The Impact of Global Crises on Employment and Talent Needs in the IT Sector: A Time-Series Analysis of COVID-19 Disruptions and AI-Driven Adaptations

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This paper looks at how the COVID-19 crisis has affected jobs in the Slovak IT sector between 2013 and 2023, focusing on trends, regional differences, and remaining vacancies. Using time series analysis and ARIMA modelling, it examines employment changes over time and predicts future developments. In addition, the study conducts a regional analysis to examine differences between Slovak regions and a job vacancy analysis to uncover the need for new talent. The results show that IT employment temporarily declined during the peak of the pandemic in 2020 but quickly bounced back, largely due to telework and digitization efforts. As for regional differences, while Bratislava and other large cities have more IT employment, smaller cities struggle more with employment shortfalls. Despite the sector's resilience, vacancies remain problematic, signaling a mismatch between demand and available talent. Forecasts suggest modest employment growth in the IT sector, but uncertainty in the economy may pose a risk. The study highlights the need for targeted policies to address labor shortages and improve skills, especially in smaller cities. By analyzing the impact of crises, vacancies, and future employment trends, this research offers valuable insights for policymakers and businesses aiming to strengthen the IT workforce in Slovakia.

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1 Introduction

The COVID-19 pandemic brought with it a variety of unexpected challenges that impacted various sectors, including the technology sector (Trenerry et al., 2021). The IT sector has played one of the most important roles in enabling teleworking (home office) for compliance with social isolation measures. This transition has led to a rethinking of traditional working patterns and an increased reliance on freelance work (Evans, 2020; Franco et al., 2023). Concurrently, it has precipitated an escalation in the demands placed upon the competencies of employees within the IT sector, as enterprises have endeavoured to optimise flexibility to contend with economic turbulence (Alpar & Osterbrink, 2020). These trends have reshaped workforce needs, requiring IT professionals to develop new skill sets in areas such as machine learning, data analytics, and AI governance (Brynjolfsson et al., 2025). Given these global shifts, our study focuses on employment trends within the IT sector in Slovakia. We analyse the impact of the COVID-19 pandemic on employment dynamics, accounting for changes in the need for certain skills, worker flexibility, and job openings. Using the ARIMA (Autoregressive Integrated Moving Average) model, we perform a time-series analysis to assess how the pandemic has affected employment trends in the Slovak IT sector. Our findings aim to shed light on workforce evolution to help policymakers and businesses better understand the pandemic's long-term effects on the labour market.

2 Literature review

The COVID-19 pandemic has resulted in significant changes in talent management and recruitment as organizations adjust to changing skill requirements, the move to remote working and financial constraints. Hiring freezes, layoffs, and pay cuts have occurred, causing workforce instability and increased employee stress (Aguinis & Burgi-Tian, 2021; Kajwang, 2022; Singh & Ahmad, 2021; Adelaine et al., 2024). The lack of clear work-life boundaries has led to an increase in burnout and highlighted the shortcomings of traditional performance appraisal methods (Aguinis & Burgi-Tian, 2021; Singh & Ahmad, 2021).

The IT sector has witnessed a remarkable rise in the demand for experts because of the pandemic-induced boom in the usage of digital technology. Job applicants have been aggressively looking for roles within industries that were minimally affected by the crisis. At the same time, more people have been interested in working from home because of health concerns and lockdowns (Hensvik et al., 2020; McFarland et al., 2020). Consequently, organizations have rushed to adjust to the new working-from-home setting, thereby accelerating the demand for cloud computing, cybersecurity, and remote work collaboration tools (Wang, 2022; Pavashe et al., 2023). Conversely, there has been heightened competition in the labor market, with individuals from other fields starting to switch to the IT industry (Aguinis & Burgi-Tian, 2021; Fernandes et al., 2022).

Companies have been compelled to explore new talent management approaches to enable them to retain able employees and enhance their responsiveness in the dynamic work environment context. They had to deal with issues such as work stoppages, layoffs, and the shift to telecommuting, which meant that they had to change the way they searched for and retained talent (Aguinis & Burgi-Tian, 2021; Vaiman et al., 2021).

With the disruption of conventional workforce arrangements, organizations have embraced more dynamic performance measurement approaches and innovative workforce management practices, including multi-source appraisal systems and contingent talent management approaches (Sigala et al., 2023; Kajwang, 2022). These not only offer solutions to immediate problems of maintaining an adequate workforce level but also help businesses remain competitive in an ever-evolving labor market (Malathi & Millath, 2020). These developments are often indicative of the reality that the processes by which organizations find, manage and retain talent have been fundamentally transformed, reaching far beyond the confines of IT and into every corner of the economy. (Vaiman et al., 2021).

