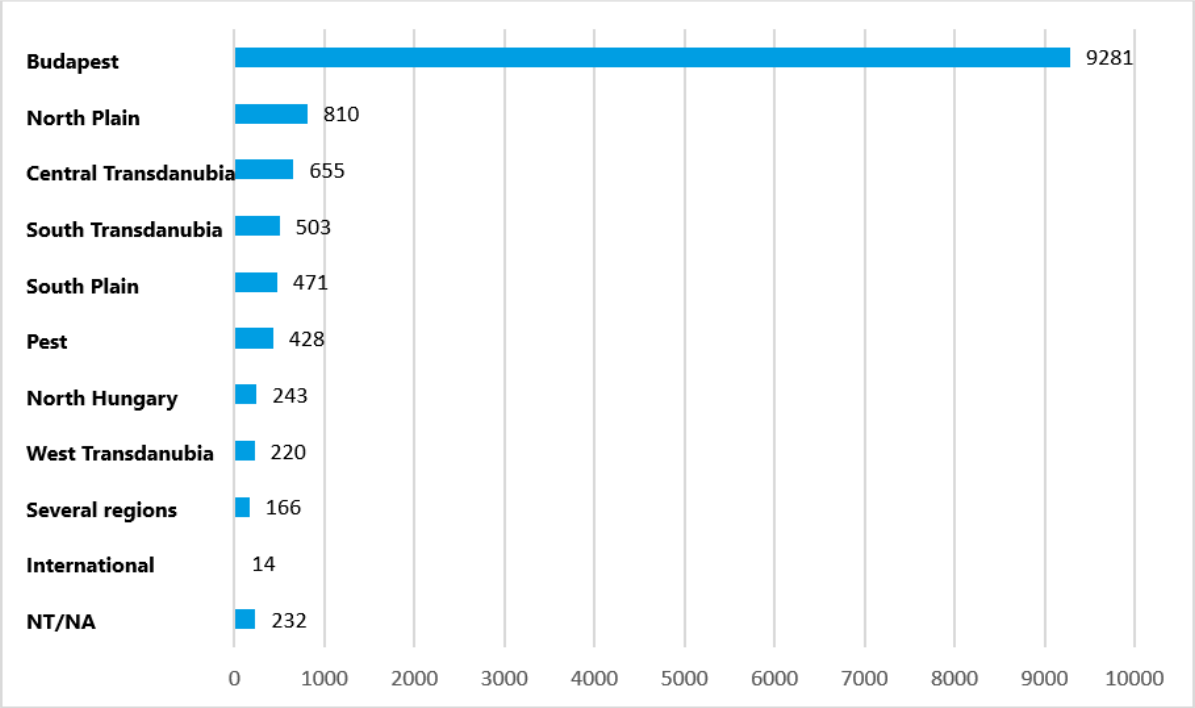
Figure 6: Number of IT job advertisements by macro-region in the period under review (N=13023)



The largest number of job advertisements appeared in Central Hungary during the period under review. The 9,715 job ads are more than six times the number of online ads in the Great Plain and North (1,525) or the Transdanubian region (1,378). More macro-regions were advertised in 173 cases, while there were only 14 calls for jobs abroad.

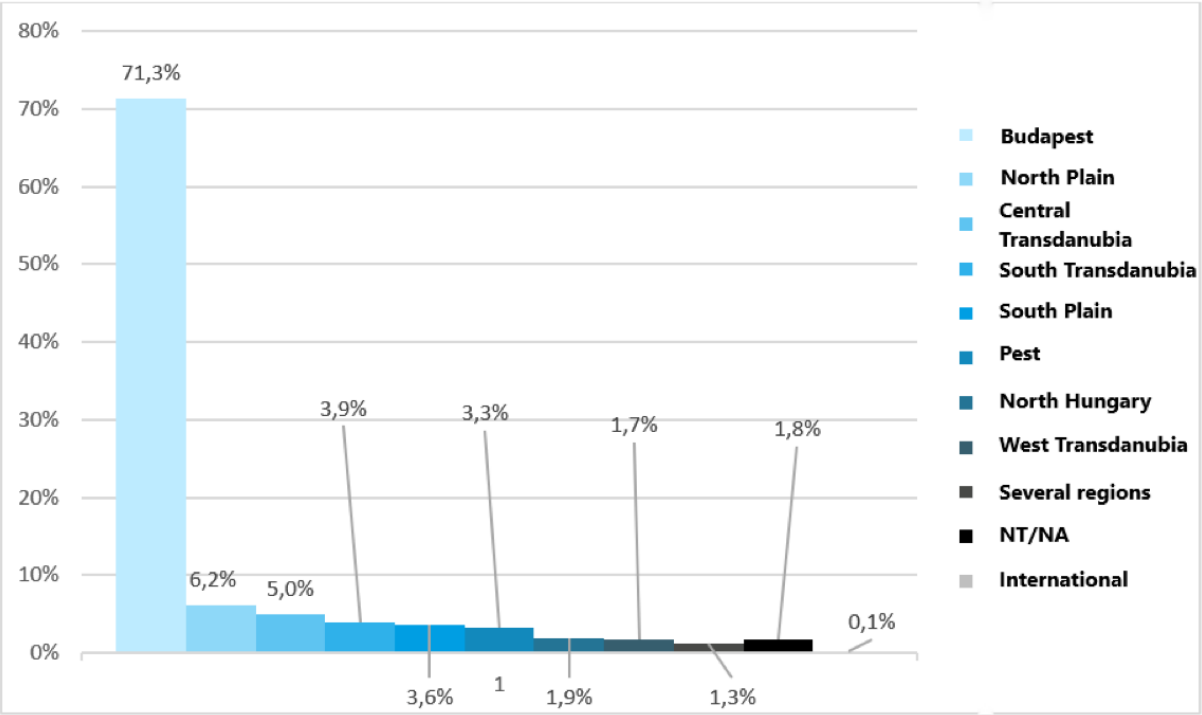
In addition to the macro-regions, we have also broken down the online job advertisements published in the period under review into individual regions of Hungary. This breakdown gives a more accurate picture of where IT workers are most in demand in Hungary.

Figure 7: Number of IT job advertisements published in the survey period by region, with Budapest and Pest county highlighted (N=13023)



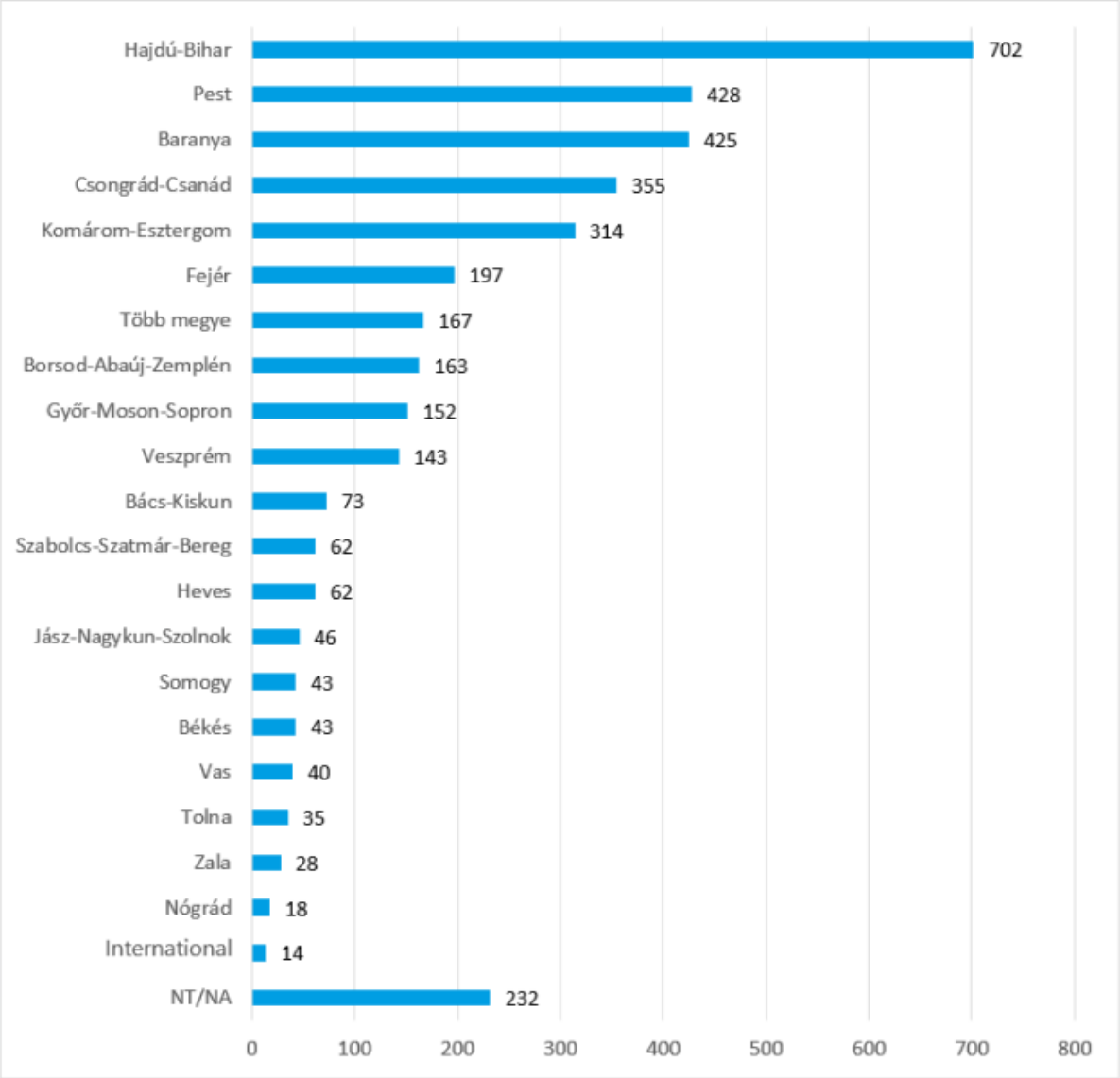
As can be seen in the graph above, 9,281 job advertisements were published in Budapest during the period under review, which represents 71% of all job advertisements. The second most advertised region, the Northern Great Plain (810), accounts for only 6% of all job ads. The region with the lowest number of job advertisements was the West Transdanubian region, with only 220 job advertisements, which is less than 2% of all job advertisements. In the next subsection we will also present the evolution of the number of job advertisements, where we will see that the regional proportions did not change significantly during the COVID-19 epidemic period, with Budapest having the highest number of job advertisements throughout the period.

Figure 8: Percentage of IT job advertisements by region in the survey period (N=13023)



If we break down the regions further and look at job advertisements at county level, we see even greater differences. Outside Budapest, the county with the most job ads was Hajdú-Bihar (702), followed by Pest and Baranya counties with just over 400 job ads. There were also 7 counties with fewer than 50 IT job vacancies posted online during the period. Nógrád County had the lowest number of IT professionals (18 ads).

Figure 9: Number of job advertisements published in the survey period by county, excluding Budapest (N=3510)

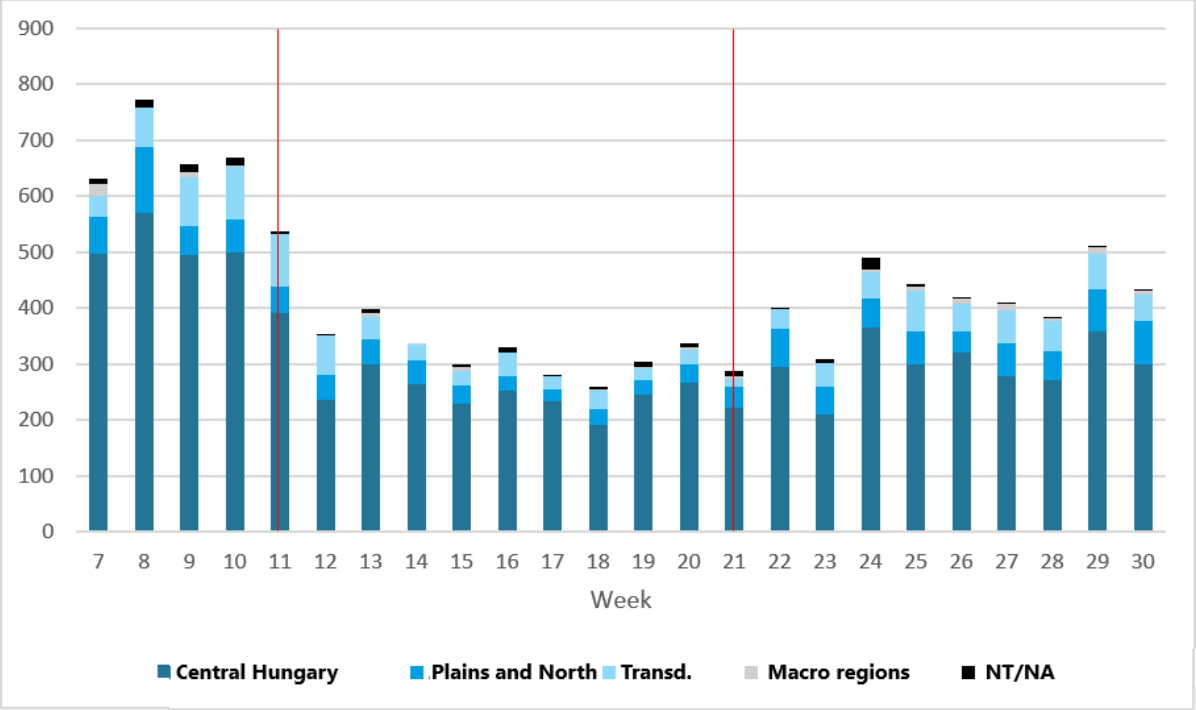


Overall, the vast majority of IT jobs are currently in Budapest. Rural regions are significantly behind Budapest in this respect. Due to the small number of elements, we do not provide deeper breakdowns than the macro-region.

4.2.1. Evolution of the territorial distribution of job vacancies

The cyclical nature of the job market and the coronavirus pandemic in 2020 make it difficult to describe a long-term trend from the data collected. However, the weekly breakdown shows that the IT labour market is slowly starting to get back to normal after the decline during the corona recession.

Figure 10: Evolution of the number of job advertisements by macro-region in the period under review (N=10706)



From week 7 to week 30 of 2020, the highest number of job vacancies were advertised in Central Hungary (Budapest). At the beginning and the end of the period, the proportion of job advertisements in the other two macro-regions was slightly higher, typically fluctuating between 22-30%. Although the total number of job vacancies fell during the recession, the share of vacancies advertised in the Great Plain and Northern and Transdanubian regions as a proportion of total vacancies also fell slightly, to around 20% or less.

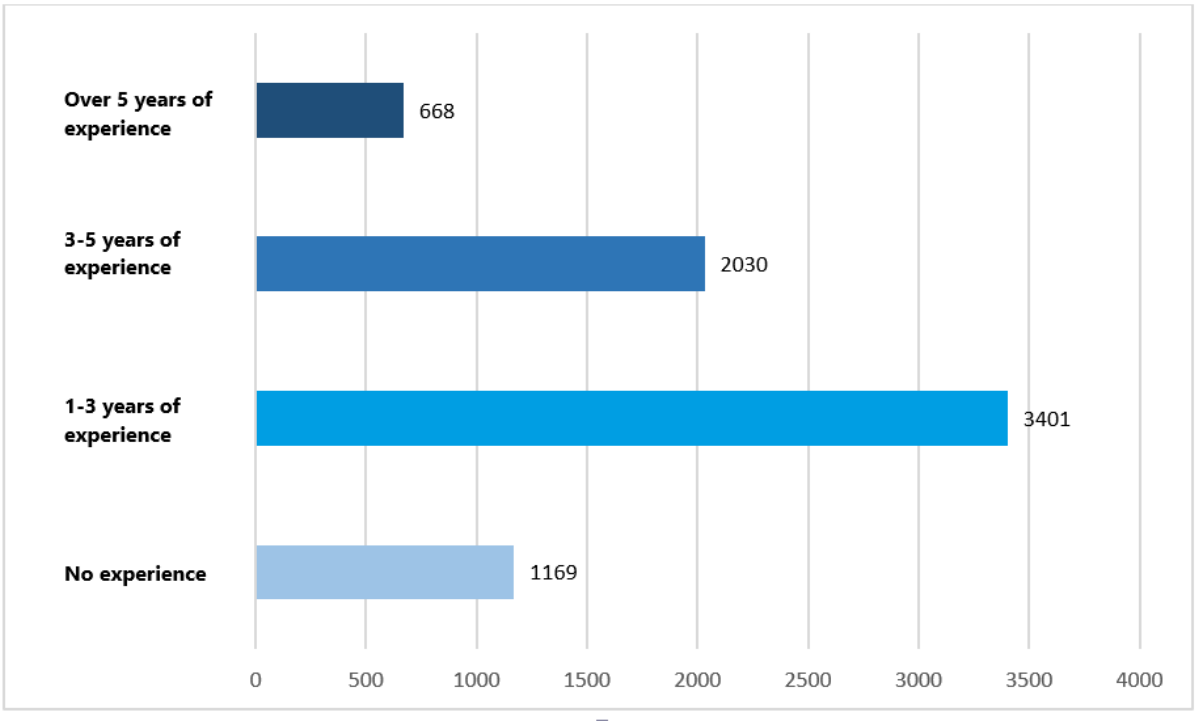
Overall, it can be said that there were no major changes in the IT labour market beyond the basic fluctuations during the period under review. Throughout Central Hungary (mainly in Budapest), the highest number of job vacancies in this field was advertised.

4.3. General requirements for IT jobs

One of the important characteristics of the IT labour market is the expectations that recruiting companies have of their employees. This section gives a general idea of the experience, qualifications and language skills expected of IT professionals in job advertisements.

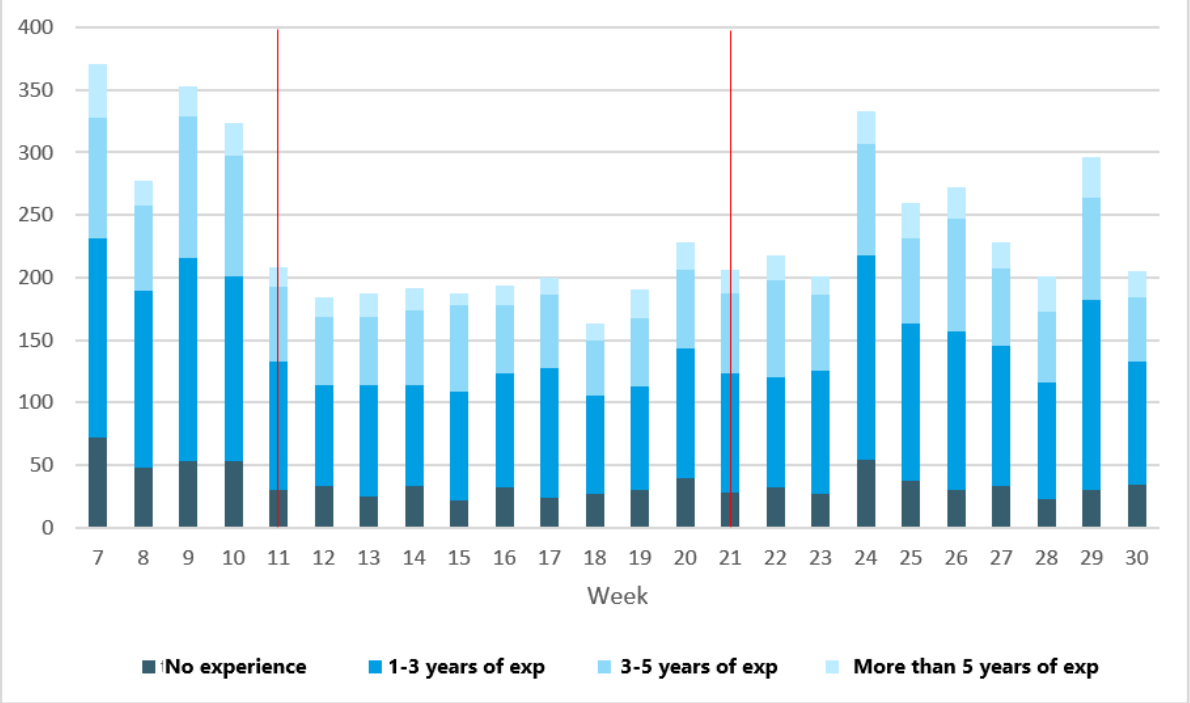
In total, nearly 7,300 advertisements mentioned the professional experience required. Most of the advertisements presumably sought workers at junior level with 1-3 years' experience (3,401). A little over 2000 advertisements were looking for employees with 3-5 years of experience. More job advertisements accepted people with no experience (1,169) than those looking for people with more than 5 years' experience (668).

Figure 11: Minimum experience required (N=7268)



During the period under review, there was typically a slight fluctuation in the proportions of experience expected. Although the percentages have changed, the position of each group has not changed compared to the others. From week 7 to week 30 of 2020, companies with 1-3 years' experience were the most popular jobseekers in IT job advertisements. This was followed by 3-5 years of experience and then the expectation of no experience. Throughout the period under review, the lowest proportion of people with more than 5 years' professional experience was sought.

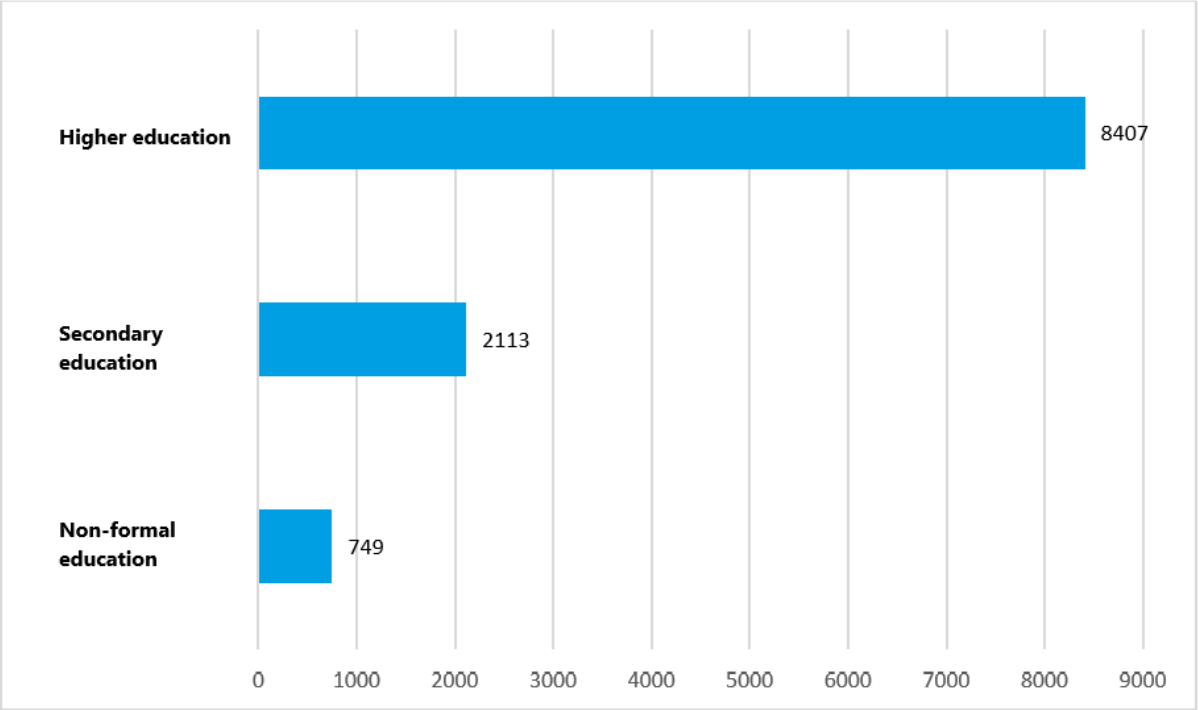
Figure 12: Evolution of minimum expected experience (N=5679)



Higher education was the most sought-after qualification in the IT job market in the period under review, according to online job sites. Of the job advertisements, 8,407 stated that the employer required at least a higher education degree. However, many employers did not provide more specific expectations. Significantly fewer, a quarter as many job advertisements (2,113) indicated that a secondary education was acceptable for the job. In 749 cases, employers indicated that they expected some kind of non-formal education[18], such as an OKJ qualification.

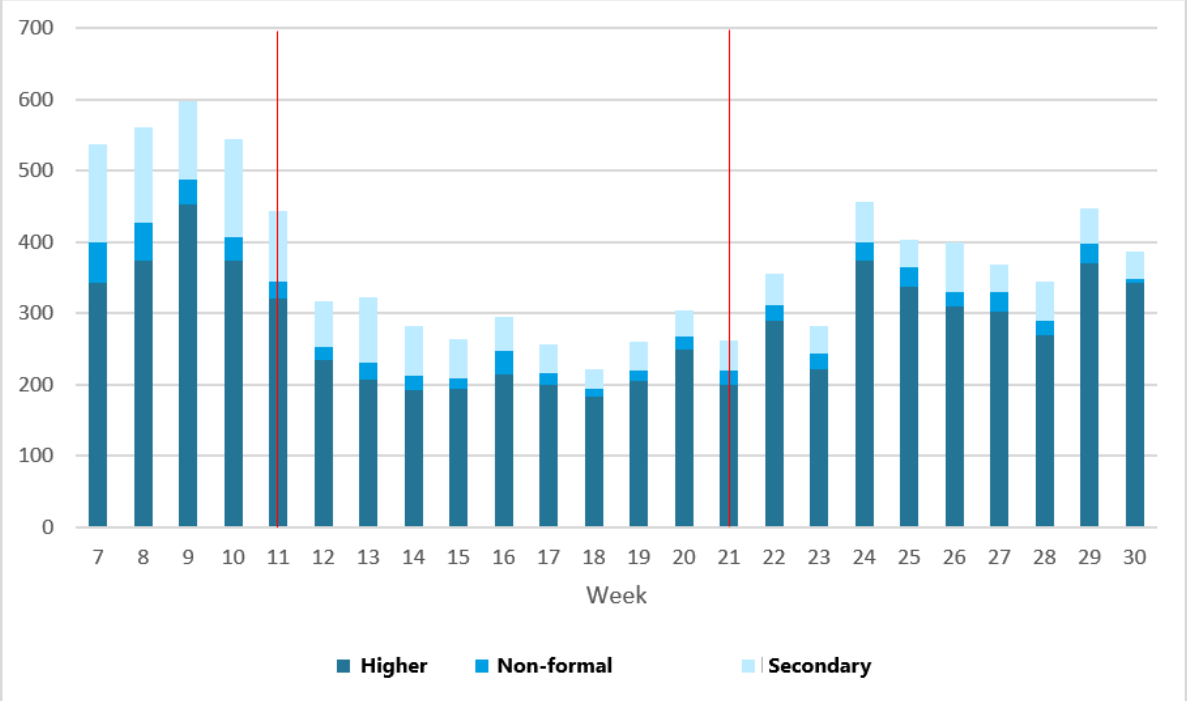
[18] Diplomas awarded by the following organisations are classified as non-formal education: International Software Testing Qualifications Board (ISTQB), International Project Management Association (IPMA), Project Management Institute (PMI), Prince2, as well as OKJ training and other required qualifications.

Figure 13: Minimum level of education required (N=11269)



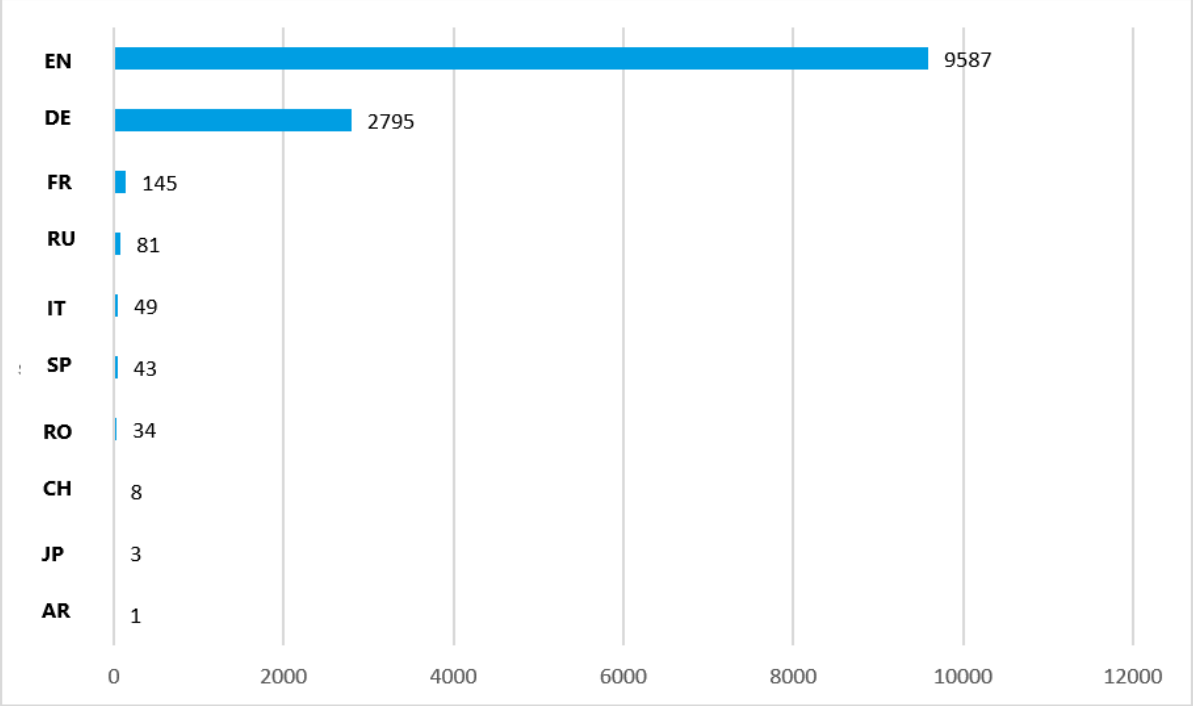
Similarly to work experience, the ratios of expected qualifications show a slightly fluctuating pattern over the period. Differences of up to more than 20 percentage points can occur between the individual values, but the order mentioned in the previous paragraph was not overturned in any week of the study. So, throughout, the highest proportion of people expected to have completed tertiary education (64-88%), followed by secondary education (10-28%) and finally non-formal education (2-10%).

Figure 14: Trends in minimum educational attainment (N=8912)



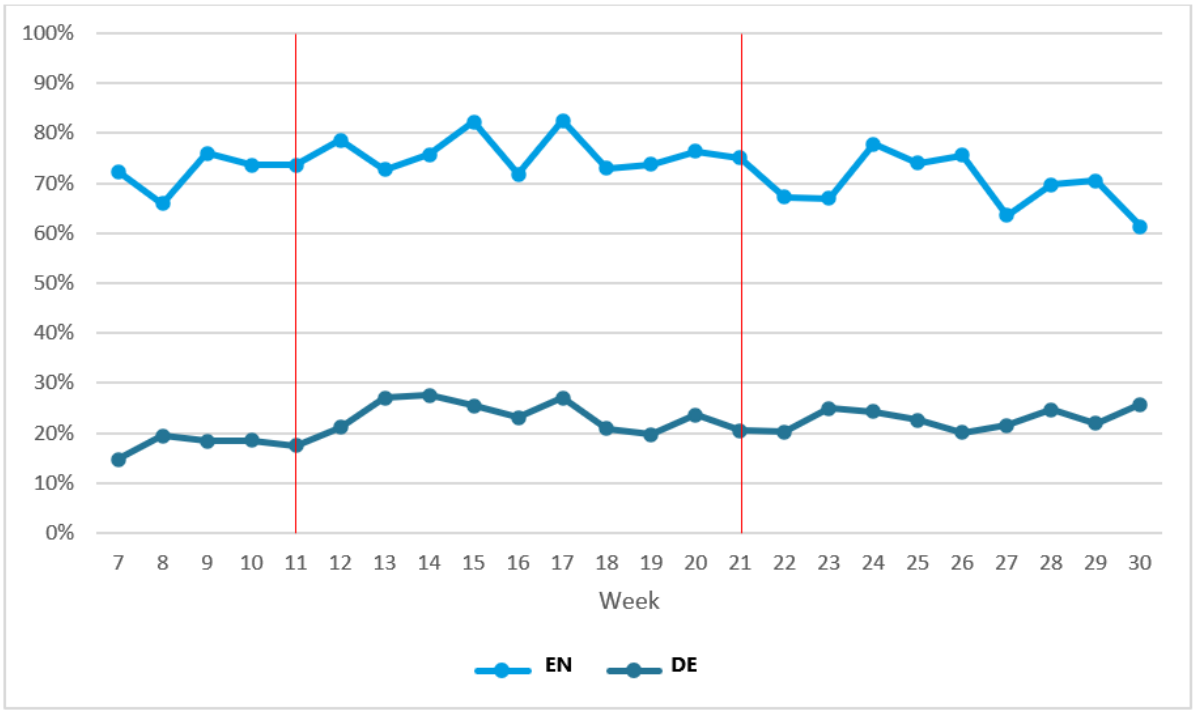
English language skills are a clear requirement in the IT job market. Of the job advertisements, 9587 mentioned that some knowledge of this language was required. Almost 40% of job advertisements were in English, which also shows the importance of this language. German language skills are expected to an even greater extent, with 2,795 job advertisements indicating that German language skills are required for the job. Although French still appeared in more than 100 job advertisements, the other languages studied (Russian, Italian, Spanish, Romanian, Japanese, Arabic) appeared even less often in the 13,023 job advertisements. Although there are several major Chinese IT companies operating in Hungary, it seems that English is also the main language spoken in these places, with only 8 job advertisements mentioning Chinese as a requirement.

Figure 15: Required language skills (N=13023)



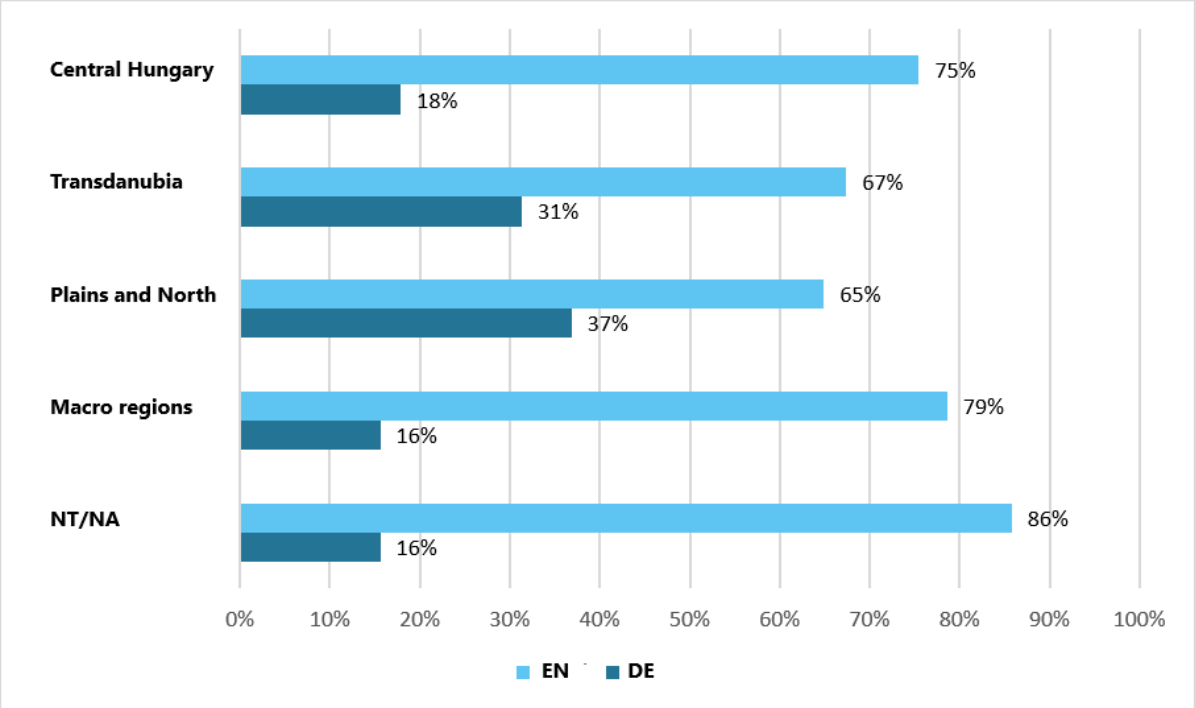
We also see fluctuations in expected language skills over the period. English was expected in 60-80% of jobs, German in 15-28%. Of course, there were also some job advertisements that required knowledge of several languages at the same time.

Figure 16: Evolution of expected English or German language skills (N=10706)



English is the language most expected by businesses in Central Hungary (75%) among the macro-regions, but in all regions, it is above 60%. German is the language most often required by companies in the Great Plain and Northern Region (37%), but it is also required in a third of job advertisements in the Transdanubian region.

Figure 17: English and German language expectation ratio by region (N=13023)



Knowledge of German is much less expected than English, but there are some counties where it is mentioned as an expectation in a significant percentage of job advertisements. In Baranya County, German was mentioned in 73% of job advertisements, followed by Hajdú-Bihar County (56%), Győr-Moson-Sopron County (41%) and Csongrád-Csanád County (39%). These high rates are mainly due to the job advertisements of Deutsche Telekom IT Solutions and IT Services Hungary Kft (except for Győr-Moson-Sopron County), which published a significant number of advertisements in these regions during the period under review.

In general, IT professionals should therefore have a good command of English and a higher education degree, and typically at least 1-3 years of professional experience.

5. Sectoral profile

In the next section, we analyse the 16 most common ICT job advertisements, using a general characterisation of the advertisements, the job requirements and the competences needed to fill the job.

5.1. Software tester

The software tester job is the simplest of the jobs examined, requiring specific IT skills.

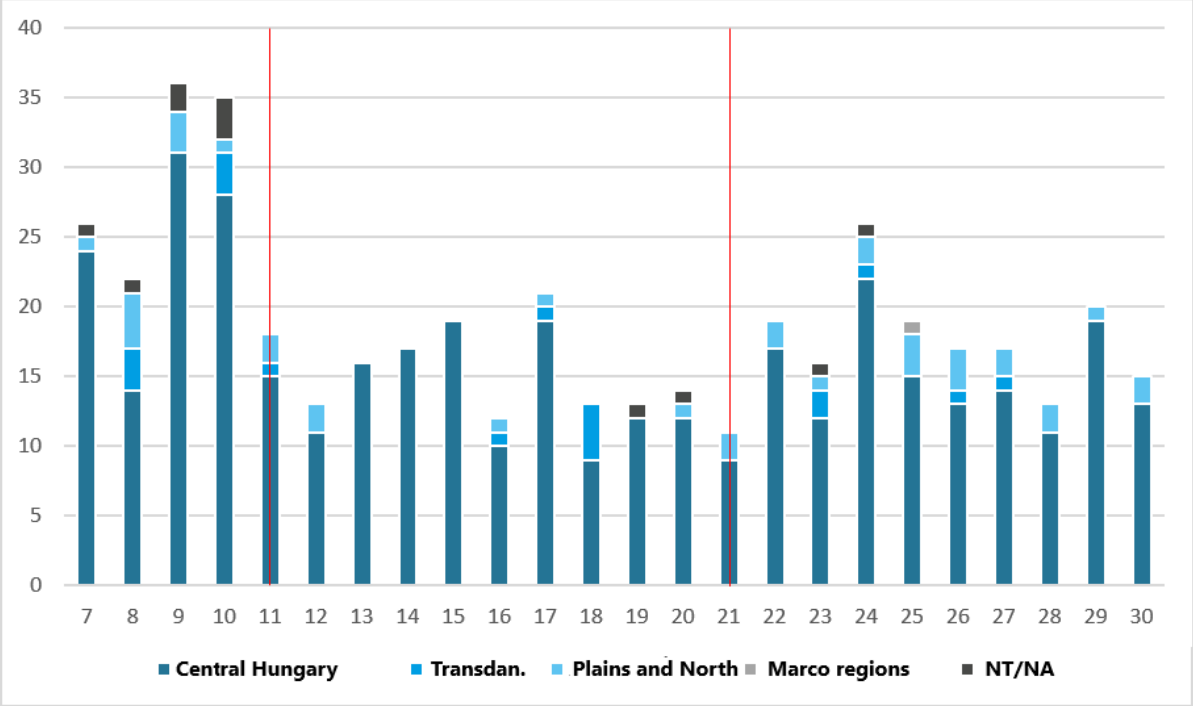
5.1.1. Definition and delimitation

In accordance with the FEOR classification, the job of a software tester is classified under other software and application developer and analyst (2149) (the name is rather misleading as to the job duties), as is usually the case for "other" jobs, the FEOR classification does not include a description. The job description can only be compiled from job advertisements. The job duties include: testing new developments, test planning, finding and documenting bugs, contributing to bug management and development.

5.1.2. Evolution of job vacancies during the period under review

The evolution of the number of job vacancies for software tester can be described in isolation and by area over the period under review. From the 7th week of the year to the 30th week of the year, a total of 448 job advertisements were placed looking for software testers or people with the skills to perform software testing tasks.

Figure 18: Evolution of the number of job vacancies in the software tester occupation, time-series by macro-region (n=448)

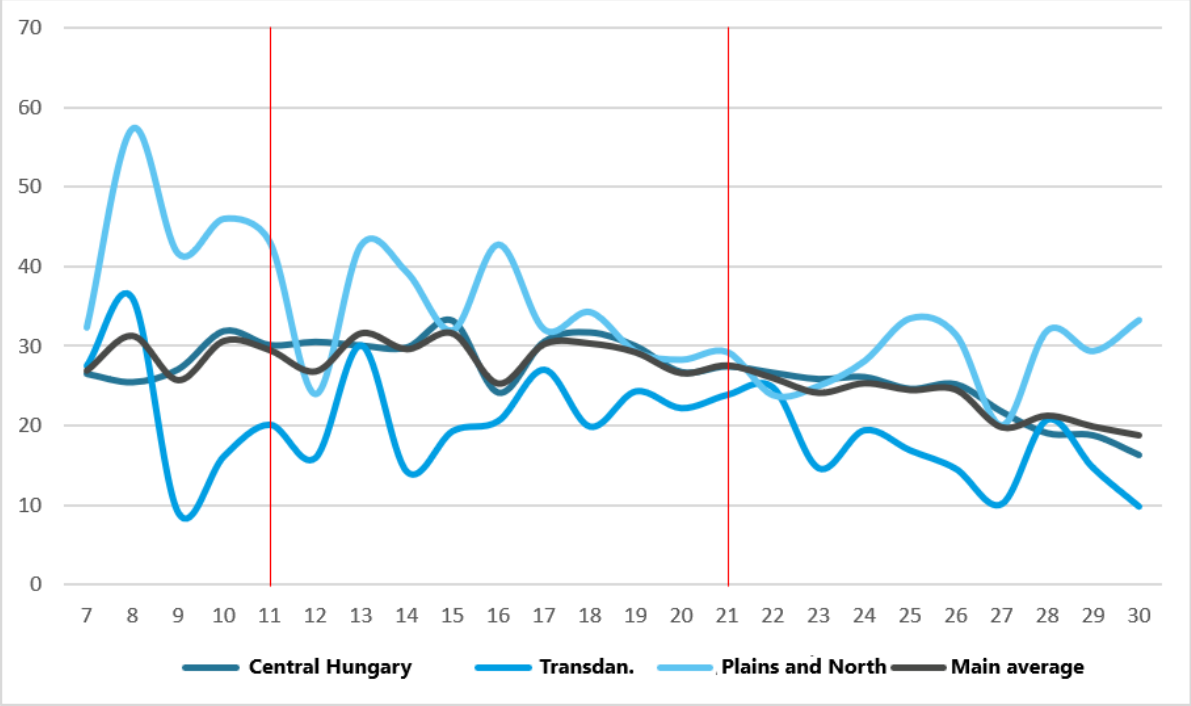


Demand for software testers was particularly high at the beginning of the period under review, but the exceptional health situation significantly reduced the number of job advertisements posted, and demand for software testers had not fully recovered by the 30th week of 2020, i.e. by the beginning of July. Most of the ads in this case were also placed in Central Hungary.

