

A data-driven analysis of digital competencies on Ukrainian labour market

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Abstract

This article presents a data-driven investigation into the integration and demand for digital competencies within the Ukrainian labour market. Using large-scale vacancy data, we analyze current trends in the use of digital skills across various sectors. The study identifies gaps in the analytical interpretation of digital competencies and assesses the completeness of digital skill disclosure in a rapidly transforming economy. Recommendations are proposed to support the development of a digitally competent workforce in the context of digital transformation.

Keywords¹

digital competence, labour market, project management, intelligent data analysis, digcomp, digital transformation, job trends, data-driven insights, digital literacy.

1. Introduction

Digital competencies are increasingly recognized as foundational for economic development, innovation, and competitiveness at both national and organizational levels. In the context of project management, digital capabilities underpin decision-making, stakeholder engagement, and operational efficiency [1].

Therefore, it is essential for contemporary businesses to equip their staff with digital capabilities. Recognizing digital competence as one of the 8 key skills necessary for a complete life and successful activity in the current world, the European Union (EU) has made this a priority. This competence is understood as the ability of a person to interact and communicate in a digital society, solve problems in a digital environment, and use information technologies logically and systematically [2, 22].

The purpose of the article is to study the impact of digital competencies on project management in Ukraine by analyzing labor market data. The employment trends are a reflection of stakeholders' demands for digital knowledge and practical skills in a data-driven world. The ability of the country's economy to be competitive in the modern technological environment, to achieve sustainable development and the well-being of society directly depends on the population's capacity to work effectively in the era of digital transformation, using its opportunities and advantages [3, 4, 25].

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2. Digital competencies

Foreign and domestic scholars have repeatedly paid attention to the definition of digital competence and the list of necessary digital skills, in particular in the context of education and employment.

However, the most comprehensive document outlining the components of this concept is the European Digital Competence Framework for Citizens or DigComp. DigComp was first published in 2013 and then updated several times. It is a reference common framework used at the European level. It helps in the development of government strategies and other initiatives that help improve the population's mastery of digital technologies, tools and services.

Specifically, in 2022, the EU unveiled its revised Digital Competence framework (DigComp 2.2) [5, 20], which includes 21 skills organized into 5 categories.



Figure 1: The DigComp conceptual reference model (Source: Vuorikari et al., 2022: 4)

The goal of this study is to assess the current level of digital competence implementation in Ukraine. Key digital skills in the EU will be compared to the current state of affairs in Ukraine, and recommendations for improvement will be made.

Digital competencies are essential in effectively managing stakeholders in a data-driven environment. Stakeholder management involves understanding, engaging, and satisfying the needs and expectations of individuals or groups affected by a project or organization. In a data-driven context, digital competencies play a crucial role in leveraging data to inform decisions and interactions with stakeholders [6, 7, 24]. Let us take into account the digital skills necessary for effective project management:

1. **Digital literacy and the ability to work with data:** Managers need to be well-versed in and comfortable using a wide range of digital technologies, including AI, data analytics, cloud solutions, etc. The benefits and drawbacks of these technologies for project planning will become clearer with this knowledge. The quantity and quality of data at a company's disposal is rapidly expanding as a result of digital transformation. Managers who can effectively assess this data will be better equipped to make informed project decisions.

2. **Communication and interaction:** Digital communication channels such as email, social media, and online forums play a significant role in stakeholder engagement. The ability to communicate and interact effectively in the digital realm depends on managers being well-versed in digital marketing strategies and tools like as social media, content marketing, email, search engine optimization (SEO), and others. Managers can better attract online audiences and streamline business processes if they have a firm grasp of the fundamentals of e-commerce and e-business management.

3. **Digital content creation:** Making content for digital platforms usually involves some degree of adaptation and originality. The ability to present data in a clear, concise, and visually appealing manner is essential for effective communication with stakeholders. Competency in data visualization tools and techniques helps convey complex information in a way that is easily understandable and actionable. It is crucial in today's digital environment to be aware of copyright and licensing regulations for data, information, and digital content.

4. **Security:** Understanding data privacy regulations and best practices for data security is essential for maintaining trust and compliance when handling stakeholder data. In order to keep the business and its customers safe, managers need to be aware of the threats they face.

5. **Problem Solving:** Digital transformation often introduces changes in workflows, processes, and technologies that can impact stakeholders. The ability to solve problems effectively calls for an organization-wide willingness to adapt to new circumstances, strong leadership, and cooperation from upper management. Competencies in change management enable stakeholders to effectively navigate and adapt to these changes, minimizing resistance and maximizing adoption.

