Skill diversification in the Arab region:
a pathway for economic prosperity

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a pathway for economic prosperity

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Executive summary

The rapid integration of technologies such as artificial intelligence (AI) is reshaping employment and the labour market, underlining the need to embrace skill diversification to adapt. The Arab region is at a critical turning point that requires a shift towards economic diversification. At the core of this transformation is the need for a diversified skill set that sets the foundation for economic resilience, competitiveness and inclusive growth.

Despite oil prices driving most of the Arab region's previous growth rates, the Economic and Social Commission for Western Asia (ESCWA) estimated a decline in the region's growth rate to 4.5 per cent in 2023 and a further drop to 3.4 per cent in 2024 compared to an economic growth of 5.2 per cent in 2022.[1] The economic landscape in the region is quite varied, ranging from the Gulf Cooperation Council (GCC) countries, which heavily depend on oil revenues, to countries such as Somalia and Yemen, which rely on their agricultural sectors. Nevertheless, both types of countries suffer from limited economic diversification and industry stagnation. The Arab region also grapples with political instability that ripples through economies and acts as a significant hindrance to firm performance. Despite the region's abundant natural resources, technology use in the Arab region is characterized by a digital paradox, with a slow growth of the region's digital economy and digital infrastructure investment.[2] Informal employment is prevalent in the Arab region's labour market, and is compounded by the mismatch between the skills offered by the workforce and those sought by employers. As the Arab region forges its path ahead, it encounters a dynamic landscape in which skill diversification acts as a linchpin to achieving resilience, competitiveness and inclusive growth. Addressing the challenges detailed in the report is essential to unlock the region's potential and reshape its economic narrative.

The report uses results from the ESCWA Skills Monitor to analyse whether the type of skills and jobs demanded in the region address the needs of the fourth industrial revolution and the new era in which AI continues to make a significant impact. The monitor is a tool that uses AI and machine learning to curate real-time information from more than 120 regional online job posting platforms, and encompasses big data from almost 2.8 million online job openings in the Arab region in the period between June 2020 and March 2023. It can also be used to track the progress of jobs in the Arab region in meeting the Sustainable Development Goals (SDGs).

Skill Demand Diversity Scores (SDDSs) are then introduced using data gathered from the monitor. The scores present a set of metrics created to assess the diversity of skills demanded in the virtual job markets of Arab countries. The SDDSs do not focus on the quantity but rather on the variety of distinct skills in the job market. They are a collection of several key components: (1) the skill variety component highlights the range and diversity of skills in demand within the online job market; (2) the skill mobility component assesses the adaptability and versatility of skills, reflecting their applicability across various domains; (3) the future-oriented skills component measures the demand for skills with a forward-looking aspect, ensuring economies remain prepared for emerging trends and technologies; and finally, (4) the balance of skill distribution component evaluates the equilibrium in the distribution of skills across the examined economies. By presenting these elements, the SDDSs provide a holistic view of skill demand diversity in each country's online job market.

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Abbreviations and acronyms

ACTVET	Abu Dhabi Centre for Technical and Vocational Education and Training
CSS	Cascading Style Sheet
ESCO	European Skills, Competences, Qualifications and Occupations
ESCWA	Economic and Social Commission for Western Asia
GCC	Gulf Cooperation Council
GDP	gross domestic product
GPT	generative pre-trained transformer
ICT	information and communications technology
ILO	International Labour Organization
ISCED	International Standard Classification of Education
ISCO	International Standard Classification of Occupations
LASSO	Least Absolute Shrinkage and Selection Operator
LOESS	locally estimated scatterplot smoothing
NIS	national innovation system
RIS	regional innovation system
SDDS	Skill Demand Diversity Score
SDG	Sustainable Development Goal
SQL	structured query language
STI	science, technology and innovation
TVET	technical and vocational education and training
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund

Introduction

As societies evolve, the demands of the labour market grow, necessitating a workforce equipped with a wide array of skills to drive economic growth and social progress. In this evolving scenario, a homogenous skill set, however proficient, can no longer meet the multifaceted needs of modern economies. With jobs becoming more interdisciplinary and digitization continuing to reshape industries, a diverse profile encompassing different trajectories of skills is necessary to stimulate innovation, enhance productivity and foster a more inclusive and sustainable economy. A critical aspect of the fourth industrial revolution is the continuous change in the demand for skills in the labour market, which reflects whether an economy is embracing technological advancements and using the set of skills to deal with changes and follow up with global economic trends.

In the Arab region, leveraging skill diversification presents an unprecedented opportunity to capitalize on its vast human potential. Historically rich in culture and intellect, the region possesses the latent capacity to cultivate a multifaceted workforce that can contribute to both local and global economies. Harnessing a wide spectrum of skills is crucial in addressing current socioeconomic challenges, from youth unemployment to diversification away from oil-dependent economies. By championing a comprehensive skill development strategy, Arab countries can empower their young people, tap into new sectors such as technology, renewable energy and entrepreneurship, and redefine their economic narratives.