5.1.2.1. Lifetime of job advertisements

A job advertisement was typically open for 27 days during the period studied. This value increased slightly during the COVID-19 period, peaking at week 13-15 with a lifespan of 31 days. Thereafter, there was a clear downward trend, with job advertisements being available for less than 20 days on each portal by week 30.

Figure 19: Evolution of job advertisement lifetime (by average days) in the software testing job category, time-series by macro-region (n=448)



Examining the lifetime of job advertisements by macro-region, we can see that the lifetime of job advertisements was the least fluctuating in Central Hungary, while the best fluctuations were observed in Transdanubia[19]. The period was also characterised by fluctuating life expectancy in the Great Plain and North. In all parts of the country, we see a decline after the epidemic period, showing that the advertised positions are being filled more quickly. It can be said, however, that the labour market situation was more uncertain in the macro-regions of Transdanubia, Great Plain and North during the period under review.

5.1.3. Job expectations

The requirements for the job in question are grouped as follows: qualifications required, language skills and professional experience.

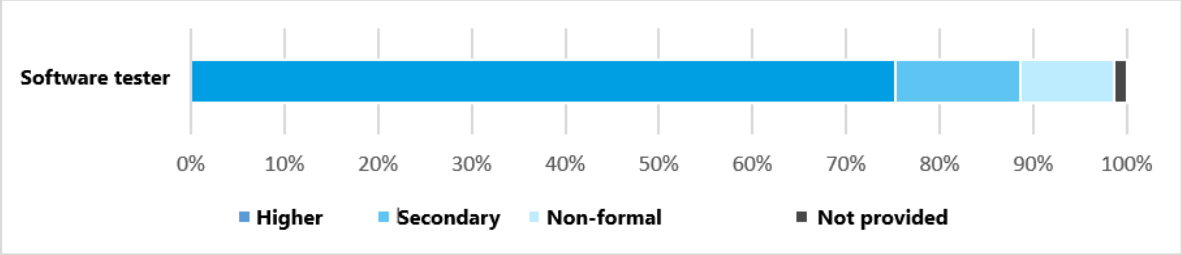
5.1.3.1. Education

Almost 75% of the job vacancies surveyed require applicants to have some form of higher education qualification, such as a degree in computer science, engineering or a university degree. Secondary education is considered sufficient by 13% of job

[19] However, this is also linked to the low number of job advertisements per week surveyed. Just over nine ads per week were placed on average over the period (9 ads per week).

advertisements, while 10% of job advertisements expect qualifications outside the school system (e.g. OKJ, ISTQB[20]). No identifiable qualification is required for 1% of job vacancies.

Figure 20: Required qualifications for software tester jobs, (n=448)



5.1.3.2. Language skills

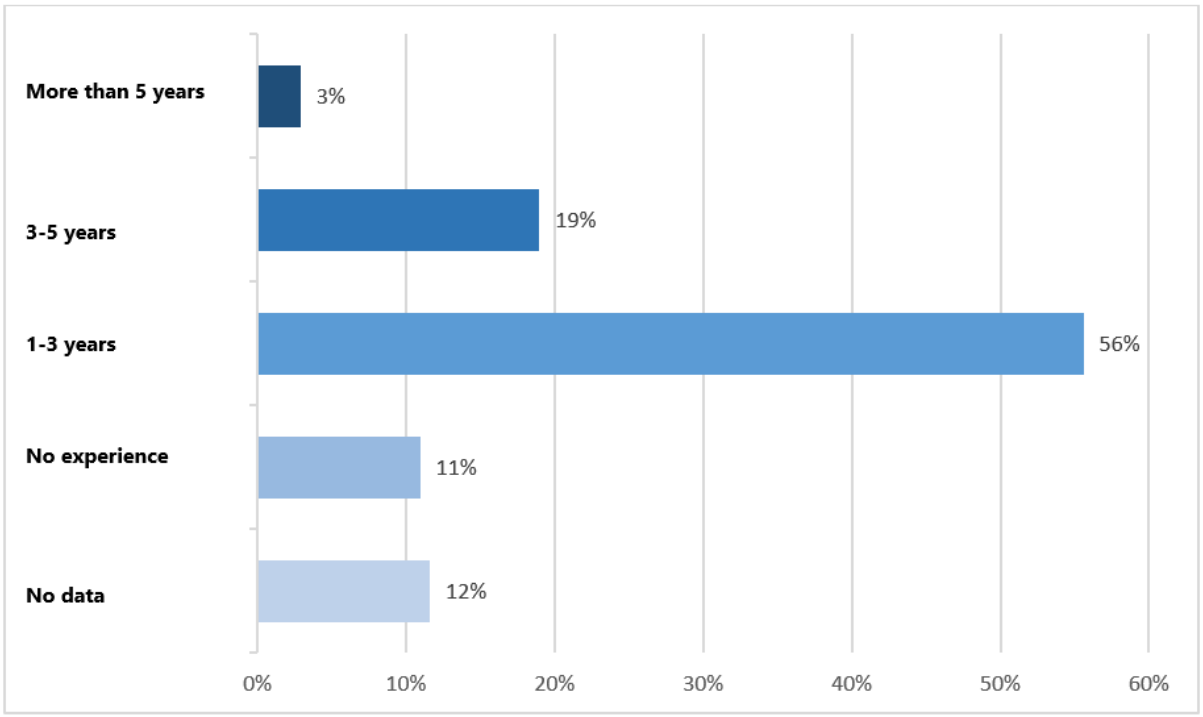
Knowledge of a foreign language is required in 91% of job advertisements. This language is typically English, but knowledge of German is also sometimes required.

5.1.3.3. Professional experience

More than half of employers expect candidates to have between 1-3 years of experience in the job (56%). A further 19% said they expected a software tester to have 3-5 years' experience, and only 3% of job advertisements expected more than 5 years' experience. 11% of employers do not expect experience.

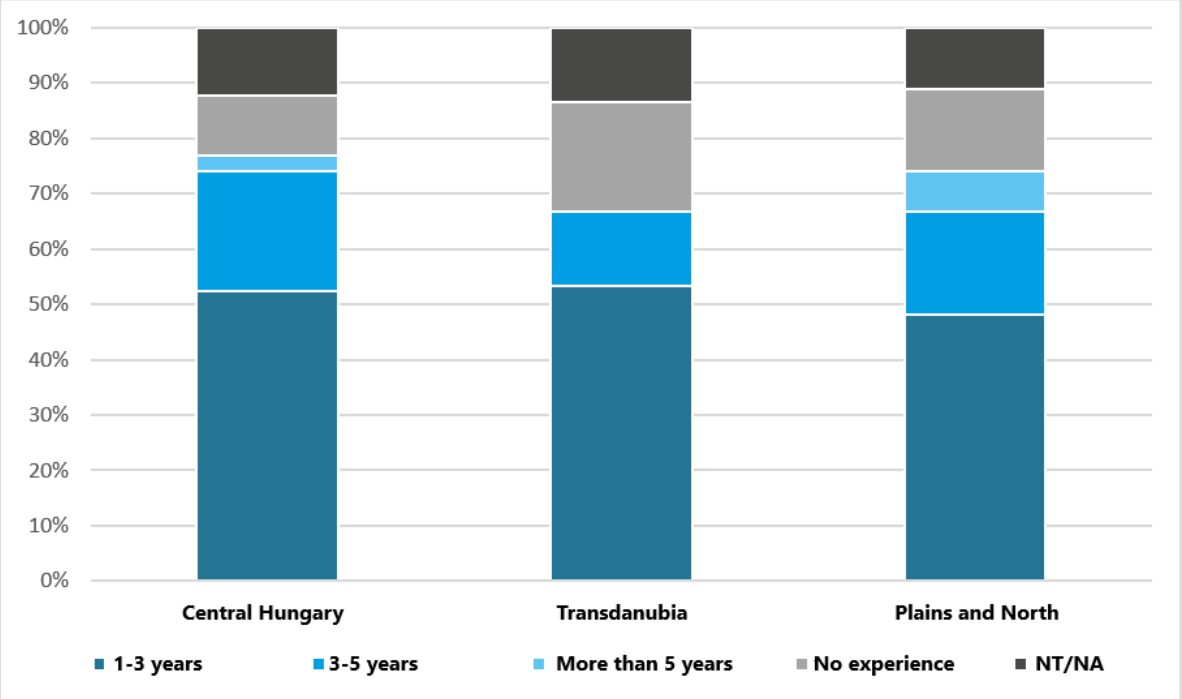
[20] International Software Testing Qualifications Board: https://www.istqb.org/ Date retrieved: 29/07/2020

Figure 21: Required professional experience in software testing (n=448)



There are no significant regional differences in experience requirements: the demand for professionals with more than 5 years of experience shows a slightly different picture. In the Transdanubian region, there were no advertisements with such a clause. In terms of experience, employers in Central Hungary expressed the highest expectations.

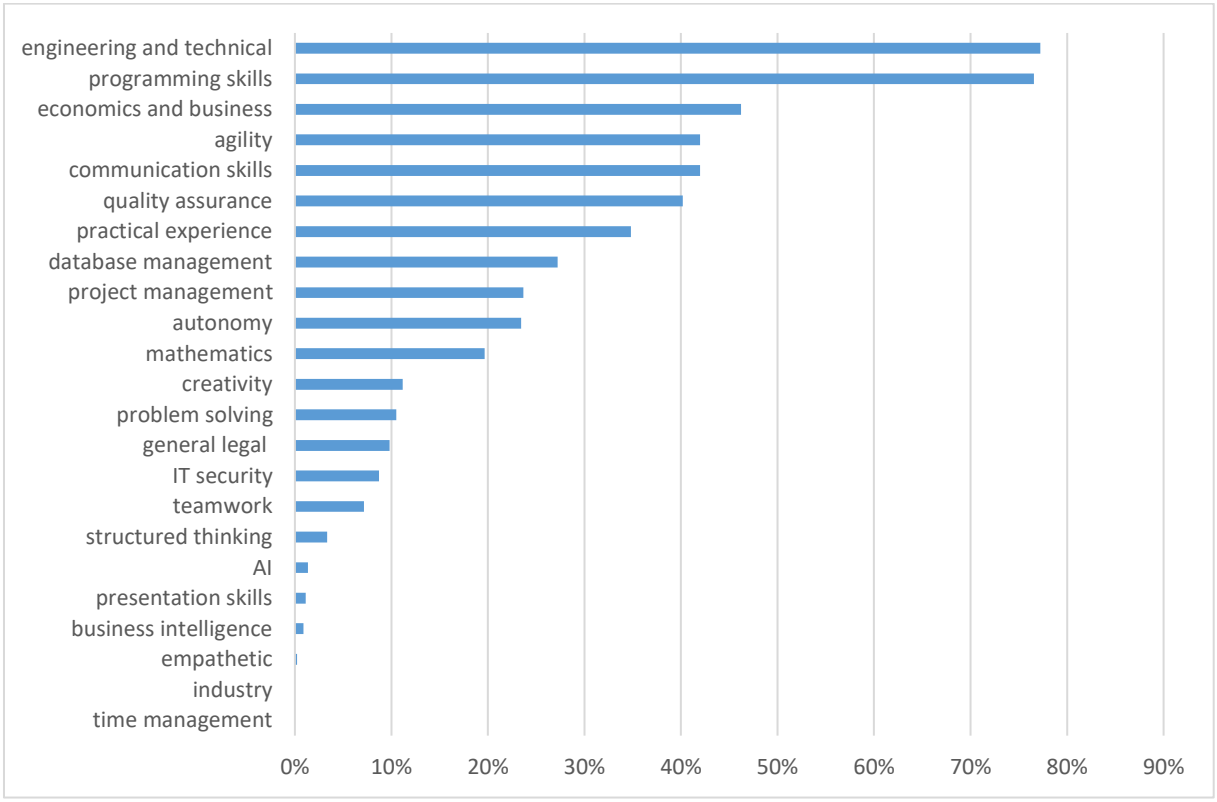
Figure 22: Required experience as a software tester, by macro region (n=448)



5.1.4. Job-related competences

Of the 23 professional and other skills surveyed for software tester, employers expect the highest proportions of candidates to have engineering and technical, programming skills (77-77%) and economics and business skills (46%), based on the job advertisements surveyed.

Figure 23: Need for competences in percentage distribution for the job of a software tester (n=448)



5.2. Administrator

The general network hardware/software administrator/technician (or administrator for short) job is one of the most common jobs in most companies. This job is also found mostly in companies with a non-IT core business, which means that the person in this job will work in an environment where, in addition to IT skills, knowledge of the operation of a company with a different profile may also play a role.

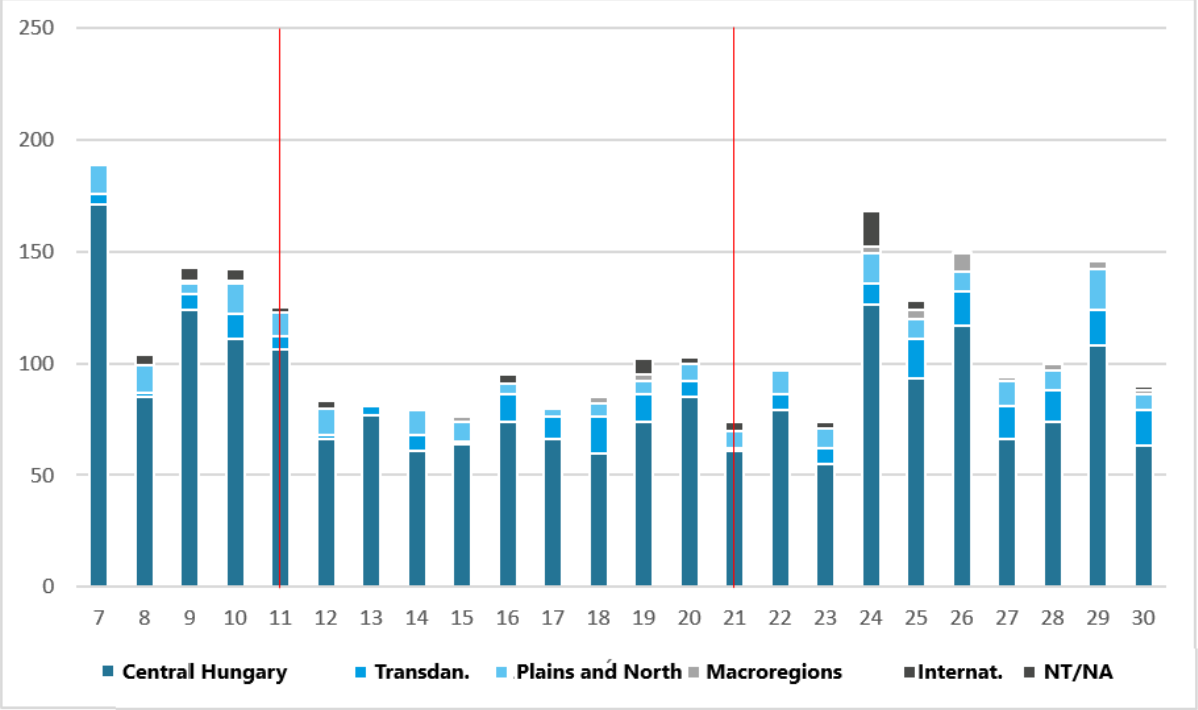
5.2.1. Definition and delimitation

In accordance with the FEOR, an administrator "designs, develops, maintains and supports information systems for optimal performance and security, and assists network users in the operation of the network and programs." The administrator's responsibilities include monitoring, repairing and controlling the performance of computer networks and the computing environment, controlling access, diagnosing hardware and software problems, backing up data, and restoring systems. Jobs related to but distinct from system administrator: IT systems analyst, software developer, network and multimedia developer, application programmer, database designer and operator.

5.2.2. Evolution of job vacancies during the period under review

The evolution of the number of job advertisements for the administrator position can be described in isolation and by area over the period considered. From the 7th week of the year to the 30th week of the year, a total of 2,620 job advertisements were placed looking for administrators or employees with the skills to perform administrator tasks.

Figure 24: Trend in the number of job vacancies for administrator, time series by macro-region (n=2620)

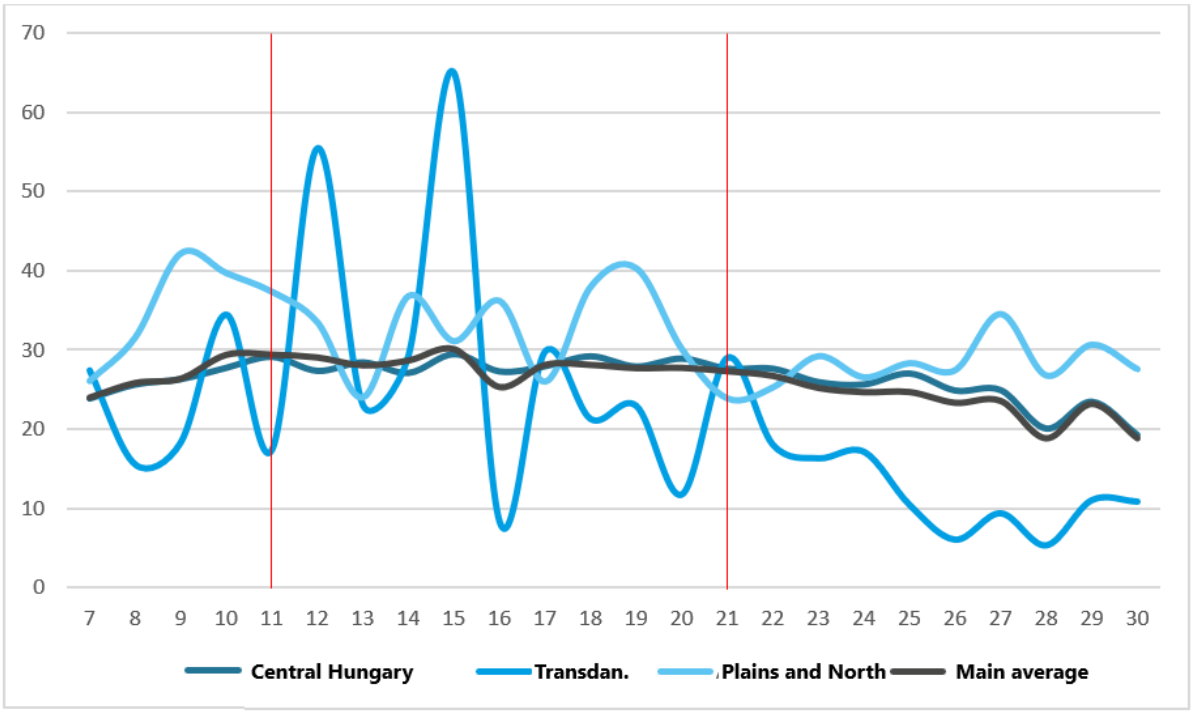


Demand for administrators was particularly high at the beginning of the period under review, but the exceptional health situation significantly reduced the number of job advertisements posted, and demand for administrators had not fully recovered by the beginning of July 2020 (week 30). Looking at the demand trend, it is clear that the demand for administrators is highest in Central Hungary (79%), with the vast majority of this demand in Budapest (77%).

5.2.2.1. Lifetime of job advertisements

A job advertisement was typically active for 26 days during the period studied. Its value increased slightly over the COVID-19 period, peaking at week 15 with a 30-day lifespan (second week of April 2020). From then on, life expectancy slowly declined, dropping to 19 days on week 30.

Figure 25: Evolution of the lifetime of job advertisements (by average number of days) in the administrator job category, time-series by macro-region (n=2620)



Looking at the lifespan of job advertisements by macro-region, we can see that the Central Hungary region remained the most stable in terms of the lifespan of job advertisements, while the best affected region was Transdanubia[21]. The period was also characterised by fluctuating life expectancy in the Great Plain and North.

5.2.3. Job expectations

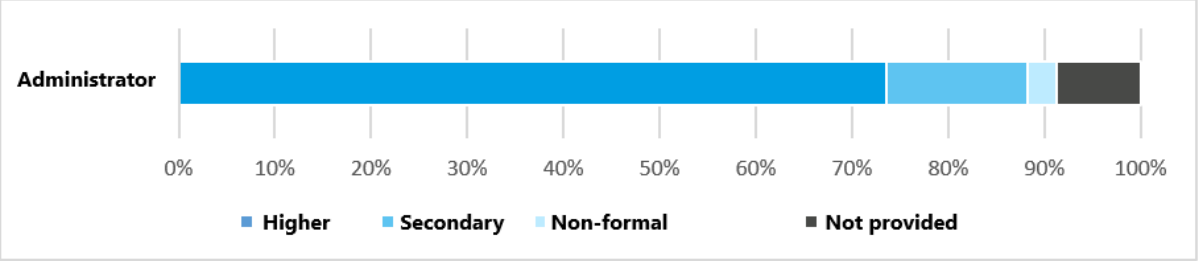
The requirements for the job in question are grouped as follows: qualifications required, language skills and professional experience.

5.2.3.1. Education

Almost 74% of the job vacancies surveyed require applicants to have some form of higher education qualification, such as a degree in computer science, engineering or a university degree. Secondary education is considered sufficient by 15% of job advertisements, while 3% of job advertisements expect qualifications outside the school system (e.g. OKJ, ISTQB[22]). No identifiable qualification is required for 9% of job vacancies.

[21] However, this is also linked to the low number of job advertisements per week surveyed. Just over nine ads per week were placed on average over the period (9 ads per week).
[22] International Software Testing Qualifications Board: https://www.istqb.org/ Date retrieved: 29/07/2020

Figure 26: Required education for the job of an administrator (n=2620)



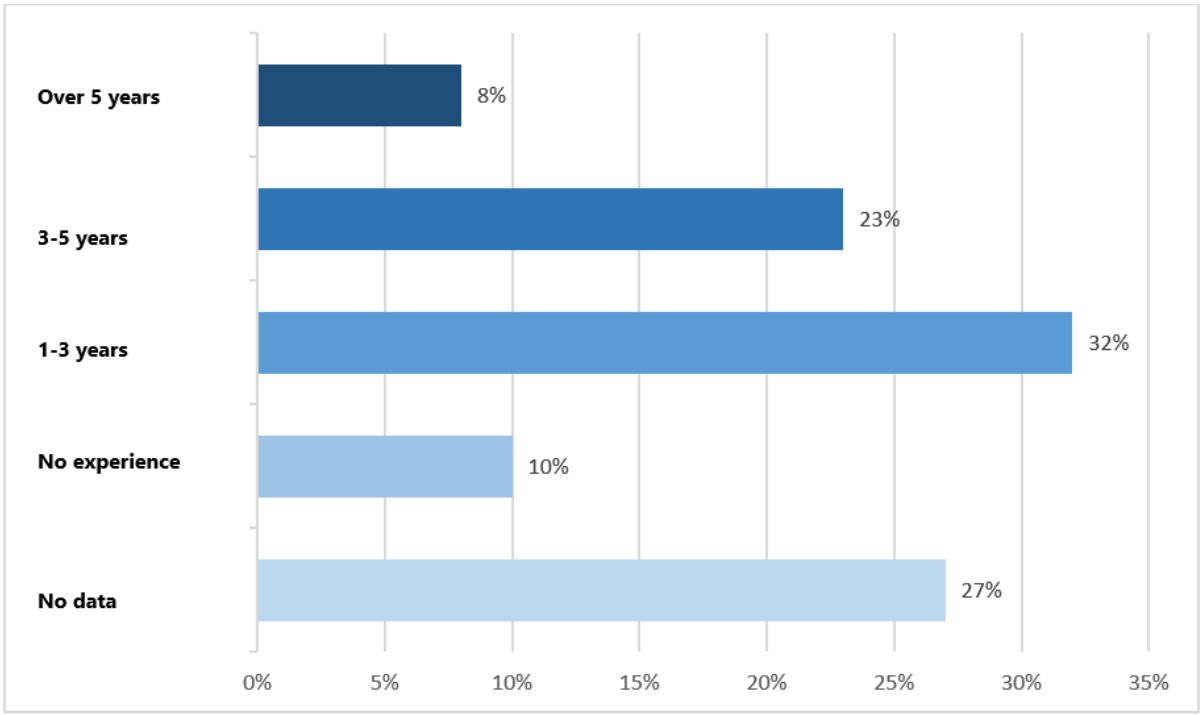
5.2.3.2. Language skills

The domestic job market typically requires administrators to have language skills. One foreign language is required in 63% of job advertisements, and two languages in 21%. Less than 1% of the advertisements required knowledge of more than two languages.

5.2.3.3. Professional experience

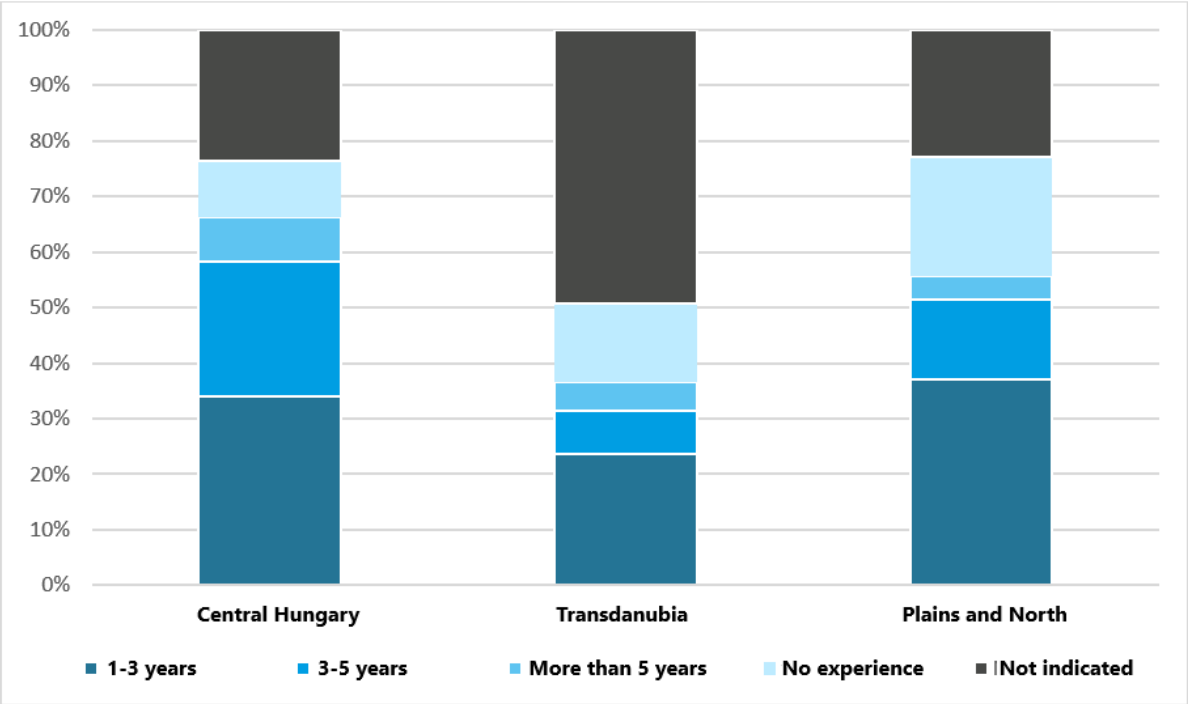
The highest proportion of the stated expectations is for 1-3 years of experience (32%), but this is not far behind for 3-5 years (23%). The number of years worked more than this is only 8%. No quantifiable experience is required in a tenth of the advertisements, while no experience information is provided in 27% of the job vacancies surveyed. The time-series analysis of the expected experience variable does not show any new pattern compared to the previous ones.

Figure 27: Required professional experience as an administrator (n=2620)



Experience is most lacking in the Transdanubian region, where all categories are below average in terms of frequency. The number of job vacancies advertised in Central Hungary best reflects the above-mentioned distribution in terms of the stated expectations, while in the case of the advertisements in the Great Plain and the North, those requiring more than 3 years of experience are underrepresented.

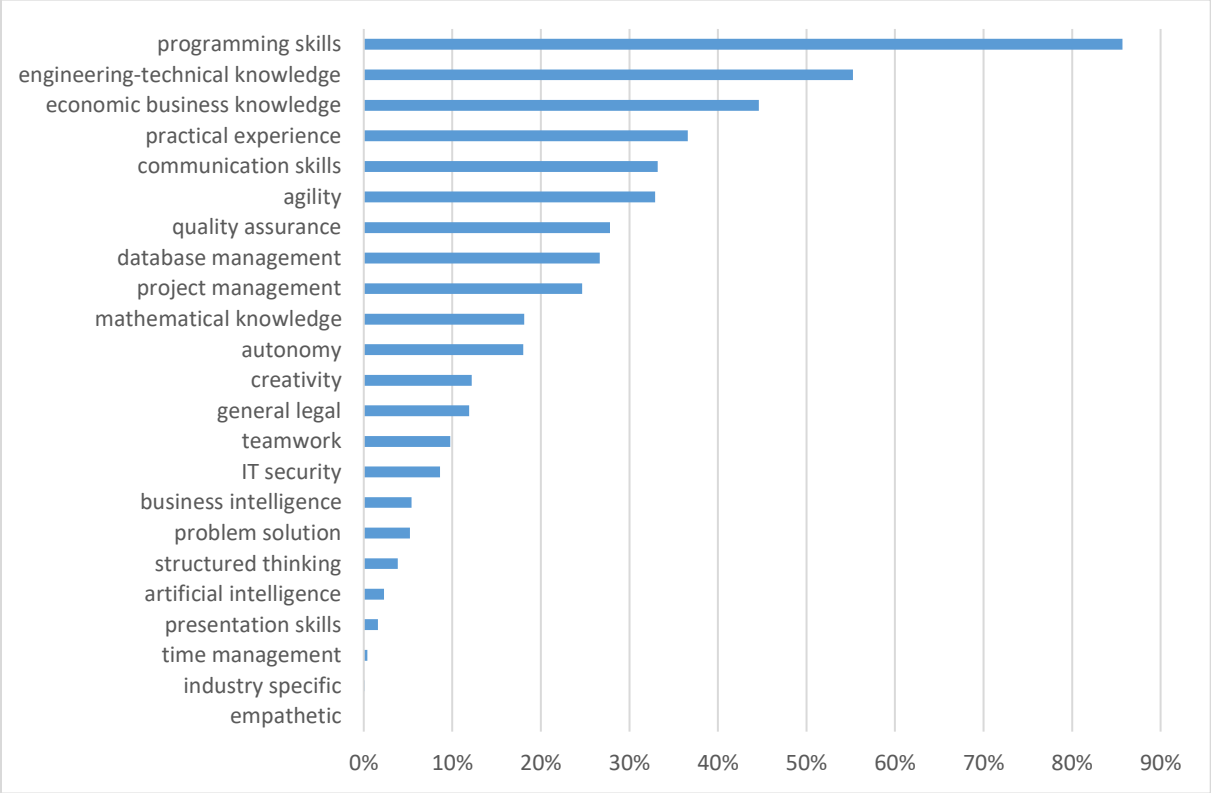
Figure 28: Required experience as an administrator, by macro-region (n=2620)



5.2.4. Job-related competences

Of the 23 skills, professional and other skills surveyed, programming skills were mentioned as an expected competence in nearly 86% of the advertisements. The second most frequently mentioned skill was engineering/technical skills, with 55% of the ads. Knowledge of economics and business is also important, mentioned in 45% of the ads.

Figure 29: Need for competences in percentages, by administrator job (n=2620)



5.3. IT Manager

An IT Manager is the responsible manager of the company's IT unit.

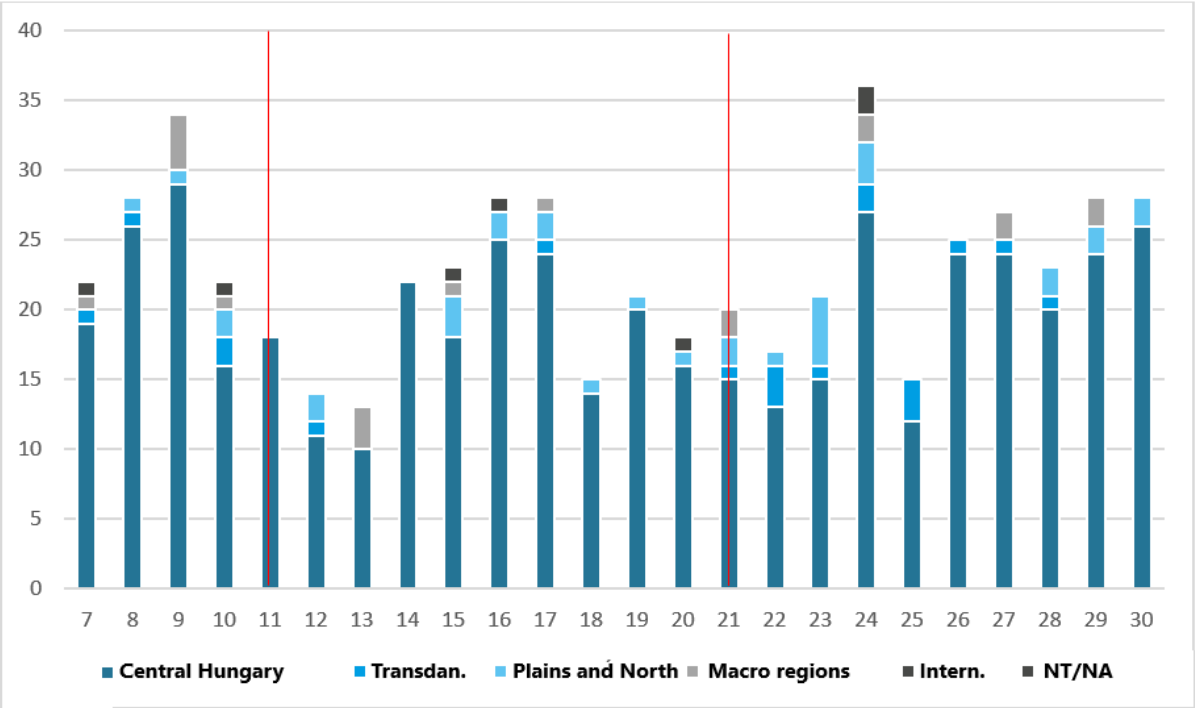
5.3.1. Definition and delimitation

Among the occupations in the FEOR, the closest job to the job under consideration is that of a manager of an information and telecommunications unit (1322). In accordance with the FEOR definition, the head of an IT and telecommunications unit "plans, manages, coordinates and controls computer and information technology services, as well as communication, telecommunications and other data communication services, network services and infrastructure systems within the organisation". FEOR mentions only one occupation from which the occupation quoted is to be distinguished: head of an economic or budgetary body, but this is clear from the definition given. The job definition can be more difficult in IT companies, where sometimes almost all middle managers can be considered IT managers or specialists in the functions of the unit. In these cases, we recommend using the IT Manager job title.

5.3.2. Evolution of job vacancies during the period under review

The evolution of the number of job advertisements for the post of IT manager can be described in isolation and by area over the period under review. From the 7th week of the year to the 30th week of the year, a total of 546 job advertisements were placed looking for IT managers or employees with the qualification to perform IT management tasks.

Figure 30: Trends in the number of job vacancies for IT manager, time-series by macro-region (n=546)

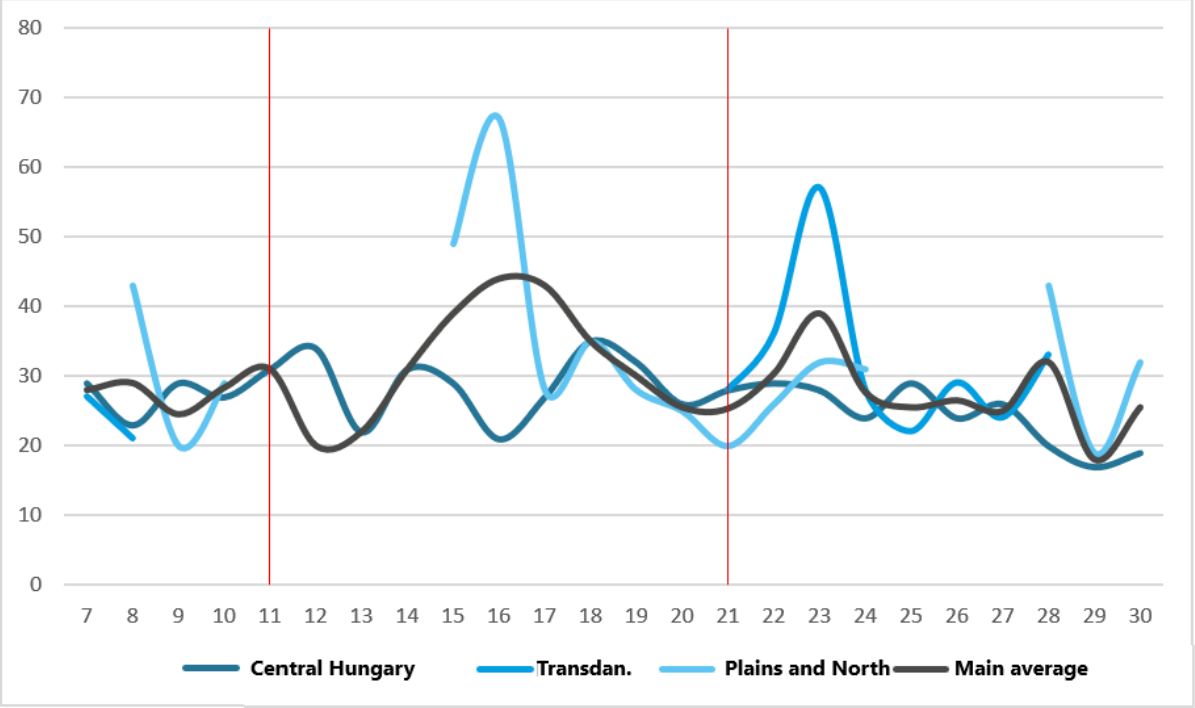


Interest in IT managers was high at the beginning of the period under review, but after a low point in mid-March, there was a steady fluctuation. The highest demand for IT managers is in Central Hungary (86%), with a significant share of this demand concentrated in Budapest (82%).

5.3.2.1. Lifetime of job advertisements

A job advertisement was typically active for 28 days during the period studied. Its length increased slightly during COVID-19, peaking in week 16 with a lifespan of 44 days (13-19 April 2020).

Figure 31: Evolution of job advertisement lifetime (by average days) for IT manager, time-series by macro-region (n=546)



Looking at the lifespan of job advertisements by macro-region, we can see that the Central Hungary region remained the most stable in terms of the lifespan of job advertisements. In the Great Plain and Northern Hungary and in the Transdanubian region, the longest period of availability was in weeks 16 and 17, but in these areas there are significant gaps in the data set: in the Great Plain and Northern Hungary there are gaps between weeks 9 and 20, in the Transdanubian region between weeks 7 and 14 and between weeks 25 and 28. No new ads were placed in the two regions during these weeks.

5.3.3. Job expectations

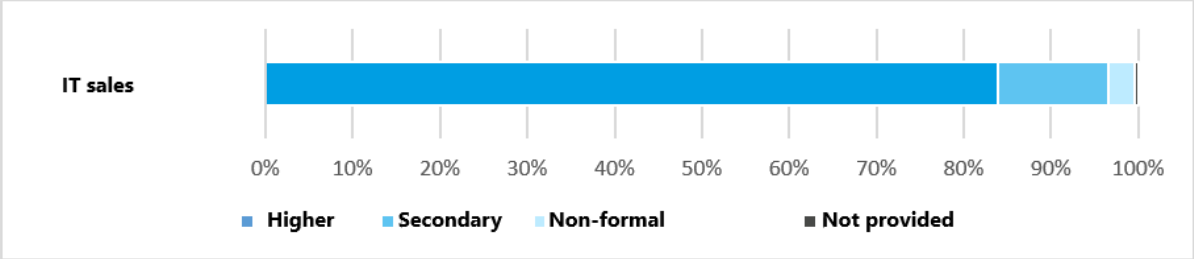
The requirements for the job in question are grouped as follows: qualifications required, language skills and professional experience.

5.3.3.1. Education

More than 84% of the job vacancies surveyed require applicants to have some form of higher education qualification, such as a degree in computer science, engineering or a university degree. Secondary education is considered sufficient in 13% of job

advertisements, while 3% of job advertisements expect qualifications outside the school system (e.g. OKJ, ISTQB[23]).

Figure 32: Expected qualification for IT manager (n=546)



5.3.3.2. Language skills

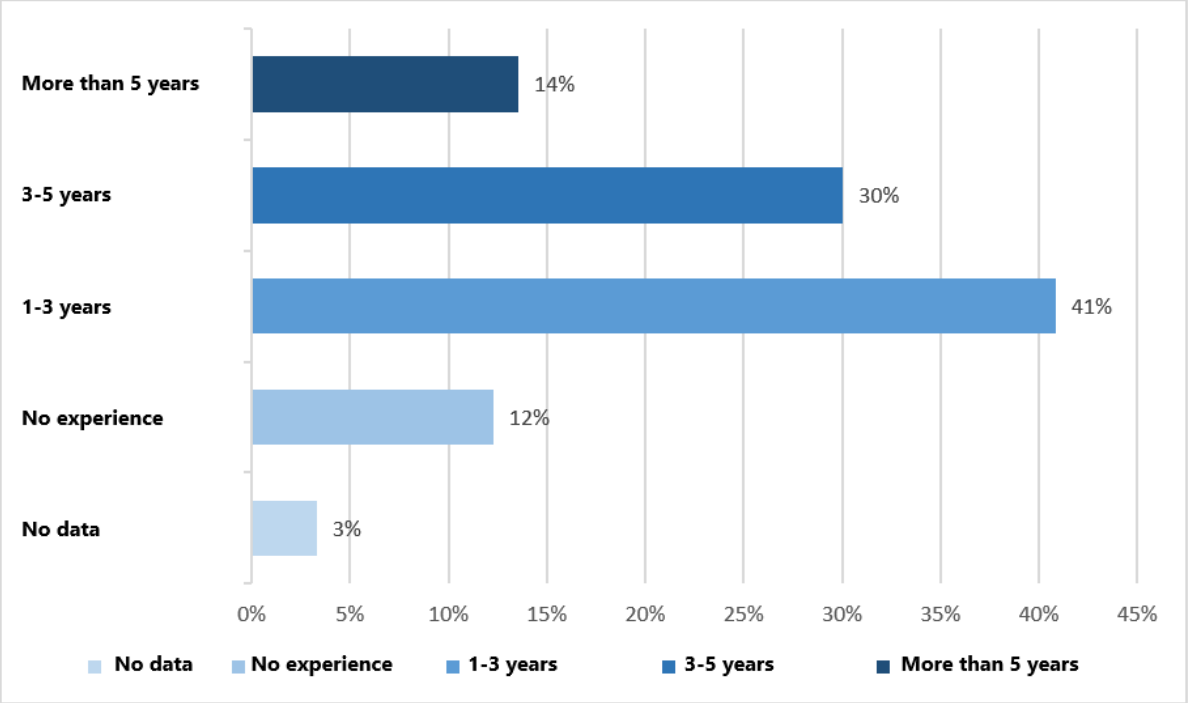
The advertisements typically (68%) require knowledge of one foreign language - knowledge of 2 languages is required in 23% of the job advertisements surveyed. English is the language required in the majority of cases (68%) and German is expected in 22% of cases. A small proportion (8%) of the advertisements did not contain any information at all on the language skills required.