Since they aid in change management, innovation, and competitive advantage, digital capabilities are quickly becoming an integral part of effective project management.

The EU has a rather low degree of digital competence application. Figure 2 shows that just 54% of Europeans have an adequate degree of computer literacy, as reported by the European Commission. This means that more than 40 percent of Europeans have trouble using digital tools.

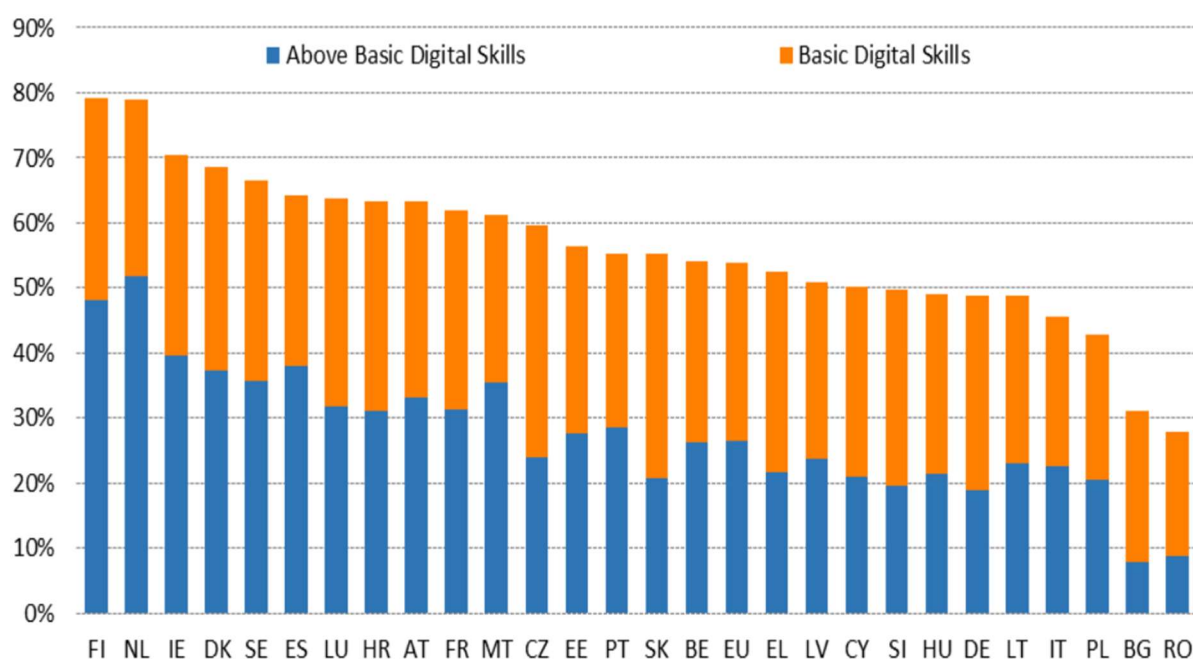


Figure 2: Basic and above basic digital skills (% of all individuals), 2021 (Source: DESI 2022, European Commission)

The European Commission's "Digital Economy and Society Index" report for 2022 includes information on the prevalence of computer illiteracy across the EU. This research analyzes the state of the digital economy and society in EU member states [8]. Data from national statistics services, the European statistics Agency, and the European Commission were used to compile the assessment. Human capital development (digital skills), communication (fixed broadband and mobile communication), technology integration (in business activities), and digital public services are the four pillars that make up this framework [16, 21, 23].

On the other hand, digitally savvy professionals, especially those working in the IT industry, are in high demand. When it comes to creating software and providing other types of IT services, Ukraine is widely regarded as a global leader. The construction of these development centers by European and American corporations in Ukraine is helping to spur the growth of the country's IT sector and meet the rising need for professionals with expertise in this area [9, 18, 19].

3. An intellectual analysis of labor market in Ukraine

We performed a semantic analysis of job postings on the State Employment Center's website (<https://www.dcz.gov.ua/>) [10] to better understand the role that digital competence plays in various industries.

We used the Requests, Pandas, Geopandas, PyMorphy2, NLTK, Seaborn, Plotly.Express, SKlearn, Matplotlib, and other Python libraries for our modeling in the cost-free Google Colab cloud environment [11], which allows users to use the interactive computing platform Jupyter Notebook without the need to download and install any third-party software.

