chaise

blockchain skills for Europe

D3.1.1:

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22	Crypto4all	C4A	FR
23	Economic and Social Research Institute	ESRI	IE

Abbreviations

AI	Artificial Intelligence
CEDEFOP	(Translated) European Centre for the Development of Vocational Training
EU	European Union
EU-LFS	European Union Labour Force Survey
ICT	Information and Communications Technology
ILO	International Labour Organization
ISCO	International Standard Classification of Occupations

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1 Introduction

The aim of this blockchain skills forecasting model is to set up a collaborative method for the anticipation of future skill demand and supply, acting as an early warning information mechanism to mitigate possible labour market imbalances, and supporting E&T and labour market actors in making evidence-based decisions. The model builds on CEDEFOP forecasting methodologies to develop a quantitative model for the anticipation of future skill demand and supply in the blockchain sector. This model is based on a time series analysis of relevant parameters and micro and macro environment developments.

2 The Forecasting Model

2.1 Data

The data to forecast blockchain skills demand and supply comes from a number of sources. To forecast blockchain skills demand, information from online jobs advertisements, European Union Labour force Survey (EU-LFS), and CEDEFOP occupational forecasts are employed. To forecast blockchain skills supply, Eurostat and national European government department/agencies are contacted to provide graduate data for each EU member state. The demand and supply of blockchain skills is forecasted for EU member states where data is available for the next five years. The methods of data analysis used in this study are based on the previous academic literature on forecasting employment and occupational outcomes. Due to the unique nature of analysing blockchain labour market outcomes this report utilises previous literature from blockchain related fields such as information communication technology, economics, and finance. The data gathering process and methods of forecasting blockchain skills demand and supply are discussed in detail below.

2.2 Forecasting Blockchain Skills Demand

A number of recent studies attempt to identify new and emerging occupations that are yet to be recognised in the current occupational classification framework. A notable example is ILO (2020), in which AI algorithms are used to incorporate language that characterises occupations based on word-embeddings in job vacancies to understand the developments of emerging technologies and their placement in the current occupational framework. CEDEFOP (2018) have also utilised a similar approach in order to map important real-time labour market information about the current job market to specific occupational categories. Mezzanzanica and Mercorio (2019) state that specific word terms that link occupations to online job vacancies also link to the skills that are important in those occupations. In this way, it is possible to accurately map the current online jobs market information to occupational classification frameworks and identify the necessary skills.

We build on the approaches set out by ILO (2020), Mezzanzanica and Mercorio (2019), and CEDEFOP (2018) to map current blockchain related jobs advertised to the ISCO occupational classifications. However, when forecasting the demand for skills it is important to incorporate macroeconomic developments and employment projections in the changing dynamic of skills demand in various occupations (McGuinness et al., 2012). CEDEFOP employment and occupational forecasts capture skills needs, economic factors and developments in the future (Biagi et al.,2020). Therefore, we also incorporate CEDEFOP employment and occupational forecasts to account for different macroeconomic and labour market developments when forecasting blockchain skills demand.

The methodology for forecasting blockchain skill demand is summarized in Figure 1 below.
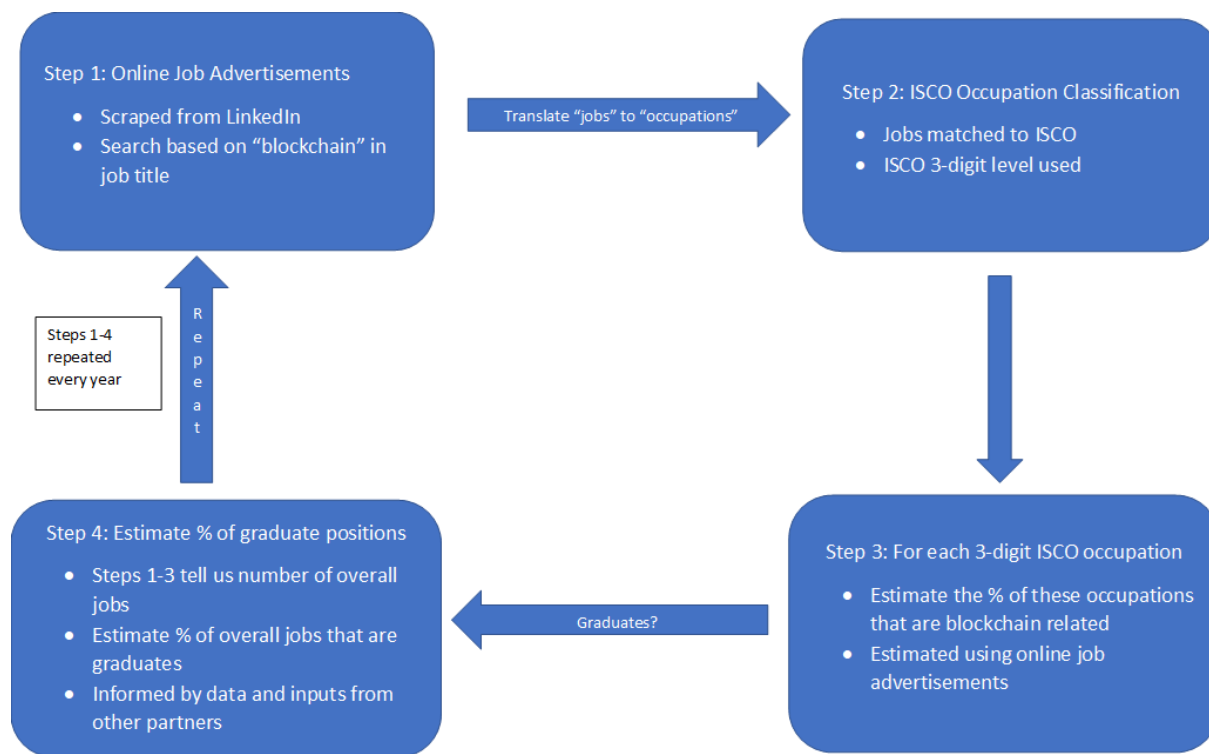