In chapter 1, the report addresses issues hindering economic diversification in the Arab region, which is known to be traditionally dominated by industries such as oil and gas, or to be suffering from industry stagnation, indicating an urgent need for skill diversification to enhance economic resilience and competitiveness. Although skill diversification can equip the region with the necessary means to better handle economic downturns and market changes, the region still faces challenges such as slow economic growth, over-reliance on specific sectors and inadequate infrastructure in some areas, limiting access to learning and training opportunities.

In chapter 2, the most recent results of the Skills Monitor developed by the Economic and Social Commission for Western Asia (ESCWA) are discussed, and the current demand for skills in the region is highlighted. The ESCWA Skills Monitor, which is a tool developed by ESCWA to track the demand for skills in the Arab region, is utilized, with real-time information collected from more than 120 regional online job posting platforms through the use of artificial intelligence (AI) and machine learning. These data are subsequently employed to identify the skills that are most in demand, as well as the skills that are becoming obsolete. Designed to assist policymakers, businesses and individuals in making informed decisions about education, training and employment, the ESCWA Skills Monitor can also be utilized to monitor the progress of the Arab region in meeting the Sustainable Development Goals (SDGs), particularly SDG 8, which aims to achieve full and productive employment and decent work for all.

In chapter 3, the Skill Demand Diversity Scores (SDDSs) are introduced as a set of quantitative scores that comprise a collection of metrics specifically designed to assess the diversity of skill

demand within various countries, and primarily within the online job market. This collection encompasses four core components: skill variety (V), skill mobility (M), future-oriented skills (F), and the entropy (balance) of skill distribution in each economy (E). The focus of the present report is primarily directed towards eleven countries in the Arab region that exhibit significant labour market demand within the online market.

Rather than concentrating on the sheer quantity of skills observed in the market, the SDDS measures predominantly emphasize the variety of distinct skills that are observed. According to data from the ESCWA Skills Monitor, while the online market in the Arab region accumulated over six million skill observations between 2020 and 2023, only 18,000 of those skills were distinct. Chapter 3 also discusses the ESCWA Skills Forest and the newly demanded skills related to large language models (LLMs), such as Chat-GPT, in the region.

The report then concludes by summarizing the key findings and emphasizing the critical role of skill diversification in the Arab region's pursuit of economic prosperity. The conclusion reiterates the importance of equipping individuals with a broad range of skills and competencies to thrive in an increasingly interconnected and dynamic global economy.

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1. Challenges impacting skill diversification in the Arab region

Key messages

There is a significant **mismatch** between the **skills imparted** by **educational institutions** and those demanded by the **labour market** in the Arab region.

The most evident mismatch between education and demand in the labour market is at the **higher education** level and the **technical** and **vocational education** and **training**.

The **main factors** contributing to the shortcomings in the education system include the **prevalence** of **outdated curricula**, a **focus** on **theoretical knowledge** over practical skills, and a **lack** of **alignment** with the evolving needs of the job market.

1. Challenges impacting skill diversification in the Arab region

Traditional industries, such as energy-intensive manufacturing, low productive services, oil and agriculture, have long dominated in the Arab region, where the need for sectoral diversification is of paramount importance. The push towards a more versatile skill set for economic diversification is not just a matter of staying competitive but also a matter of survival. However, embarking on such a transformative journey is not without its obstacles. According to the International Labour Organization (ILO), skills consist of the ability to conduct tasks and responsibilities associated with a particular job or occupation, as defined in the context of the International Standard Classification of Occupations 88 (ISCO-88).[3] The determinants of a "skill", as per the ILO, are (a) the skill level, which refers to the diversity of responsibilities and tasks undertaken in a certain job; and (b) the skill specialization, which is defined by the specific field of knowledge required, the tools, machinery and materials used, and the resulting products and services.[4] Skill diversification, at its core, means broadening the skill base of a workforce.

Skill diversification enhances economic resilience in multiple ways. Firstly, a skill-diversified economy helps individuals adapt to changing economic and job market conditions by providing an economy-wide broader skill base, enabling individuals to move to different proximity career paths as opportunities shift. Secondly, at the individual level, in the face of setbacks such as job loss, diversified skills empower individuals to bounce back by leveraging their versatile expertise to secure new employment or embark on entrepreneurial ventures. Diversified skills also contribute to greater personal resilience, enabling individuals to manage stress effectively by drawing upon a wide array of resources, helping them to withstand and overcome adversity. Lastly, diversified skills fortify the economy against shocks by ensuring a broader range of expertise across various sectors and industries, rendering it less vulnerable to market fluctuations.