Jupyter Notebook is a web-based notebook that supports the execution of Python programs. All commands are executed on a kernel within this web app. Includes both a plain text and a code portion. Due to the order of launching pieces with code, it is possible to determine which model will work at a given time, and the fact that each block of code can be performed independently of the others allows for the creation of many different models in a single notebook. Because the kernel process can be linked to multiple interfaces at once, this sequence of events is possible.

Like Google Docs or Sheets, you can collaborate on a notebook in Colab. To share a file from your Colab notebook, either click the Share icon in the top right corner or use these Google Drive sharing instructions [12].

Information such as job ID, location, description, posting date, wage range, and employer are recorded. There will be a total of 912,532 openings in 509 different occupations between 2020-01-04 and 2023-03-31.

Digitization is the transformation of formerly analog activities, structures, or information into a digital format. This indicates that computer technology is being used to digitize and process data and operations that were previously stored or carried out in an analog format.

If the duties of a certain position involve extensive use of digital resources and methods, we might call it a "digital" position.

After all the information was gathered, we made sure that the columns were easy to read. The job description will contain the bulk of the information needed to complete the project. All the standard preprocessing operations necessary for NLP are carried out first [13]. This includes using regular expressions to remove unnecessary characters, removing common and irrelevant stop words, marking each individual description. Parsing the text into words, as well as reducing them to their initial form, was performed using the Pymorph2 library [14].

Among those words that need to be analyzed, let's look at the most frequent words used in job descriptions (Figure 3).

For the sake of generalizability, we'll also take into account information regarding openings posted on the work.ua portal [15]. Let's examine the most often used words in job descriptions (Figure 4) to get a sense of the scope of the problem.

The image makes clear that the following terms predominate in this data set: accountability, motivation, and output. Which suggests that "soft" talents are becoming increasingly valued in the workplace.