3 Methodology

This section describes the research design, data collection, data structure, and methods used in this study. The Web of Science database was selected as the primary source for identifying relevant articles related to the impact of the global crisis on

employment and talent needs in the IT sector. The search was restricted to peer-reviewed academic journal articles published in English that included the terms ("COVID-19" OR "pandemic") AND ("IT sector" OR "IT employment") AND ("talent management" OR "labour market") in their title, abstract, or keywords.

The data for this study were sourced from the statistical database Datacube.sk and pertain to Slovakia. Our analysis focused on the average number of employed persons and the number of job vacancies in the IT sector, categorized according to the SK NACE classification. The SK NACE classification is a system used in Slovakia to categorize economic activities, providing a framework for statistical data collection and analysis across various sectors. This classification is crucial for understanding sectoral dynamics, financial health, and economic performance in Slovakia. The SK NACE classification helps identify clusters of sectors with similar patterns of indebtedness. In Slovakia, sectors such as C, F, G, and H, which belong to the tertiary sector, and sectors K, R, and S, part of the secondary sector, have been identified as having homogeneous debt patterns. This clustering is significant for benchmarking and understanding sectoral stability and independence, which is vital for economic growth in the V4 nations (Gajdosiková et al., 2024). For our analysis, we use data from sector J, which is the Information and Communication sector according to the SK NACE classification, encompassing activities such as publishing, telecommunications, software development, IT services, and information-related activities.

To examine employment trends and make predictions, we developed an ARIMA model based on the data on the average number of employed persons. This approach enabled us to identify patterns and forecast employment dynamics within the Slovak IT sector. The Autoregressive Integrated Moving Average (ARIMA) model is a widely used statistical tool for modeling and forecasting time series data. It combines three components: Autoregressive (AR), Integrated (I), and Moving Average (MA) models. The AR component involves regressing the variable on its own lagged values, the I component involves differencing the data to make it stationary, and the MA component models the error term as a linear combination of error terms from previous time steps (Liu et al., 2020; Cao, 2024; Liu, 2024).

4 Results

The **Fig.1** shows how the average number of employees in the IT sector has changed in different regions of Slovakia between 2013 and 2023. The Bratislava region (blue) is the most important center of the IT industry in Slovakia. The number of employees in the IT sector was 21,732 in 2013 and has been growing steadily, with some small changes. After a small decrease in 2018-2019, growth increased again, and 2022 reached the highest value in the monitored period. The Košice region (brown) is the second most important IT center in Slovakia. It had 5,308 employees in 2013 and was growing steadily until 2019.There was a significant jump in 2019-2021.This growth may have been supported by increased digitization during the pandemic and the expansion of IT companies in the region. The Žilina region (light blue) showed steady growth. The Trnava region (orange) had a total It had 1,878 employees in 2013, and this increased to 2,369 by 2021, but then went down to 1,638 in 2023, which is lower than in 2013. The Trenčín region (grey) has seen steady growth from 915 employees in 2013 to 1,428 in 2023, indicating a slight strengthening of the sector. The Nitra region (yellow) grew from 1,191 employees in 2013 to 2,269 in 2021, but then went down to 1,728 in 2023, which may be related to people leaving the area. The Banská Bystrica region (green) shows a fluctuating trend from 2013 to 2019. The Prešov region (dark blue) had the smallest number of employees in the IT sector. The **Fig. 1** shows that the Bratislava and Košice regions are the main IT centers in Slovakia. Other regions show moderate growth or stagnation, and some regions, such as Nitra and Trnava, saw a decline after 2021. This may be because of the effects of the pandemic, which might have led to a temporary increase in demand for IT services and jobs.