Skill diversification also plays a crucial role in reducing inequality, fostering inclusiveness and enhancing resilience in several interconnected ways.[5] It offers individuals the opportunity to find jobs that align with their skills and interests, irrespective of their gender or their social, racial, ethnic, or socioeconomic origins. This inclusiveness promotes a more equitable and diverse workforce by

Infrastructure, especially in the digital economy, is often found lacking, particularly in rural territories

dismantling the barriers that impede disadvantaged or marginalized groups. The diversity, which encompasses various backgrounds and skill sets, fosters innovation and creativity by bringing together a multitude of perspectives and ideas.[6]

As the Arab region shifts from traditional sectors such as agriculture or oil to embrace sectoral diversification, the structural transformation of economies is necessary to achieve economic growth. Human capital, defined as the set of knowledge, skills and expertise possessed by individuals, is an essential factor that influences the structural transformation of an economy. Emphasizing the role of human capital by investing in skill development is crucial to ease the movement of labour between sectors and enhance the labour's employability in the emerging sectors.[7]

The work of Buera and Kaboski[8] suggests that all growth in the United States' service sector post-World War II occurred in high-skill services, which means that human capital facilitated the shift of resources from goods-producing sectors to the service sector in the United States. It is equally plausible that human capital plays a crucial role in the movement of workers from one sector to another. This perspective is further emphasized by Caselli and Coleman,[9] who underscored the significance of human capital during the structural transformation from agricultural to non-agricultural sectors.

As the dynamics of economic development continue to transform, the question of whether this development is driven by economic diversification or specialization is extensively explored in the literature. Early theories of international trade, such as David Ricardo's theory of comparative advantage and Heckscher-Ohlin's theory of relative abundance of the factors of production, state that nations should specialize in the production of goods in which they have a comparative advantage.

Imbs and Warcziag[10] suggest that, as countries develop, their specialization pattern follows a U-shape. Low-income countries tend to be highly specialized, and then they diversify and respecialize in a few key sectors. On the contrary, Hausmann and others[11] claim that high-income countries tend to maintain a diversified export basket.

Bahar[12] investigates two key relationships: (1) openness to trade and income per capita, and (2) export concentration and income per capita. Findings reveal that, on average, countries with higher openness to trade tend to have a higher income per capita, implying that specialization might lead to development. However, results also show that less export concentration is linked to higher income per capita, meaning countries that diversify tend to be richer. The discrepancy in the data is justified by focusing on two aspects: "outliers and natural resource-rich countries" and the "disaggregation level of export data". The first focuses on the presence of outliers in the relationship between export concentration and the level of income. Natural resource-rich countries are characterized with a high export-basket concentration (due to their reliance on a limited range of commodities such as oil or minerals) and a high level of income, which can skew the data. When these countries are excluded from the analysis, the respecialization pattern is less noticeable. The second aspect discusses how the level of data disaggregation may affect the observed results. Rich countries that specialize in specific sectors may still maintain a high level of diversification within these sectors. Thus, when digging into richer countries' broad industry categories, the respecialization pattern appears more evident, whereas disaggregating the data to a sectoral level reveals that these countries have a significant degree of diversification within those sectors. In the electronics sector, for example, a country's production portfolio may not be limited

to a sole product within that sector but may include a diverse range of items, from microchips to industrial machinery and more. This suggests that diversification is indeed a pivotal pathway to fostering economic development. Conversely, the Arab region grapples with challenges that thwart the quest for skill diversification. The recent years' sluggish economic growth in many countries has posed significant barriers to pivotal investments in education and training. Furthermore, the region's deep-rooted dependence on sectoral unilaterality, makes it susceptible to industry-specific shocks, and causes it to struggle to magnetize investments and catalyse job creation. Additionally, infrastructure, especially in the digital economy, is often found lacking, particularly in rural territories, rendering education and training opportunities scarce and further widening the digital divide.