5.3.3.3. Professional experience

For the job, employers typically expect at least 1-3 years (40%) or 3-5 years of experience (30%). 17% of the advertisements indicated that more than 5 years' experience was required to apply, while 12% did not. A low proportion of ads did not specify any experience requirements (3%).

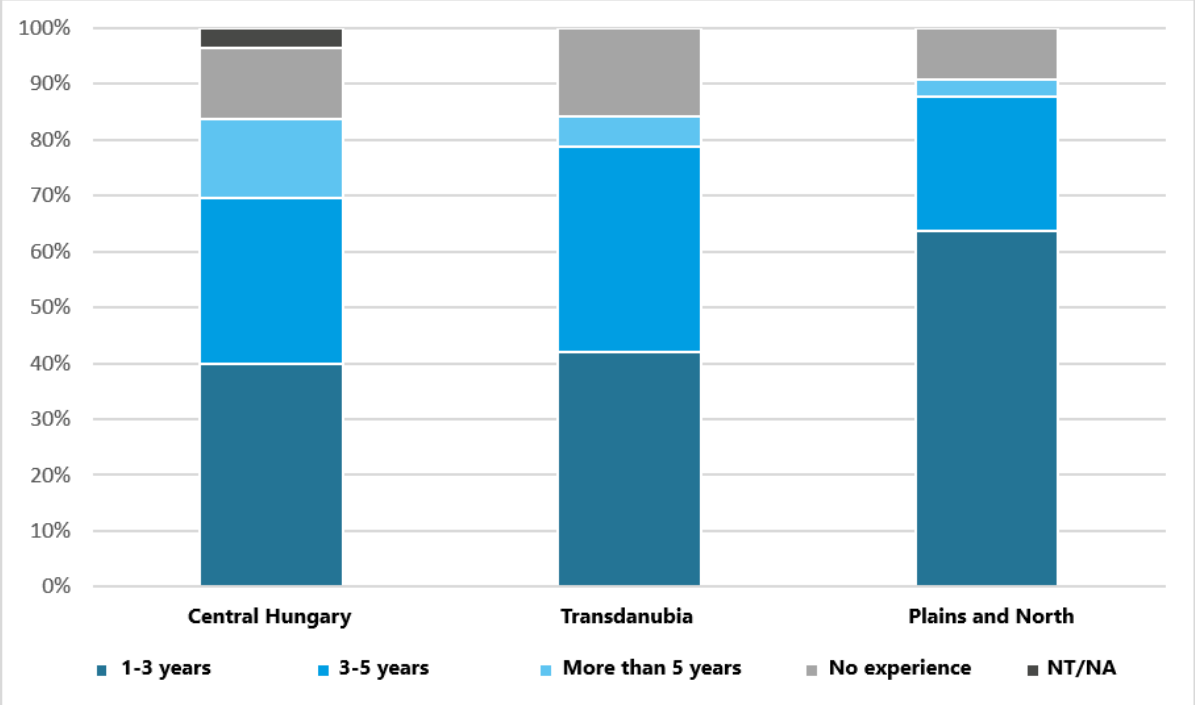
[23] International Software Testing Qualifications Board: https://www.istqb.org/ Date retrieved: 29/07/2020

Figure 33: Required professional experience for IT manager (n=546)



By region, it can be seen that job advertisements for the Great Plain and Northern Hungary region mostly require 1-3 years of experience. The highest proportion of professionals with 3-5 years of experience are sought in Transdanubia, while those with more than 5 years of experience are most likely to be found in Central Hungary.

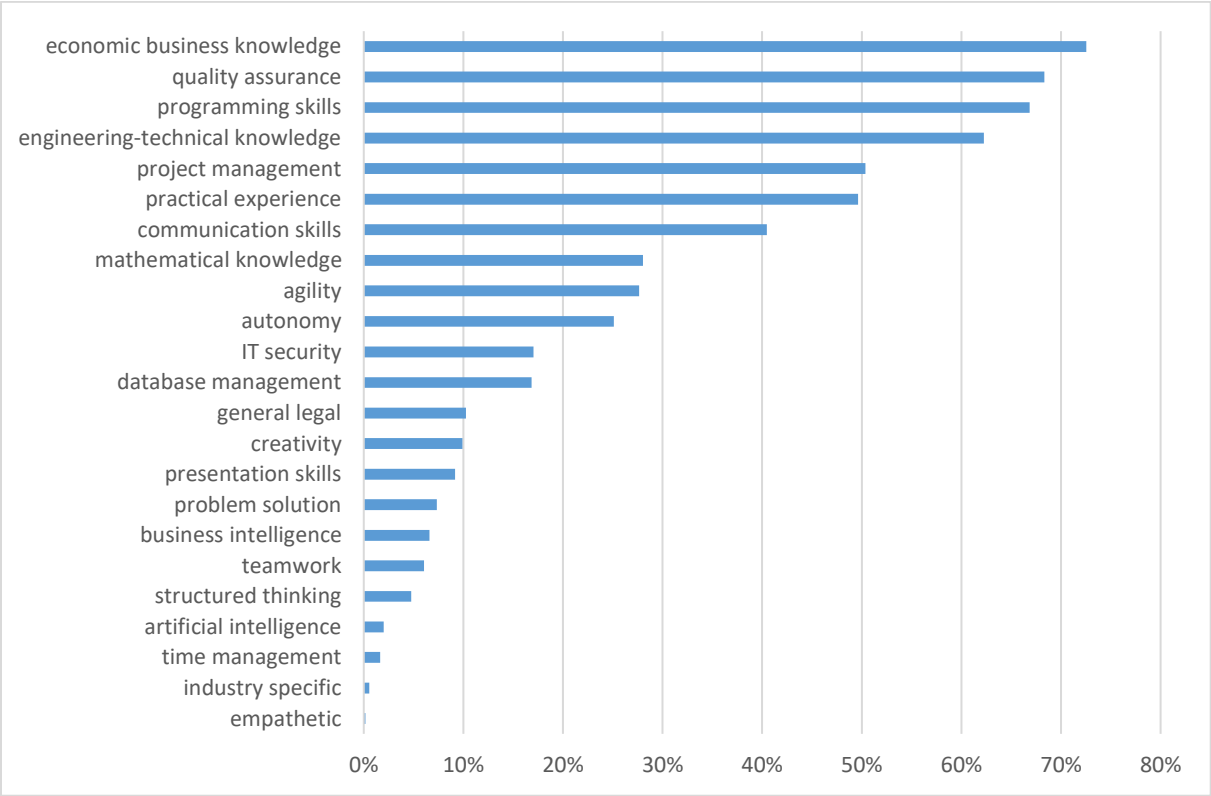
Figure 34: Required experience as IT manager, by macro-region (n=546)



5.3.4. Job-related competences

Of the 23 professional and other skills surveyed, 73% of the advertisements mentioned business and economics as a required competence. In addition, quality assurance (68%) and programming skills (67%) are also expected competences.

Figure 35: Need for competences (by percentage) for IT manager (n=546)



5.4. Data scientist

A data scientist is a job title that describes an increasingly popular but poorly defined field (from physics to informatics to social sciences) that involves analysing and understanding data, and the ability to communicate information across disciplines.

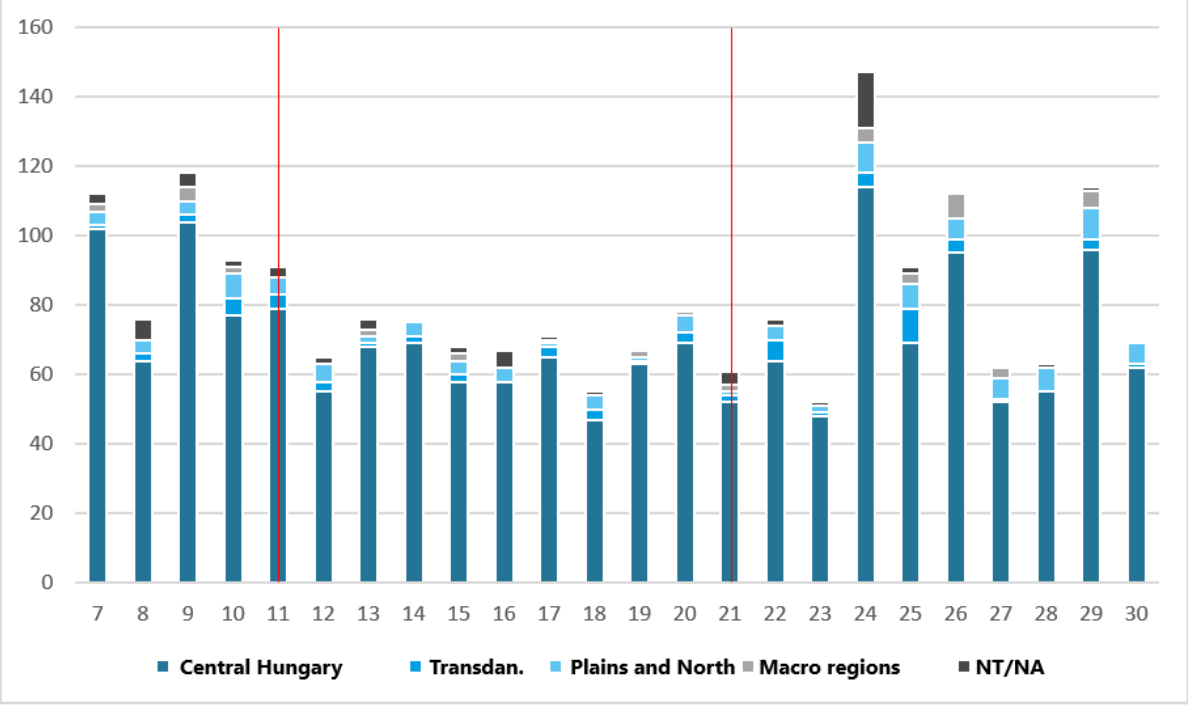
5.4.1. Definition and delimitation

The job of a data scientist cannot be classified under the FEOR. Based on the job advertisements reviewed, the typical tasks of the job include: coordinating artificial intelligence and "Big Data" projects, designing data-driven processes, collaborating with other areas, identifying and exploiting useful data from outside and inside the organisation, data mining, analysing and aggregating data, creating and operating machine learning models, prediction, interpreting and communicating results, data visualisation.

5.4.2. Evolution of job vacancies during the period under review

A total of 1960 job advertisements for data scientist jobs were published during the period covered by the survey. The overwhelming majority of advertisements were for jobs in Budapest (84%). For the other regions there are no significant differences.

Figure 36: Evolution of the number of job advertisements in the data scientist occupation, time-series by macro-region (n=1960)

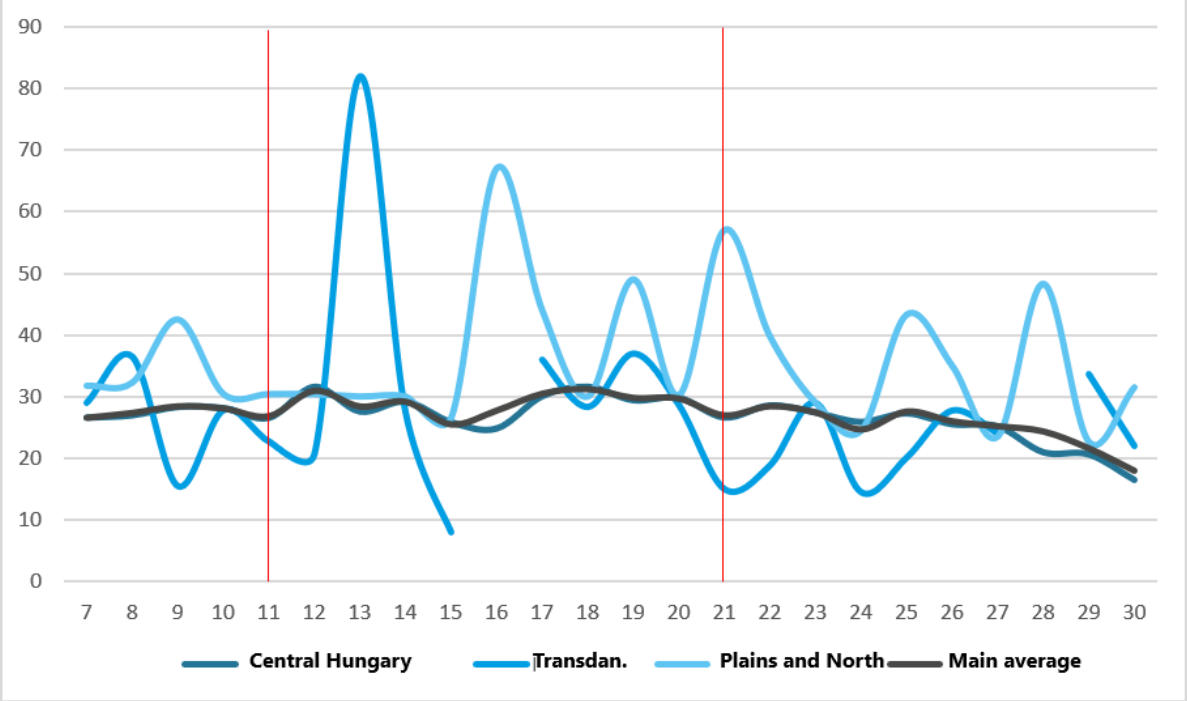


A slight drop in demand for data scientists is observed from week 10 of the year, followed by a sharp jump in the number of job advertisements in week 24.

5.4.2.1. Lifetime of job advertisements

A job advertisement was typically open for 26 days during the period studied. This value is relatively stable until week 25, from which point it shows a downward trend - 18 days in the last week examined.

Figure 37: Evolution of job advertisement lifetime (by average days) in the data scientist job category, time-series by macro-region (n=1960)



Looking at macro-regions, the overall lifetime of job advertisements is the lowest in Transdanubia (25 days), while it is 27 days in the central part of the country and 34 days in the Great Plain and Northern Hungary. However, the latter is due to the fact that, because of the low number of elements, 1 or 1 outlier can significantly change the average.

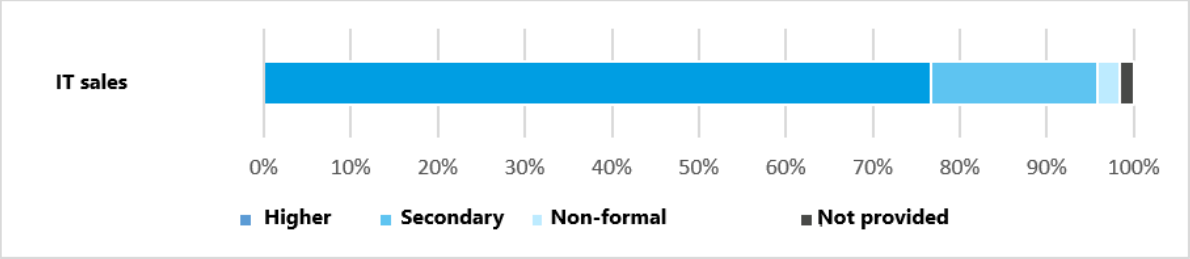
5.4.3. Job expectations

The requirements for the job in question are grouped as follows: qualifications required, language skills and professional experience.

5.4.3.1. Education

In 77% of the job advertisements surveyed, advertisers require a higher education qualification. Secondary education is accepted in 19% of jobs, while 3% of jobs accept non-formal qualifications.

Figure 38: Required education for data scientist job (n=1960)



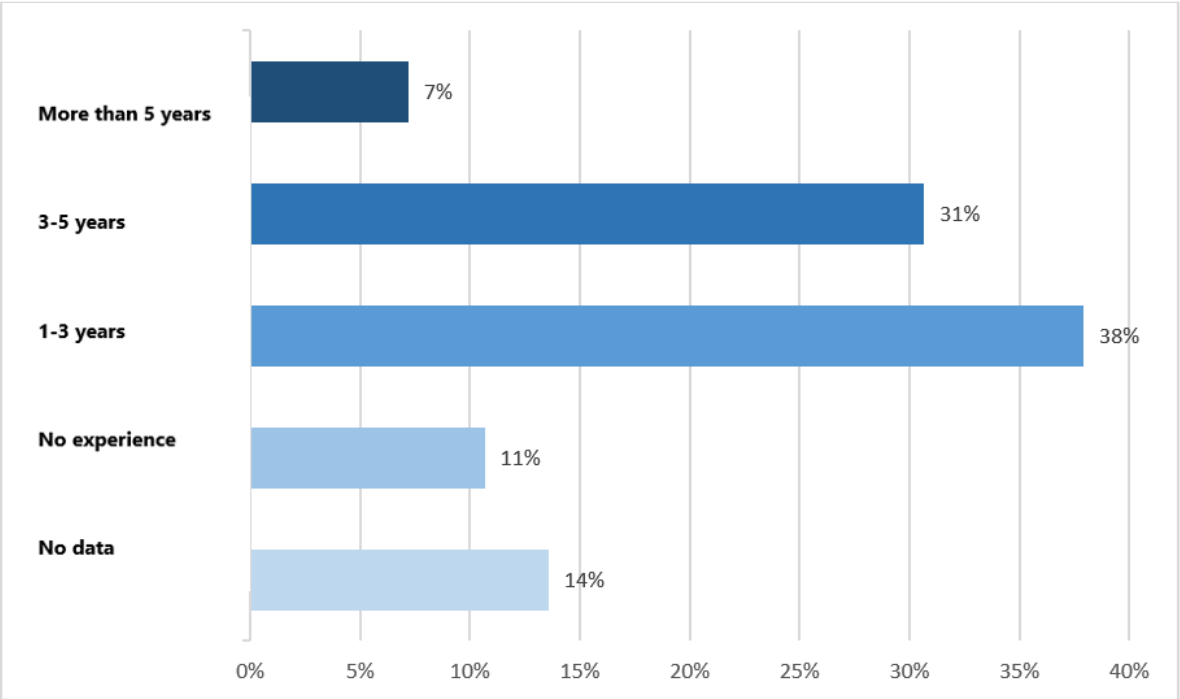
5.4.3.2. Language skills

The most important language is English, which is required for 90% of job advertisements. In 13% of job advertisements, no language skills were specified.

5.4.3.3. Professional experience

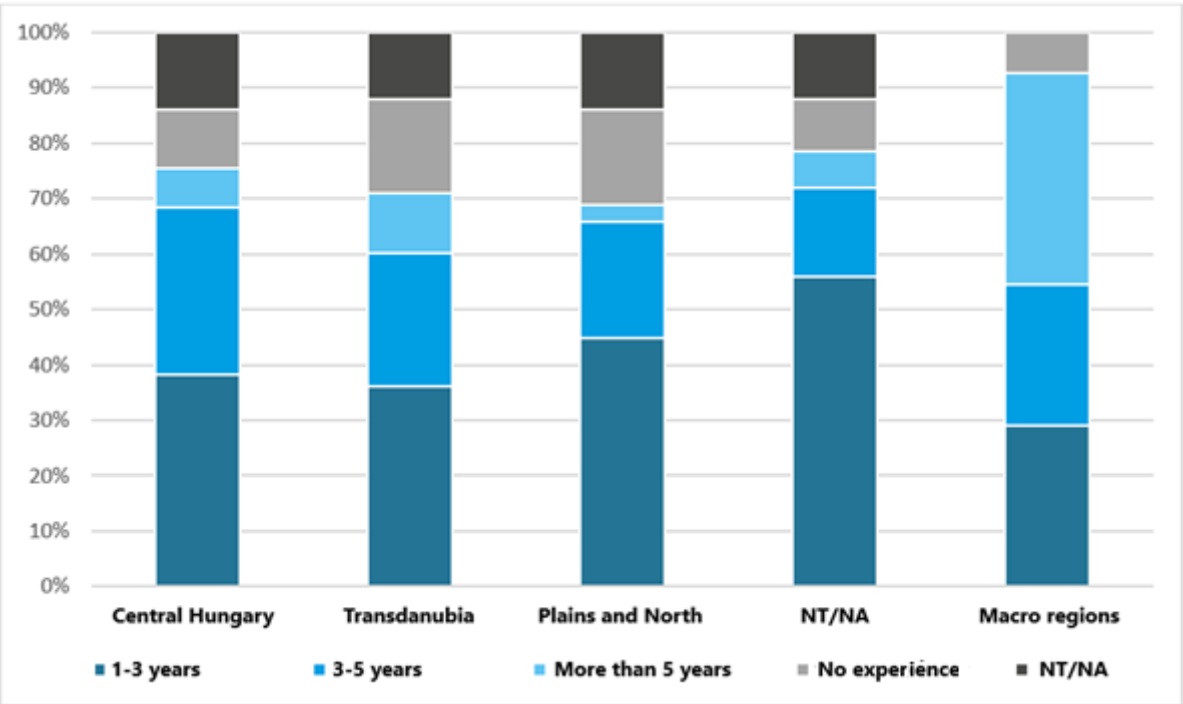
For the job, employers typically expect at least 1-3 years or 3-5 years of experience (38% and 31% respectively). Only 7% indicated that they expect a data scientist to have more than 5 years of experience, while in a further 24% of the advertisements either no experience was specified or it was highlighted that they would hire without experience.

Figure 39: Required professional experience as a data scientist (n=1960)



In regional terms, it should be highlighted that Central Hungary is more likely to be looking for professionals with 3-5 years of experience, and jobs covering several macro-regions are most likely to require more than 5 years of professional experience.

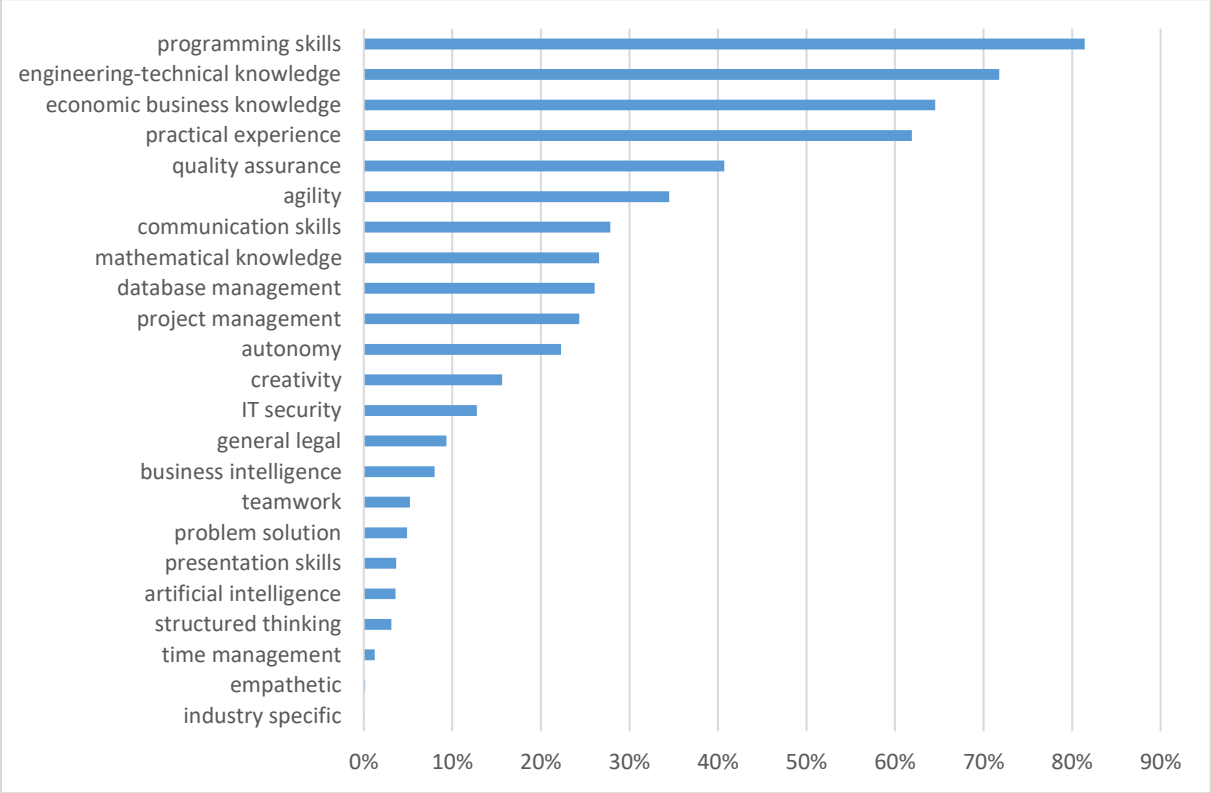
Figure 40: Required experience as a data scientist, by macro-region (n=1960)



5.4.4. Job-related competences

Of the 23 skills, professional and other skills surveyed, programming skills were mentioned as an expected competence in nearly 82% of the advertisements. The second most frequently mentioned skill was engineering/technical skills, with 72% of the ads. Knowledge of economics and business is also important, mentioned in 65% of the advertisements.

Figure 41: Need for skills by percentage of data scientist jobs (n=1960)



5.5. Database designer

Database integrator, database designer is a job requiring database knowledge and practice, which is difficult to separate from database operator or database developer jobs.

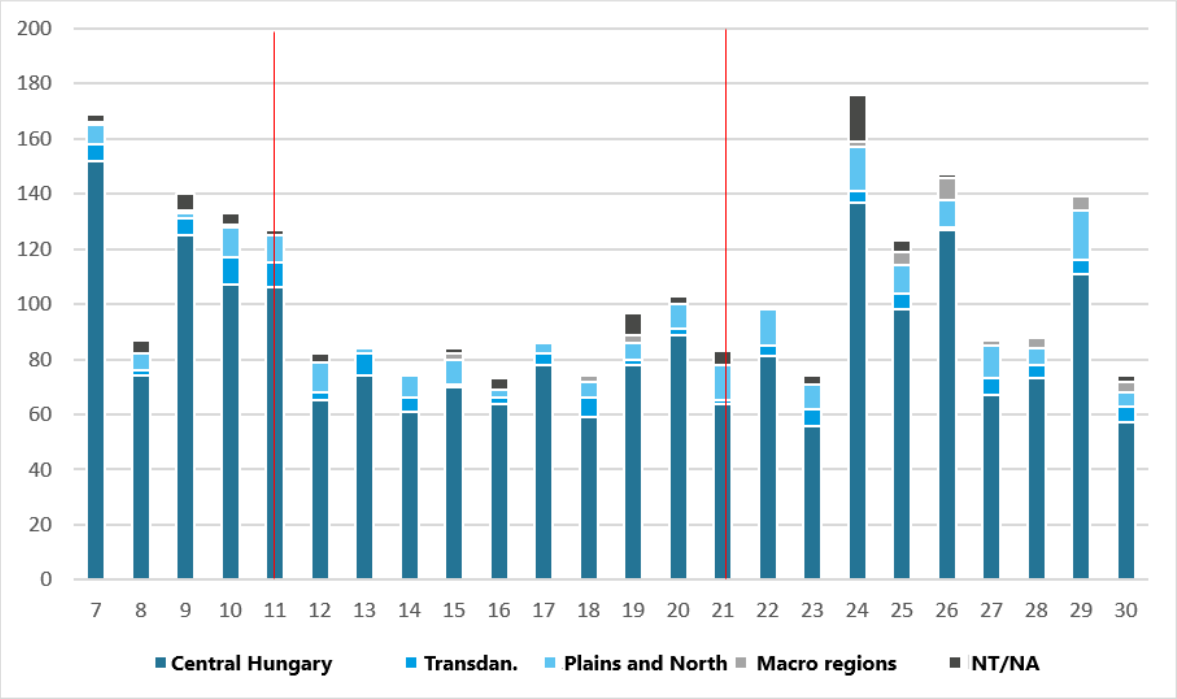
5.5.1. Definition and delimitation

The job of a database designer is classified in the FEOR classification as a database designer and operator (2151). However, this classification cannot be followed for the purposes of the present research, as another job examined (database developer) would also be essentially classified here, which would make separation impossible. Unfortunately, the information on job portals does not allow for a clear definition, as the job of a database designer is often treated as a job related to software designer or database operator. In the following, we will therefore rely on the data from the research, and then discuss the possibility of separation in the conclusions.

5.5.2. Evolution of job vacancies during the period under review

A total of 2,508 database designer job vacancies were published from week 7 to week 30 of 2020.

Figure 42: Evolution of the number of job vacancies in the database design job, time-series by macro-region (n=2508)



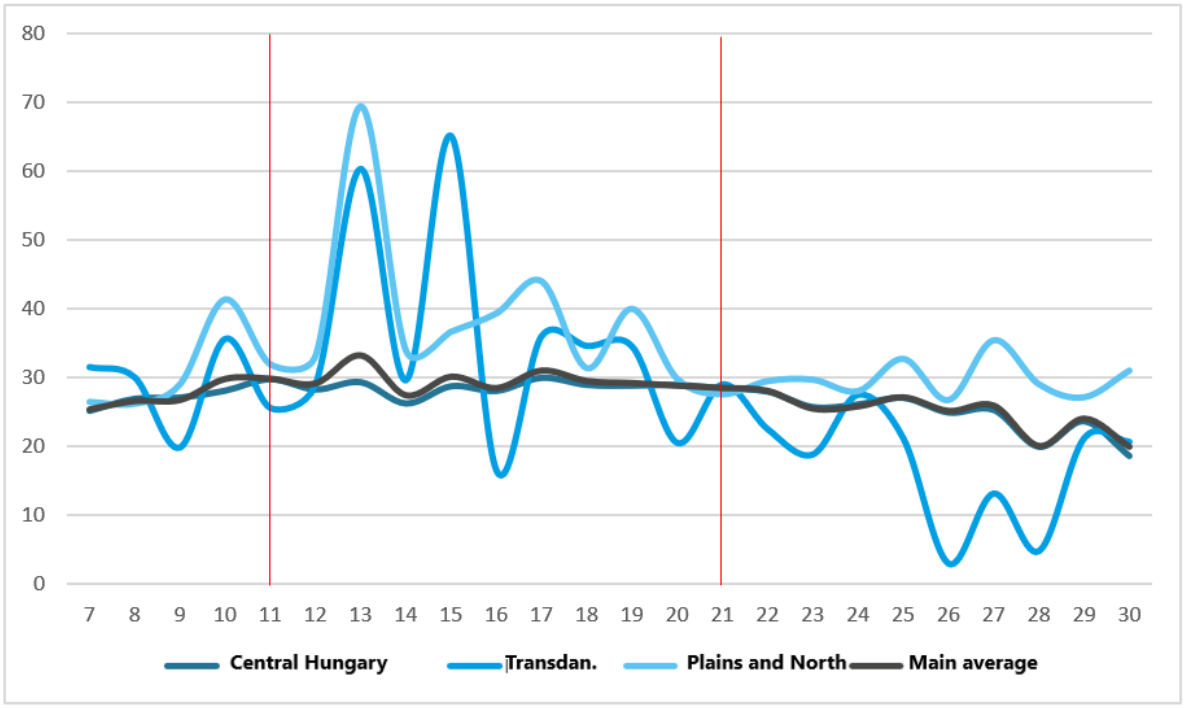
More than four-fifths (83%) of database designers were looking for a database in Central Hungary (but mostly only in Budapest) during the period under review. In the

spring, the number of job advertisements fell immediately after the emergency was declared, while in the week before it was lifted (on the 24th) the number of job advertisements had already risen significantly.

5.5.2.1. Lifetime of job advertisements

On average, a job advertisement was available for 27 days during the period studied.

Figure 43: Evolution of job advertisement lifetime (by average days) in the database design job, time-series by macro-region (n=2508)



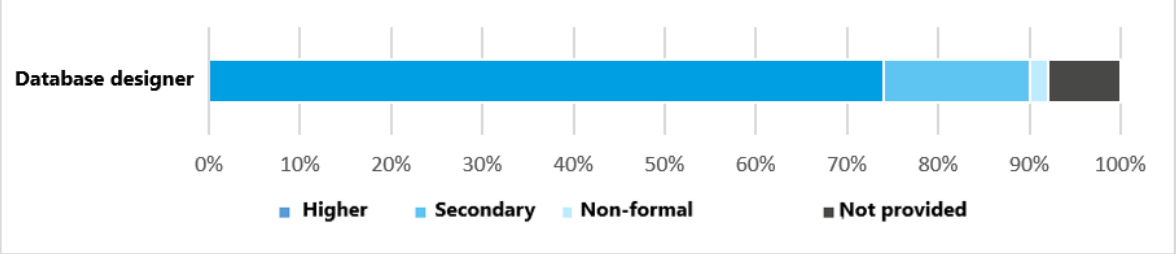
Job advertisements were available for an average of 30 days during half of the period under review, but after the opening following the coronavirus emergency, the number of advertisements and the likely recovery in demand reduced the time for job advertisements to 20-25 days.

5.5.3. Job expectations

5.5.3.1. Education

Three quarters of job vacancies (74%) asked for a tertiary level qualification, while one in six to seven asked for a secondary level qualification. A non-formal qualification (e.g. a vocational qualification) was also sufficient for 2% of job vacancies, while 8% did not specify any criteria.

Figure 44: Expected qualification in database design (n=2508)



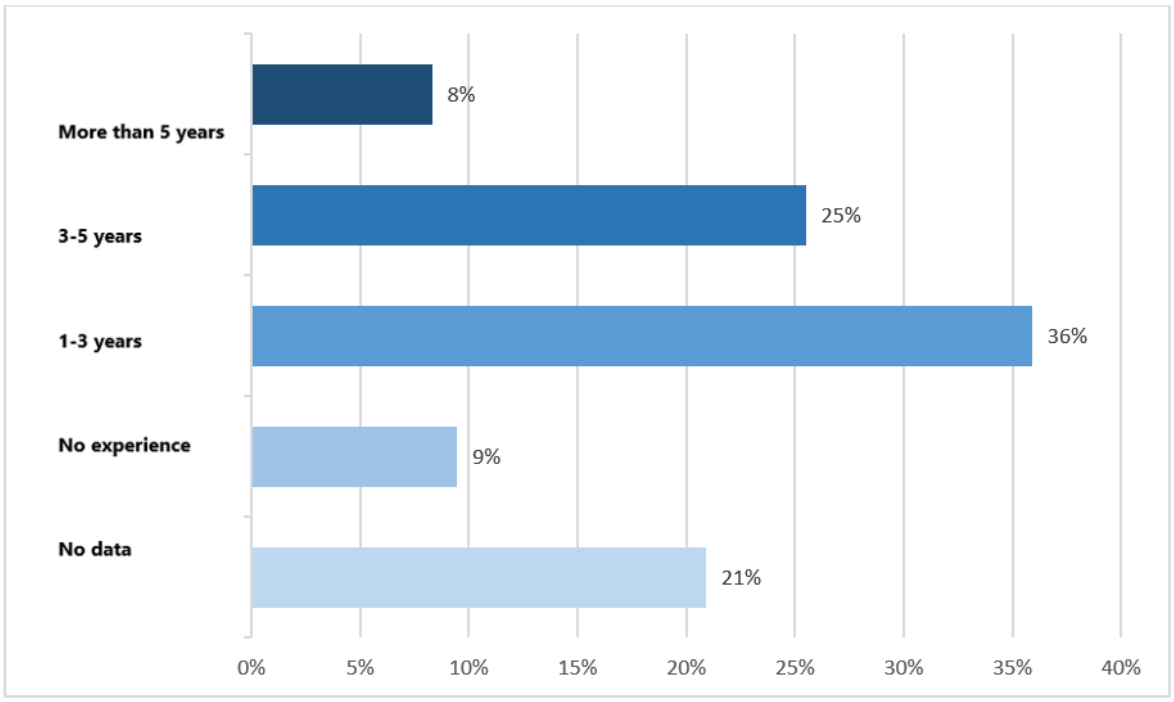
5.5.3.2. *Language skills*

The domestic job market typically requires database designers to have language skills. One foreign language is required in 66% of job advertisements, and two languages in one in five. Only 5 advertisements required knowledge of more than two languages.

5.5.3.3. Professional experience

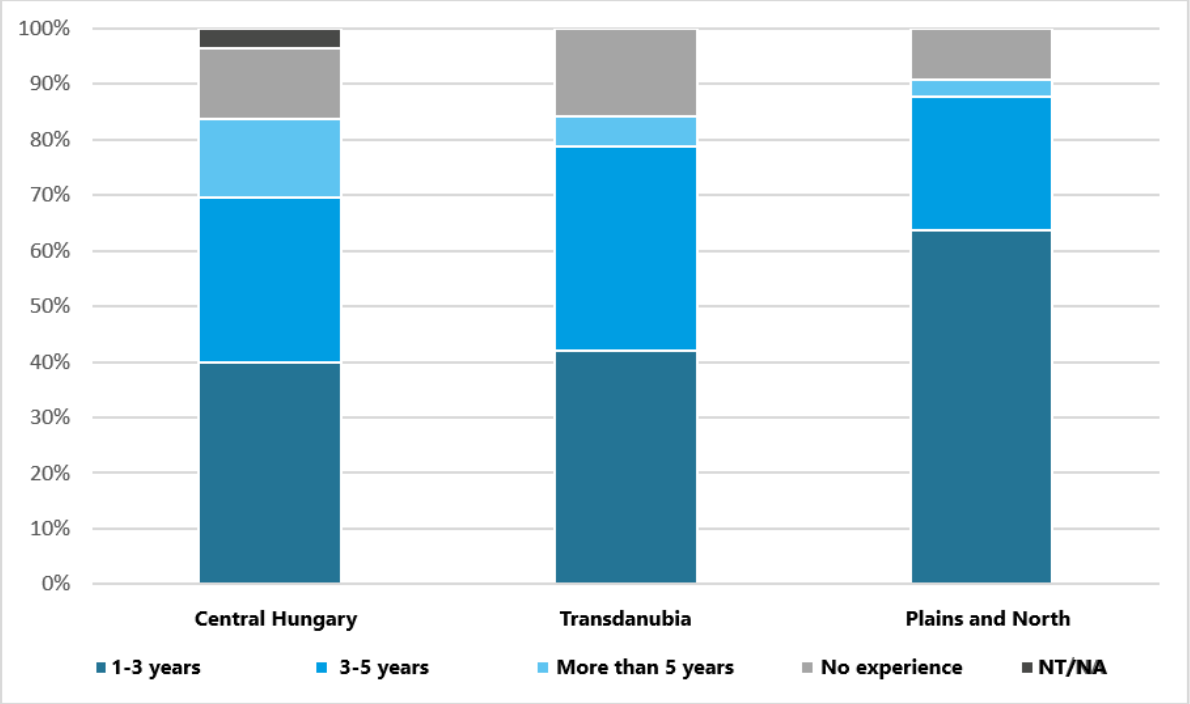
In the period under review, a good third (36%) of job advertisements stated 1-3 years' experience, a quarter (25%) stated 3-5 years' experience, a narrow tenth (8%) stated 5 years' experience or more, while no previous references were requested in a tenth (9%) of advertisements and a fifth (21%) had no previous work experience information.

Figure 45: Required professional experience as a database designer (n=2508)



Regionally, Central Hungary was the region where the previous experience was expected the most. The Great Plain and Northern macro-regions were most in demand for workers with 1-3 years of experience.

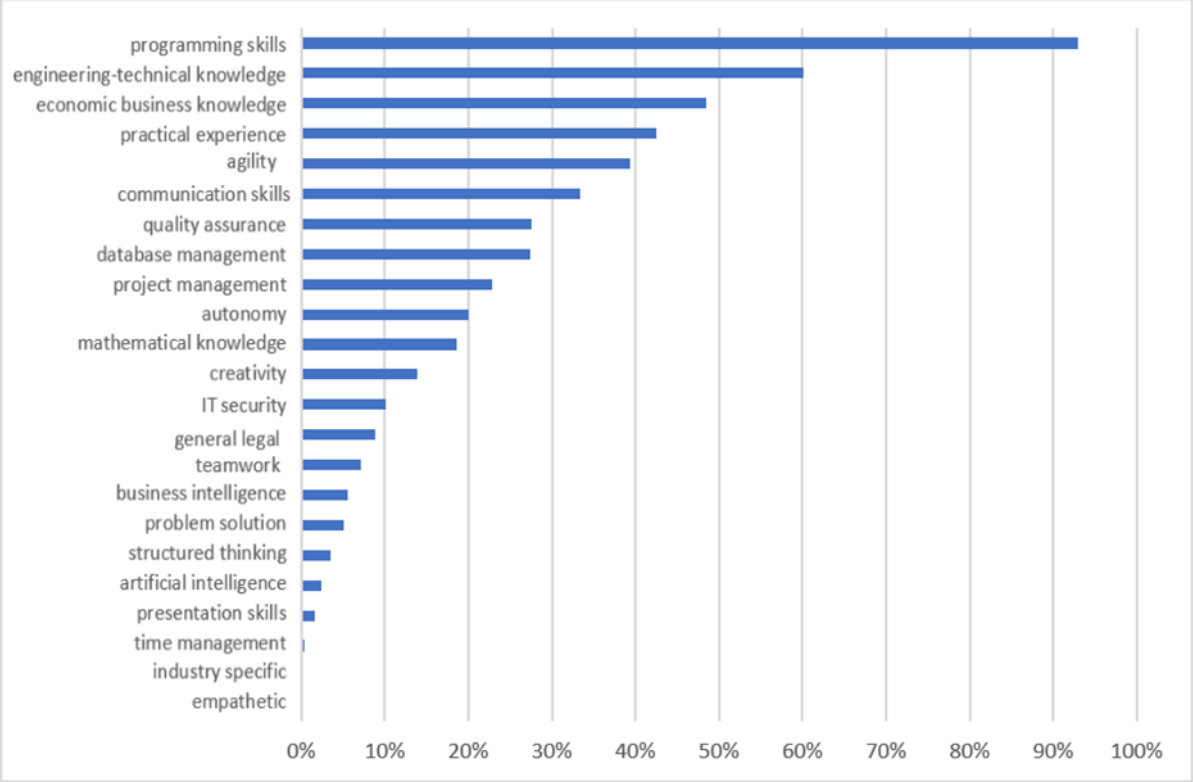
Figure 46: Required experience in database design job, by macro-region (n=2508)



5.5.4. Job-related competences

Of the 23 skills, professional and other skills surveyed, employers most often mentioned programming skills as an expected competence in their advertisements (93% of advertisements). The second most sought-after skill was engineering/technical skills, accounting for 60% of the advertisements. Business and economics skills were also significant, appearing in 49% of the ads.

Figure 47: Percentage of need for competences in database design jobs (n=2508)



5.6. Database developer

Database developer is a job that is difficult to separate from database operator and database designer, and employers do not have clear expectations of database developers in several of the dimensions studied.