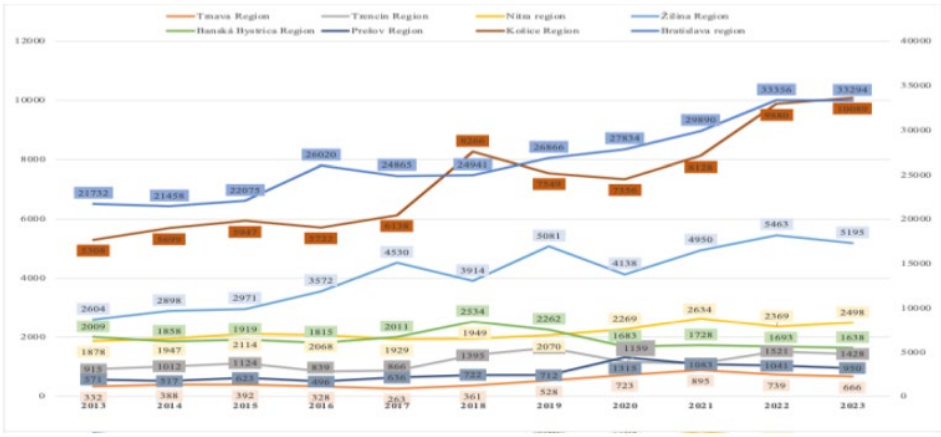

Figure 1: Average number of employees in the IT sector in Slovak regions (2013-2023)
Source: datacube.sk, own processing; Number of employees in all regions shown on the primary (left) axis; Bratislava region shown on the secondary (right) axis due to significantly higher values.

The **Fig. 2** shows the number of available jobs in the IT sector in Slovakia between 2013 and 2023, with significant fluctuations. The lowest point was in 2014 (221 positions), which may be related to lower demand for IT specialists, while the highest point was in 2018 (544 positions), probably due to the growth of technology firms and digitalization. After 2019, the number of available positions declined, reaching only 303 in 2020, which could be due to the COVID-19 pandemic. Subsequently, from 2021 onwards, the demand for IT professionals grew again, reaching 468 positions in 2022. This development can be compared with employment growth in the IT sector (**Fig. 1**), where Bratislava region and Košice region have seen a steady increase in jobs, while Nitra region and Trnava region have seen a decline after 2021.A rise in employment was observed in the Košice region in 2019–2021, which is consistent with a rise in the number of open positions in 2021–2022. The trend line indicates a long-term slight growth of job opportunities in the IT sector. All things considered, the dynamics of the number of open positions in the IT industry reflect the effects of the pandemic and digitization.

Figure 2: Average number of available jobs in the IT sector in Slovakia (2013-2023)
Source: datacube.sk, own processing

The decomposition of multiplicative time series, as shown in **Fig. 3**, analyzes how global crises have affected employment trends and talent requirements in the IT industry. Data are divided into four main components: observed values, trends, seasonal variations, and random fluctuations. According to the data, IT employment is on the rise overall, though it experiences occasional fluctuations that reflect recurring patterns in the labor market. Also, the trend component shows a long-term rise in IT employment. The pace slowed down in 2020-2021 because of the pandemic-disrupting impacts of COVID-19. This was the period in which the jobs market was adapting, had job losses, freezing of recruitments, and a massive switch to remote working. All these modifications are altering the dynamics of employment. The seasonal component, which normally shows predictable fluctuations, deviates during the pandemic, suggesting disruptions in workforce demand and hiring cycles. Uneven fluctuations are captured by the random component, which is especially volatile in 2020–2021. This showcases the volatility the crisis has caused, as companies rapidly changed their hiring practices in the wake of unstable economic conditions. But post-pandemic employment data show not just a recovery but an acceleration of job growth, fueled by the growing adoption of AI-driven technologies. Having been handed an altered requirement for IT professionals, companies have directed themselves towards digital transformation and automation. Fields like data science, cybersecurity, and cloud computing emerged due to AI, with a vision of the work role and capability. Upskilling continuously and being flexible are required skills to adapt to this inevitable robotic assault for the IT professionals as the processes fueled by AI continue to consume most branches of the business.

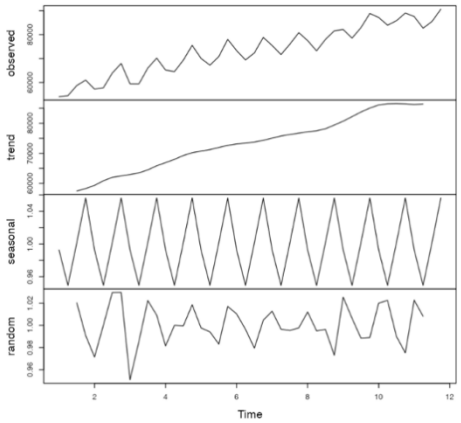

Figure 3: Decomposition of multiplicative time series for IT sector employment
Source: own processing