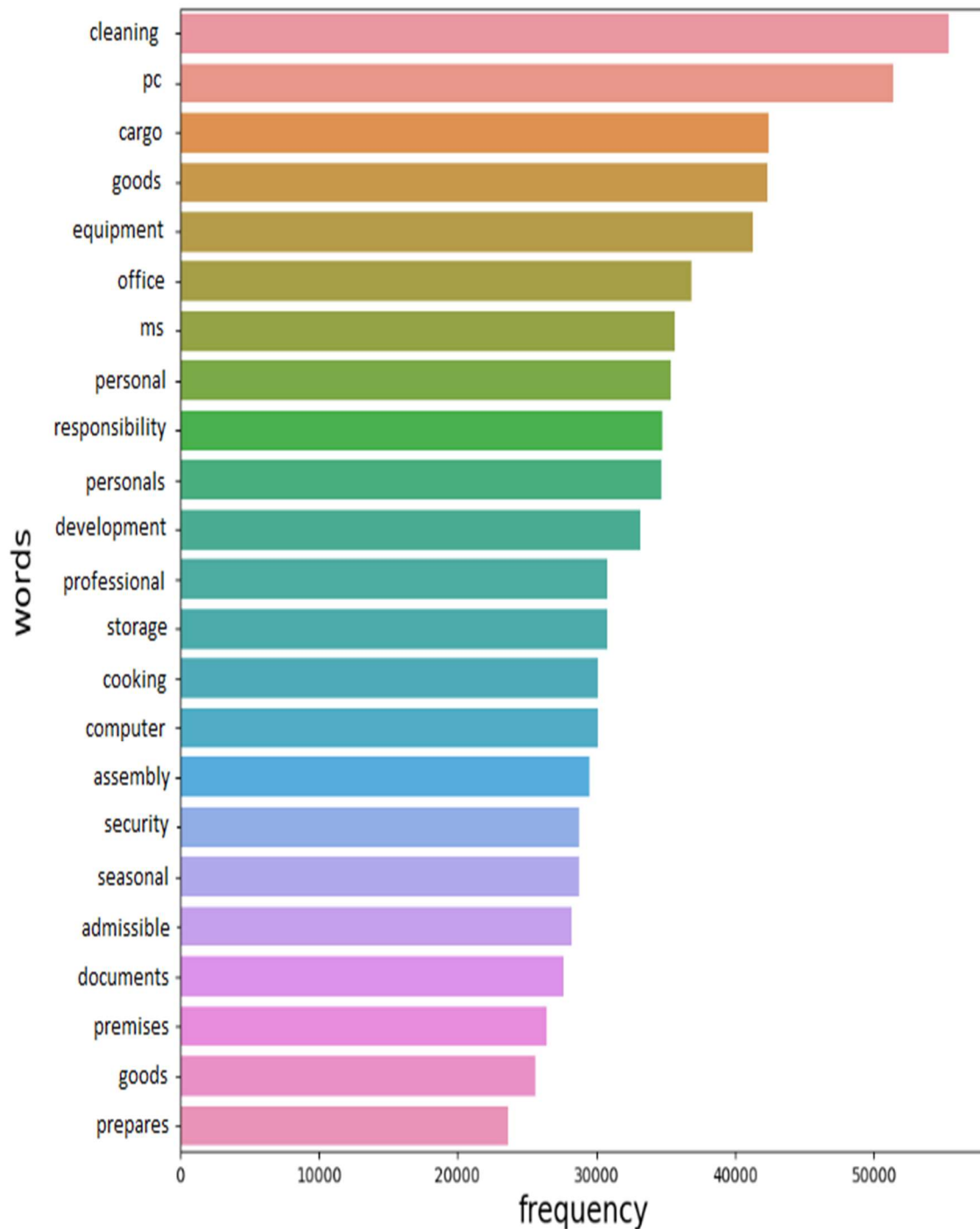


Figure 3: Visualization of the most frequent words

In this case, we employed part-of-speech tags to identify and emphasize words. Since the final list was somewhat noisy and needed to be compared to a master list of all abilities needed for all position categories, we added the results of our extraction of a set of five skill attributes from each role description to the existing list to determine which were the most frequently mentioned.

The rule mapping algorithm could not have been comprehended without the reference space. The following is a code for an extractor of matching abilities (Figure 5). Input a list of words into the code, and it will pull out only the ones that correspond to the rule.