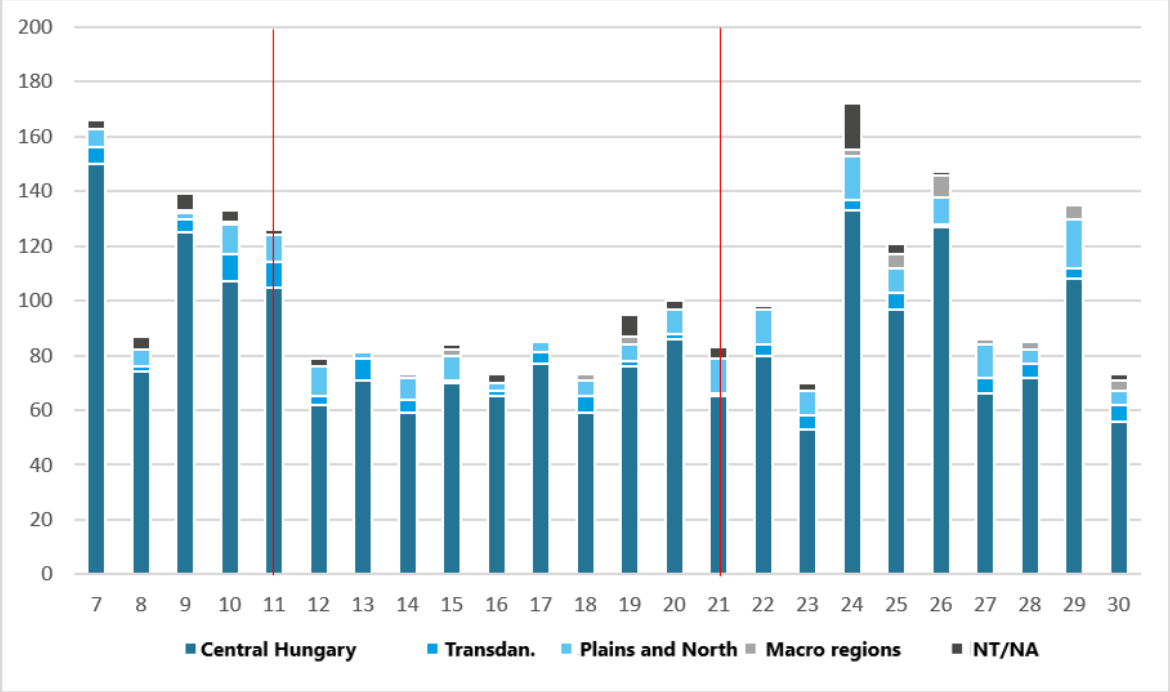
5.6.1. Definition and delimitation

The job of a database developer is classified in the FEOR classification as database designer and operator (2151). However, this classification cannot be followed for the purposes of the present research, as another job (database integrator, database designer) would also be essentially classified here, which would make separation impossible. Thus, starting from the descriptions of the job portals, the tasks to be performed in the job can be identified: server-side development, database platform and content migrations, database tuning, query creation, optimization, test execution, documentation preparation. Based on the tasks to be performed, it can be seen that there is little separation between the database developer and the database operator jobs discussed earlier. This is also reflected in the frequent dual titling of job advertisements (database developer/operator). The delimitation is particularly difficult when the database design job is taken into account.

5.6.2. Evolution of job vacancies during the period under review

A total of 2,468 database developer job vacancies were published from week 7 to week 30 of 2020.

Figure 48: Trend in the number of job vacancies in database developer occupations, time-series by macro-region (n=2468)

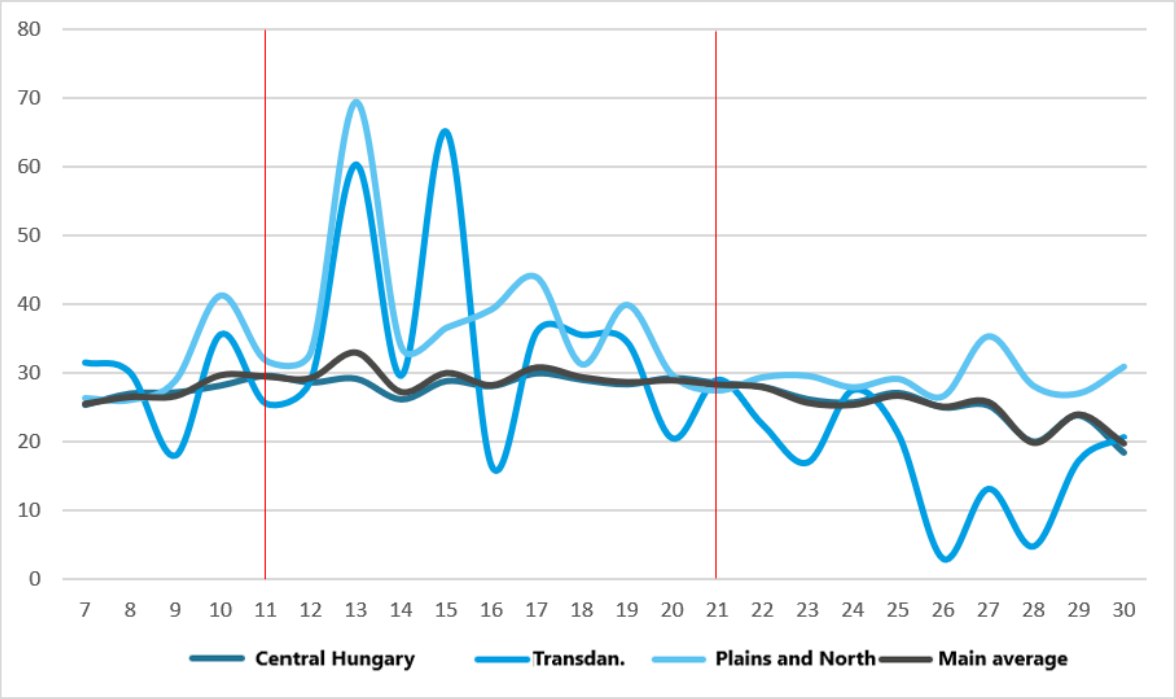


More than four-fifths (83%) of database developers were looking for jobs in Central Hungary (but mostly only in Budapest) during the period under review. In the spring, the number of job advertisements fell immediately after the emergency was declared, while the number of job advertisements already rose significantly in the week before the emergency was lifted (week 24).

5.6.2.1. Lifetime of job advertisements

On average, a job advertisement was available for 27 days during the period studied.

Figure 49: Trends in the lifetime of job advertisements (by average number of days) for database developer jobs, time-series by macro-region (n=2468)



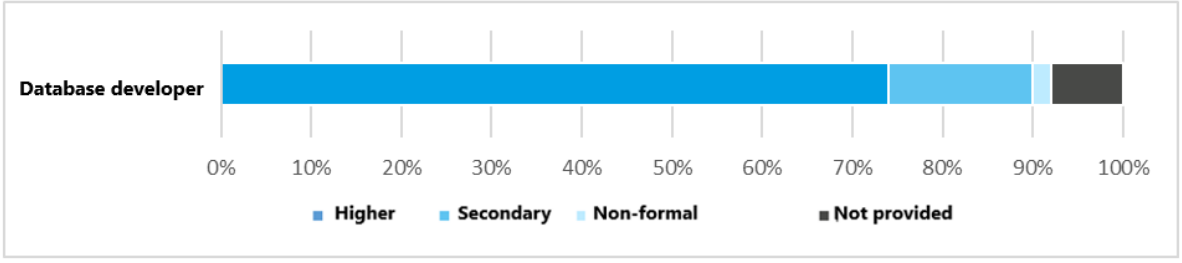
Job advertisements were available for an average of 30 days during half of the period under review, but after the opening following the coronavirus emergency, the number of advertisements and the likely recovery in demand reduced the time for job advertisements to 20-25 days.

5.6.3. Job expectations

5.6.3.1. Education

Three quarters of job vacancies (74%) asked for a tertiary level qualification, while one in six to seven asked for a secondary level qualification. Non-formal education (e.g. a vocational qualification) was also sufficient for 2% of job vacancies, while 8% did not specify any criteria.

Figure 50: Expected qualification in database development (n=2468)



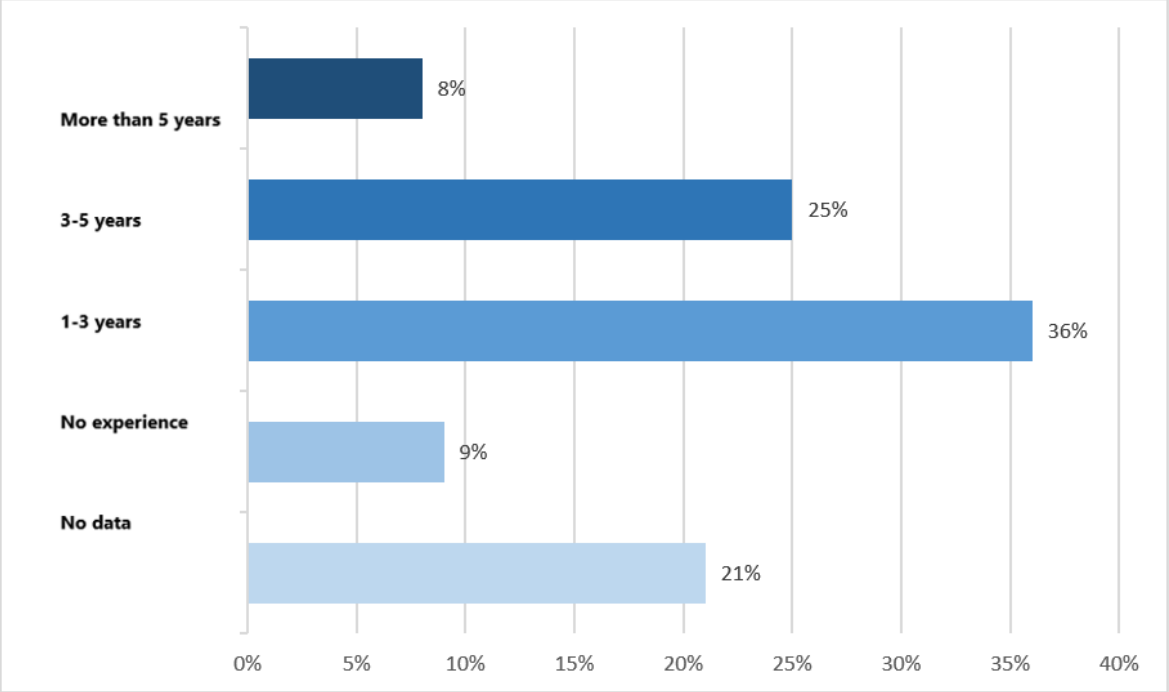
5.6.3.2. Language skills

The domestic job market typically requires database developers to have language skills. One foreign language is required in 66% of job advertisements, and two languages in 19%.

5.6.3.3. Professional experience

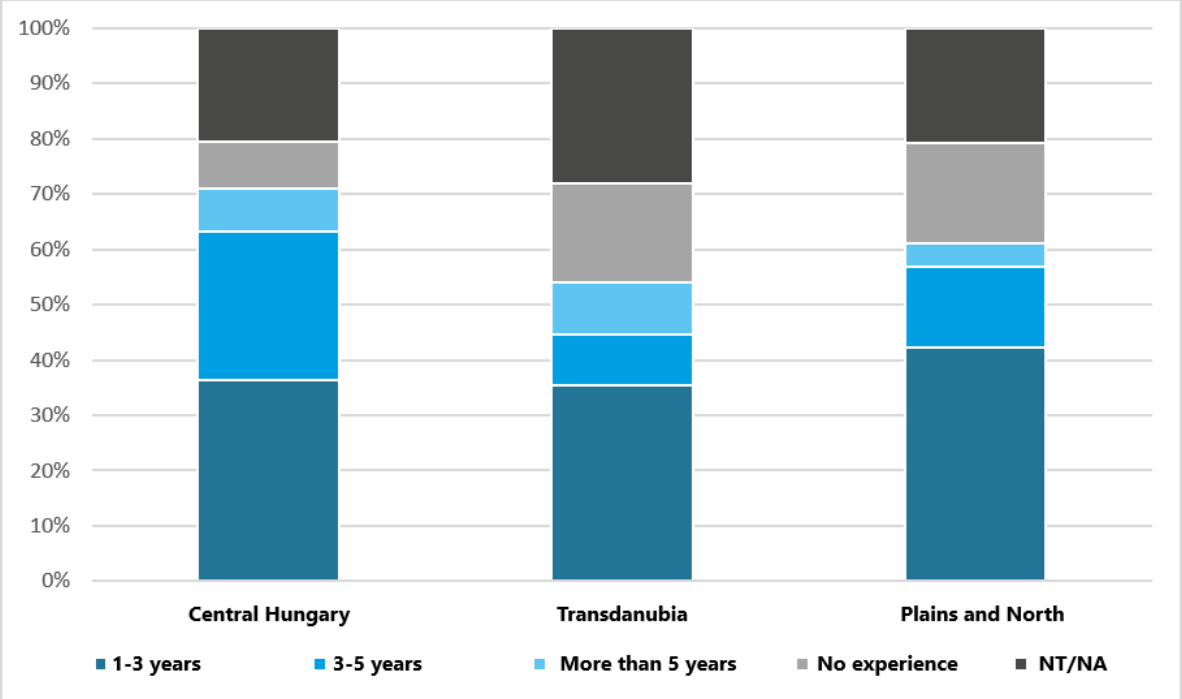
In the period under review, a good third (36%) of job advertisements stated 1-3 years' experience, a quarter (25%) stated 3-5 years' experience, a narrow tenth (8%) stated 5 years' experience or more, while no previous references were requested in a tenth (9%) of advertisements and a fifth (21%) had no previous work experience information.

Figure 51: Required professional experience in database development (n=2468)



Based on the advertisements surveyed, previous experience was expected most in Central Hungary. Typically, in the Great Plain and North macro region, 1-3 years of experience in database development is required.

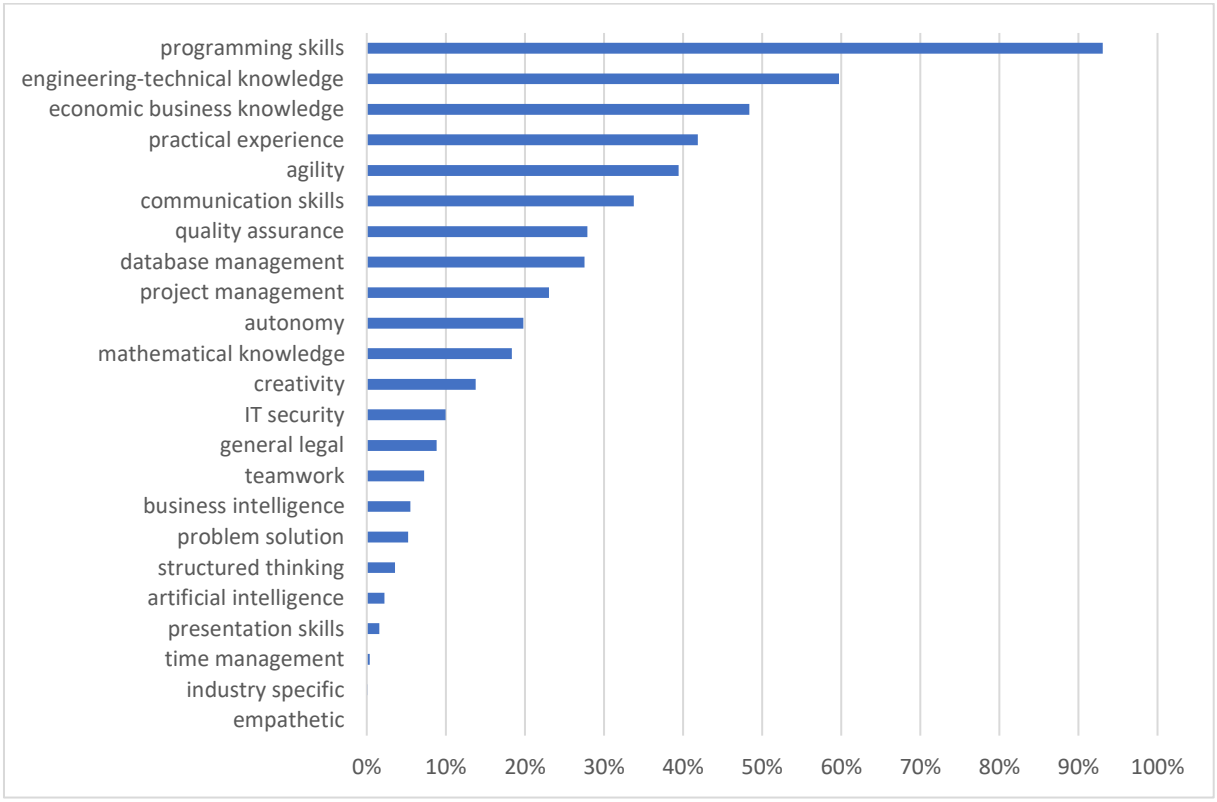
Figure 52: Required experience in database development job, by macro-region (n=2468)



5.6.4. Job-related competences

Of the 23 skills, professional and other skills surveyed, 93% of the job advertisements most frequently cited by employers as a job-related competency were programming skills. In database development jobs, engineering/technical skills (60%) and business/economics skills (48%) are the most important.

Figure 53: Need for skills by percentage in database developer jobs (n=2468)



5.7. Web developer

The web developer job differs from the developer jobs studied mainly in the subject of development and the development environment, but in other respects it has many similarities with them.

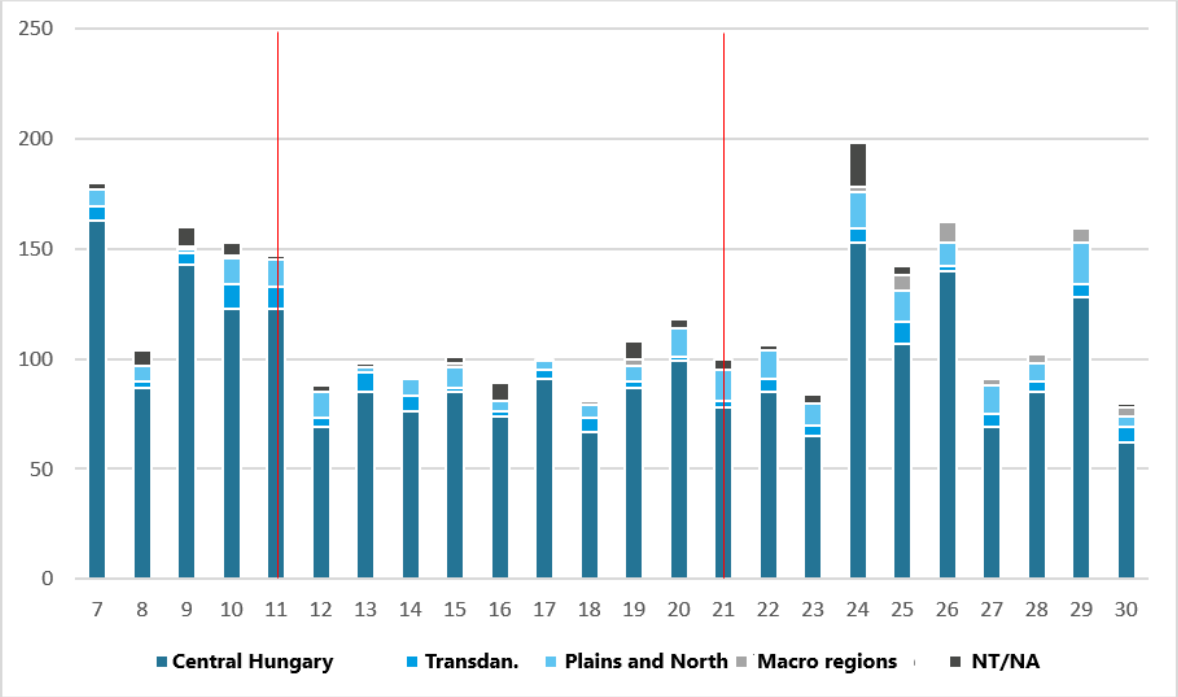
5.7.1. Definition and delimitation

The job of a web developer is classified (and appears) in the Network and multimedia developer occupation (2143) of the FEOR. In accordance with the FEOR, a network and multimedia developer "combines design and technical skills to research, analyse, evaluate, design, program and adapt web pages and applications that include text, graphics, animation, images, audio and video presentations and other interactive media". From the definition quoted, research may not be an integral part of the web developer's job, but none of the other elements can be excluded. The detailed tasks that seem relevant include: analysing, designing and developing web pages using software programming and scripting languages, linking them to different operating environments, and consulting with network professionals on security and hosting of network pages to verify and ensure the planning of internet and network server security, site allocation, user access, business continuity, network site backup, and disaster recovery. FEOR lists among the occupations to be distinguished several of those covered by our analysis: software developer, database designer and operator, system administrator. However, the separation in these cases seems clearer on the basis of the development objective or activity.

5.7.2. Evolution of job vacancies during the period under review

A total of 2,846 job advertisements for web developer jobs were published during the research period. Most of the advertisements were for jobs in Central Hungary (82%), including Budapest (80%). Of the other regions, the Great Plain and the North is second with 8%. There are no advertisements for working abroad.

Figure 54: Trends in the number of job advertisements for web developer, time-series by macro-region (n=2846)

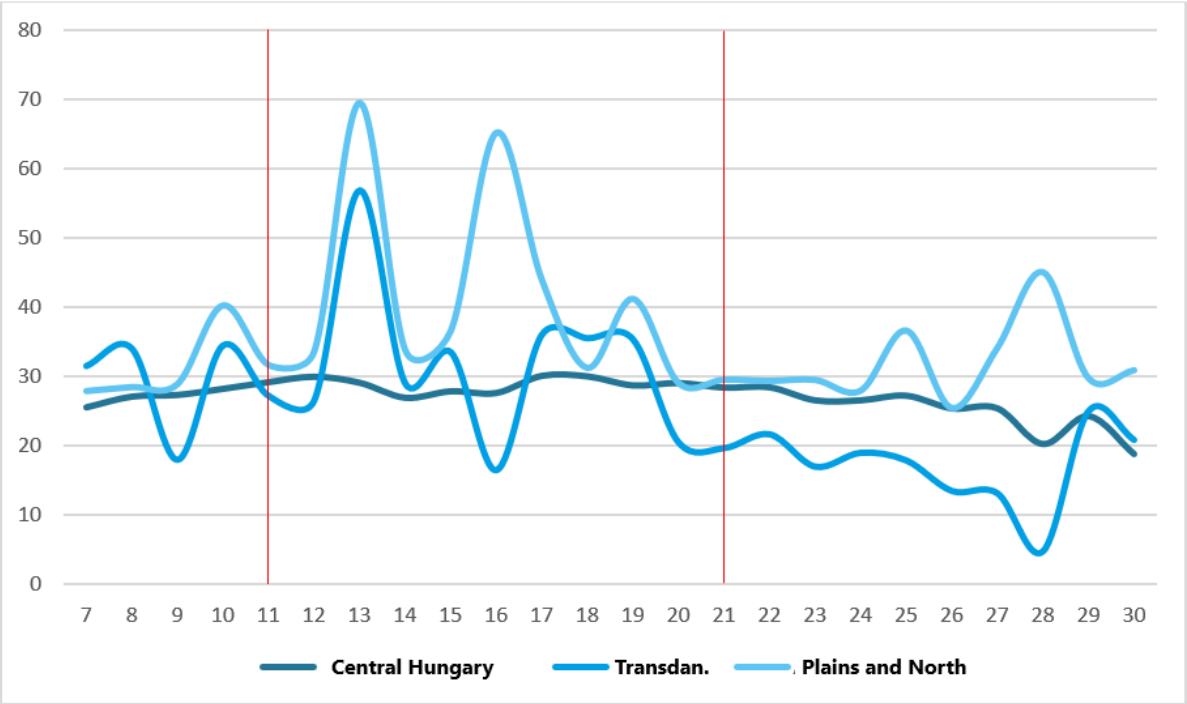


The demand for web developers is well separated between weeks 7 - 11 and 24 - 30. The former published an average of 149 ads per week, which later dropped to an average of 97 ads per week. There is a significant increase at week 24, which drops dramatically again at the end of the period.

5.7.2.1. Lifetime of job advertisements

A job advertisement was typically open for 27 days during the period studied. This value fluctuates over time until week 19, and then shows a minimal decrease from then on. The longest interval was 30 days in week 12.

Figure 55: Evolution of job advertisement lifetime (by average days) in web developer job category, time-series by macro-region (n=2846)



In terms of macro-regions advertisements in the Great Plain and the North were typically open longer than in the Transdanubian region or Central Hungary. The last of the three macro-regions showed the least volatility.

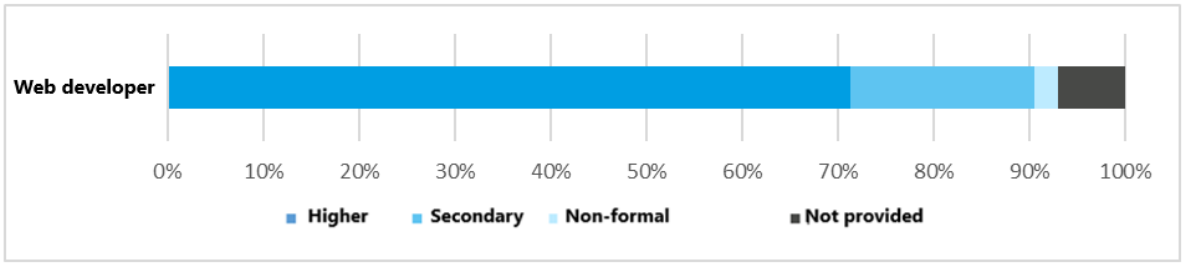
5.7.3. Job expectations

The requirements for the job in question are grouped as follows: qualifications required, language skills and professional experience.

5.7.3.1. Education

In 71% of the job advertisements surveyed, advertisers require a higher education qualification. Secondary education is accepted in 19% of jobs, while 7% do not specify an educational qualification. In the case of web developer jobs, only 2% of the advertisements mentioned non-formal qualifications as a requirement.

Figure 56: Required qualifications for web developer jobs (n=2846)



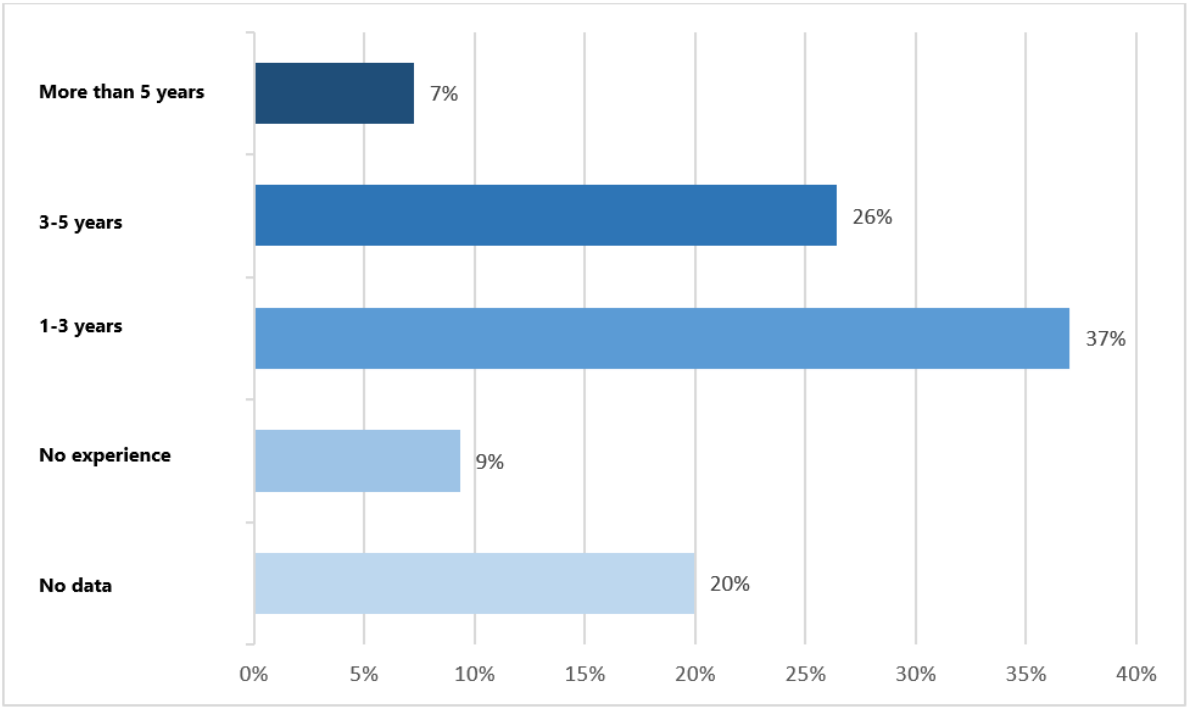
5.7.3.2. Language skills

Advertisements typically require knowledge of a foreign language. English is the most important language, required in 86% of job vacancies, German is required in 20% and 14% of vacancies have no foreign language requirement.

5.7.3.3. Professional experience

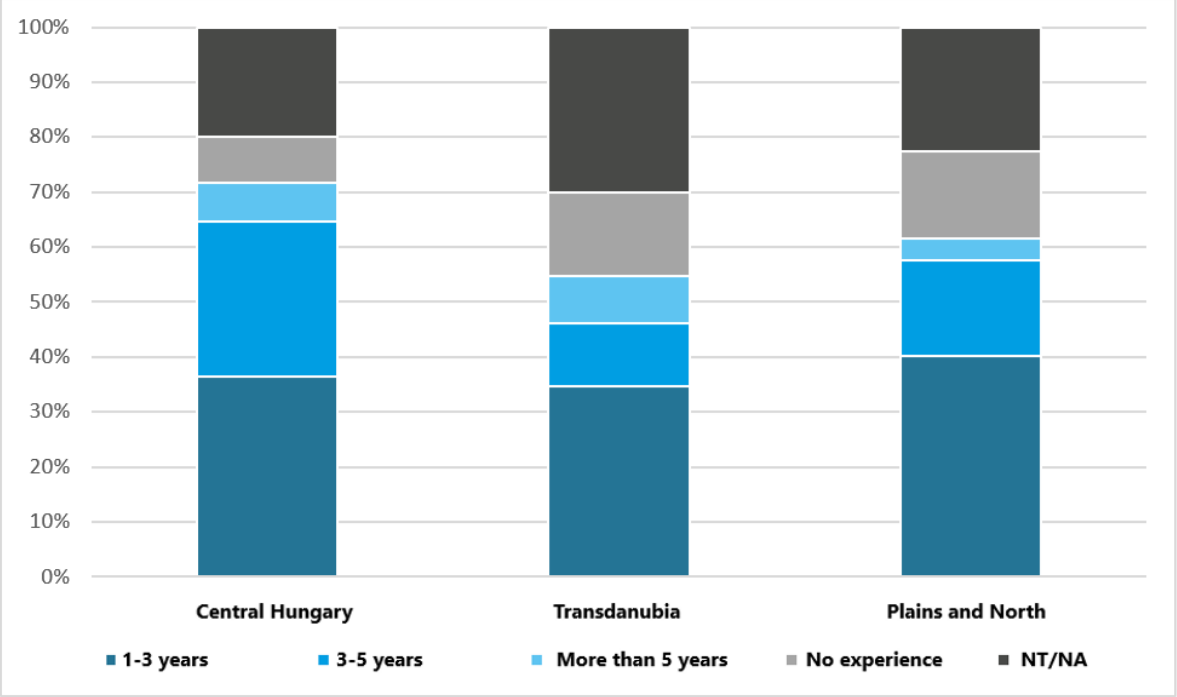
The experience most often sought by employers in the jobs shown is between one and three years (37%), and between three and five years in a quarter of the advertisements. This compares with a lower proportion of applications where the candidate has more than 5 years' experience (7%) or can be recruited without any professional experience (9%). In 20% of the advertisements, the employer's request was not indicated.

Figure 57: Required professional experience in web development (n=2846)



The spatial breakdown shows significant differences. The Eastern region has the highest proportion of job vacancies requiring between 1 and 3 years' experience and the lowest proportion requiring between three and five years' experience. The central region of the country has the lowest number of advertisements without a specific professional experience requirement.

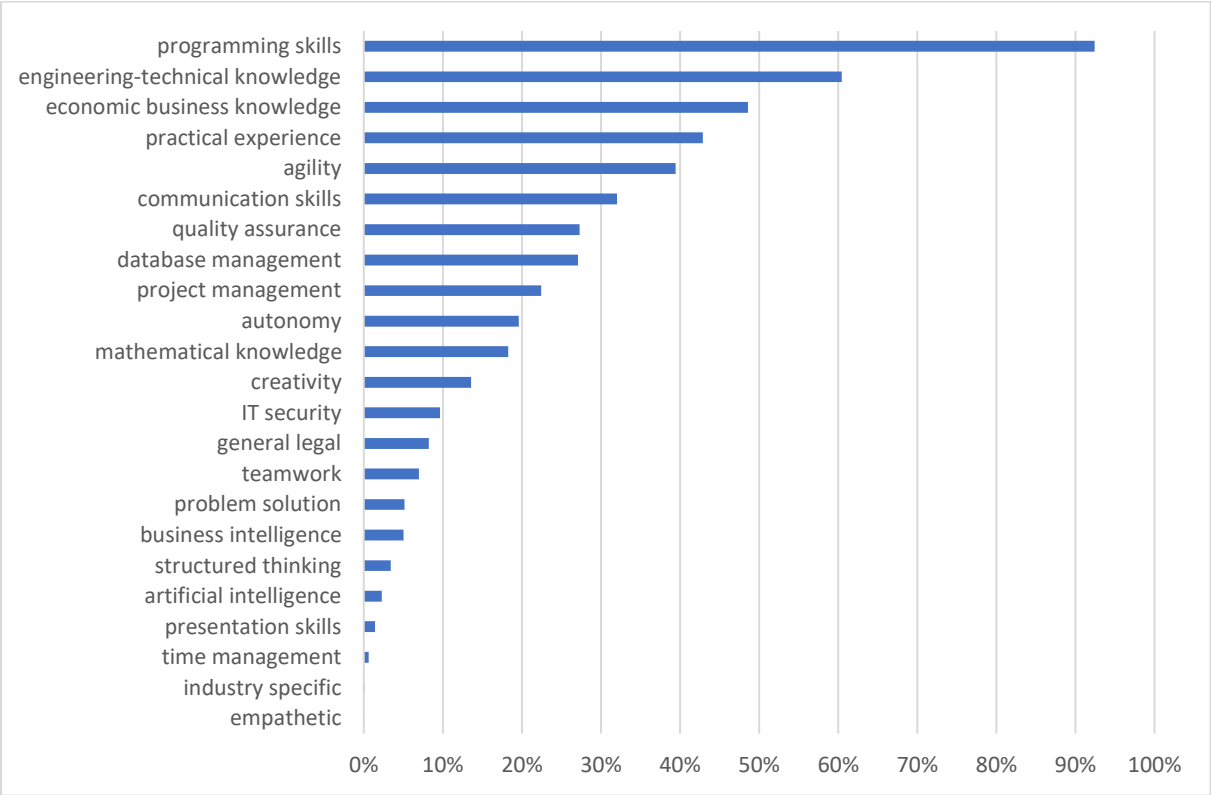
Figure 58: Required experience in web developer job, by macro region (n=2846)



5.7.4. Job-related competences

Of the 23 skills, professional and other skills surveyed, 92% of the job advertisements most frequently cited by employers as a job-related competency were programming skills. For web development jobs, engineering/technical skills (60%) and business/economics skills (49%) are the most important.

Figure 59: Need for skills in web developer jobs by percentage (n=2846)



5.8. DevOps engineer (development and operations engineer)

The Development and Operations Engineer job is a high-status job with high professional skills.

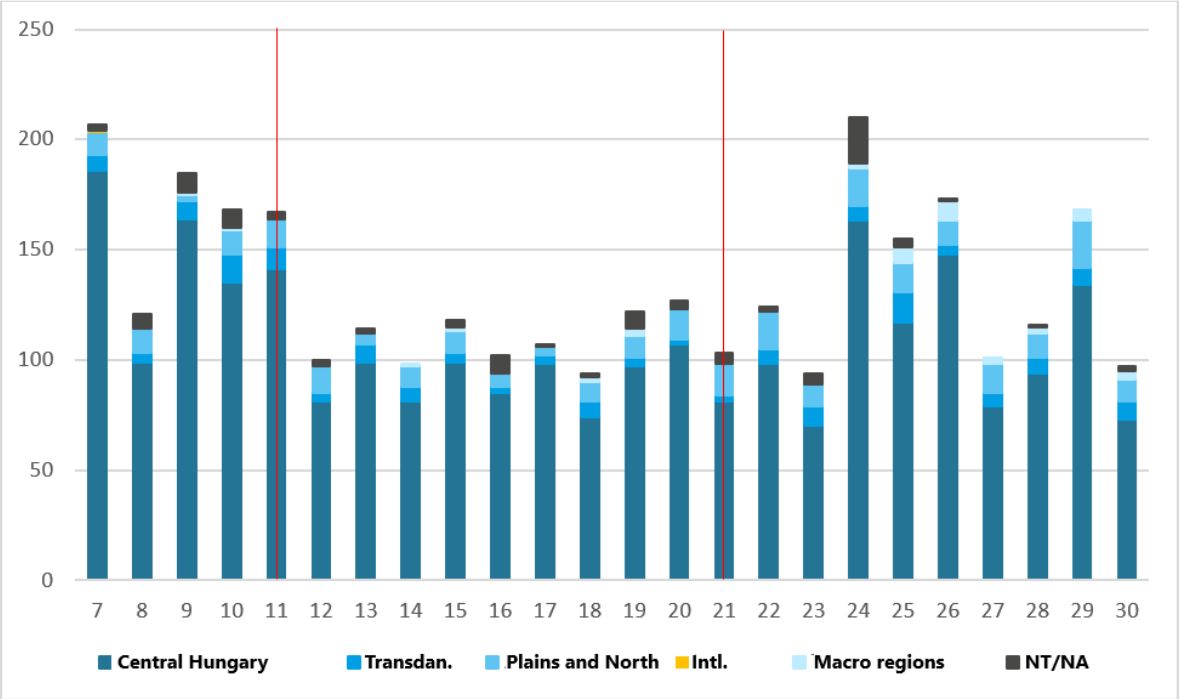
5.8.1. Definition and delimitation

The job of a development and operations engineer is closely linked to the increasingly popular approach of integrating previously separate IT development and operations (the emergence of the so-called DevOps approach and culture). Given the newness of the phenomenon, it is rather a job in the making, so an FEOR classification is not possible. DevOps is a job that is related to both development and operations, providing an overview of both processes, and the ability to coordinate DevOps processes is an important requirement.

5.8.2. Evolution of job vacancies during the period under review

The trend in the number of advertisements for the job of a DevOps engineer can be described, among other things, by area distribution over the time period under study. From week 7 to week 30 of the year, a total of 3,171 job advertisements were posted looking for DevOps engineers and employees who can perform both IT development and operations tasks.

Figure 60: Evolution of the number of job advertisements for DevOps engineer, time-series by macro-region (n=3171)

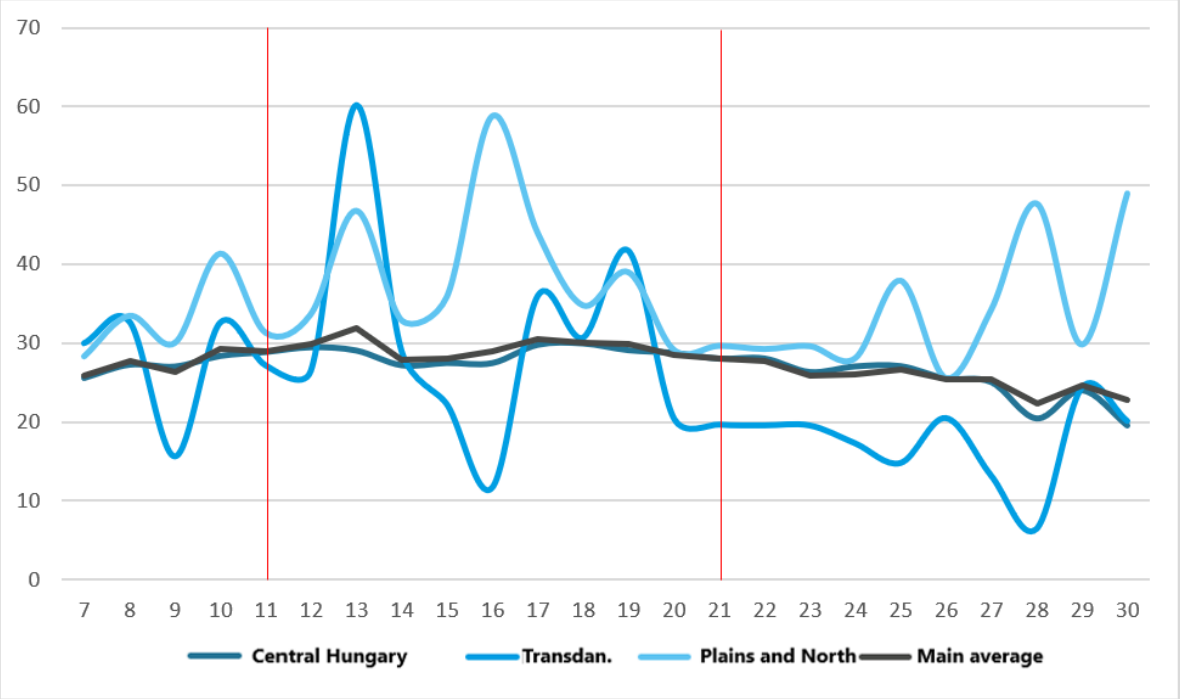


Interest in DevOps engineers was strongest at the beginning of the period analysed, but the exceptional economic and health situation reduced the number of job advertisements posted between weeks 12 and 23. Demand showed a significant increase in week 24 compared to the preceding period, which did not prove to be sustained in the period thereafter. In terms of macro-regions, employers are clearly most interested in DevOps engineers in the Central Hungary region (82%), with a significant share in Budapest (80%).

5.8.2.1. Lifetime of job advertisements

On average, a DevOps Engineer job was open for 27 days during the period. At the beginning of the COVID-19 period, this value increased, reaching its maximum in week 13 with a lifetime of 32 days (third week of March 2020). From week 17 onwards, the lifetime of the ads decreased steadily, falling to 23 days in the last week of the period under review.

Figure 61: Evolution of job advertisement lifetime (by average days) for DevOps engineer jobs, time-series by macro-region (n=3171)



Looking at the job advertisements by region, we can see that the Central Hungary region had the most consistent job advertisement lifetime, while the Transdanubian region was the most affected by the recent period[24]. Life expectancy was also volatile in the macro-region of the Great Plain and North.