The box plot, as you can see in **Fig. 4**, provides a clear picture of how employment in the IT sector fluctuated across the four quarters (Q1–Q4) from 2013 to 2023. As we can see from the data below, there are also clear seasonal patterns, with the median employment low occurring in Q2 and high occurring in Q4. That indicates IT employment typically falls during the second quarter, perhaps thanks to summer slowdowns, before peaking at year's end, when companies increase hiring to meet project deadlines and budget cycles. Also note the difference in variation between quarters. Q1 and Q3 exhibit larger swings, suggesting moments of greater turnover, while Q2 is more stable, indicating more consistent employment. The general trend shows cyclical behavior in IT employment with seasonal variation in the data. The 2020–2021 COVID-19 pandemic interrupted these trends briefly due to interruptions. Throughout that period, hiring slowdowns in the pace and restructuring of staff generated additional volatility, interrupting the seasonally normal trend. As the industry adapted, though, not only was employment restored but also expanded, driven in part by increased investment in AI-driven solutions and digitalization. These trends have reshaped demand for the workforce, favoring the greater demand for AI-skilled capabilities and flexibility within the IT sector.

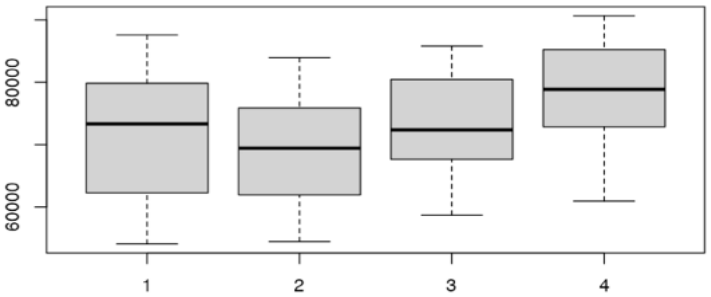

Figure 4: Box plot
Source: own processing

The ARIMA model employed as ARIMA (1,0,0) (0,1,1) [4] with drift, as you can see in **Fig. 5**, is applied to forecast time series, giving insight into the impacts of global crises, such as the COVID-19 pandemic, on jobs and talent needs in the IT sector. The model incorporates both non-seasonal and seasonal components to capture underlying trends and cyclical behavior within the data. The seasonal period of 4 represents quarterly data, picking up any cyclical patterns in employment or talent requirements that overlapped with fiscal quarters or other periodic factors. The drift term of the model assumes that the data have a long-run tendency, and this tendency is a slow rise or fall with the progression of time. It is especially important in the tech industry, as worldwide pandemics like COVID-19 have massively disturbed and changed employment patterns. The model forecasts give valuable insights regarding future trends so that stakeholders can forecast changes in the employment levels, talent supply, and other key numbers. The world crisis, e.g., the COVID-19 pandemic, has heavily impacted the IT industry. At first, demand for IT services increased due to the remote work and digitalization shift. However, budget constraints and financial uncertainties have also led to hiring freezes and layoffs in some industries. In addition, the evolution of Artificial Intelligence (AI) has helped in two capacities in terms of IT employment. Firstly, AI has opened new jobs in fields like machine learning, data science, and AI programming. On the contrary, AI automation has led to job replacement of some work, particularly jobs with repetitive tasks. This cyclical interaction between AI innovation and economic dynamics continues to shape the IT employment market.

By using this ARIMA model, policymakers can forecast the potential long-term effects of global crises on the IT job market. For instance, when the forecast reveals a decrease in employment, organizations can invest more in AI-based transformations and automation to counter the effect of falling demand for labor. Conversely, a favorable trend in the demand for talent can initiate intense recruitment and training efforts to offset talent deficits and foster an equilibrium workforce. In conclusion, the ARIMA (1,0,0) (0,1,1) [4] with drift model provides a rational and methodical approach to analyze and predict the complex phenomena of the IT sector's response to global crises. With its ability to record trend and seasonality elements, is an important tool for forecasting and planning in the context of ongoing disruption and increasing role of AI-driven adjustments in shaping the future of work.