Figure 1: Job Forecasting Methodology

The challenge in forecasting demand for blockchain skills is that there are currently no blockchain specific job categories in the existing occupation taxonomies used in current survey data. Therefore, in order to forecast blockchain skills demand we utilised an approach set out in CEDEFOP (2018) to map blockchain related job advertisements to international standard classification of occupations. The mapping of blockchain related job advertisements to ISCO categories provided a sample of blockchain skills demand for forecasting analysis. In Step 1, the data on blockchain jobs is collected by employing a purpose made automated online job scraping software to extract online jobs information from a popular job advertisement website. The approach is similar to CEDEFOP (2018) who also used a web scraping technology to extract online jobs information.

After consulting a variety popular job advertisement sites around Europe, LinkedIn was identified as the most reliable source for blockchain related jobs data, as it consistently produced high numbers of

blockchain jobs across all European countries[1]. LinkedIn is also the world's largest and most developed professional network. Unlike other job advertisement sites considered, it also provided us with the seniority level for each job to derive valuable information on entry level or graduate jobs. We also believe that blockchain employment is largely in professional occupations and that LinkedIn is suited very well for professional jobs advertisements. Furthermore, our consideration of job advertisement sites and the source of data have been reviewed by the CHAISE consortium and over 40 external blockchain sector experts (during six virtual expert consultations held by the ESRI) in November 2021, who agreed that LinkedIn is the most appropriate data gathering source for blockchain jobs. From a survey of over 120 sectoral experts in March 2022 approximately 80% agree that LinkedIn is the most appropriate source of blockchain related jobs data.

The search criteria for LinkedIn is based on the keyword "blockchain" appearing in the job title and/or the detailed job advertisement. LinkedIn online jobs advertisements are collected for each of the EU-27 countries, for example in November 2021 there were approximately 7,000 job advertisements across the countries. These jobs are classified as blockchain-related jobs. Then, in Step 2, blockchain related jobs are translated into occupations (ISCO) based on the job title, job description, and keywords. Important ISCO categories and keywords used to link blockchain jobs to specific ISCO occupations were verified by CHAISE partners.[2] Further, each CHAISE partner is required to review the mapping of blockchain jobs to ISCO categories for their home country for robustness. The following 3-digit ISCO categories emerge as the key occupations in blockchain:

- Software and Applications Developers and Analysts (ISCO 251)

- Database and Network Professionals (ISCO 252)

- Information and Communications Technology Services Managers (ISCO 133)

- Business Services and Administration Managers (ISCO 121)

- Legal Professionals (ISCO 261)

Based on the November 2021 data, approximately 88% of all blockchain related jobs can be mapped to one of the ISCO categories identified above. The remaining 12% of blockchain related jobs are

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[1] While it is recognised that LinkedIn job advertisements may not be representative of the entire European labour market, the consortium, and expert partners, assume that it provides an adequate representation of current blockchain jobs at a country level within the EU, or at least the most adequate information that exists.

[2] Keywords and mapping criteria available on request. Consultations were held with the following CHAISE partners: INTRASOFT, C4A, IOTA, FUJITSU.

represented by the 'other' category since their overall representation by a specific ISCO was relatively insignificant. However, all blockchain jobs, including 'other', are used in the forecasting analysis.

We utilise CEDEFOP occupational forecasts for each European member state to identify, in absolute terms, by how much employment in each blockchain related ISCO category is likely to change over the next five years. Since CEDEFOP occupational forecasts incorporate important information on future employment, education, and labour force trends, as well as European and global economic developments, they are a valuable source of data to forecast blockchain labour market trends in Europe. Similarly, Biagi et al. (2020) have previously utilised CEDEFOP employment forecasts in their labour market analysis.