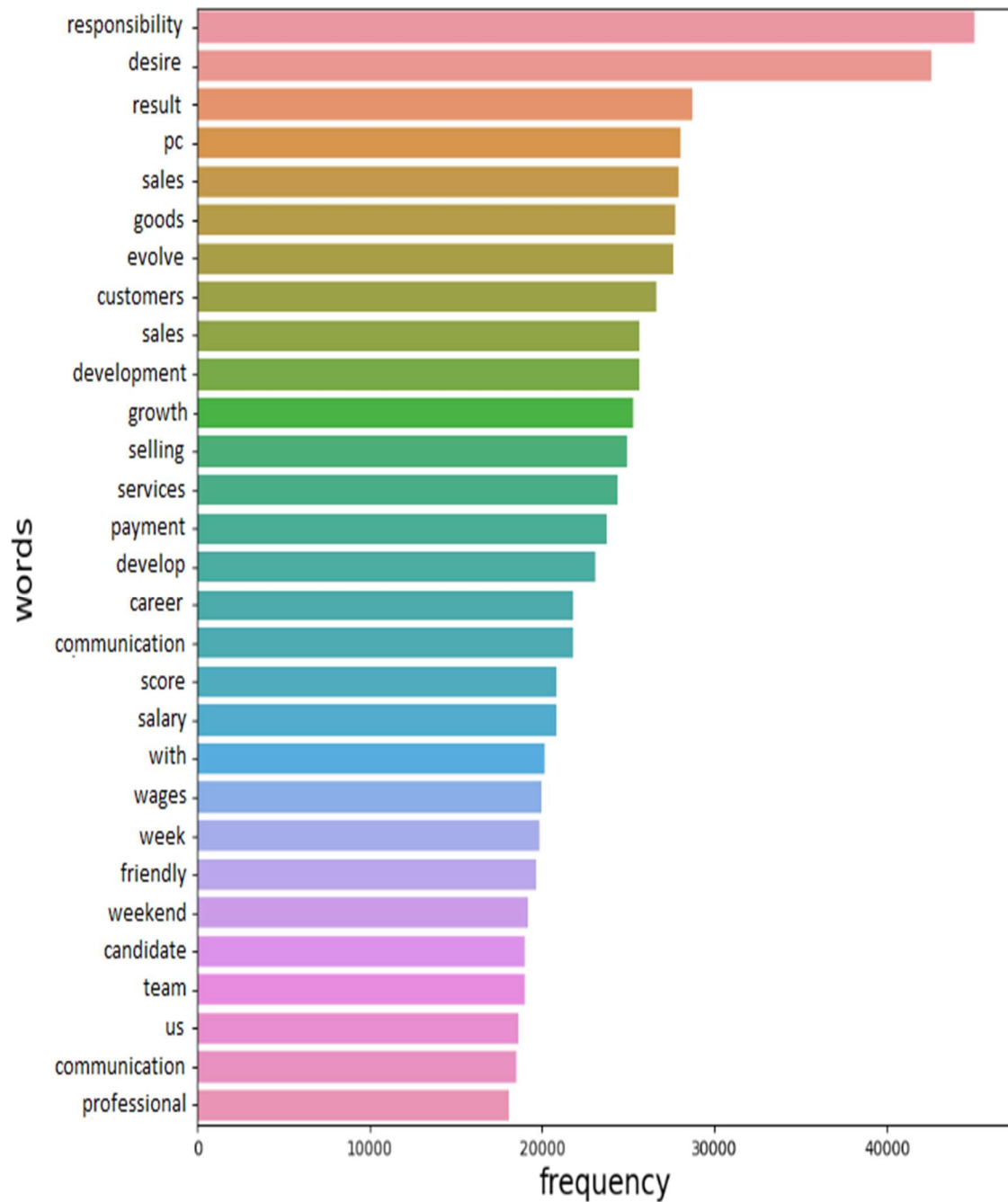


Figure 4: Visualization of the most frequent words

```
df = df[df['tokenized_desc_join'].notna()]

options = ['pc', 'office', 'scanner', 'printer', 'programming', 'development', 'software', 'problems',
           'program', 'reporting']

df["is_digit"] = df['tokenized_desc_join'].apply(lambda x: 1 if any(i in x for i in options) else 0)
```

Figure 5: The code for extracting compliance-related skills

Computer, Office, Scanner, Printer, Programming, Development, Software, Issues, Program, and Reporting ('пк', 'office', 'сканер', 'принтер', 'програмування', 'розробка', 'програмне', 'проблем', 'програма', 'звітність') are the most often used tags.

As a second method, we looked into using neural networks, namely the word2vec model [16] to generate the necessary skill vectors. To train the model, we took the tokens that were retrieved from the job description and performed a similarity measure on them. The following code snippet (Figure 6) displays the digital skills domain's most related words. Finding talents for each role fails if the description doesn't include the role, as the word2vec similarity is predicated on the description we've trained. The word2vec model failed in its role-search attempts because vocabulary is corpus-dependent.

```
import gensim.utils
import gensim.downloader as api
from gensim.models.word2vec import Word2Vec
from gensim.utils import simple_preprocess
from gensim.models import CoherenceModel

model = Word2Vec(df['normal_tokenized_desc'],
                 window=10,
                 min_count=10,
                 workers=5, vector_size = 500)
model.train(df['normal_tokenized_desc'], total_examples=model.total_examples, epochs=model.epochs)
model.build_vocab(df['normal_tokenized_desc'], progress_per=100, update=True)

# digital specific skills
model.wv.most_similar(['office', 'word', 'excel', 'scanner', 'printer', 'programming', 'development',
                      'software', 'communication', 'cooperation'], topn=25)

[('sql', 0.6188371777534485),
 ('excel', 0.6100712418556213),
 ('server', 0.5948401689529419),
 ('windows', 0.5821477174758911),
 ('adobe', 0.581726610660553),
 ('photoshop', 0.5815576314926147),
 ('html', 0.5787284970283508),
 ('css', 0.5703566074371338),
 ('corel', 0.5607632994651794),
 ('программ', 0.5599780082702637),
 ('draw', 0.555258572101593),
 ('erp', 0.5471287369728088),
 ('point', 0.5455071926116943),
 ('linux', 0.5435844659805298),
 ('web', 0.5325785875320435),
 ('illustrator', 0.5323614478111267),
 ('mysql', 0.5307382345199585),
 ('programic', 0.5307325720787048),
 ('autocad', 0.5301836729049683),
 ('excel', 0.5275077223777771),
 ('medoc', 0.5256964564323425),
 ('адміністрування', 0.5248759984970093),
 ('клієнт-банк', 0.519995391368866),
 ('internet', 0.5174419283866882),
 ('google', 0.5171661972999573)]
```

Figure 6: Words highlighting digital competence's most synonymous terms

Our research led us to conclude that various digital occupations require specialized knowledge and abilities. Microsoft Office, Microsoft Word, Microsoft Excel, a printer and scanner, development and programming, communication and teamwork were the most frequently necessary skills for this position.