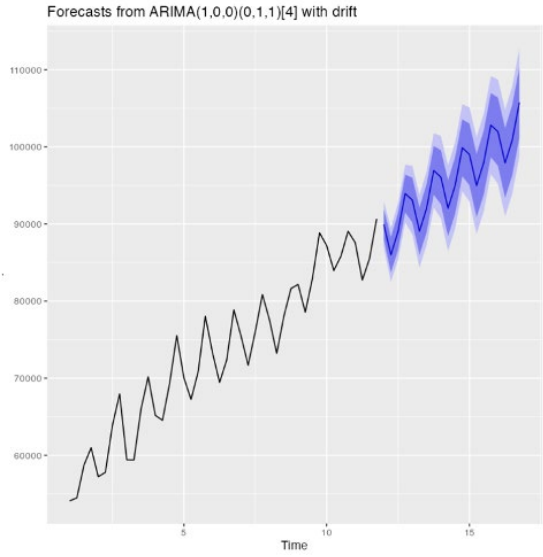

Figure 5: Automatic ARIMA forecasts
Source: own processing

5 Discussion

Our findings indicate that the COVID-19 pandemic caused a short-term decline in IT employment in Slovakia. However, the sector quickly resumed, with high resilience being observed. Mura et al. (2022) note that the pandemic led to a sharp

increase in unemployment in most sectors of the Slovak economy, particularly the industrial sector. On the other hand, Kiner & Štefaník (2022) point out that the intrinsic flexibility of the IT industry and its reliance on digital infrastructure allowed it to recover quickly. IT professionals and technicians were relatively well insulated from the pandemic's economic dislocations.

A key finding of our study is that the shift to remote work and accelerated digitalization helped mitigate job losses and even created new employment opportunities in IT. Balsmeier & Woerter (2019) argue that digitalization has increased employment for high-skilled workers, as new tasks generated by digital technologies often complement their expertise. However, it has simultaneously reduced employment for low-skilled workers, resulting in a slightly positive net effect on overall employment. Furthermore, Braesemann et al. (2021) note that the rise of remote work has contributed to global job market polarization. Employment is increasingly concentrated in large cities and regions with strong digital infrastructure, while rural areas lag.

Our ARIMA projections suggest moderate employment growth in the IT sector, although economic uncertainties could impact these estimates. Tsuboi (2020) and Gumata & Ndou (2017) admit that in the IT sector, uncertainties can slow down economic growth and affect employment dynamics. Persistent uncertainty can lead to a reallocation of employment between sectors, often resulting in a decline in private-sector employment.

Additionally, AI is redefining talent needs, with greater need for data science, cybersecurity, and AI deployment skills. Businesses are calling for more workers who can use AI strategically, pointing to the need for continuous upskilling and reskilling. Jadhav & Banubakode (2024) believe that with emerging AI technologies, the need for specialists in AI development and data analysis will continue to grow. These roles are essential for maintaining and creating AI-driven business operations and innovation. Upadhya (2024) and Olutimehin et al. (2024) also highlight that successful AI implementation requires people who can transcend challenges in data governance, ethical challenges, as well as successful AI strategies. As such, investment in AI education, digital skillset training, and talent mobility will be essential in the long run to maintain the industry's growth and competitiveness.

6 Conclusions

This research has examined the impact of the COVID-19 pandemic on demand for talent and trends in employment in Slovakia's information technology sector. Through time-series analysis and ARIMA model techniques, the study has presented the overview of the variations in employment, geographical disparities, and shifting demands for IT professionals.

The results show that although IT employment slightly decease in the short term during the peak of the 2020 due to pandemic, it recovered quickly, demonstrating the resilience of the sector. Remote working and accelerated digitisation minimised job losses and created new ones. Regional imbalances persist, with Bratislava and Košice performing well as IT centres, but delayed regions such as Nitra and Trnava stagnate or deteriorate after 2021, and special talent development strategies outside the metropolises are called for.

Job vacancy analysis shows that IT professionals are in high demand, but there is a shortage of skilled talent, which is one of the factors driving the labour shortage. The development of artificial intelligence is changing the demand for the skills of IT specialists. Among the most important are skills in data science, cybersecurity and cloud computing. Continuous re-skilling of the existing workforce is needed to properly address the changing demands of the industry.

The ARIMA projections point to modest long-term employment growth in the IT sector. However, these forecasts would be affected by uncertainty in the domestic and global economy. Businesses and policies are required to be adaptable to keep pace with new trends. Investments in AI training, digital literacy as well as increased mobility of indigenous talent would be key to ensuring sustainable growth and competitiveness of the sector.

In conclusion, this study highlights the fundamental role of changes driven by the crisis in shaping IT work and talent needs. Further research is needed to examine in more detail the longer-term impact of AI on job displacement and creation, as well as how to improve the readiness of the workforce for digital transformation. By

reducing skills gaps and territorial inequalities, stakeholders can promote a more sustainable and inclusive IT labour market in Slovakia.

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