5.8.3. Job expectations

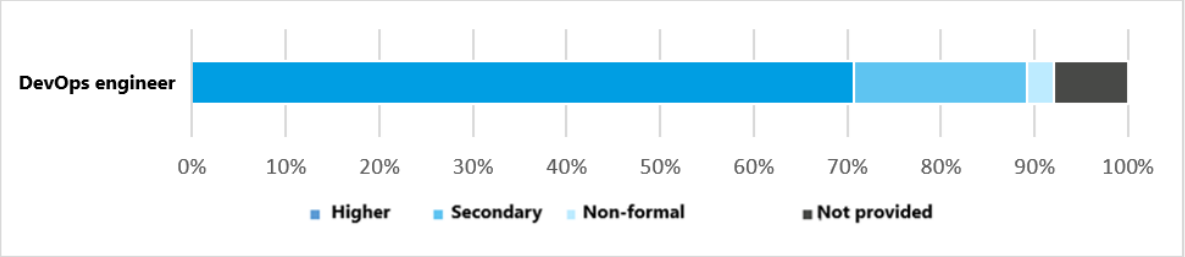
The requirements for the job in question are grouped as follows: qualifications required, language skills and professional experience.

5.8.3.1. Education

In more than 70% of the advertisements analysed, the employer is looking for a higher education qualification, such as telecommunications, computer science, college or university. 19% of the job advertisements consider secondary education to be sufficient, while 3% mention studies outside the school system (e.g. OKJ, ISTQB[25]). The qualification requirement cannot be categorised for 8% of job vacancies.

[24] However, this is also linked to the low number of job advertisements per week surveyed. Just over seven ads per week were placed on average over the period (7.4 ads per week).
[25] International Software Testing Qualifications Board: https://www.istqb.org/ Date retrieved: 29/07/2020

Figure 62: Required education for DevOps engineer job (n=3171)



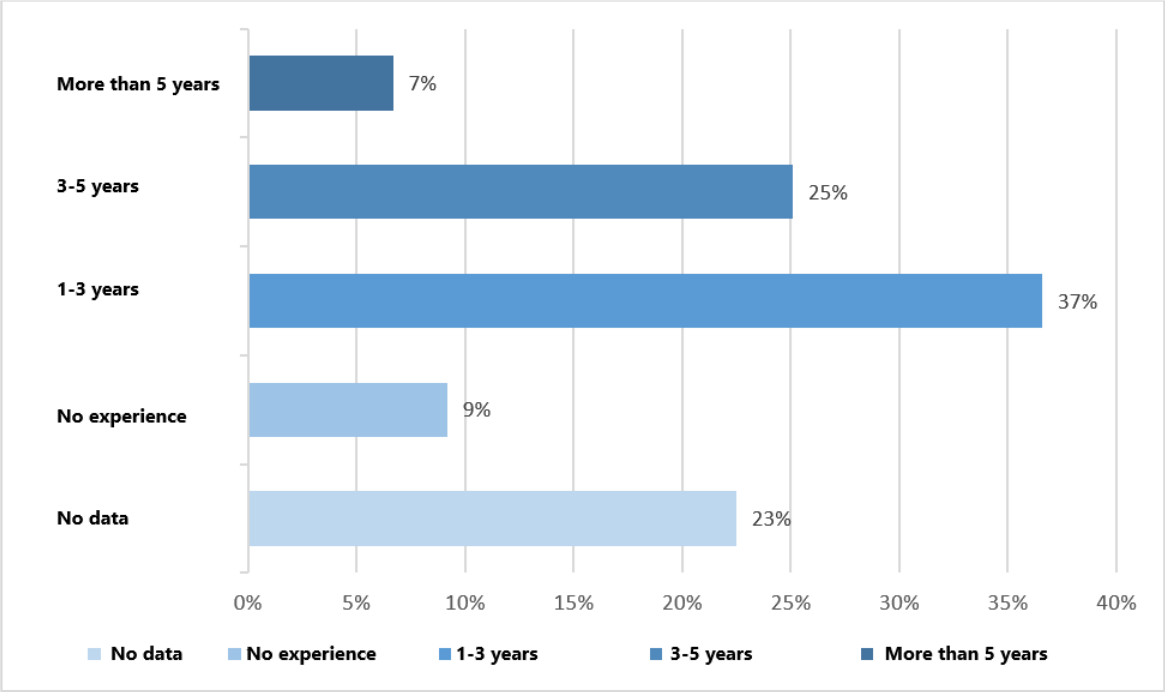
5.8.3.2. Language skills

On average, the advertisements published require knowledge of one foreign language, while employers in the Transdanubian region more often prefer knowledge of two foreign languages. English is the most important language, required in 85% of job vacancies, German in 21% and 14% of vacancies without a foreign language requirement.

5.8.3.3. Professional experience

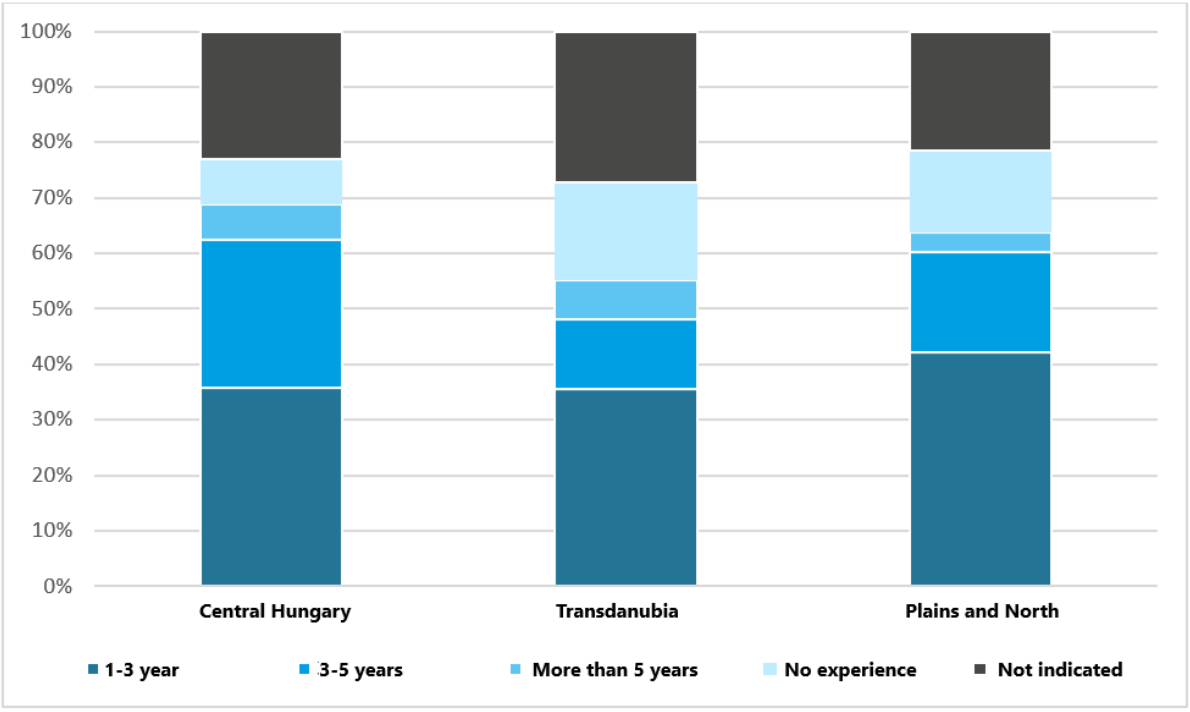
The experience most often sought by employers in the jobs shown is between one and three years (37%), and between three and five years in a quarter of the advertisements. This compares with a lower proportion of applications where the candidate has more than 5 years' experience (7%) or can be recruited without any professional experience (9%). In 23% of the advertisements, the jobseeker's request was not specified.

Figure 63: Required professional experience as a DevOps engineer (n=3171)



The regional breakdown reveals significant differences in expectations. The Eastern part of the country has the highest proportion of job vacancies requiring 1-3 years of experience, and Central Hungary between three and five years.

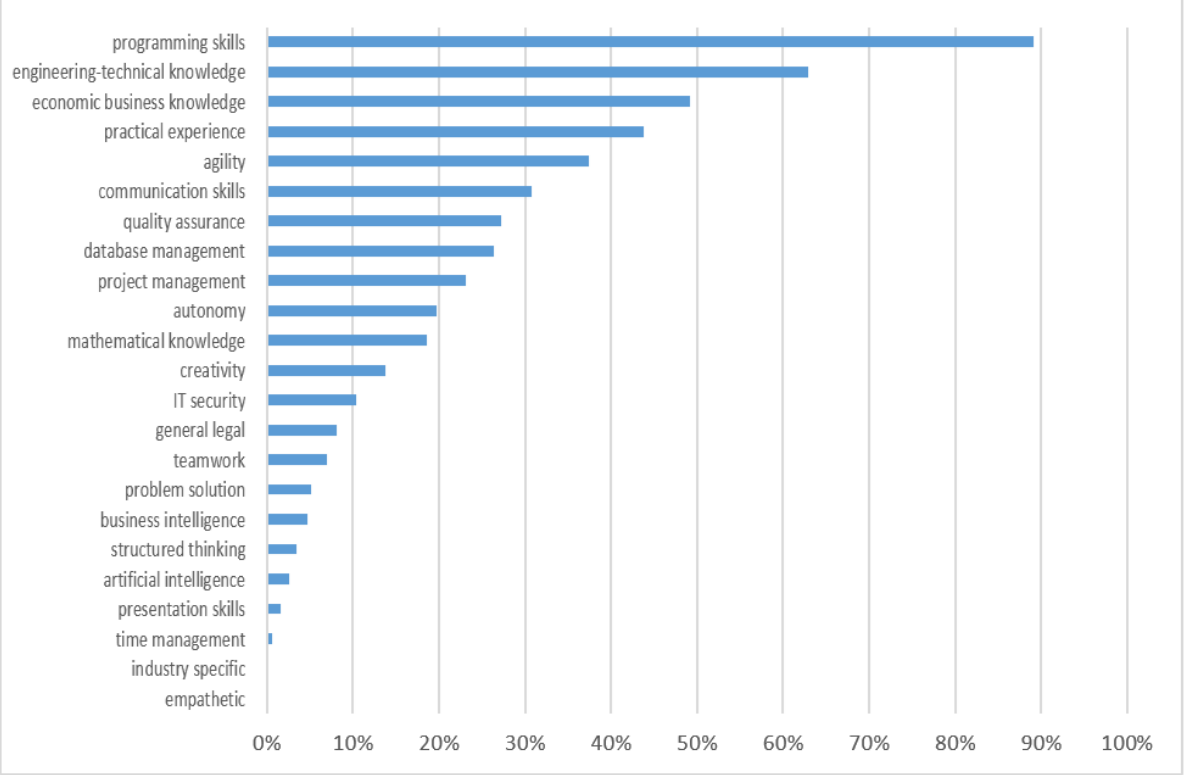
Figure 64: Required experience as a DevOps engineer, by macro region (n=3171)



5.8.4. Job-related competences

Of the 23 professional and other competences surveyed, employers expect the highest proportions of DevOps engineers to have programming (89%), engineering and technical (63%) and economics and business (57%) skills, according to the job advertisements surveyed.

Figure 65: Need for competences in percentage of DevOps engineer jobs (n=3171)



5.9. Mobile developer (Android or IOS)

The mobile developer job is difficult to distinguish from the software developer job (it is essentially a specific part of it). Its isolation is supported by the significant demand and the specific programming environment.

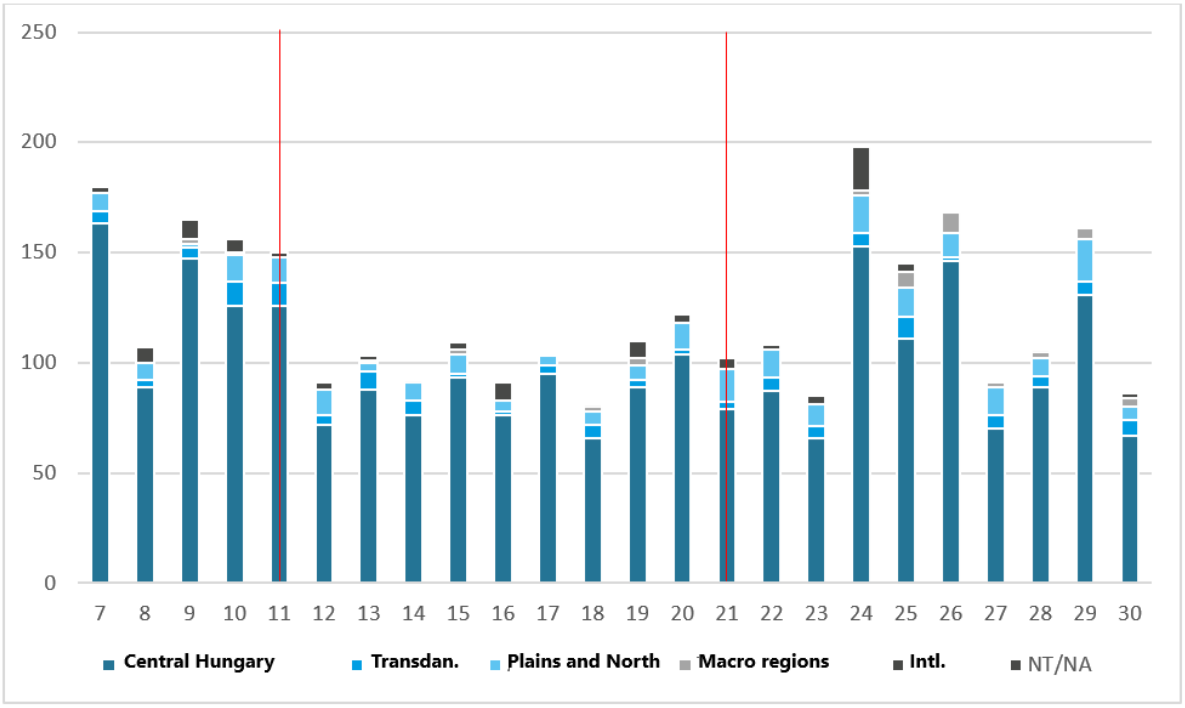
5.9.1. Definition and delimitation

In the FEOR system, mobile developer does not correspond to the occupation (more precisely, the corresponding occupation would be application programmer (2144), but this is not very specific and difficult to distinguish from software developer). At the same time, the mobile developer job can be well approached from the mobile application developer qualification. In accordance with the job description of the qualification, the "a mobile application developer prepares, designs and develops software applications for mobile devices (smartphone, tablet, ultra-mobile computer, etc.). Selects the architecture proposed for the planned development, the technologies required, based on the knowledge of the standards and protocols in use. Defines the mobile device-side and server-side development tools needed to produce applications. In the context of application design, the developer analyses user requirements and formulates the development objective. Designs functional, logical and physical systems using a common methodology or system. Designs the user interface of the mobile application, the interactions related to its functionality - taking into account the specificities of mobile devices. Functional units are designed using an algorithm description tool. Integrates and optimises modules and source materials into a system. Sets up the environment, installs and runs the application. Coordinates test operations, prepare test documentation. Evaluates the results of the testing, coordinates, implements and documents the changes".

5.9.2. Evolution of job vacancies during the period under review

The number of job advertisements in the mobile development sector between the 7th and 30th week of 2020 was 2,912. There was a larger drop in mobile development-related job ads in the middle of the period under review. The numbers jumped in the second week of June (week 24) compared to previous weeks, but then fell again in the following period.

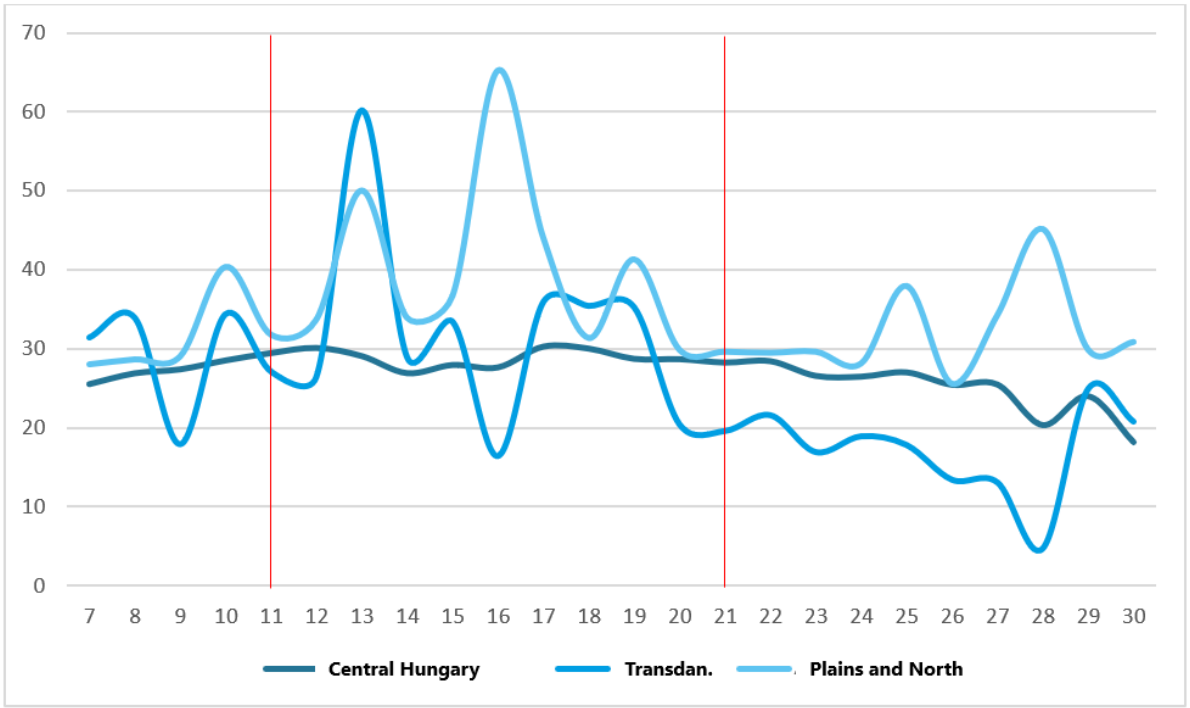
Figure 66: Evolution of the number of job advertisements in the mobile developer job category, time-series breakdown (n=2912)



5.9.2.1. Lifetime of job advertisements

Average lifespan of job advertisements for mobile developer jobs was 27 days, which increased at the beginning of the period and then showed a downward trend after a peak in week 17 during the period under review.

Figure 67: Evolution of job advertisement lifetime (by average days) in the mobile developer job category, time-series by macro-region (n=2912)



In the period under review, the most balanced job advertisement lifetime by region was in Central Hungary. On average, the Great Plain and North region had the longest life expectancy, at 34 days.

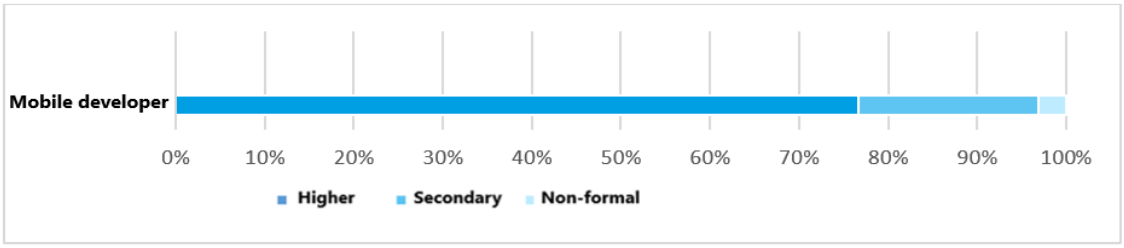
5.9.3. Job expectations

We have grouped the job requirements into the following categories: qualifications required, language skills and professional.

5.9.3.1. Education

For mobile developer jobs, a higher education degree is the most sought-after qualification in the job advertisements surveyed (72%). 550 job advertisements accept secondary education, while only 2.5% of the advertisements mention non-formal education as a requirement.

Figure 68: Expected qualification for a mobile developer job (n=2912)



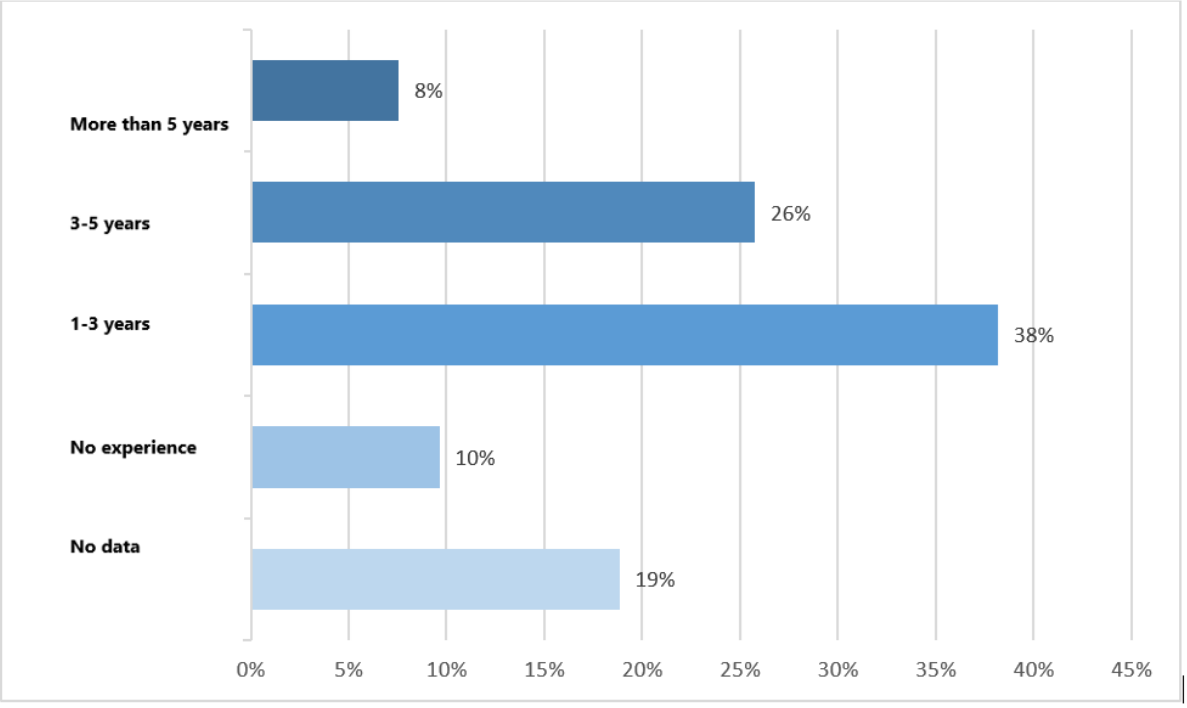
5.9.3.2. Language skills

In the case of job advertisements for mobile development, 66% of them ask for English language skills. The second most requested language is German, requested in around 20% of the advertisements (570). The number of job vacancies where knowledge of a foreign language was not required was similarly low (396).

5.9.3.3. Professional experience

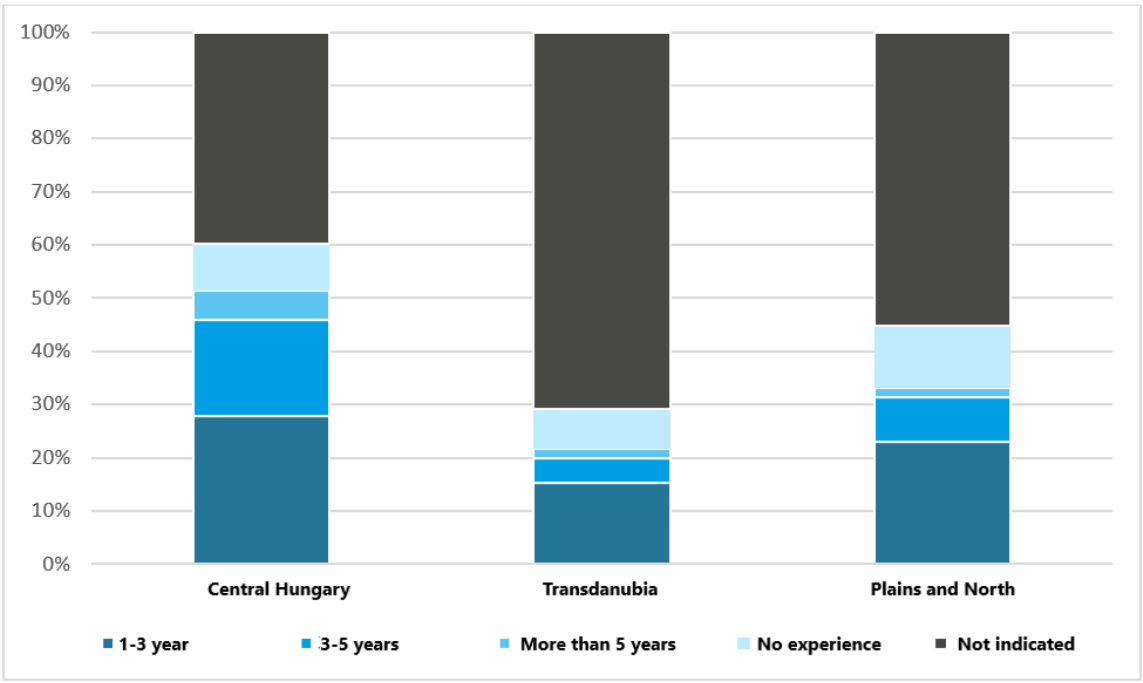
In terms of experience requirements, the most sought-after job advertisements (37%) are for people with 1-3 years of experience. There is a small difference between this and the number of ads seeking people with 3-5 years of experience, where the share is 27%. Low number of advertisements looking for people with more than 5 years of experience or no experience.

Figure 69: Required experience in a mobile developer job (n=2912)



In regional terms, the Central Hungary region differs from the rest of the country in that it is the region with the highest level of specific experience expectations, and the proportion of 3-5 years of experience expected is also higher here compared to the other regions.

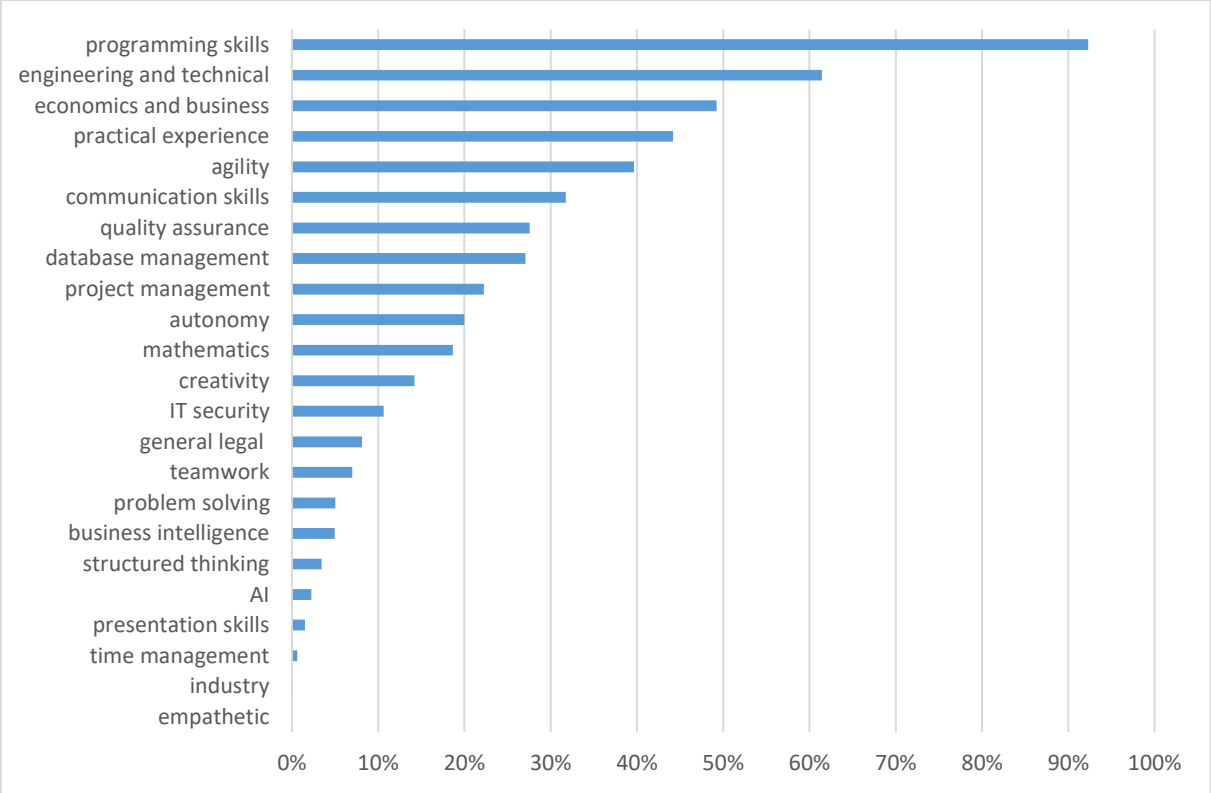
Figure 70: Required professional experience in a mobile developer job, by macro-region (n=2912)



5.9.4. Job-related competences

Among the 23 professional and other skills surveyed, employers expect the highest proportions of mobile developers to have programming (92%), engineering and technical (61%) and economics and business (49%) skills, according to the job advertisements surveyed.

Figure 71: Percentage of mobile developer jobs requiring skills (n=2912)



5.10. Software developer, Software developer, Business application developer

The software developer is a rather heterogeneous job that involves working in a variety of programming environments.

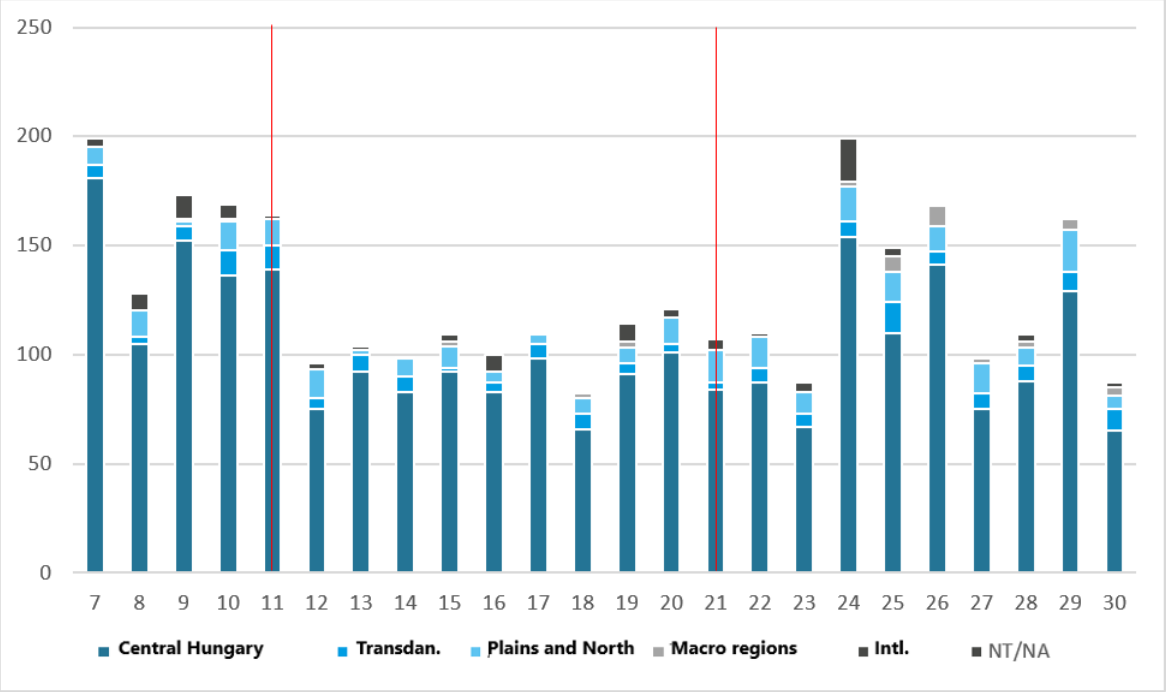
5.10.1. Definition and delimitation

The job of a software developer seems to be clearly mapped to the FEOR software developer occupation (2142). In accordance with the job description, a software developer "researches, analyses and evaluates the needs of existing or new software applications and operating systems, and designs, develops, tests and maintains software solutions to meet those needs." From this brief description, it is clear that the job of a software developer is difficult to distinguish (at least according to the FEOR definitions) from the job of a software tester. Looking further into the definition of FEOR, the typical jobs in this occupation include a further job surveyed, systems designer.

5.10.2. Evolution of job vacancies during the period under review

From week 7 to week 30 of 2020, 3,046 job advertisements for software developer jobs were posted nationally.

Figure 72: Trends in the number of job vacancies for software engineers, time series by macro-region (n=3046)

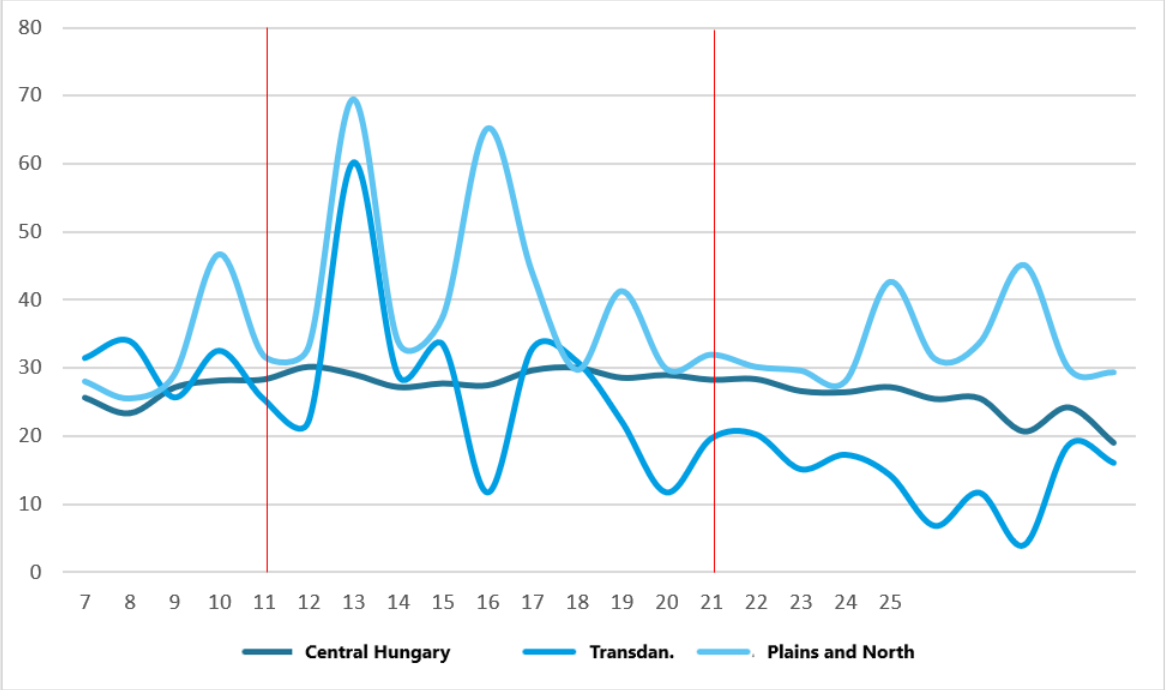


Generally speaking, there is a high demand for jobs as software developers or with this skill set. However, after stagnation in week 7, the exceptional health situation caused a larger drop in the number of job advertisements. Trends in demand show that there is a vast majority of open job vacancies for Software developer occupations in Central Hungary (82%). 80% of the advertisements posted are related to the capital.

5.10.2.1. Lifetime of job advertisements

A job advertisement was typically open for 27 days during the period studied.

Figure 73: Evolution of job advertisement lifetime (by average days) for software developer jobs, time-series by macro-region (n=3046)



By macro-region, the regions with the highest increase in the length of job advertisements during the epidemic were the Great Plain and Northern regions, with the highest average number of days (34 days) per job advertisement. The peak in the region was reached at week 13 with a life expectancy of 70 days, but this is considered an outlier. The largest fluctuations are also seen in this region. In Central Hungary, the longevity of job advertisements remained the most stable. In Transdanubia, the number of days was volatile, with an average ad lifetime of 23 days and a steady downward trend from week 13 onwards.

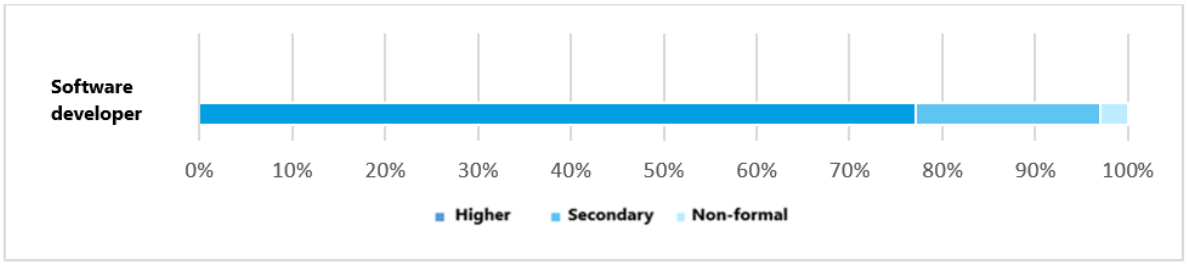
5.10.3. Job expectations

The requirements for the software developer job are grouped according to the following: qualifications, language skills and experience.

5.10.3.1. Education

In 71% of the job vacancies surveyed, a higher education degree was required for software developer jobs. Secondary education is considered sufficient for 18% of job vacancies. Knowledge acquired outside the school system seems to be the least appropriate, with only 3% of the advertisements stating this as an expectation.

Figure 74: Required qualifications for software developer jobs, (n=3046)



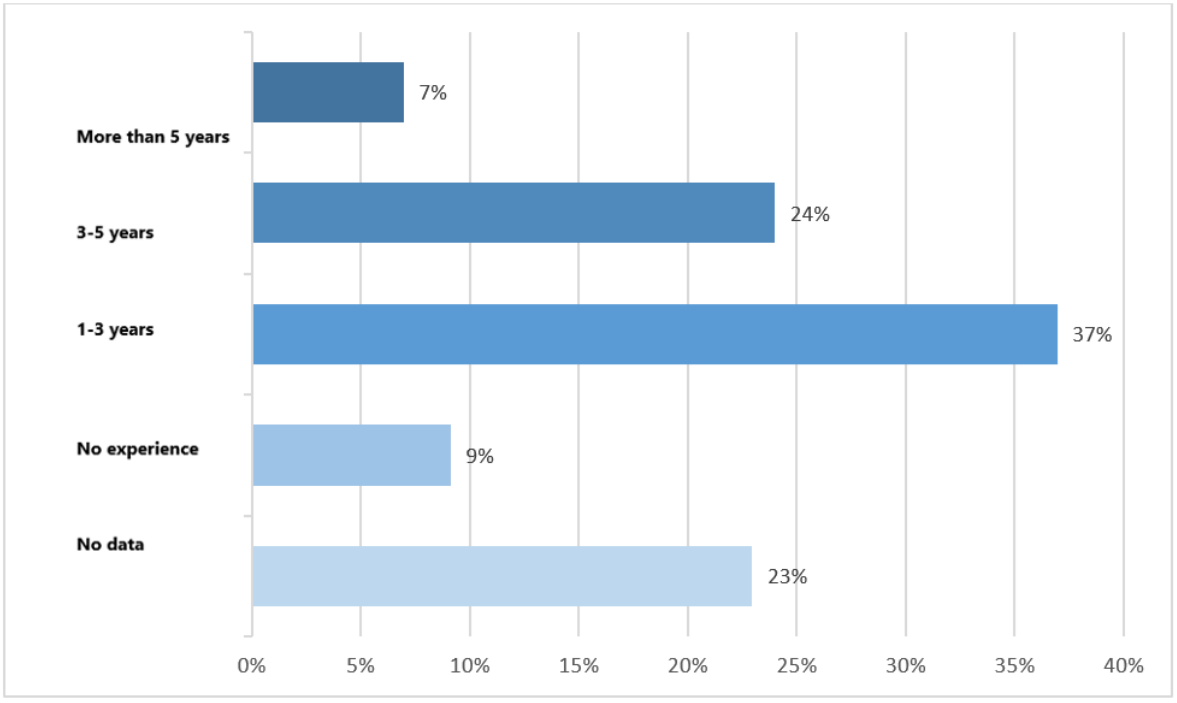
5.10.3.2. Language skills

The software developer job market in our country typically requires language skills. Of the 3046 adverts examined, English only was required in 1960 (64.3%) and German only in 609 (20%). 14% of the ads do not ask for foreign language skills.

5.10.3.3. Professional experience

In the advertisements, workers with 1-3 years of experience are most sought (36%). This is not far behind for those with 3-5 years' experience, where the rate is 25%. There is a surprisingly low number of advertisements looking for people with more than 5 years of experience. This is presumably because only a small percentage of the advertisements are looking for professionals for senior positions.

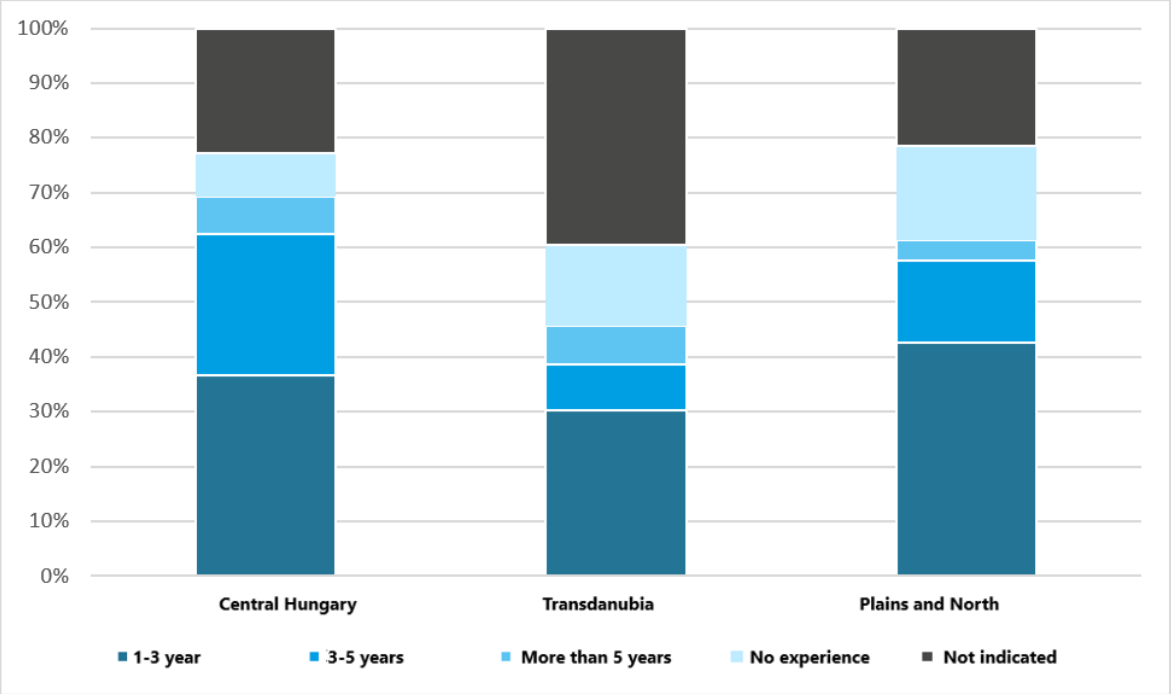
Figure 75: Required experience in software development (n=3046)



In a regional comparison, it is notable that a much higher number of people in the Transdanubian region did not have the required experience than in other regions.