Sadly, the development of Ukraine's national economy since independence has been hampered by a lack of innovative technologies and the economy of knowledge, resulting in the construction of inefficient industries and low productivity at the workplace. Flexible work schedules and the proliferation of non-standard forms of employment in the formal economy are hindered by regulatory and institutional limits in the social and labor domain.

Drivers, seamstresses, boiler plant operators and machinists, fitters, electricians, electric gas welders, turners, tractor drivers, track installers, gas station operators, complex building maintenance workers, painters, masons, and carpenters are in particularly high demand among employers, per data compiled by the State Employment Service.

Salespeople, cooks, bakers, security guards, waiters, aides, junior nurses, bartenders, hairstylists, social workers, public transport conductors, firefighters, rescuers, and others all play significant roles in the Ukrainian labor market. Experienced accountants, educators, teachers, physicians, engineers, pharmacists, and pharmacists are also in high demand. Workers in the utilities sector, as well as cleaners, porters, janitors, heaters, packers, storekeepers, cooks, and security guards, are in high demand. For a visual representation, a visualization of the distribution of vacancies by professional groups and types (Digital/Non-Digital) of the State Employment Service is built in fig. 7.

Figure 7 shows a depiction of the State Employment Service's vacancy distribution by professional group and type (Digital/Non-Digital).

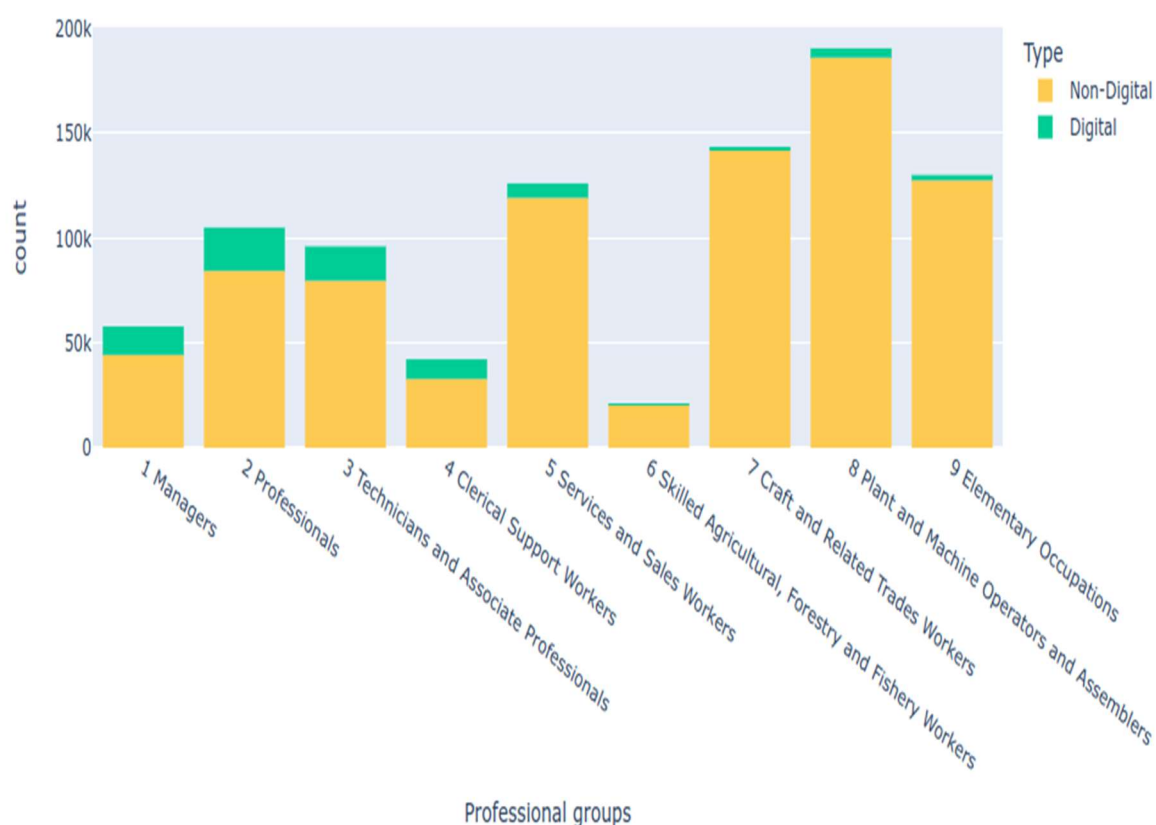


Figure 7: Visualization of the distribution by professional groups and types

Visualizing the breakdown of job openings by industry and function (Digital/Non-Digital) could be useful, too.