CEDEFOP occupational forecasts are available at 2-digit ISCO level. However, this study examines demand for blockchain skills at a 3-digit ISCO level. In order to apply CEDEFOP forecasts to our data the EU Labour Force Survey data is used for each country to derive 3-digit ISCO proportions from the 2-digit ISCO categories and apply them to the CEDEFOP forecasts. The results highlight the proportion of CEDEFOP occupational forecasts in each of the blockchain related occupations at a 3-digit ISCO level.

Furthermore, we must also consider that not every job within an ISCO 3-digit classification relates to blockchain. In Step 3, to identify the proportion of each of ISCO categories that are blockchain jobs it is necessary to estimate the percentage of each of 'software and applications developers and analysts', 'database and network professionals', 'information and communications technology services managers', 'business services and administration managers', and 'legal professionals' occupations advertised online that are blockchain jobs. Thus, for each of the key 3-digit occupations identified, we estimated the share of blockchain-related jobs as a proportion of total jobs for each occupation using LinkedIn.

To forecast blockchain skills demand across Europe over the next five years, the percentage of blockchain jobs in each ISCO category is applied to the CEDEFOP forecasts at a 3-digit ISCO level to estimate the number of new blockchain jobs for each country over the forecasting period. Although most blockchain jobs fall into one of the five ISCO categories identified previously some jobs cannot be allocated to these five specific ISCO categories. These jobs are classified as 'other'. We incorporated

these 'other' jobs in the final forecasting model to obtain a more accurate estimation by inflating our forecasts by the appropriate percentage for each country. In Step 4, from the scraping of online jobs advertisements, we are also able to identify the proportion of all blockchain jobs that are advertised at an entry level or graduate level. Entry level positions are estimated as all jobs that state 'entry level' in the job advert posting on LinkedIn and 75% of those positions who either did not specify the education level, i.e. 'not applicable' or where the information was missing. This enables us to also estimate the proportion of total forecasted blockchain jobs that may be at the graduate level. The final blockchain skills demand forecasts are presented for each European country for which relevant data is available and at specific occupational categories.

2.3 Forecasting Blockchain Skills Supply

Blockchain skills supply is estimated by identifying the number of graduates from blockchain specific higher education courses. However, accurate and reliable information on the number of graduates from blockchain specific courses is not readily available across Europe. Therefore, this model utilises graduate data from blockchain related fields of study to forecast blockchain skills supply over the next five years for EU-27 member states. CHAISE partner input and information from Eurostat is used to produce estimates for new labour market entrants from blockchain related degree programmes. From expert consultations and CHAISE partner feedback, the Information and Communication Technology (ICT) field contained the most blockchain relevant degree programmes. Therefore, we forecast ICT graduates over the next five years for each member state using linear trends based on data sourced from the previous five years.

Blockchain-specific graduate information may be supplied by the CHAISE partnership for their home countries. This allows an estimation of the share of blockchain specific graduates as a share of total ICT graduates for those countries in a given year. The average of these estimates of blockchain-specific graduates is to be used to estimate the number of blockchain specific graduates for all other countries for which blockchain graduate data was unavailable. These supply-side forecasts provide a framework that allows individual member states to estimate blockchain specific supply based on their understanding of their country's education system.

2.4 Data Limitations

Although this model utilises a unique method of forecasting blockchain skills supply and demand it may encounter data issues that need to be acknowledged. First, mapping of blockchain jobs to ISCO categories involves a mixture of automated and manual mapping processes based on keywords that may misallocate some jobs to different ISCO categories. Second, missing CEDEFOP forecasts and EU-LFS occupational data for some countries means that such forecasts rely on additional assumptions and estimates. Third, unavailable information on the number of blockchain specific graduates for most EU countries means that blockchain supply forecasts for countries that are missing this information are based on average EU estimates of blockchain specific graduates rather than country specific data. Fourth, unlike demand side forecasts, supply forecasts do not incorporate macroeconomic and demographic changes in their projections. Although data issues are important to acknowledge this model is the first to measure and forecast blockchain skills demand and supply in Europe. The resulting forecasts will facilitate the EU, and individual member states, to review and assess the extent to which labour market imbalances are likely to occur in the short-term that could inhibit the development of the blockchain sector. In particular, the results of the study will inform the development of a more strategic approach to the delivery of a blockchain skills strategy that will help future proof the sector against forms of skills mismatch.

3 Conclusion

The report outlines a novel dynamic methodological framework for forecasting the demand for blockchain skills across EU countries and matching this against educational supply. The forecasting model is designed to provide key inputs into any national, or EU level, skills strategies designed to ensure that the growth of blockchain employment is not restricted as a consequence of skill mismatches. It is a fully dynamic model, which means that it can be updated to incorporate changes in occupation categories, data gathering techniques, and graduate information to capture forecasting estimates over time. The model builds on previous forecasting methodologies to provide a unique method to blockchain skills demand and supply forecasting. As part of the CHAISE project, the forecasting model is going to be applied annually from 2022 to 2024 to produce reports of annual blockchain skills forecasts.

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