There were no significant differences between Central Hungary and the Great Plain and Northern regions.

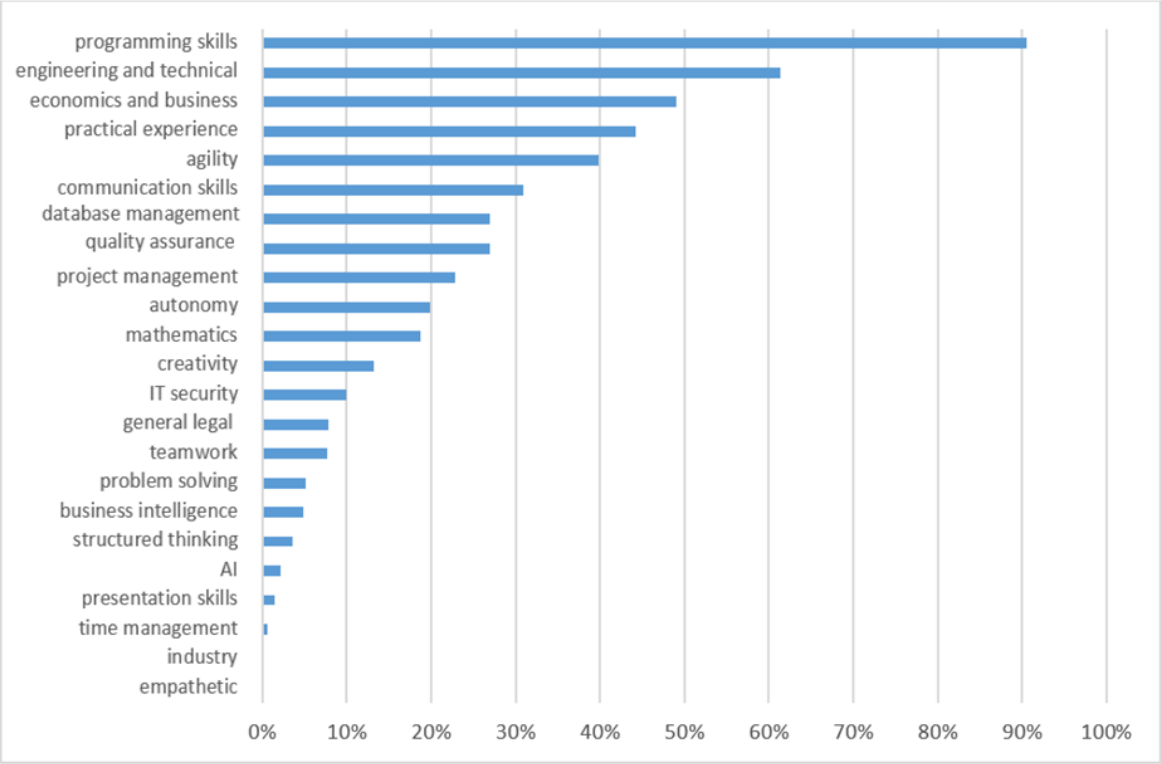
Figure 76: Required experience in a software development job, by macro region (n=3046)



5.10.4. Job-related competences

For software developers, employers expect the highest proportions of applicants to have programming (90%), engineering and technical (61%) and economics and business (49%) skills among the 23 professional and other skills surveyed, according to the job advertisements surveyed.

Figure 77: Need for skills in percentage of software developer jobs (n=3046)



5.11. IT sales representative

The IT sales representative job requires general IT skills and industry knowledge.

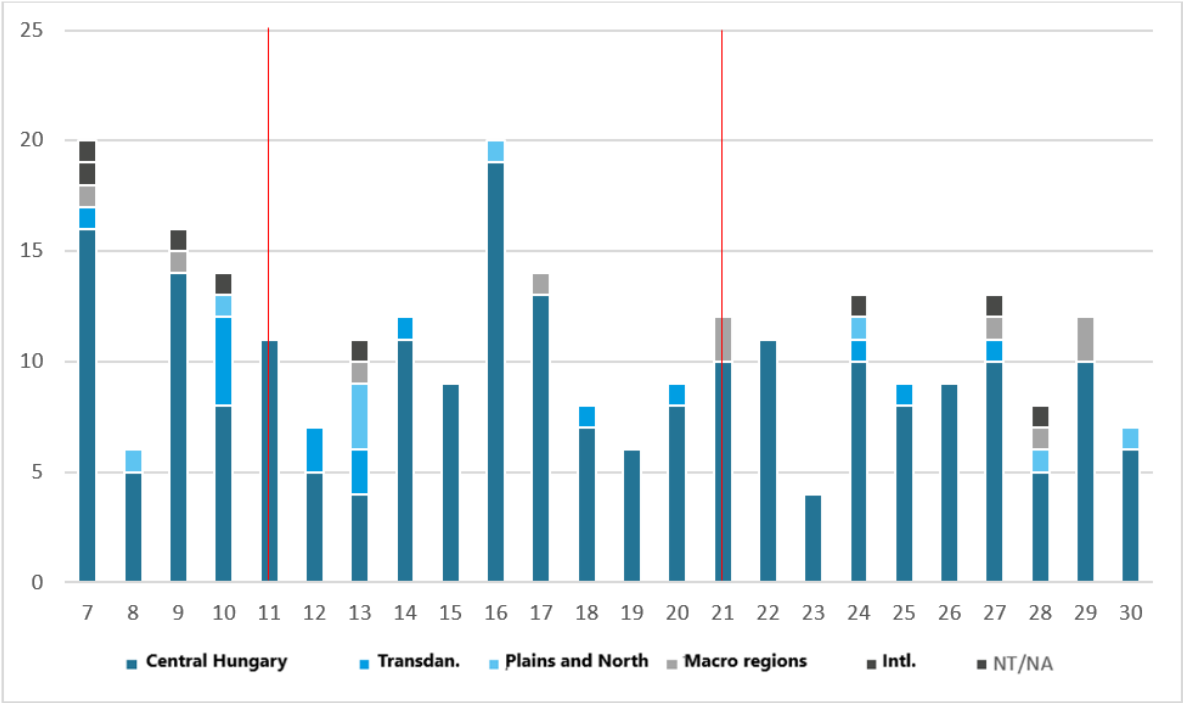
5.11.1. Definition and delimitation

The job of an IT sales representative is clearly identifiable with FEOR category occupation of planning and organising the sale of information and telecommunications technology products (2534). The FEOR describes the occupation as "the wholesale of various computer hardware, software and other information and telecommunications technology products and services, including their installation, and the provision of expert advice as required." At the same time, one of the job portals surveyed (profession.hu) defines the tasks of IT salespeople as: maintaining daily contact with existing partners, expanding the portfolio, finding new clients, contacting potential partners, developing quotations, assessing clients' and the market's current needs. A significant difference between the two definitions is that the FEOR definition includes specific IT activities (installation), but limits the scope of the job to wholesale, whereas the job portal definition does not include IT activities, but does not limit the scope of the job to wholesale, which is more difficult to interpret in the case of services.

5.11.2. Evolution of job vacancies during the period under review

A total of 261 job advertisements for IT sales jobs were published during the period covered by the survey. The overwhelming majority of advertisements were for jobs in Budapest (84%). For the other regions there are no significant differences. Only a few foreign advertisements appeared, which is also due to the nature of the job.

Figure 78: Trends in the number of job advertisements for IT sales jobs, time-series by macro-region (n=261)

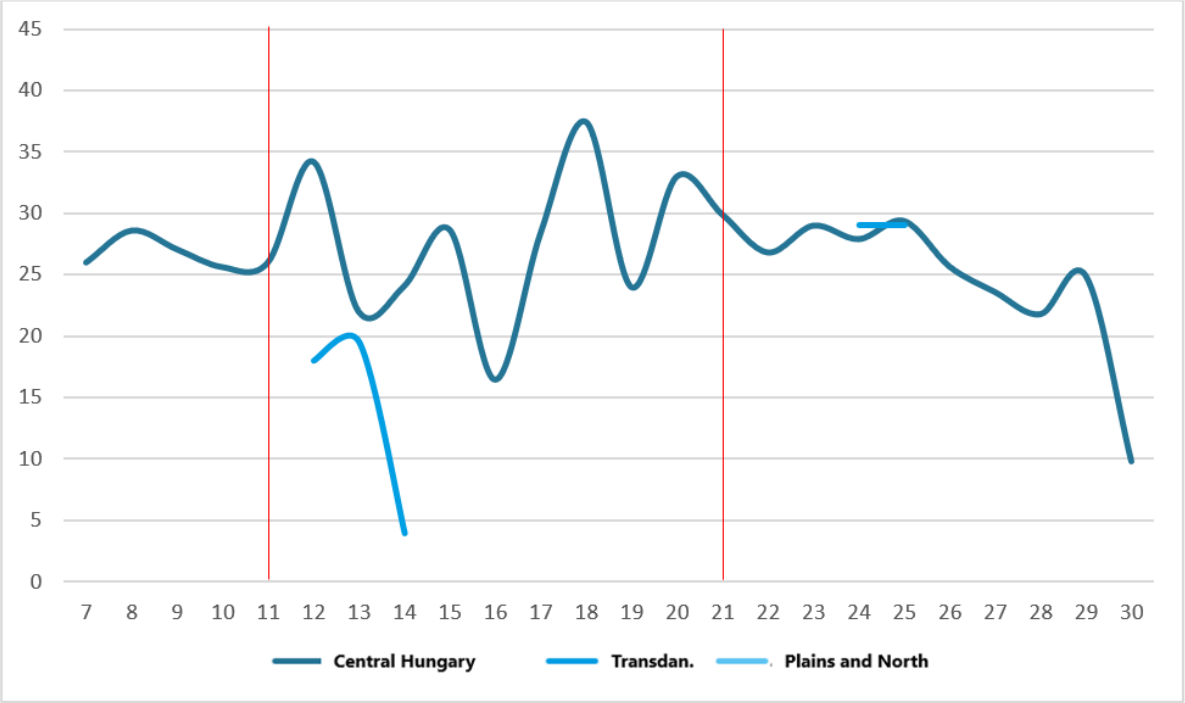


The demand for IT sales staff is well separated between weeks 7-17 and 18-30. The former published an average of 13 ads per week, which later dropped to an average of 9 ads per week.

5.11.2.1. Lifetime of job advertisements

A job advertisement was typically open for 26 days during the period studied. This value fluctuates over time until week 18 and then shows a minimal downward trend from then on.

Figure 79: Evolution of job advertisement lifetime (by average days) in IT sales jobs, time-series by macro-region (n=261)



Comparative analysis in terms of macro-regions is not possible due to the small number of cases. During the period, only in Central Hungary were there continuous advertisements, while in the other regions they were sporadic.

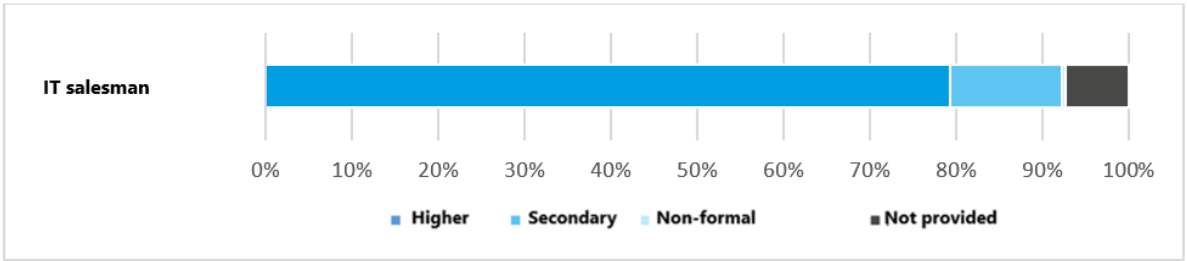
5.11.3. Job expectations

The requirements for the job in question are grouped as follows: qualifications required, language skills and professional experience.

5.11.3.1. Education

In 80% of the job advertisements surveyed, advertisers require a higher education qualification. Secondary education is accepted in 13% of jobs, while 7% do not specify an educational qualification. In the case of IT sales jobs, there was practically no school-based training during the survey period (1 occurrence).

Figure 80: Expected qualification for IT sales job, (n=261)



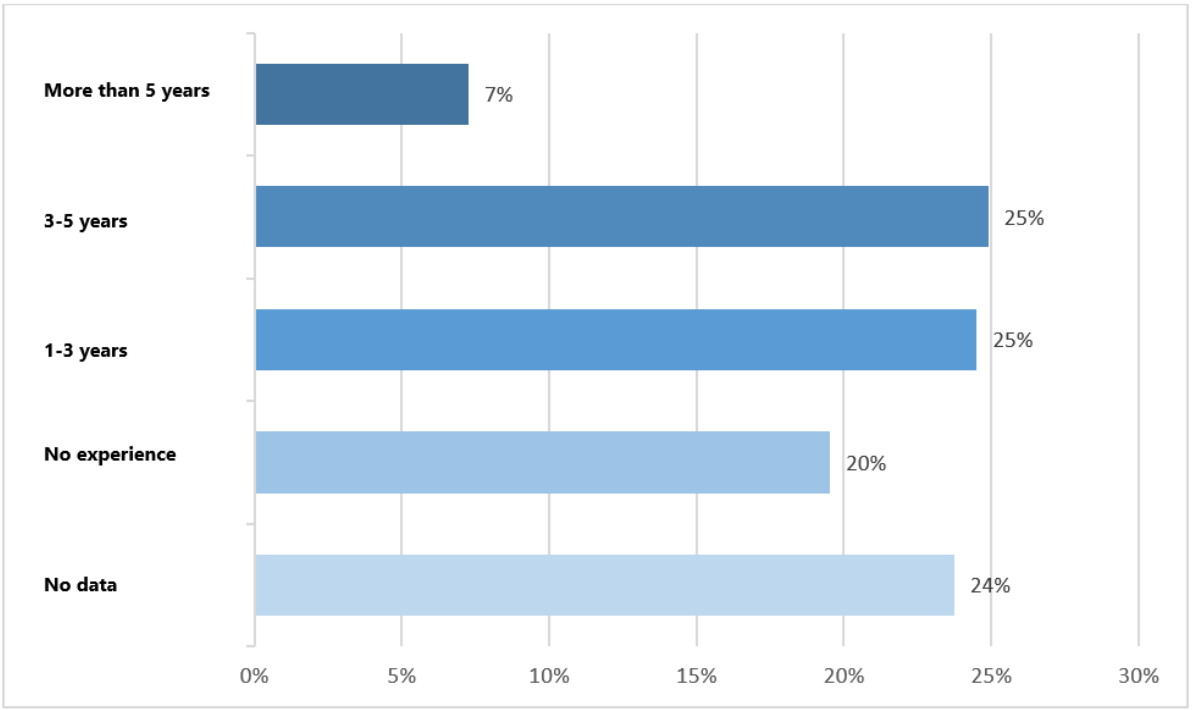
5.11.3.2. Language skills

Advertisements typically require knowledge of a foreign language. The evolution of this over time is shown in the following graph: there is minimal fluctuation, but this is partly due to the low number of items and partly due to the nature of the job. English is the most important language, with 87% of job vacancies requiring it. in 34 job advertisements, there were no language requirements.

5.11.3.3. Professional experience

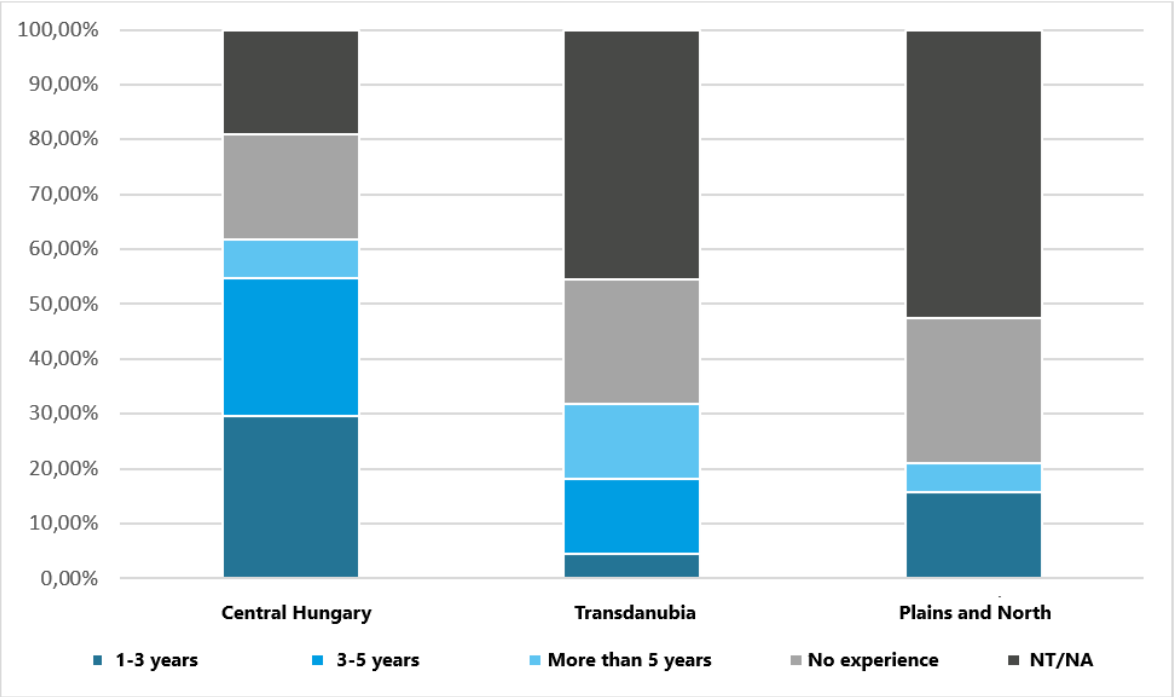
For the job, employers typically expect at least 1-3 years or 3-5 years of experience (25-25%). Only 7% indicated that they expect an IT salesperson to have more than 5 years of experience, while more than 40% of the ads either did not specify an expectation or highlighted that they would hire without sales experience.

Figure 81: Required professional experience in IT sales job (n=261)



There are significant regional differences in the experience expectations for the job: while in Budapest, 60% of advertisers expressed an expectation in their advertisements, in rural areas this proportion is around 30%. The main difference is not in the demand for new entrants and inexperienced workers, but in the lack of expectations. However, the low number of cases means that the results should be treated with caution.

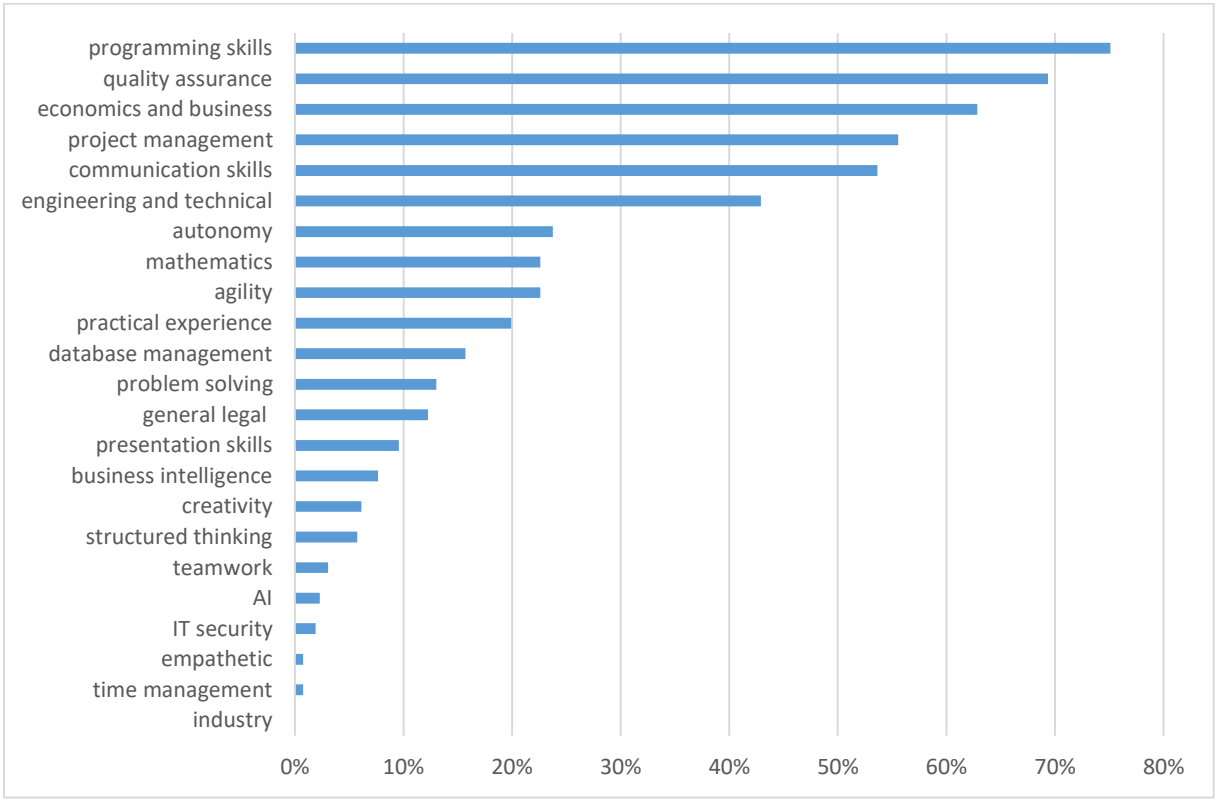
Figure 82: Required experience in IT sales job, by macro region (n=261)



5.11.4. Job-related competences

Of the 23 professional and other skills surveyed for IT sales, employers most often expect candidates to have programming (75%), quality assurance (69%) and economics and business skills (63%), according to the job advertisements surveyed.

Figure 83: Percentage of skills required for IT sales jobs (n=261)



5.12. Database operator (database administrator)

Being a database operator is a job that requires specific IT skills in some areas and is difficult to separate from database developer or database designer.

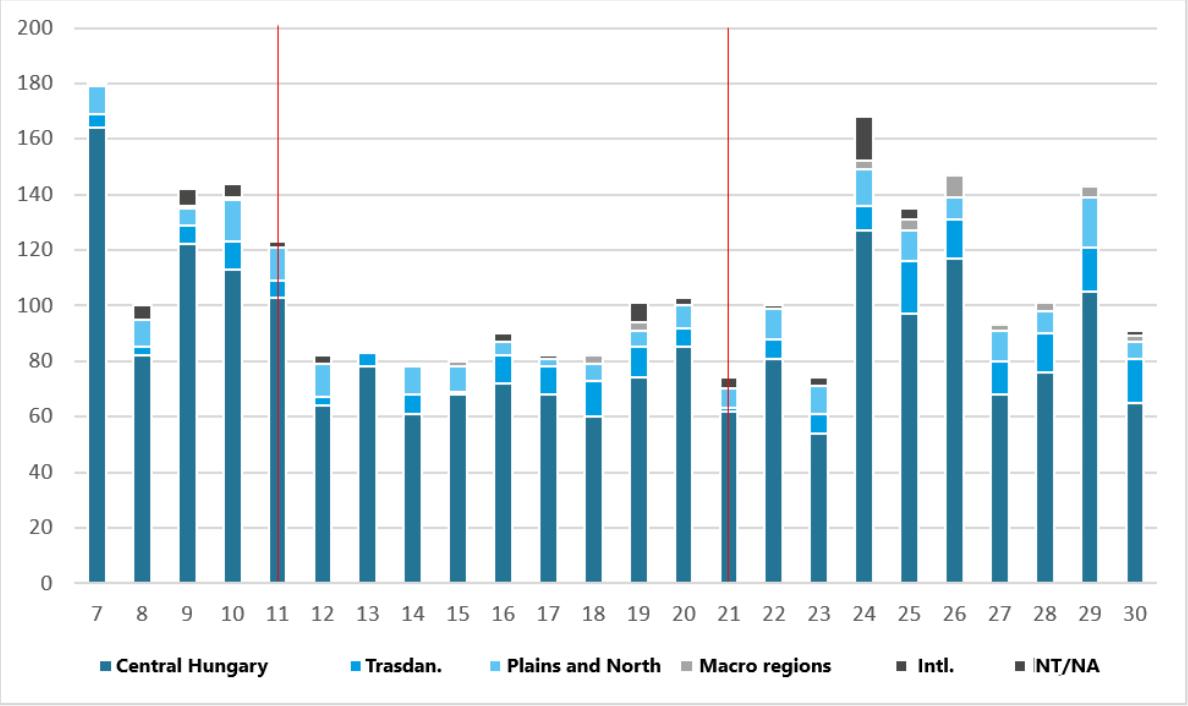
5.12.1. Definition and delimitation

The job of a database operator cannot be clearly matched to an FEOR category. The FEOR category that seems closest to the job is technician supporting users of information and communication systems, but this is much more common than database operator, and database designer and operator (2151), which is common to another job discussed later (database designer). By analysing the job portals, the following picture can be drawn about the tasks to be performed in the job: daily database operation, expert participation in projects, design and deployment tasks in database management environment, database backup and restore management, monitoring, alarms, incident management, data migration support, support of development and operator area, security audits, design and implementation of protocols, performance optimization. The job is difficult to separate from the database developer job.

5.12.2. Evolution of job vacancies during the period under review

The evolution of the number of job advertisements for the job category of database operator can be described in isolation and by area over the period under review. From the 7th week of the year to the 30th week of the year, a total of 2605 job advertisements were placed looking for database operators and database administrators.

Figure 84: Trends in the number of job vacancies for database administrator, time series by macro-region (n=2605)

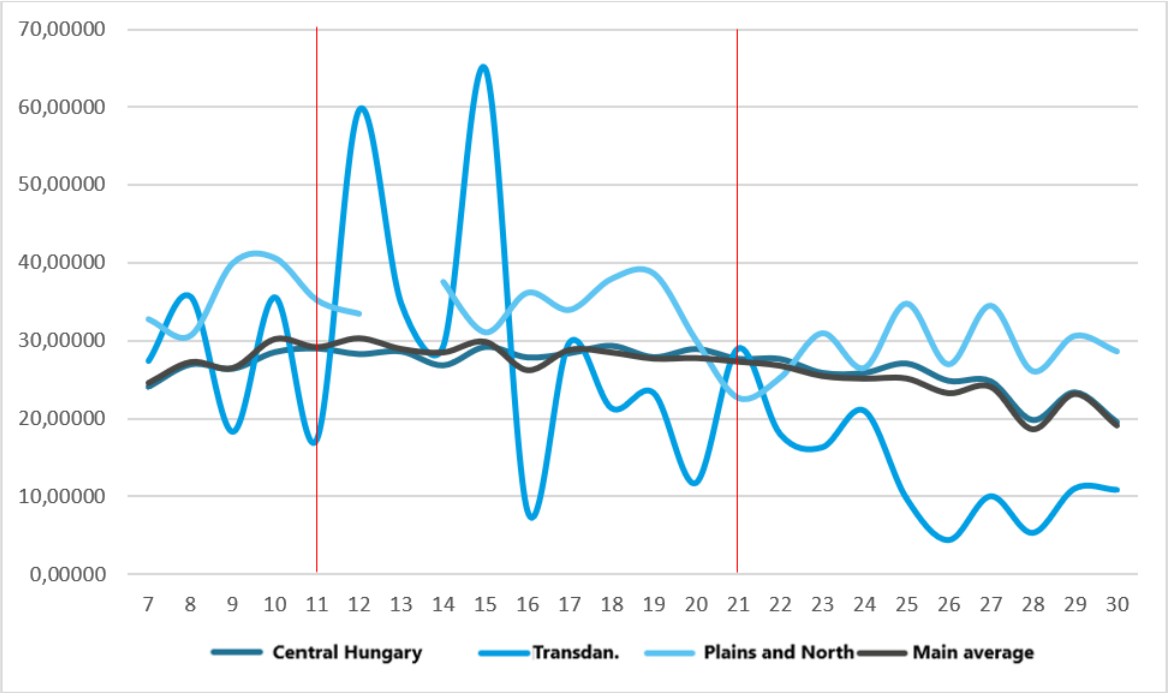


Interest in database operators was particularly high at the beginning of the period under review, but the exceptional health situation significantly reduced the number of job advertisements posted, and demand for database operators had not fully recovered by the 30th week of 2020, i.e. by the beginning of July. Looking at the demand trend, it is clear that the demand for administrators is highest in Central Hungary (79%), with the vast majority of this demand in Budapest (77%).

5.12.2.1. Lifetime of job advertisements

A job advertisement was typically open for 26 days during the period studied. Its value increased slightly over the COVID-19 period, peaking at week 15 with a 30-day lifespan (second week of April 2020). From then on, life expectancy slowly declined, dropping to 19 days at week 30.

Figure 85: Evolution of job advertisement lifetime (average days) for database administrator jobs, time-series by macro-region (n=2605)



Looking at the lifespan of job advertisements by macro-region, we can see that the Central Hungary region remained the most stable in terms of the lifespan of job advertisements, while the best affected region was Transdanubia[26]. The period was also characterised by fluctuating life expectancy in the Great Plain and North.

5.12.3. Job expectations

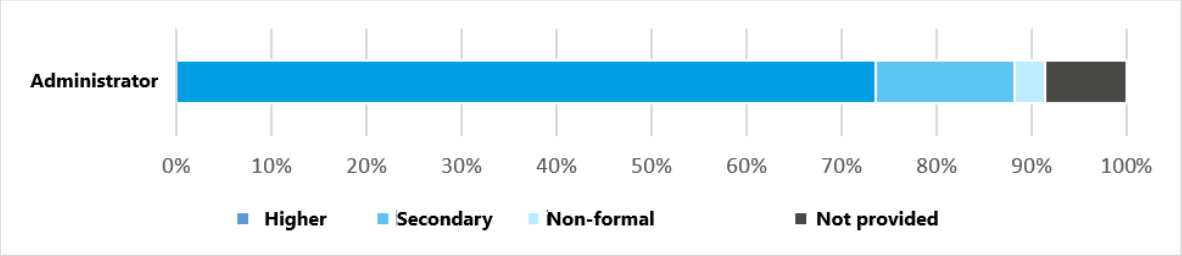
The requirements for the job in question are grouped as follows: qualifications required, language skills and professional experience.

5.12.3.1. Education

Almost 74% of the job vacancies surveyed require applicants to have some form of higher education. Secondary education is considered sufficient by 15% of job advertisements, while 3% of job advertisements expect qualifications outside the school system (e.g. OKJ, ISTQB[27]). No identifiable qualifications are expected in 9% of job vacancies.

[26] However, this is also linked to the low number of job advertisements per week surveyed. Just over nine ads per week were placed on average over the period (9 ads per week).
[27] International Software Testing Qualifications Board: https://www.istqb.org/ Date retrieved: 29/07/2020

Figure 86: Expected qualification for database operator job (n=2605)



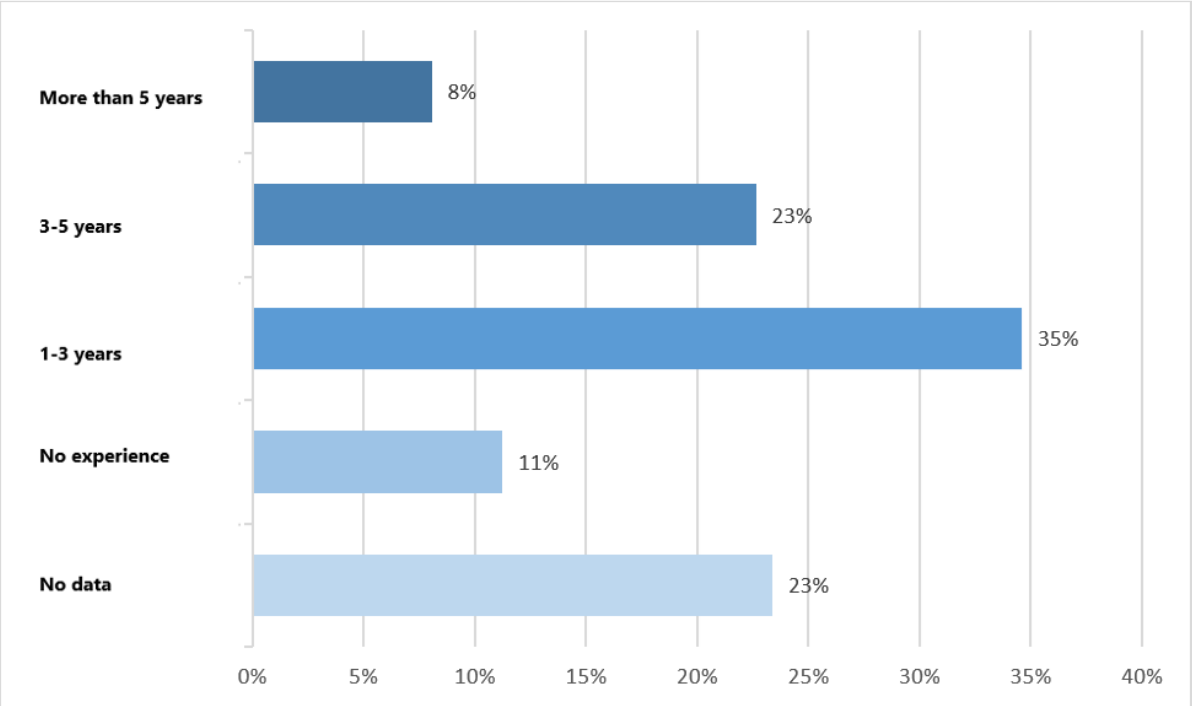
5.12.3.2. Language skills

The domestic job market typically requires database operators to have language skills. One foreign language is required in 62% of job advertisements, and two languages in 22%. In only a minority of job advertisements was there a requirement to know more than 2 languages.

5.12.3.3. Professional experience

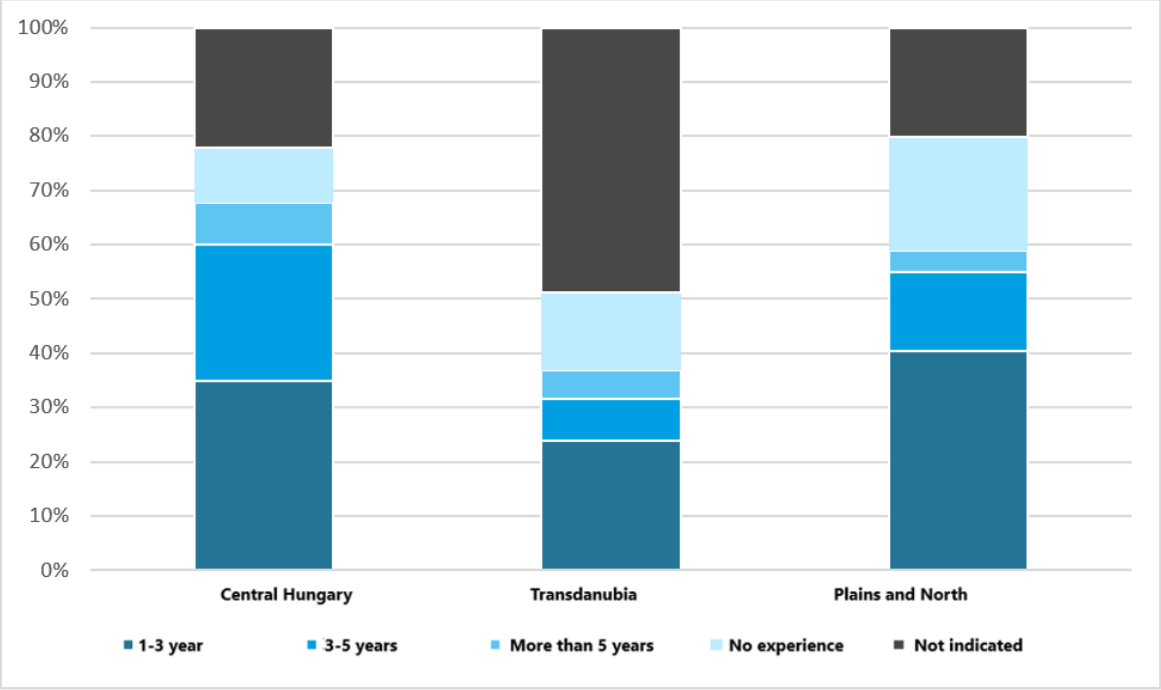
The highest proportion of the stated expectations is for 1-3 years of experience (33%), but this is not far behind for 3-5 years (23%). The number of years worked more than this is only 8%. No years of experience is required for a tenth of the advertisements, while no experience information is provided for 25% of the job vacancies examined.

Figure 87: Required experience as a database administrator (n=2605)



Experience is most lacking in the Transdanubian region, where all categories are below average in terms of frequency. The number of job vacancies advertised in Central Hungary best reflects the above mentioned distribution in terms of the stated expectations, while in the case of the Transdanubian region, vacancies requiring more than 3 years of experience are underrepresented.

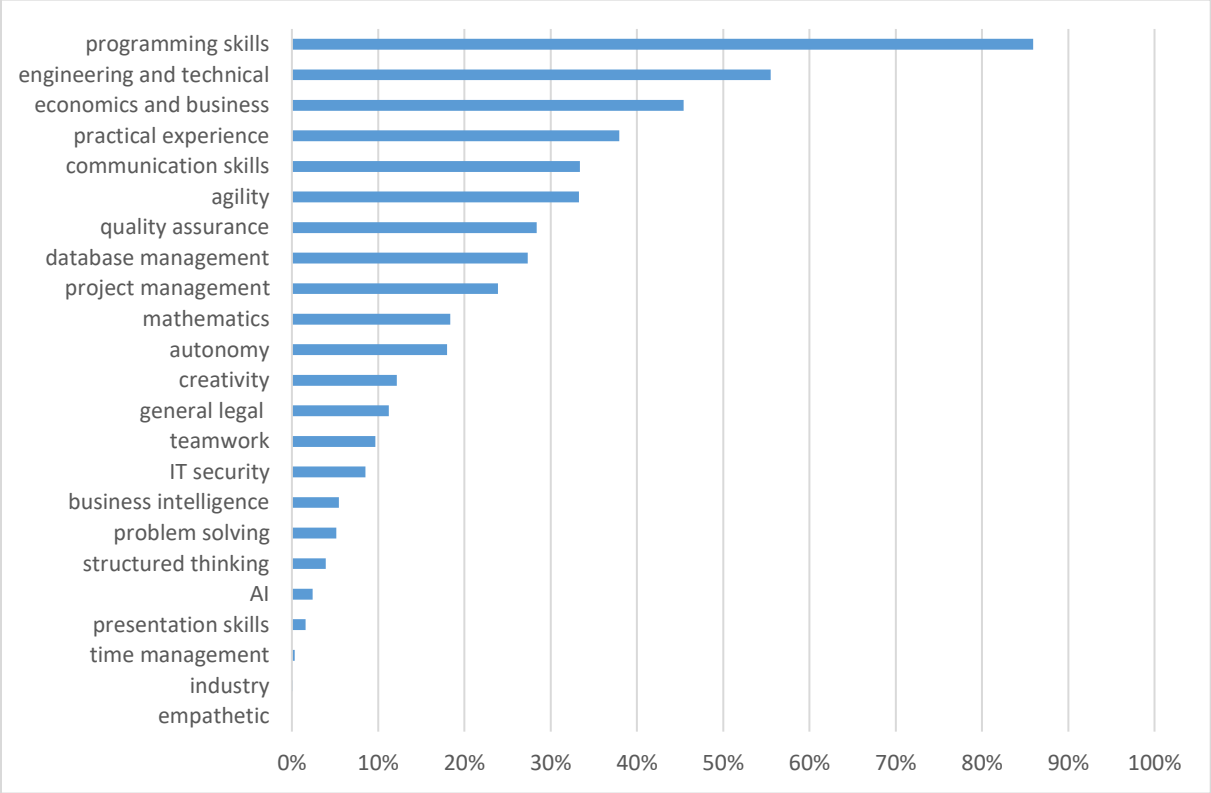
Figure 88: Required experience as a database administrator, by macro-region (n=2605)



5.12.4. Job-related competences

Among the 23 professional and other skills surveyed, database administrator employers most often require applicants to have programming (86%), engineering and technical (56%) and economics and business (45%) skills, according to the job adverts surveyed.

Figure 89: Percentage of skills required for the job of a database administrator (n=2605)



5.13. Basic or Intermediate Customer Service Representative

Basic or mid-level customer service representative is one of the least specific IT jobs of the jobs surveyed.

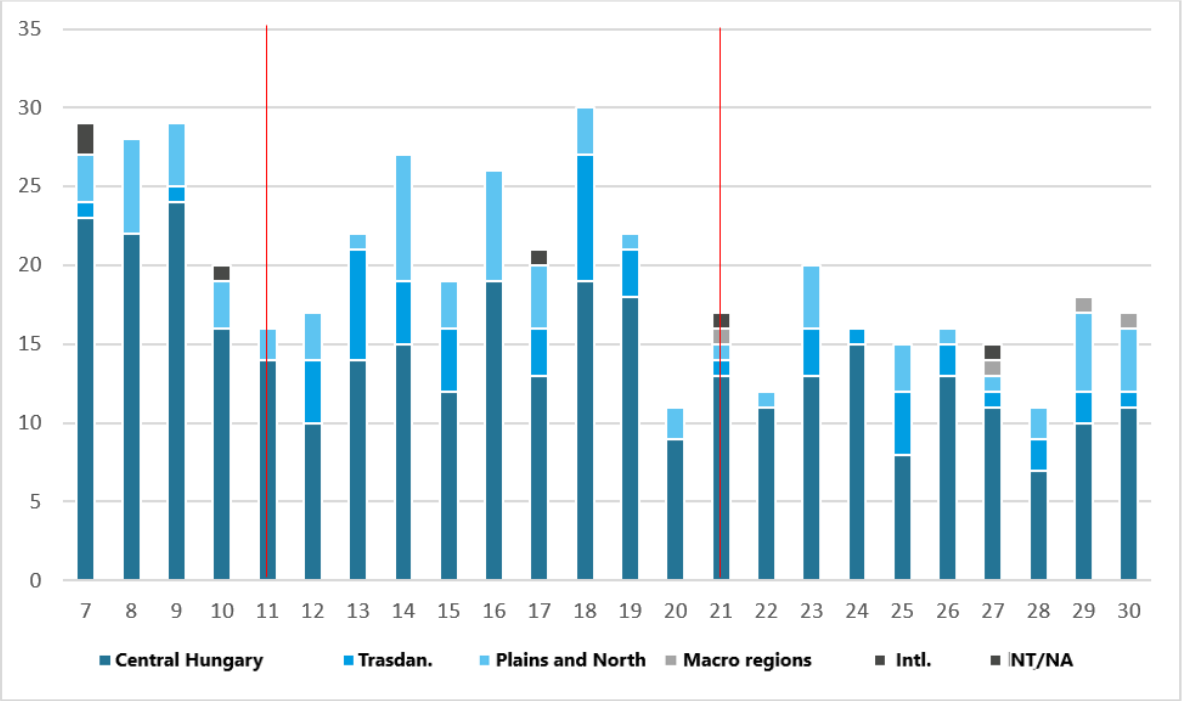
5.13.1. Definition and delimitation

This job cannot be identified by any FEOR code. The job title in the FEOR closest to this job is Customer Service Centre Information Officer (4225). Defining the job is easier with the National Training Register. The brief description of a customer service administrator here is "to establish and maintain contact with customers and enquirers in person, in writing, by telephone or through electronic communication channels, observing the rules of courtesy and protocol. Receives and initiates enquiries; provides information, information or recommendations in the field of the organisation's activities, and receives, interprets, deals with complaints, problems or forwards them to the appropriate place. Prepares and manages the necessary documents related to his/her work. S/he searches for data, analyses information and identifies correlations within the scope of its activities".