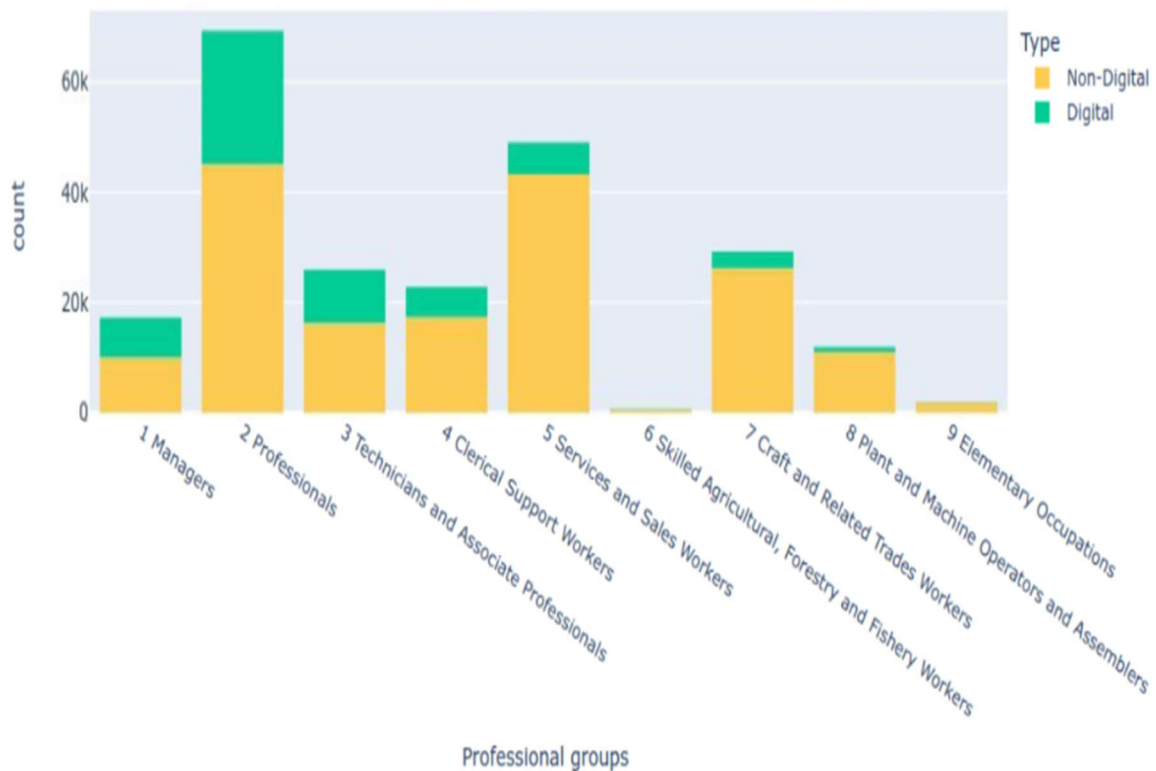


Figure 8: A representation of the distribution by occupational classifications

4. Conclusions

Based on the results of this study, we found that a total of 837,019 openings in the State Employment Center database were classed as non-digital and 75,513 were classified as digital, for a total digitalization rate of 9%. However, to ensure that the data was representative, we also looked at data on job openings from the work.ua portal for the years 2022-01-01 to 2023-05-12, which totals 228,124 positions.

A total of 171,651 were not digitized, while 56,473 were, yielding a digitization rate of 33%. In conclusion, the average degree of digitalization in the Ukrainian labor market is likely to be around 21%. This points to the limited growth of digitalization, which is linked to the state of the economy and the scarcity of available resources.

The graphic comparison reveals a common pattern among occupations: The bulk of digital employment are held by managers, professionals, specialists, technicians, and people in the trades and services. This demonstrates that further digitalization of these groups is possible with the availability of resources through digital job creation: researching and implementing techniques to create new digital jobs, such as sponsoring innovative start-ups and small technology businesses.

Declaration on Generative AI

The authors have not employed any Generative AI tools.

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