5.13.2. Evolution of job vacancies during the period under review

From the 7th week of the year to the 30th week of the year, a total of 474 job advertisements were placed looking for basic or intermediate level customer service staff or employees with the skills to perform such tasks.

Figure 90: Trend in the number of job advertisements for customer service representative, time-series by macro-region (n=474)

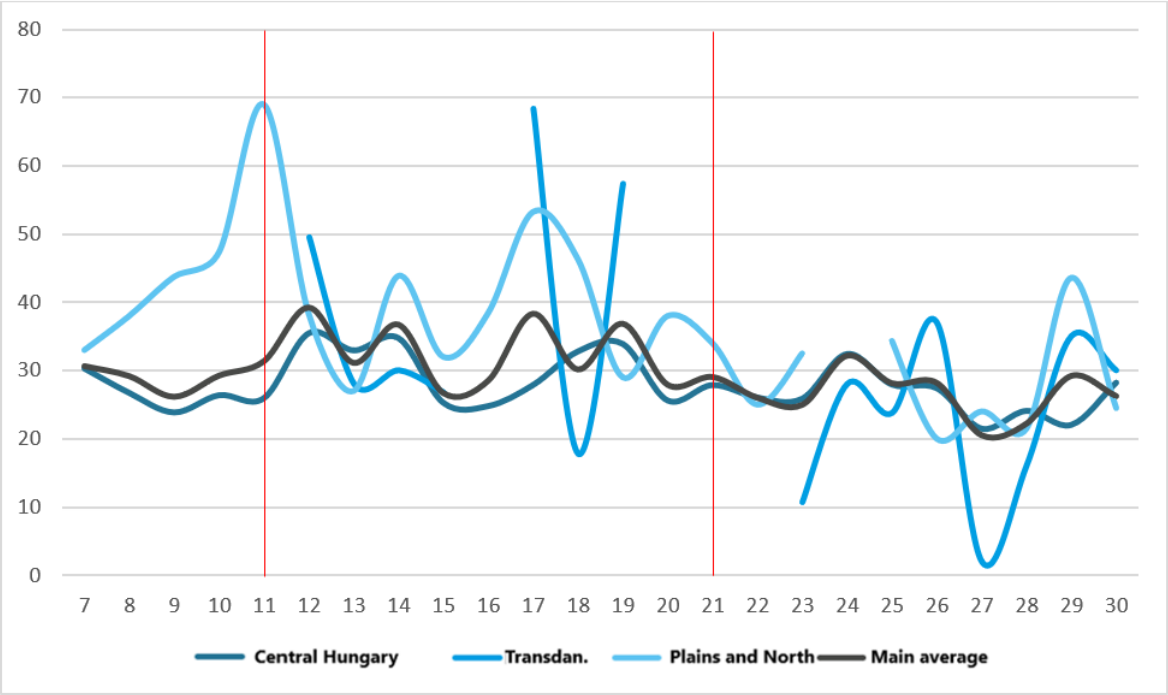


Demand for customer service agents was volatile over the period: while demand was high overall at the beginning of the period and for a few weeks in the spring (14, 16, 18), the exceptional health situation significantly reduced the number of job advertisements posted, and demand for customer service agents did not fully recover even by week 30 of the year. Overall, the demand for customer service staff is highest in Central Hungary (72%), with the vast majority of this demand in Budapest (70%).

5.13.2.1. Lifetime of job advertisements

A job advertisement was typically open for 30 days during the period studied. This value has fluctuated over time throughout the period under study.

Figure 91: Evolution of job advertisement lifetime (by average days) for the job of a customer service representative, time-series by macro-region (n=474)



From a macro-regional point of view, no comparative analysis can be made, due to the sporadic occurrence of case numbers. Only in Central Hungary were the advertisements continuous (with a lifetime in line with the main average), and except for week 24, they were stable in the Great Plain and Northern regions (where advertisements were typically longer on the portals before the start of the epidemic).

5.13.3. Job expectations

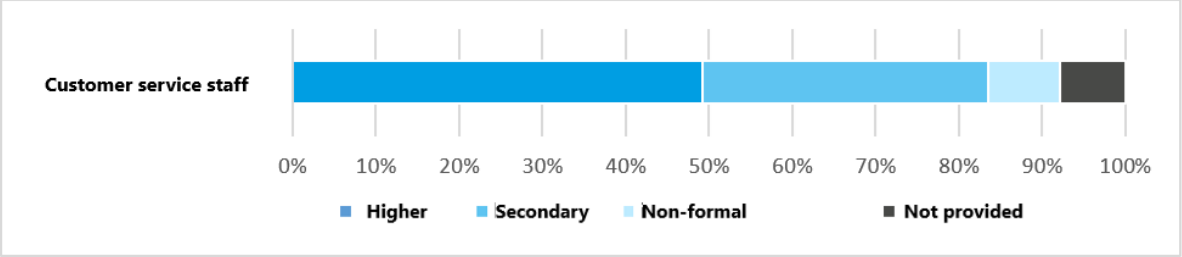
The requirements for the job in question are grouped as follows: qualifications required, language skills and professional experience.

5.13.3.1. Education

For customer service representative, half (49%) of the job vacancies surveyed require applicants to have some form of higher education qualification, such as a degree in IT, engineering or a university degree. One third (34%) of job advertisements consider secondary education sufficient, while 9% of job advertisements expect qualifications outside the school system (e.g. OKJ, ISTQB[28]). No identifiable qualifications are expected in 8% of job advertisements.

[28] International Software Testing Qualifications Board: https://www.istqb.org/ Date retrieved: 29/07/2020

Figure 92: Required education for the job of a customer service representative, (n=474)



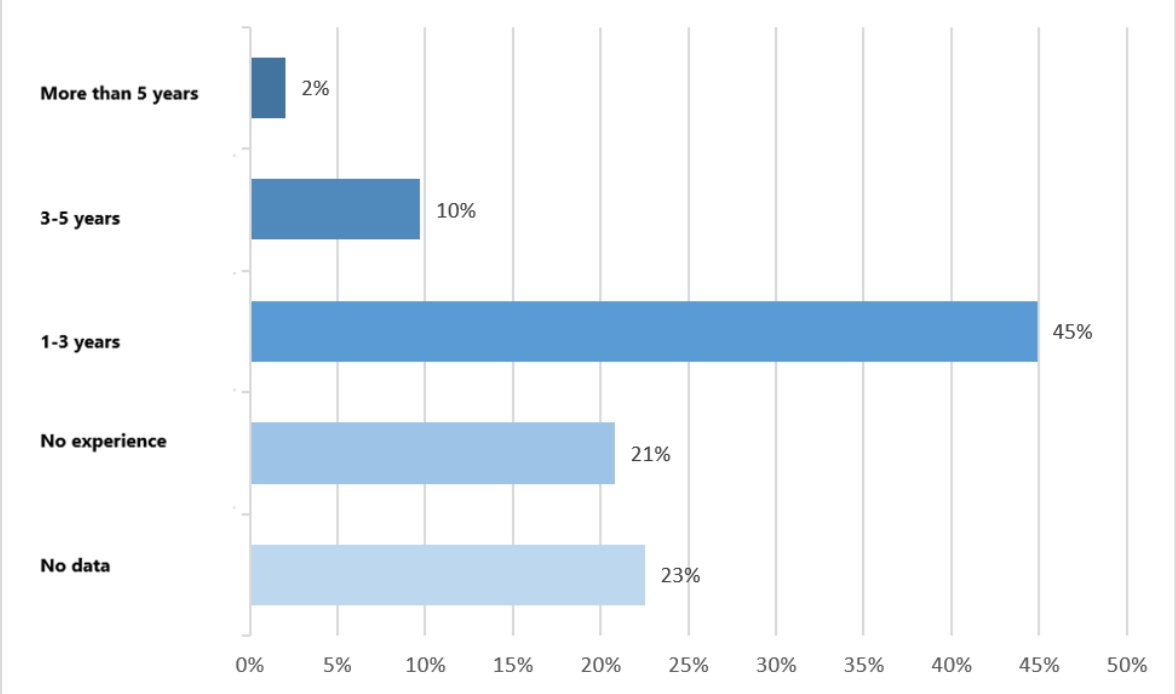
5.13.3.2. Language skills

The job market in Hungary typically requires one or two foreign languages for customer service staff: almost half of job advertisements (46%) require one language and 40% two. Only 6% of them need more than one language.

5.13.3.3. Professional experience

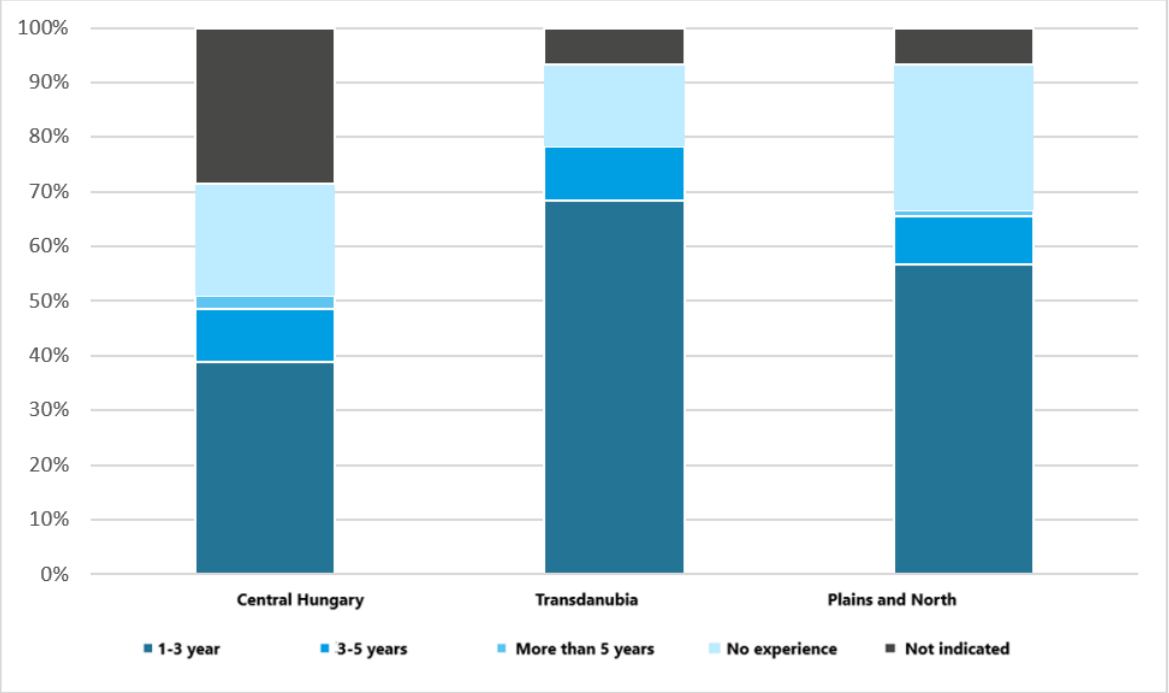
The highest proportion of jobseekers' expectations is 1-3 years of experience (47%), while the second highest proportion of jobseekers' expectations is no experience (21%). 10% require 3-5 years of experience, while only 2% require more than that.

Figure 93: Required professional experience as a customer service representative (n=474)



By region, companies in Transdanubia (73%) are most likely to have 1-3 years of work experience, but more than half (58%) of companies in the Great Plain and the North also have enough work experience.

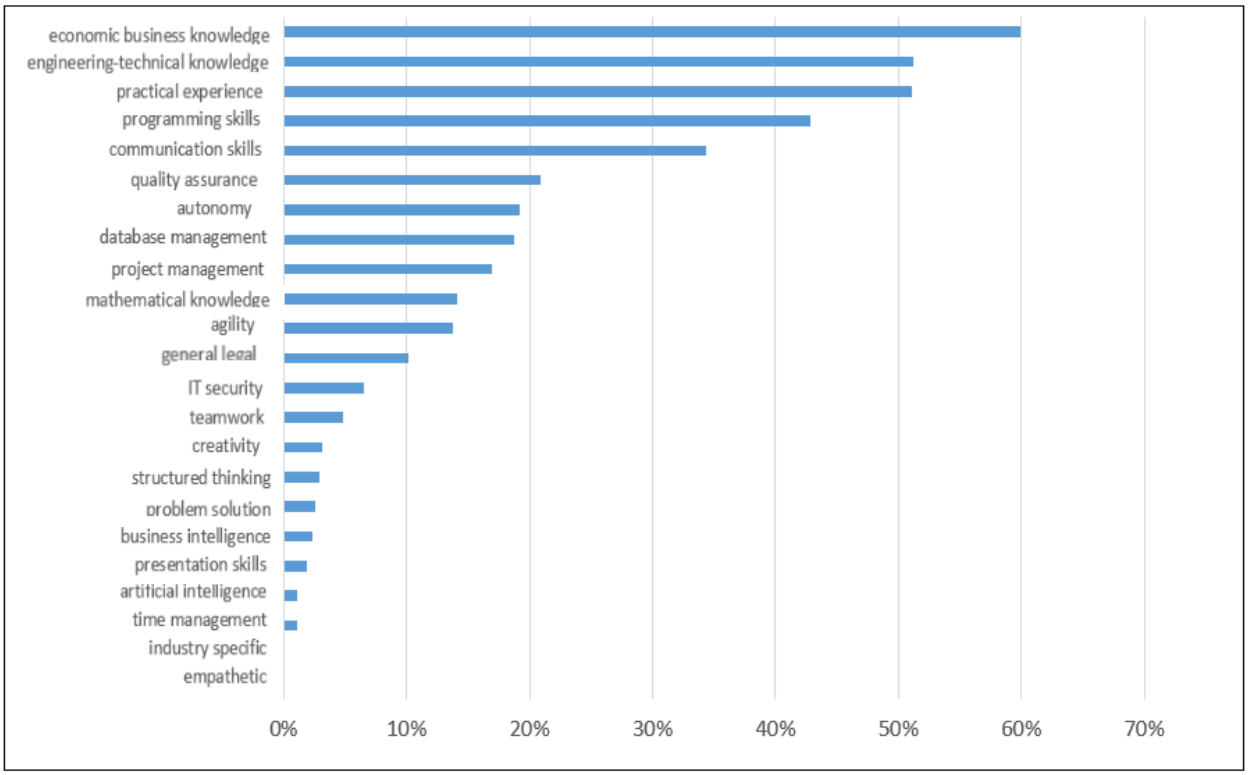
Figure 94: Required experience as a customer service representative, by macro-region (n=474)



5.13.4. Job-related competences

For customer service representative, employers expect the highest proportions of the 23 professional and other skills surveyed to be economics and business (60%), engineering and technical skills and practical experience (51-51%), according to the job advertisements surveyed.

Figure 95: Need for competences by percentage of customer service agent jobs (n=474)



5.14. Business analyst, Business analyst

Unlike in the past, the job of a business analyst is mainly based on the use of IT tools, with a greater use of statistical and economic skills.

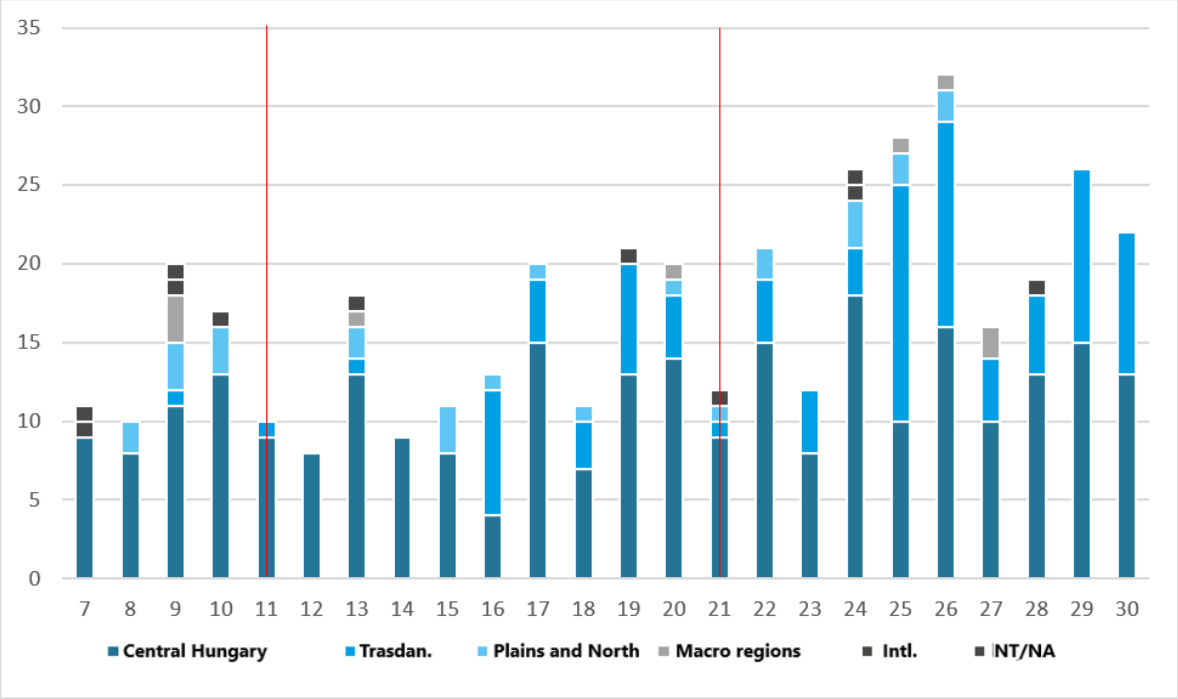
5.14.1. Definition and delimitation

The job of a business analyst corresponds to the FEOR occupation of business policy analyst, organiser. In accordance with the FEOR, a business policy analyst or organiser "analyses financial, human resources development, customer and public relations, marketing and sales issues, and carries out audits and reorganisations to help managers achieve their objectives." The second group of tasks defined clearly refers to organisational tasks, which are not part of the duties of the job in question.

5.14.2. Evolution of job vacancies during the period under review

A total of 407 job advertisements for business analysts were published during the period covered by the survey. Two thirds of the advertisements were for jobs in Central Hungary (66%). In addition, nearly a quarter of the jobs were advertised in the Transdanubian region. No foreign advertising has appeared at all.

Figure 96: Trends in the number of job advertisements in the business analyst job category, time-series by macro-region (n=407)



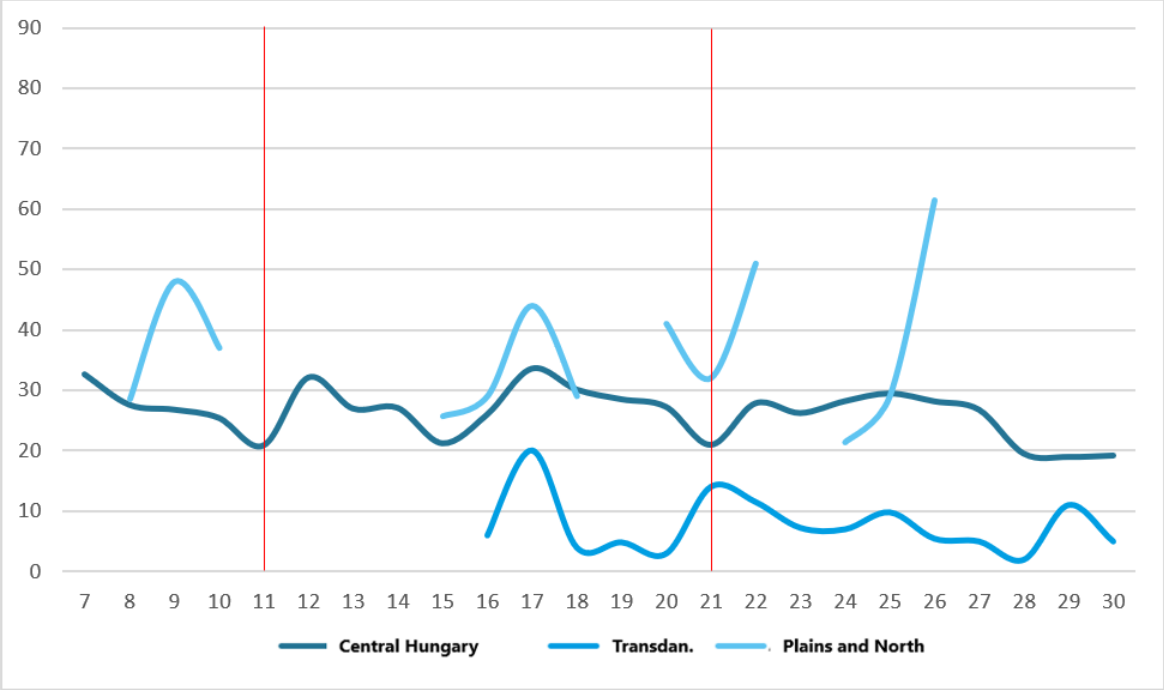
An overall increase in demand for business analysts is clearly visible, with a particular jump in the number of firms looking for this type of job in weeks 24-26.

Central Hungary was dominant at the beginning of the period, but by the end of the period the number of job advertisements in Transdanubia had increased significantly, with more job advertisements in this region (15) than in Central Hungary (10) in week 25.

5.14.2.1. Lifetime of job advertisements

A job advertisement was typically open for 23 days during the period studied. This value fluctuates over time until week 24, and then shows a downward trend from then on.

Figure 97: Evolution of job advertisement lifetime (by average days) in the business analyst job category, time-series by macro-region (n=407)



Comparative analysis in terms of macro-regions is not possible due to the small number of cases. During the period under review, advertisements appeared continuously only in Central Hungary, with occasional occurrences in other regions.

5.14.3. Job expectations

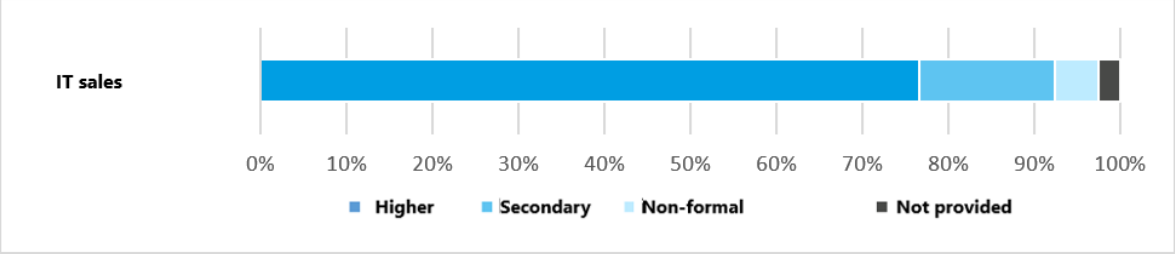
The requirements for the job in question are grouped as follows: qualifications required, language skills and professional experience.

5.14.3.1. Education

In 77% of the job advertisements surveyed, advertisers require a higher education qualification. Secondary education is accepted in 16% of jobs, while 2% do not

specify an educational qualification. In the case of the business analyst job, 5% of jobs in the survey period accepted formal training.

Figure 98: Expected level of education for the job of a business analyst, (n=407)



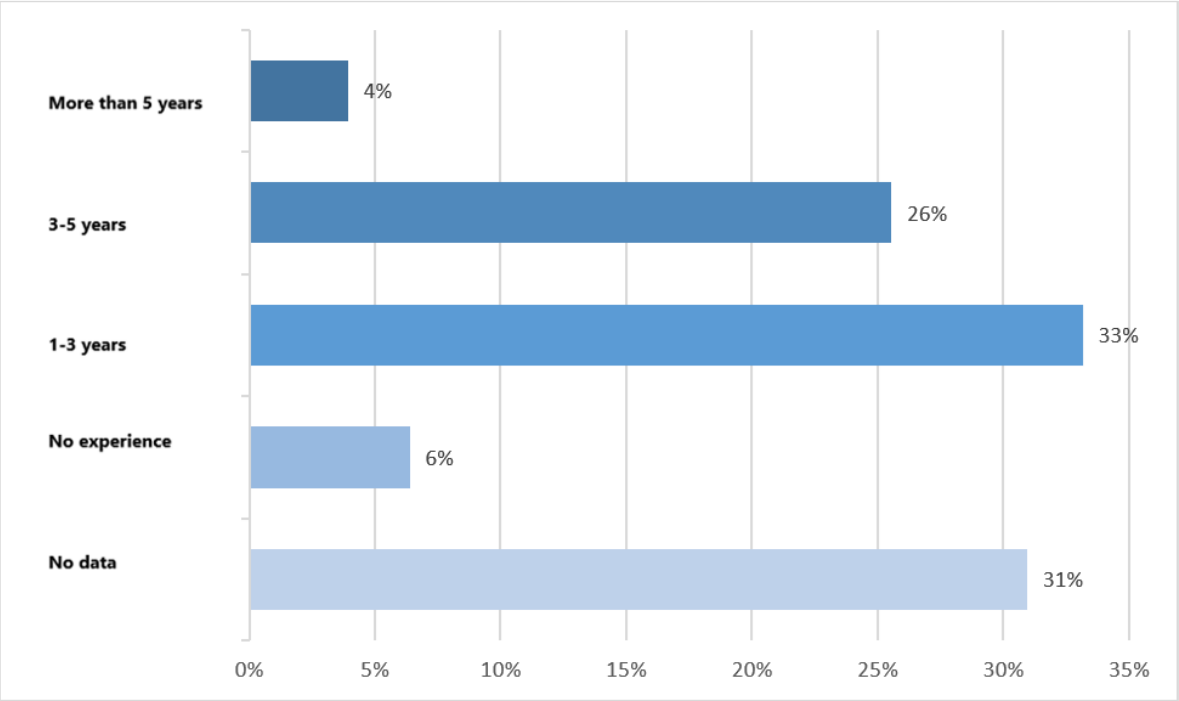
5.14.3.2. Language skills

Advertisements typically require knowledge of a foreign language. The exception is the Transdanubian region, where knowledge of two foreign languages (English and German) is more common. English is the most important language, with 96% of job vacancies requiring it. in 14 job advertisements, there were no language requirements.

5.14.3.3. Professional experience

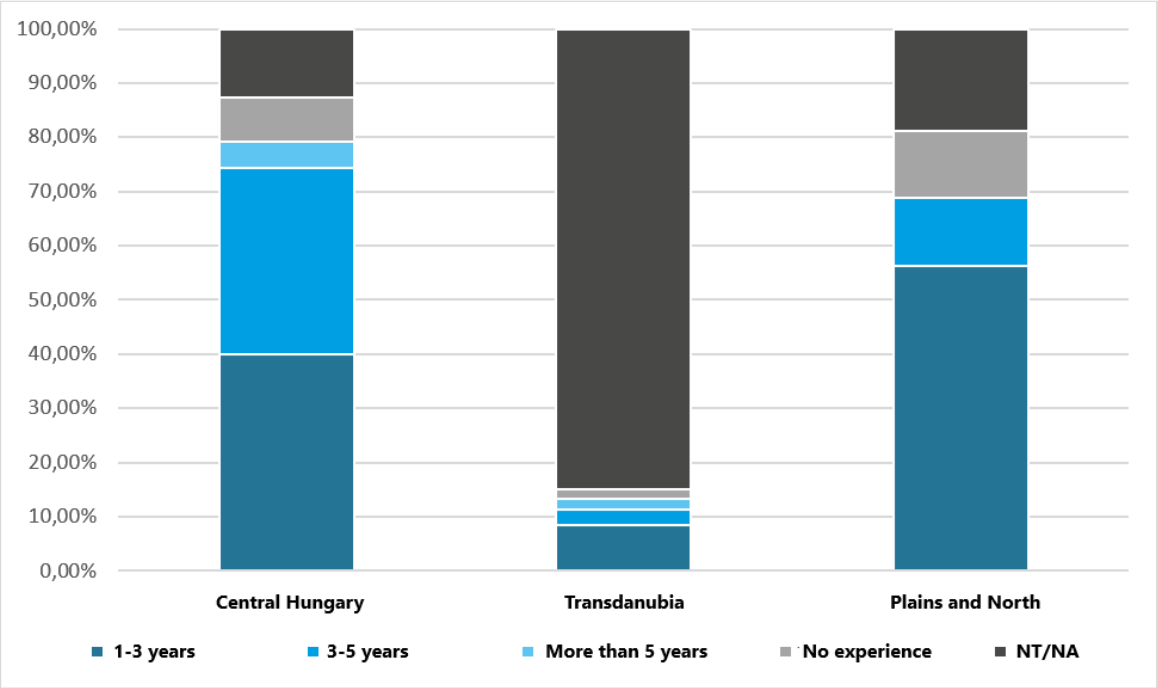
For the job, employers typically expect at least 1-3 years (33%) or 3-5 years of experience (26%). Only 4% indicated that they expect an IT business analyst to have more than 5 years' experience, while 31% of the ads did not specify any expectations. 6% of jobs highlighted that they would hire a colleague without business analyst experience.

Figure 99: Required professional experience in the job of a business analyst (n=407)



There are significant regional differences in the experience expectations for the job: while in Central Hungary advertisers formulated expectations in almost 90% of the advertisements, this proportion is around 15% in Transdanubia. The main difference is not in the demand for new entrants and inexperienced workers, but in the lack of expectations. However, due to the low number of cases, the results can be treated with great uncertainty.

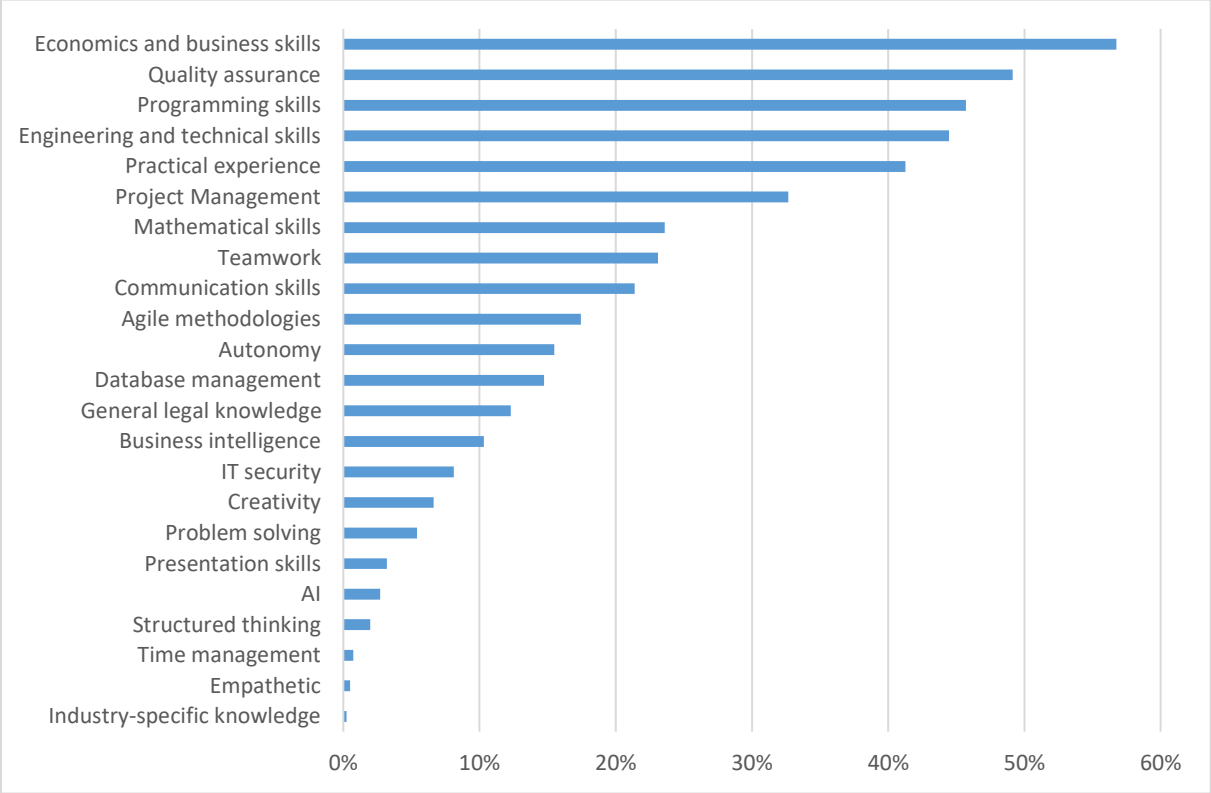
Figure 100: Required experience in business analyst job, by macro region (n=407)



5.14.4. Job-related competences

Of the 23 skills, professional and other skills surveyed, employers expected the highest proportions of candidates to have economics and business skills (57%), quality assurance skills (49%) and programming skills (46%), based on job advertisements.

Figure 101: Need for skills by percentage of business analyst jobs (n=407)



5.15. IT project manager

An IT project manager is a professional who manages the implementation of defined IT tasks.

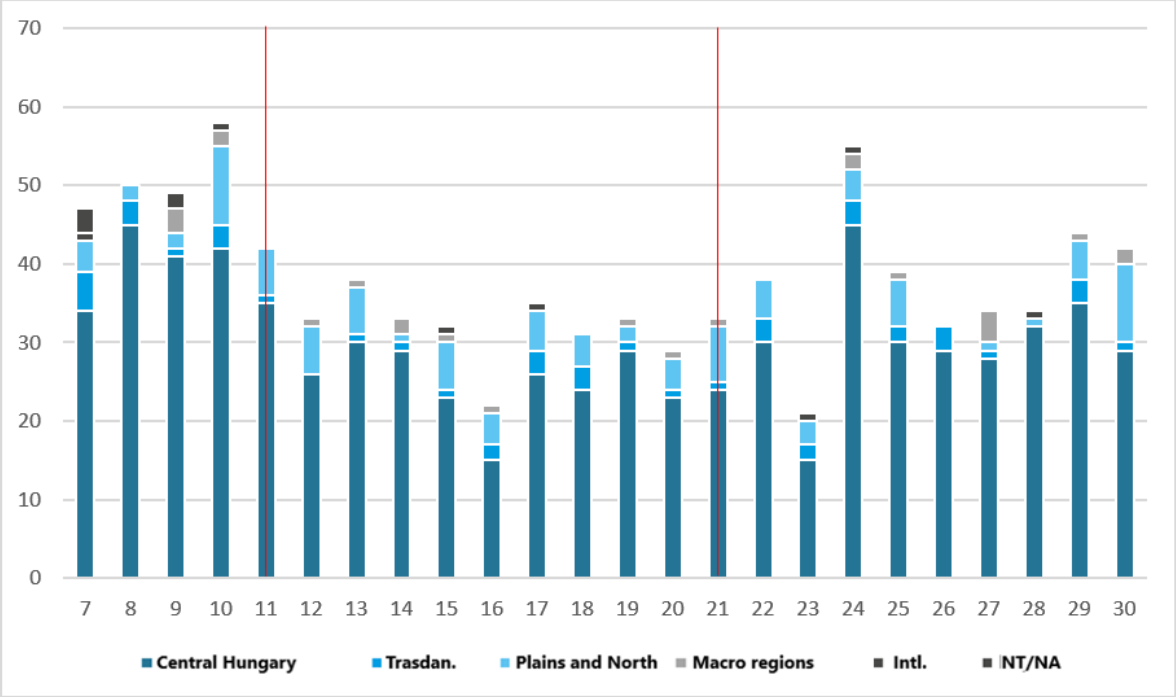
5.15.1. Definition and delimitation

Being an IT project manager cannot be defined either by the FEOR or by job portals, so an experimental definition is used, based on some information from job portals. In accordance with this, the IT Project Manager prepares, plans, monitors and controls IT projects, prepares status reports, manages project finances, communicates results, documents the project process and results, and maintains continuous contact with the client, co-organisations and project contributors. It is necessary to separate the IT project manager from the general project manager and the IT manager and developer/operating engineer. The IT project manager can be separated from the project manager job in its specific field, and the reason for this separation is the significant additional expertise required to manage an IT project. The IT project manager job is distinguished from the IT manager job by the time and subject bounded nature of the task and the specificity of the responsibilities. The most difficult to distinguish from the job of the developer, operating engineer, in this case perhaps the time delimitation is the decisive difference, and not independently of this, the fact that the IT project manager is involved in the operation until the end of the test phase at the most.

5.15.2. Evolution of job vacancies during the period under review

The trend in the number of job vacancies for IT project manager can be described in isolation and by area over the period under review. From the 7th week of the year to the 30th week of the year, a total of 904 job advertisements were placed looking for IT project managers or employees with the skills to perform such tasks.

Figure 102: Trend in the number of job vacancies for IT project manager, time series (n=904)

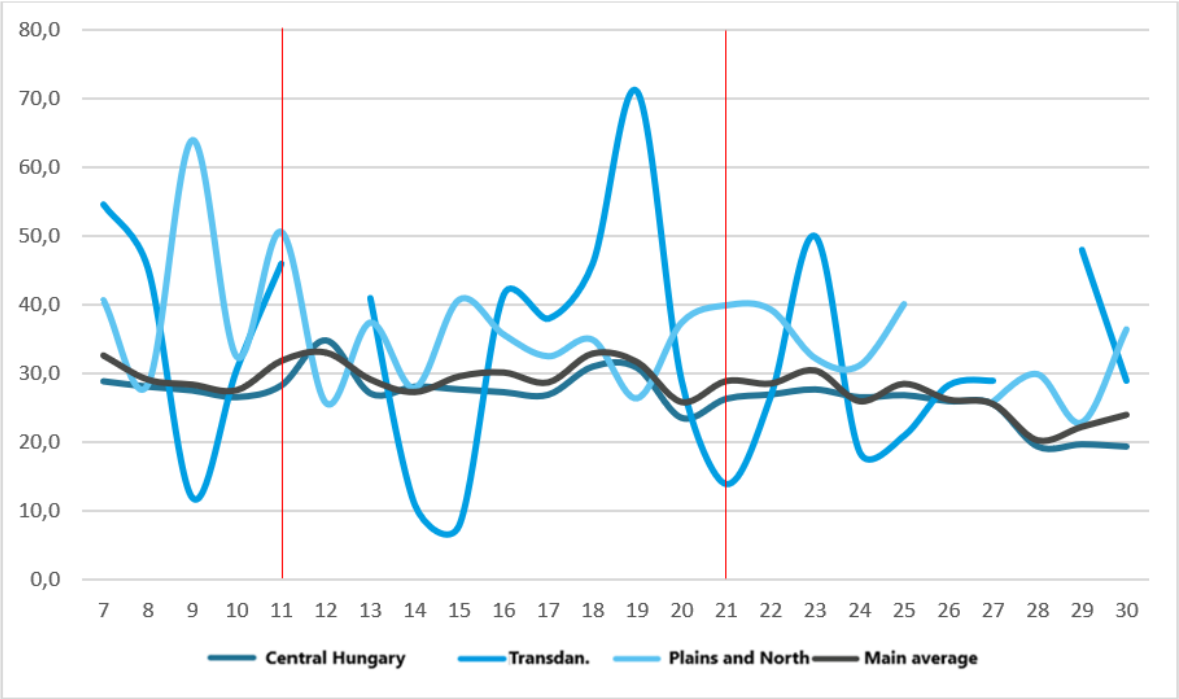


Interest in IT project managers was particularly high at the beginning of the period under review, but the exceptional health situation significantly reduced the number of job advertisements posted, and demand for database operators had not fully recovered by the 30th week of 2020, i.e. by the beginning of July. Looking at the demand trend, it is clear that the demand for IT project managers is highest in Central Hungary (80%), with the vast majority of these in Budapest (75%).

5.15.2.1. Lifetime of job advertisements

A job advertisement was typically open for 28 days during the period studied. Its value increased slightly during the COVID-19 period, peaking at weeks 12 and 18 with a lifetime of 33 days. From then on, life expectancy slowly declined, dropping to 20 days on week 28.

Figure 103: Evolution of job advertisement lifetime (by average days) for IT project manager, time-series by macro-region (n=904)



Looking at the lifespan of job advertisements by macro-region, we can see that the Central Hungary region remained the most stable in terms of the lifespan of job advertisements, while the epidemic situation had the greatest impact on the lifespan of job advertisements in Transdanubia during the period under review. The period was also characterised by fluctuating ad life expectancy in the Great Plain and North.

5.15.3. Job expectations

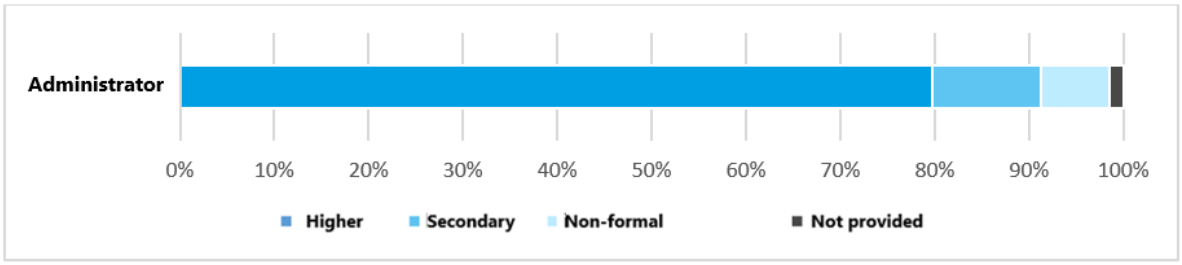
The requirements for the job in question are grouped as follows: qualifications required, language skills and professional experience.

5.15.3.1. Education

80% of the job vacancies examined require applicants to have a higher education qualification. Secondary education is considered sufficient by 12% of job advertisements, while 7% of job advertisements expect qualifications outside the school system (e.g. OKJ, ISTQB[29]). No identifiable qualifications are expected in 1% of job vacancies.

[29] International Software Testing Qualifications Board: https://www.istqb.org/ Date retrieved: 29/07/2020

Figure 104: Required qualification for IT project manager (n=904)



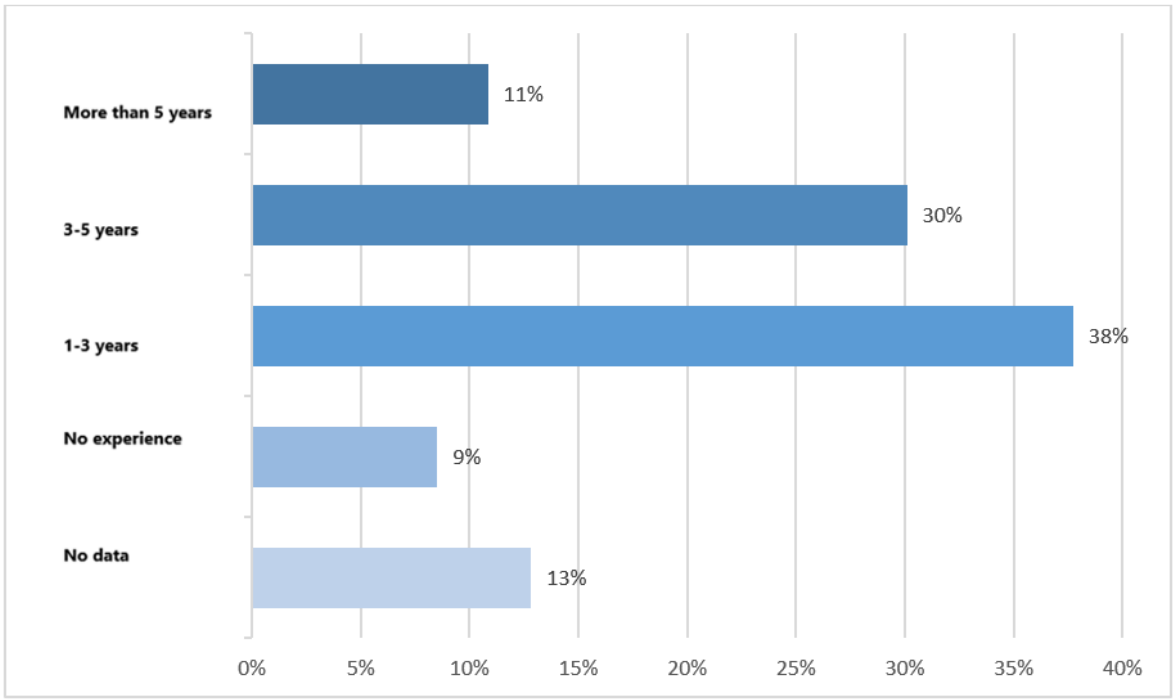
5.15.3.2. Language skills

The domestic job market also typically requires IT project managers to have language skills. One foreign language is required in 60% of job advertisements, and two languages in 31%. Less than 1% of the advertisements required knowledge of more than two languages.

5.15.3.3. Professional experience

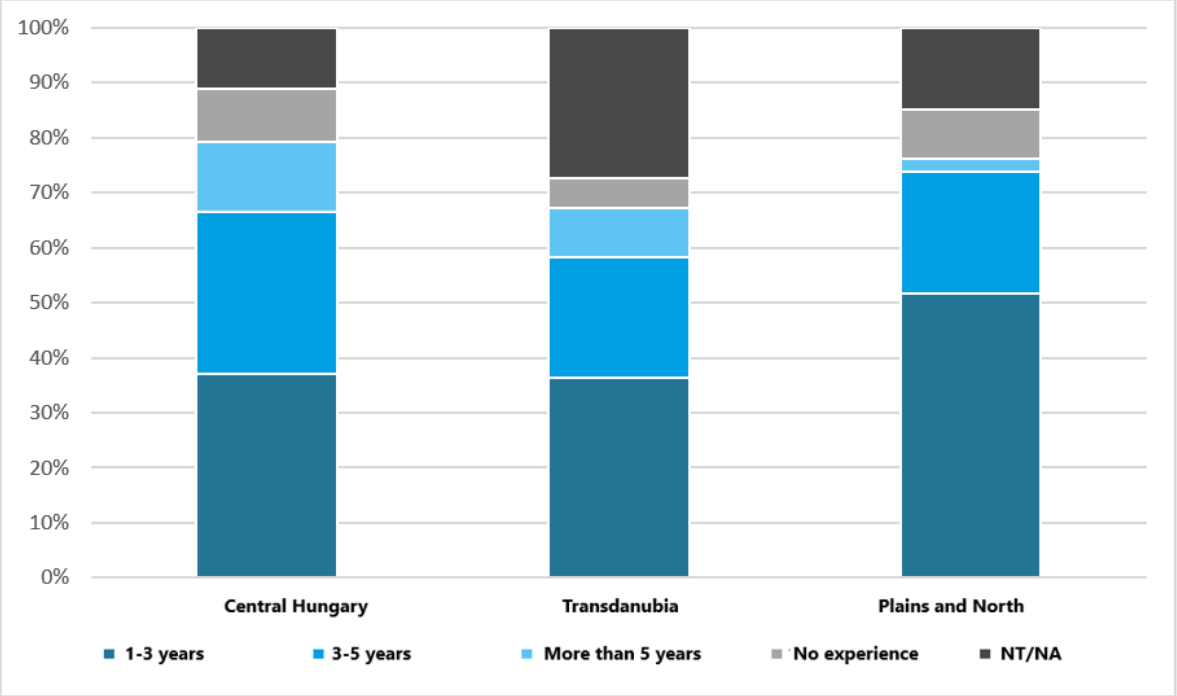
The highest proportion of the stated expectations is for 1-3 years of experience (38%), but this is not far behind for 3-5 years (30%). The demand for more years worked is only 11%. Zero years of experience is required in 9% of the advertisements, while no experience information is provided in 13% of the job vacancies surveyed.

Figure 105: Required professional experience as IT project manager (n=904)



The macro-regional breakdown shows that there are differences in employer needs for experience. The Great Plain and North region has the highest demand for 1-3 years of experience, while the region has the lowest demand for experience over 5 years.

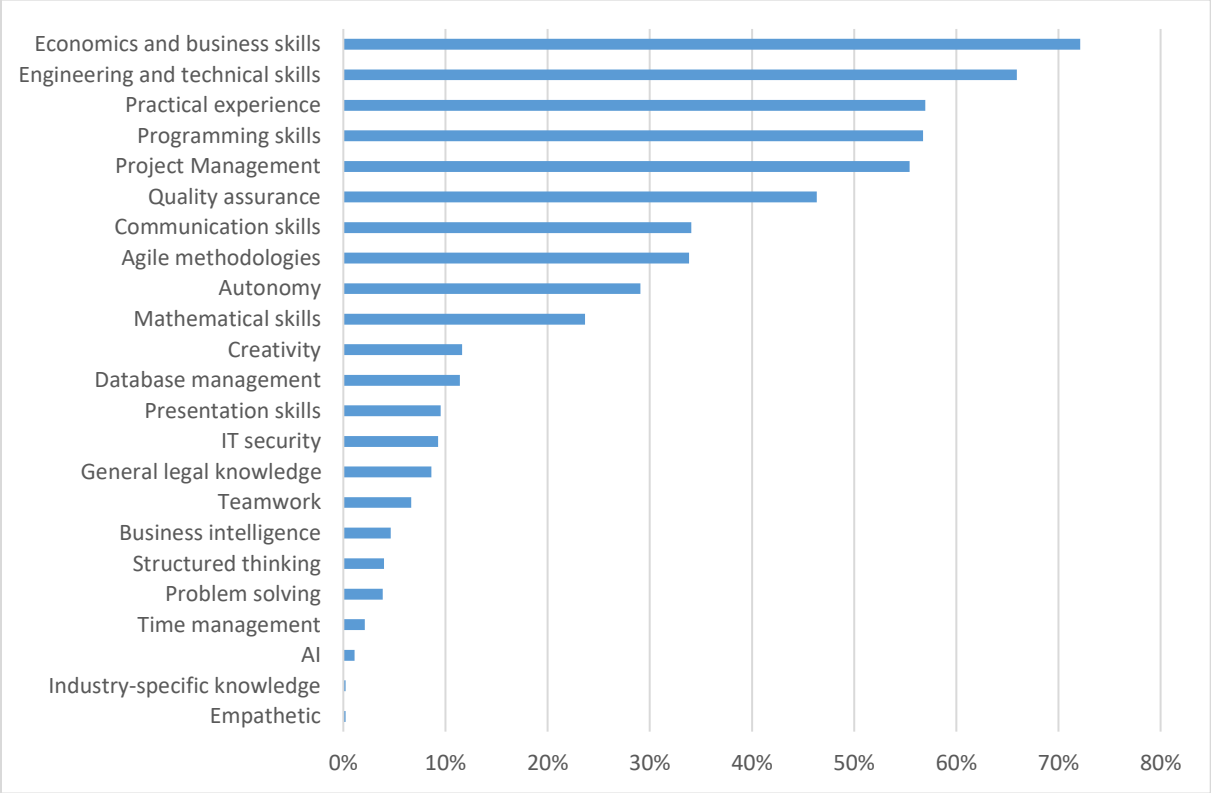
Figure 106: Expected experience in IT project management, by macro-region (n=904)



5.15.4. Job-related competences

Of the 23 skills, professional and other skills surveyed, the demand for economic and legal skills (72%), engineering and technical skills (66%) and practical experience (57%) is the most popular in the advertisements. Industry-specific knowledge and empathy are the least important competences for IT project managers.

Figure 107: Need for competences in percentage of IT project manager jobs (n=904)



5.16. IT systems designer, IT architect

Being a systems designer requires a wide range of IT skills and a high level of expertise.

5.16.1. Definition and delimitation

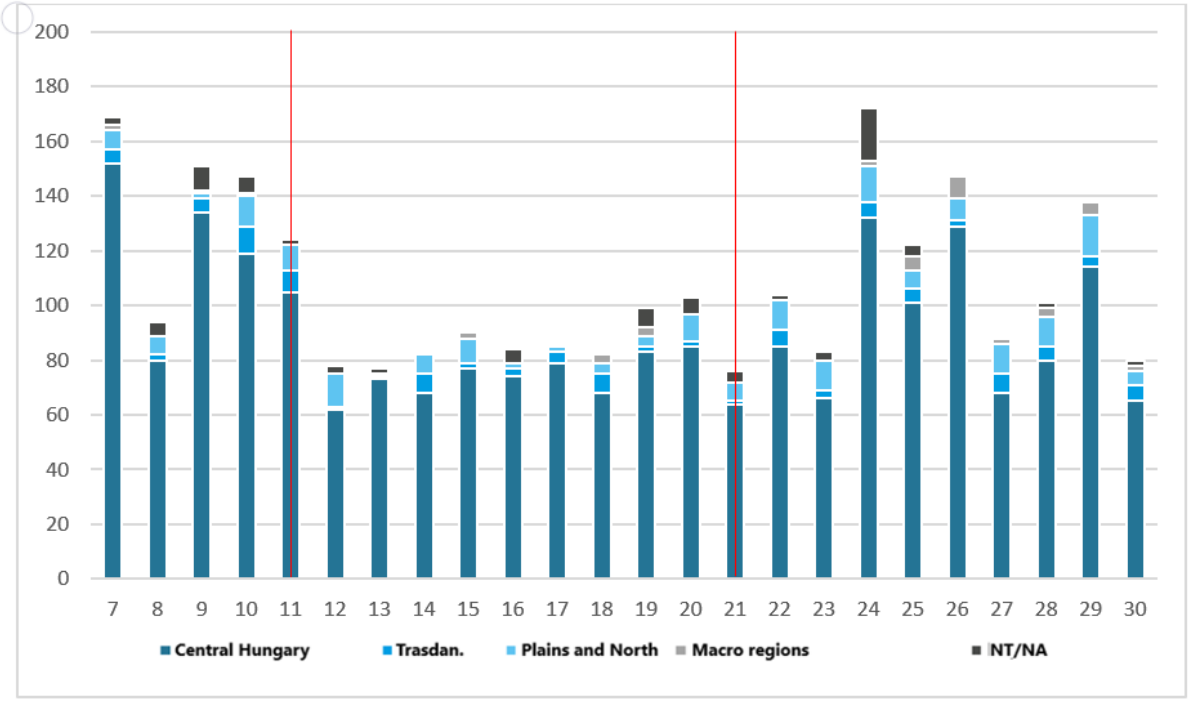
This occupation is not precisely identified in the FEOR, the closest occupation being information systems analyst (2141). In accordance with the FEOR, a systems analyst "analyses and assesses the client's needs, existing processes and problems with IT systems, and based on these, proposes, designs and implements possible solutions for current and future IT systems". In accordance with the job portals, the job duties of the employees include: agreeing customer requirements, preparing business specifications, assessing established business processes, proposing streamlining, preparing system design and functional specifications for developers, planning, coordinating and documenting the testing of new systems. The job under examination is related to all the jobs under examination, except IT sales and web development, and the managerial jobs discussed below, but is clearly distinguishable from them on the basis of the characteristics described.[30]

5.16.2. Evolution of job vacancies during the period under review

A total of 2,582 job advertisements for IT systems designer jobs were published during the period covered by the survey. In terms of macro-regions, employers are clearly most interested in IT system designers in the Central Hungary region (84%), with a significant share in Budapest (82%). Of the other regions, the Great Plain and the North is second with 7%. No foreign advertisements were published.

[30] Source: http://www.ksh.hu/docs/szolgaltatasok/hun/feor08/2/2534.html, last downloaded: 30/07/2020.

Figure 108: Evolution of the number of job vacancies in the job category of system designer, time-series by macro-region (n=2582)

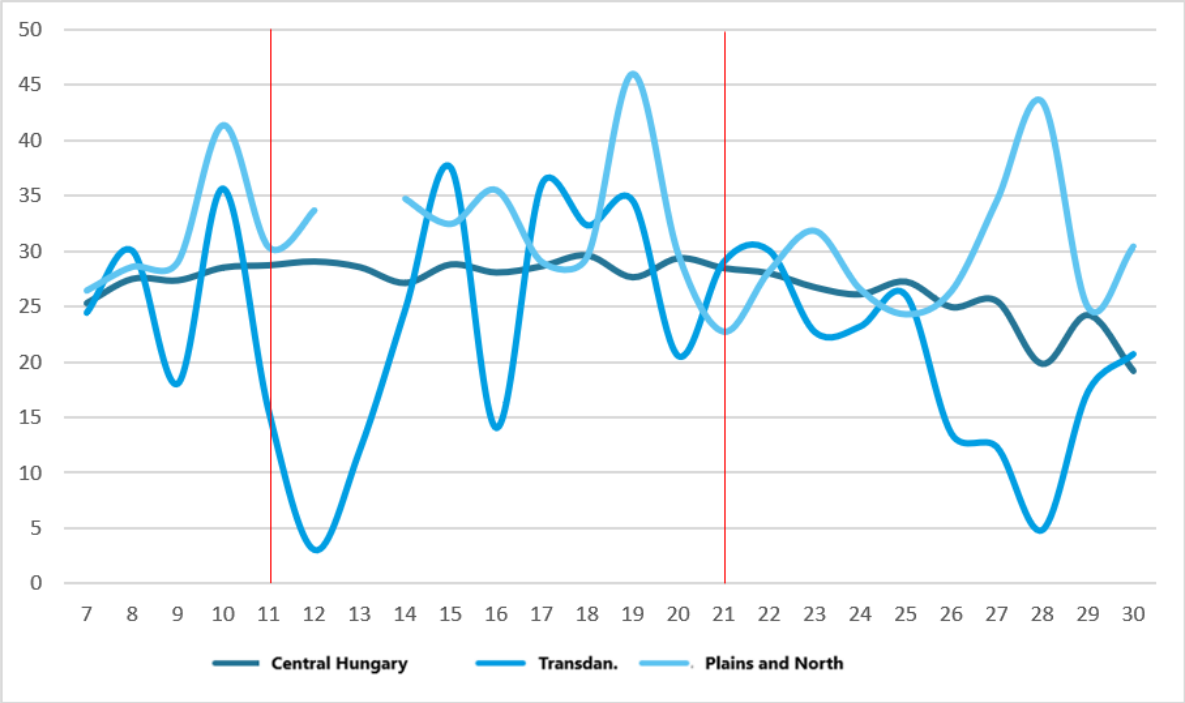


Demand for systems designers is well separated between weeks 7-11 and weeks 24-30. The former published an average of 137 ads per week, which later dropped to an average of 87 ads per week. There is a significant increase at week 24, which drops dramatically again at the end of the period.

5.16.2.1. Lifetime of job advertisements

A job advertisement was typically open for 27 days during the period studied. This value fluctuates over time until week 20, and then shows a minimal decrease from then on. The longest interval was nearly 30 days in weeks 10 and 18, compared to only 20 days in the last week of the survey.

Figure 109: Evolution of job advertisement lifetime (by average days) in the job category of system designer, time-series by macro-region (n=2582)



In terms of macro-regions, advertisements in the Great Plain and the North were typically open longer than in the Transdanubian region or Central Hungary. The last of the three macro-regions showed the least volatility.

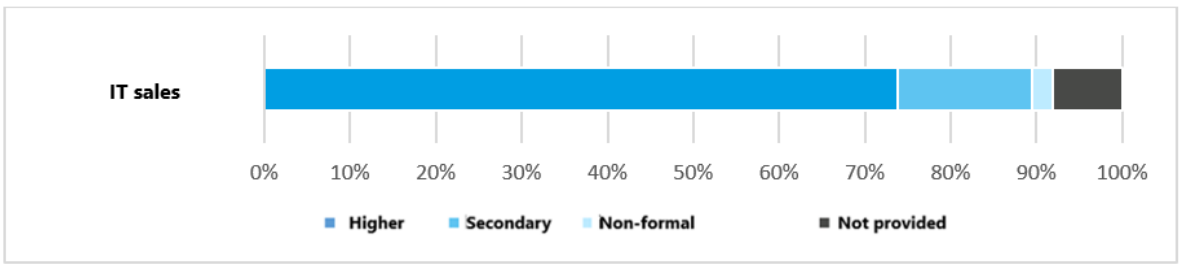
5.16.3. Job expectations

The requirements for the job in question are grouped as follows: qualifications required, language skills and professional experience.

5.16.3.1. Education

In 74% of the job advertisements surveyed, advertisers require a higher education qualification. Secondary education is accepted in 16% of jobs, while 8% do not specify an educational qualification. In the case of the systems designer job, only 2% of the advertisements mentioned non-formal qualifications as a requirement.

Figure 110: Expected level of education for the job of a system designer (n=2582)



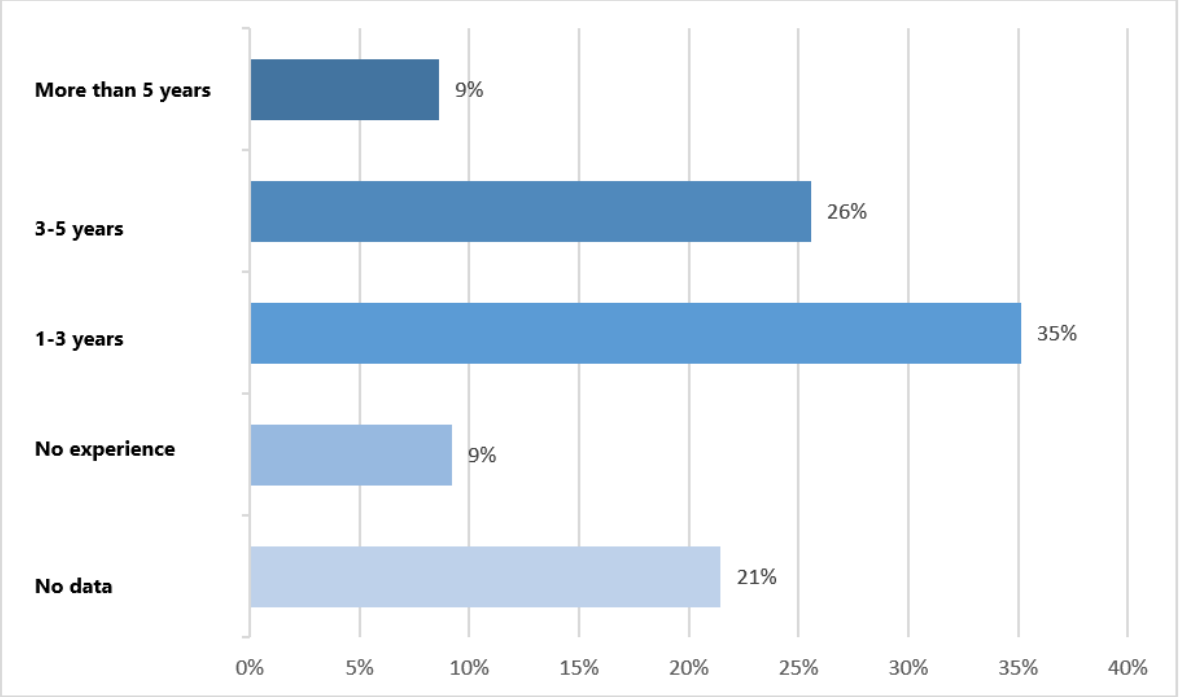
5.16.3.2. Language skills

Advertisements typically require knowledge of a foreign language. The evolution over time is shown in the following graph: there are fluctuations, mostly in the western part of the country. English is the most important language, required in 84% of job vacancies, German is required in 18% and 16% of vacancies have no foreign language requirement.

5.16.3.3. Professional experience

The experience most often sought by employers in the jobs shown is between one and three years (35%), and between three and five years in a quarter of the advertisements. This compares with a lower proportion of positions where the candidate has more than 5 years' experience (9%) or can be recruited without professional experience (9%). In 21% of the advertisements, the jobseeker's request was not specified.

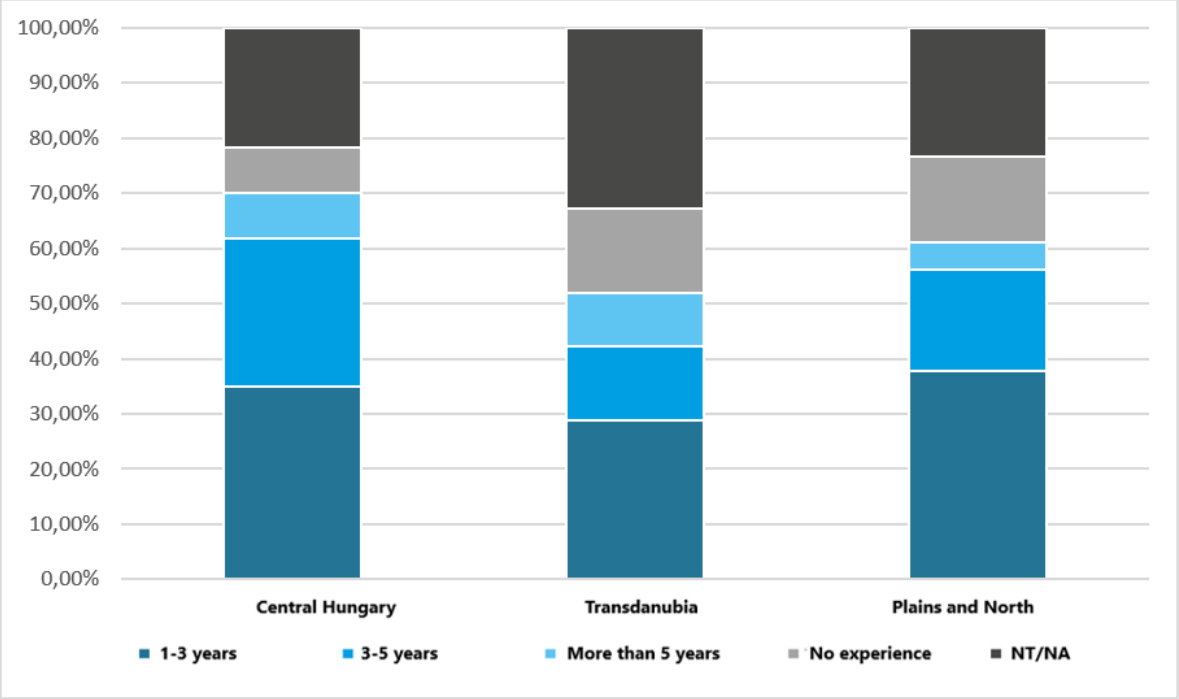
Figure 111: Required professional experience as a system designer (n=2582)



Unlike the previous ones, the spatial breakdown shows significant differences. In the Eastern part of the country, the highest proportion of job advertisements require 1-3 years of experience and the lowest proportion require between three and five years of experience. Companies with this latter experience are most in demand in the

central region. The central region of the country has the lowest number of advertisements without a specific professional experience requirement.

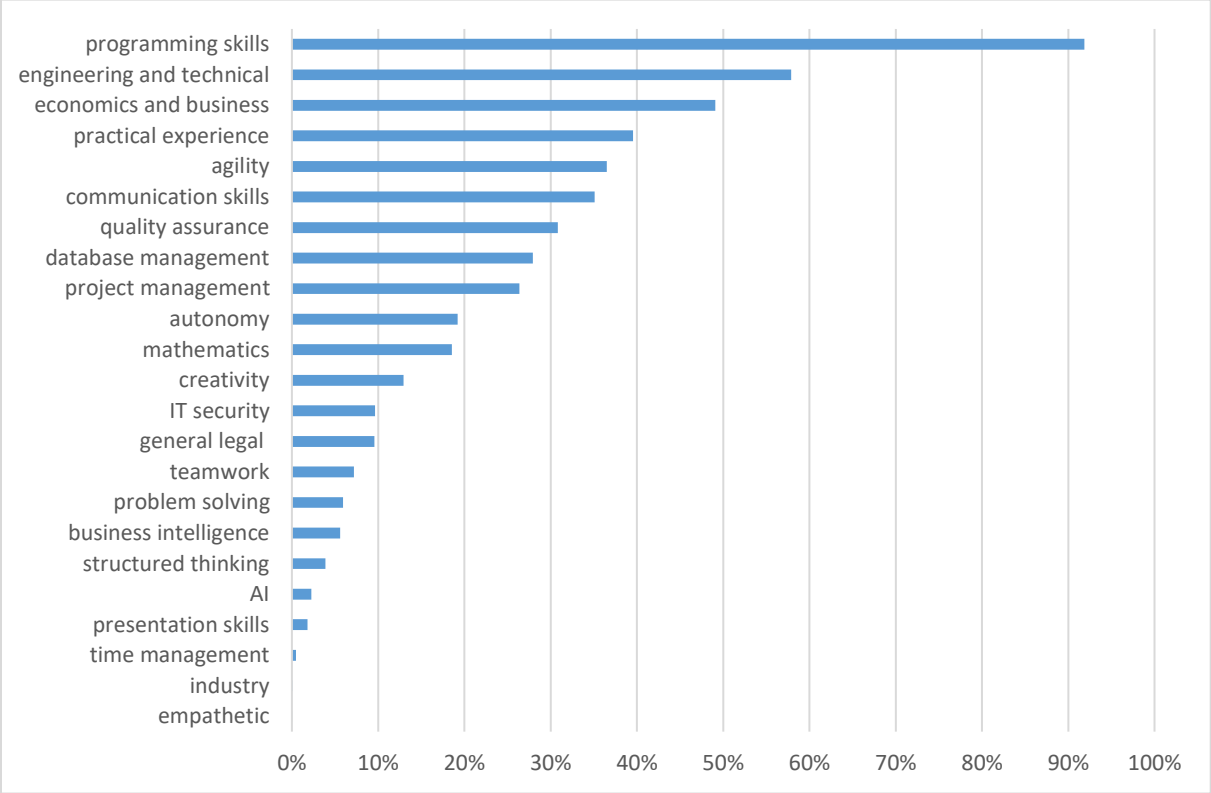
Figure 112: Required experience as a system designer, by macro-region (n=2582)



5.16.4. Job-related competences

Among the 23 professional and other skills surveyed, employers expect the highest proportions of IT sales job candidates to have programming (92%), engineering and technical (58%) and economics and business (49%) skills, based on the job advertisements surveyed.

Figure 113: Need for competences in percentages for the job of a systems designer (n=2582)



6. Interpretation of results, conclusions

During the survey, a total of 13,023 online job advertisements were collected by web scraper, of which 10,706 formed the basis of the trend analysis. These 10,706 job vacancies were published between the seventh and the thirtieth week of 2020 on the portals surveyed. A significant part of the short study period fell during the COVID-19 epidemic, which also affected the IT labour market. Due to the short study period and the epidemiological situation, it is not possible to make long-term predictions based on trends. Also, the uncertainty of the data is higher than in a normal period.

The number of IT job advertisements has been decreasing over the period under review. In the tenth to eleventh week, the number of online ads dropped significantly, coinciding with the period of the declaration of the epidemic. An increase was only seen again in week 24, with the end of the epidemic emergency. However, after week 24, the number of job vacancies did not reach the pre-epidemic level. This is presumably partly due to the recovery of the market and partly to the summer holidays.

The epidemic situation has had a different impact on different job sectors, not all of which have seen a large drop in the number of advertisements during the COVID-19 emergency. The job advertisements for customer service jobs were the least negatively affected by the epidemic, with even a small increase in this job category. This rise in the number of job advertisements is presumably due to the surge in internet usage, which may have caused several residential internet problems that were handled by the telecom companies' call centres. Apart from customer service, the business analyst job was the least negatively affected by the corona virus. The number of job advertisements for business analysts stagnated during the virus outbreak and then increased afterwards. This is probably due to the fact that businesses want to assess the damage caused by the virus, and business analytics can also help them to plan for the future.

Looking at the number of job advertisements for the 16 job categories surveyed, it is possible to see in order of magnitude which job categories generated the greatest demand over the period (apart from the fact that employers may also look for employees through their contacts in addition to the actual advertisements). This suggests that there is a particular need for developers in Hungary, whether with

engineering, web or mobile development skills. The second major group includes jobs related to databases and their analysis. The lower-demand jobs of IT project manager and IT manager were already a third as many job advertisements as the two groups above. While domestic firms are least likely to be looking for workers for support positions, such as customer service or sales.

The centrality of the IT labour market in Budapest was clearly highlighted in the survey: 70% of jobs were advertised in Budapest during the period under review. The figures are not surprising in this respect, as most and the largest IT firms are located in Budapest. Rural locations accounted for 30% of all advertisements in the period under review, but again, it is more likely that larger cities are more likely to be the location of choice for IT jobs. There seems to be a clear correlation between the size of the municipality and the location of larger IT firms. Infrastructural conditions are typically best developed in larger settlements, especially in Budapest. The quality and speed of internet networks in Budapest is the best, and as this is essential for IT businesses to work, it is likely to influence the decision.

The role of universities in deciding where a large IT company will create jobs is not negligible, as universities are the main source of graduate talent. University students can also be the source of trainees, who are more likely to become employees of the companies where they have taken part in the traineeship programme. Partly because of the larger universities, the number of job vacancies in Pécs, Szeged or Debrecen can be outstanding in addition to Budapest.

The role of universities may also be supported by the fact that IT jobs require mainly higher education at college or university level. 75% of job advertisements include this kind of expectation on the part of the employer. The share of advertisements mentioning secondary education was almost 20%, with employers only requiring an OKJ or similar qualification in 6% of cases.

At least 7 out of 10 advertisements, except for customer service representative, require a higher education qualification. For ads looking for a customer service representative, the figure is 49%. Unsurprisingly, the IT manager job requiring managerial skills is the most common job requiring at least a college degree (84%).

At national level, the demand for programming, engineering and technical skills is the most typical demand from employers. At present, the best place for workers to

acquire this kind of professional knowledge is in universities. This can be inferred from the fact that in Hungary, the demand for IT workers is mainly for people with tertiary education.

In addition to professional and contextual knowledge, it is typically expected that the employee has 1-3 or 3-5 years of professional experience. At the same time, more job advertisements were looking for people with no professional experience than for people who had worked in the profession for more than 5 years. Fewer senior positions were open than entry-level, junior or mid-level positions during the period under review. For all the jobs examined, the required work experience of 1-3 years was predominant during the period under review. Analysis of job advertisements also confirmed the importance of English in this sector. 74% of all online adverts during the period under review included some level of English language proficiency. The importance of English is due to several factors. On the one hand, programming languages are closely related to English, so programming-related jobs require workers to use some English on a daily basis. On the other hand, multinational companies make up a significant part of the domestic IT job market, where everyday communication may require the use of English.

The important role of multinational companies is best illustrated by the example of German language requirements, where half of the approximately 2,800 advertisements were job advertisements linked to a multinational company.

In addition to large international companies, the role of intermediary companies in the IT job market is also worth highlighting. These recruitment agencies, such as Randstad (2070) or Recruit Kft (700), uploaded the most job advertisements on online portals. A significant number of IT jobs are advertised through intermediary firms. Apart from larger firms, IT companies are unlikely to be able to engage in first-round recruitment.

Overall, despite the greater uncertainty in the data, it can be concluded that the market is Budapest-centric and that the high proportion of English language and higher education qualifications is a good indicator of the IT labour market. Furthermore, it can be assumed that professional and contextual knowledge are among the most important expectations that employees have.

To reduce the uncertainty of the data, it is proposed to continue the study. Due to the cyclical nature of the labour market and the epidemic situation, it is very uncertain how to draw long-term, firm conclusions from the period studied so far. We therefore consider it important to continue to collect data through the web scraper and then analyse the data on a yearly basis, which would allow us to see and better manage the cyclical nature of anomalies and the labour market.

7. Presentation of the limitations of the analyses, the scope of generalisability

In order to interpret the results properly, we should also mention the difficulties encountered in the research. One of these was the imposition of an epidemic during the data collection period, and the other major difficulty was the limitations of the text mining methods on which the methodology was based.

The COVID-19 coronavirus had an impact on the labour market in all aspects of the study. It is clear from the available data that the advertisements placed during the epidemic period differ in many respects from the previous period. There were fewer ads posted during this period, and the expectations expressed in these ads differed from those in the weeks before and after the viral period. In addition, it is important to note that the market did not immediately return to its pre-plague state after the end of the emergency, and the uncertainty that remains is still having a small impact. The results may need to be treated in this light, as this period does not give a fully realistic picture of the labour market situation in the ICT sector. To examine the real situation, it may be more useful to create and analyse a bigger database, covering 1-2 years of data, which, in addition to trend analysis, may also be suitable for identifying and measuring cyclicality over the year.

The text mining methods used in this research also have some limitations, but there is no better way to carry out such a massive text analysis.

Text mining is the processing and analysis of textual data to uncover new information hidden in the document. In doing so, it draws primarily on the methods of computational linguistics and language technology. The first step in the general model of text mining is to collect the documents to be studied and then to pre-process them. Then text mining methods are used - such as classification, clustering, information retrieval and extraction. To ensure efficient access, it is useful to store this information using an information management system. Text mining has a wide range of applications, including business intelligence and information retrieval, public administration and e-government, and web search and advertising.

However, text mining has a fundamental problem: language, speech, has evolved for the purpose of communication between people, as a result of its natural evolution,

and therefore does not take into account the computer processing aspects. There are language patterns that people use easily, but which are difficult to identify in computer analysis - for example, handling spelling variations, recognising context or stylistic features. In contrast, the computer has the advantage of being able to analyse text in large quantities and at high speed. Text mining therefore aims to combine the human ability to understand unstructured text with the machine ability to analyse it quickly.[31]

In addition, the problem with text mining and related methods is which of the large number of relationships discovered are the ones that may actually be relevant to the study. This is especially true for less clear, weaker links - in these cases it is particularly difficult to identify which are the most interesting relevant links.

Text mining as a whole therefore has two major problems. First, it is not possible to write a program that can fully interpret the documents selected for analysis. Another problem is that often the information that is important for analysis is not clearly presented in textual form.[32]

Another aspect to highlight is the management of duplicates in the database. During the scraper's operation, it also collected the corresponding URL for each ad tested, which serves as a unique identifier for each ad. When cleaning the database, we could therefore remove duplicates from the database based on the URL. However, there may still be duplicates in the recorded data, as sometimes an employer may advertise a position on several platforms. These could be filtered out using additional text mining methods, but it is also possible that the employer advertises the same position with different wording, which makes it impossible to identify the advertisements posted for the position and thus to filter out duplicates. For this reason, no such duplication filtering was performed in the database.

[31] Source: Tikk D. (ed.) (2007): Text mining. TYPOTEX Publishing.
[32] Source: Hearts, M. (2003): What is Text Mining?, SIMS, UC Berkeley.

8. Annexes

8.1. Analysis of the popularity of job portals

On the demand side, the choice of a job portal can be influenced by a number of factors. One is the number of jobs advertised, which can be one indicator of the popularity of an advertising site. In terms of IT recruitment advertising, a few portals dominate the market. Profession.hu, the leading job website, published 1-2 thousand more IT jobs than its competitors (a total of 3,471 jobs in the period under review). The top 3 IT job portals also include cvonline.hu (2,384 ads) and jobline.hu (1,745 ads). There were also a significant number of jobs advertised on workania.hu (1,428), but more than 1,000 administrative jobs were also advertised during this period. The fewest job vacancies were published by job agencies, with 214 jobs at randstad.hu and only 35 at kellyservices.hu.

It is also worth looking at the characteristics of the top 3 job portals in general (apart from IT occupations), as this is a good indicator of the popularity of a portal. In terms of the total number of ads, compared to the number of ads for IT jobs, a similar trend can be observed. in February 2020 (based on the available dates published by the Wayback Machine), which was considered the average period before the virus outbreak, the TOP3 job portals had the following results: profession.hu had 16,412 ads, cvonline.hu 13,721 ads and jobline.hu 2,232 ads, more than 10 thousand ads behind its competitors.

In addition to the number of ads, traffic figures also confirm the market leaders' position. In accordance with data from SimilarWeb's traffic monitoring service (between January and August 2020), the number of visits to the first-ranked profession.hu averaged 3.4 million people a month, while the number of visits to the second-ranked cvonline.hu was 315.9 thousand, and the number of visits to the third-ranked jobline.hu 207.5 thousand.

Based on the number of IT job ads examined, the total number of ads on all portals and the number of visits to the site, profession.hu offers the widest range of jobs for those who are looking for a job in the IT job market, and therefore the best chance for IT jobseekers to find a job on this site. In terms of the number of IT jobs, profession.hu "led" the second and third players with at least 1,000 ads in the period under review, and also had an advantage of the order of 1,000 in terms of the total

number of ads (in February 2020): while it "left" the second player with nearly 2,700 ads, it had 14,000 more ads than the third player. The main difference between the market leader websites is in the traffic figures, where profession.hu has millions of visits per month, while its competitors can generate a few hundred thousand visits.

8.2. Variables in the database

The database variables used in the analysis, their explanations and, in the case of trained variables, the way they are created, are presented in the following table:

number	Job advertisement serial number
company_name	Name of the company placing the advertisement
location	The place of work according to the advertisement
job_title	Name of the position based on the advertisement
description	Description of the position based on the advertisement
url	Ad URL
keywords	Keywords highlighted in the ad
platform	Advertising space
sub_category	Subcategories of the advertised position
upload.time	Date of posting of the advertisement
first	Date on which the ad was first noticed
last	Last time the ad was seen
text	Text of the advertisement
language	Language of the advertisement
Location	Definition of town based on location field
District	Definition of district based on location field
County	Definition of county based on location field
Region	Definition of region based on location field
Macroregion	Definition of macro-region based on location field
Telework	If only telework was specified in the location field
upload	Corrected upload date (upload.time): if the date is before 10/11/2019 or after 28/07/2020, the upload date has been deleted
first_appearance	First appearance of the ad, same as the first variable - technical

last_appearance	Revised last appearance date (last): if the date falls on the last run date (28/07/2020) the last_appearance date has been removed
original_job_open	Number of days open before dates are input (last_apperance - upload): where one date is missing, the value is also missing
notice_time	Time elapsed until the ad was detected (first_apperance - upload); where one of the dates is missing, the value is also missing
RF_est_job_open	Estimation of missing values of the variable original_job_open with RanfomForest
KMeans_est_job_open	Estimation of missing values of the variable original_job_open with KMeans
KNN_est_job_open	Estimation of missing values of the original_job_open variable with KNearestNeighbors
KNN_est_notice_time	Estimation of missing values of time to ad detection with KNearestNeighbors algorithm
job_start	Corrected upload date (upload) added based on the following: -if the value is given: the original value is included -if the value is missing but the corrected last date is included: last_apperance - KNN_est_job_open -if both are missing: first_apperance - KNN_est_notice_time
job_end	Fixed last_appearance date (Last_appearance) added based on: -if the value is given: the original value is included -if the value is missing but the corrected upload date is included: upload + KNN_est_job_open -if both are missing: first_apperance - KNN_est_notice_time
megtalalt_keresoszo	The variable is used to check the search for expectations based on the text of the job advertisement. This variable contains the perceived expectation categories and the corresponding word.

calc_adatbaziskezeles	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_agilis	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_ai	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_alt_jogi	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_csapatmunka	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_empatikussag	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_gyakorlati_tapasztalat	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_idomenedzsment	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_iparagi_spec	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_it_biztonsag	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_kommunikacios_keszseg	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_kreativitas	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_közg_üzleti	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_matematikai_ismeret	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_mernoki_muszaki_ismeret	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_minosegbiztositas	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_onallosag	If the value for the category was included in the text of

	the job advertisement, it is assigned a value of 1
calc_prezentacios_keszseg	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_problema_megoldas	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_programozoi_ismeret	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_projektmenedzsment	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_strukturalt_gondolkodas	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
calc_üzleti_intelligencia	If the value for the category was included in the text of the job advertisement, it is assigned a value of 1
sum_oszlop	Number of job expectations
megtalalt__munkakor_keresoszo	The variable is used to check the search for expectations based on the categories of the job advertisement. This variable contains the job categories found and the corresponding words.
adatbazis_adminisztrator	If the value for the category was included in the job ad category, it is assigned a value of 1
adatbazis_fejleszto	If the value for the category was included in the job ad category, it is assigned a value of 1
adatbazis_tervezo	If the value for the category was included in the job ad category, it is assigned a value of 1
adattudos	If the value for the category was included in the job ad category, it is assigned a value of 1
egyeb	If the value for the category was included in the job ad category, it is assigned a value of 1
ertekesito	If the value for the category was included in the job ad category, it is assigned a value of 1
helpdesk	If the value for the category was included in the job ad category, it is assigned a value of 1
it_vezeto	If the value for the category was included in the job ad

	category, it is assigned a value of 1
mernok	If the value for the category was included in the job ad category, it is assigned a value of 1
mobilfejleszto	If the value for the category was included in the job ad category, it is assigned a value of 1
projektmenedzser	If the value for the category was included in the job ad category, it is assigned a value of 1
rendszergazda	If the value for the category was included in the job ad category, it is assigned a value of 1
rendszertervezo	If the value for the category was included in the job ad category, it is assigned a value of 1
szoftverfejleszto	If the value for the category was included in the job ad category, it is assigned a value of 1
szoftvertesztelo	If the value for the category was included in the job ad category, it is assigned a value of 1
uzleti_elemzo	If the value for the category was included in the job ad category, it is assigned a value of 1
webfejleszto	If the value for the category was included in the job ad category, it is assigned a value of 1
keywords_list	Turning a keyword variable into a list - technical
megtalalt_tapasztalat_keresoszo	If the value for the category is included in the job ad keywords, it is assigned a value of 1
tapasztalat_nelkul	If the value for the category is included in the job ad keywords, it is assigned a value of 1
1_3_ev_tapasztalat	If the value for the category is included in the job ad keywords, it is assigned a value of 1
3_5_ev_tapasztalat	If the value for the category is included in the job ad keywords, it is assigned a value of 1
5_ev_feletti_tapasztalat	If the value for the category is included in the job ad keywords, it is assigned a value of 1
sum	Number of experience categories found for the job
minimum_tapasztalat	Of the four categories, the minimum experience
description_v1	description field in lower case

keywords_v1	keywords field in lower case
english_language_v1	Variable recording English language skills based on the description field and the keyword
german_language_v1	Variable recording German language skills based on the description field and the keyword
russian_language_v1	Variable recording Russian language skills based on the description field and the keyword
french_language_v1	Variable recording French language skills based on the description field and the keyword
romanian_language_v1	Variable recording Romanian language skills based on the description field and the keyword
italian_language_v1	Variable recording Italian language skills based on the description field and the keyword
spanish_language_v1	Variable recording Spanish language skills based on the description field and the keyword
japanese_language_v1	Variable recording Japanese language skills based on the description field and the keyword
chinese_language_v1	Variable recording Chinese language skills based on the description field and the keyword
arabic_language_v1	Variable recording Arabic language skills based on the description field and the keyword
school_v1	Variable recording the qualification based on the description field and the keyword