A. Slow economic growth, economic dependency and high political instability

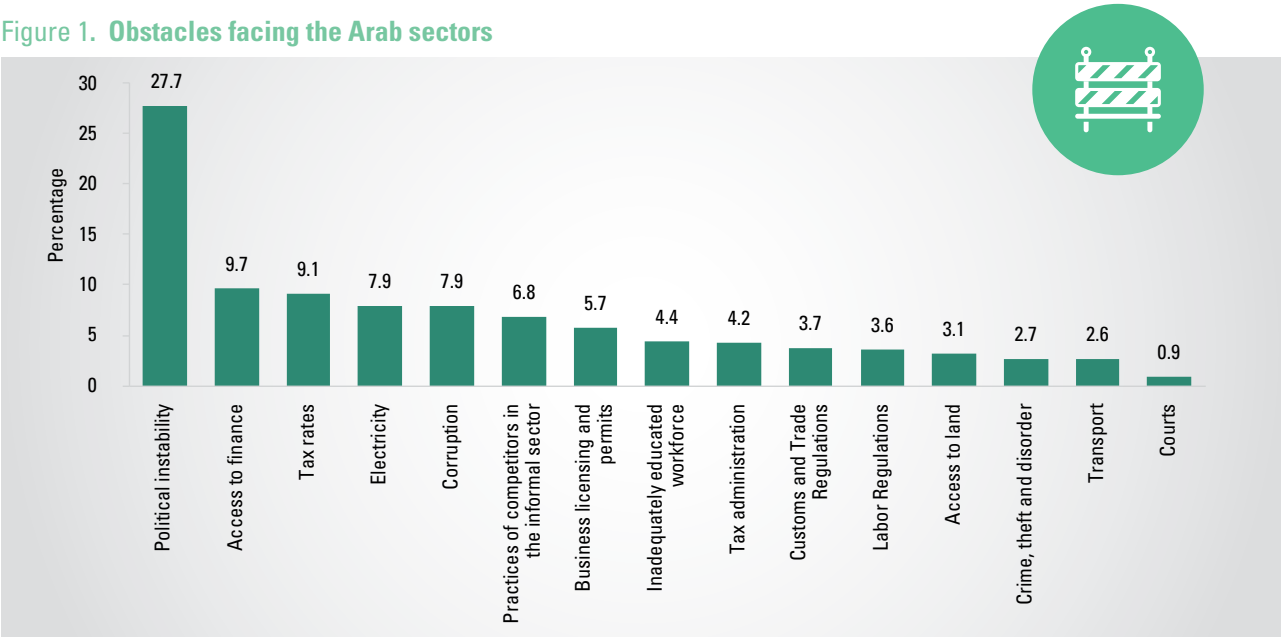
The economy of the Arab region has grown by an average of 2 per cent during the past ten years, with oil prices driving most of this growth.[13] ESCWA predicted a decline in the region's growth rate to 4.5 per cent in 2023 and a further drop to 3.4 per cent in 2024 compared to an economic growth of 5.2 per cent in 2022. Although economic growth does not necessarily mean more jobs and less unemployment, it sets the ceiling within which employment and labour productivity growth can occur. On average, there is a positive link between the real gross domestic product (GDP) and employment growth during growth periods, but the relationship varies widely. A global analysis of per capita growth episodes reveals that changes in the working-age population, labour force participation, and employment rate explain only about 20 per cent of GDP per capita growth, while the remaining 80 per cent is attributed to labour productivity growth.[14]

Delving into the Arab countries, both economically-affluent and disadvantaged countries in the Arab region suffer from limited economic diversification and industry stagnation. For instance, some of the wealthiest countries in the region, such as countries in the Gulf Cooperation Council (GCC), heavily rely on the oil sector for economic growth. Meanwhile, the agricultural sector in Yemen contributed to around 80 per cent of its national income in 2023.[15] Somalia also proves to be an illustrative case, where agriculture constituted approximately 75 per cent of the country's GDP in 2018.[16]

The limited range of products and industries in the Arab region has also been restricting the variety of skills demanded in the market. Increased sectoral diversification in an economy can have a significant impact on the demand for a wider variety of skills. When an economy diversifies, it means that it is not heavily reliant on a single industry or sector for its economic well-being. This diversification often leads to the creation of new businesses and industries, as well as the expansion of existing ones.

As a result, the demand for various skills and expertise grows. For example, a country that is traditionally dependent on agriculture predominantly demands skills related to farming, such as agricultural practices and crop management, but as the economy diversifies, new sectors emerge. If the country starts developing a technology sector, including software development and

Figure 1. **Obstacles facing the Arab sectors**



Source: World Bank Enterprise Survey 2020.

information technology (IT) services, for example, it will require a workforce with skills in programming, software engineering and IT.

An expanded service industry requires individuals with customer service, marketing and hospitality skills. This diversification also impacts education and training, as institutions will need to adapt their programmes to meet the evolving demands of the job market. As a result, a wider variety of skills becomes crucial for individuals seeking employment, and emphasizes the importance of lifelong learning and adaptability in today's dynamic job market.

Aligning supplied skills with labour market demand through skill diversification is also essential for supporting economic diversification, which, in turn, is a key element of economic development that provides a stable path for equitable growth.[17] Evidence on the vocational skill training programme in rural Bhutanese households[18] highlights a significant correlation: effective skill development training programmes amplify growth. The evidence was based on a project that addressed changes driven by two main themes: (1) diversifying income sources for rural households beyond agriculture and (2) reducing housing repair costs through training to acquire new skills in areas such as carpentry, plumbing and more. The findings reinforce the idea that a diversified skill set acts as a stimulant for development, as indicated by the programme's effect on the region's increased income growth.

It is also evident that other socioeconomic impediments in a country affect skill diversification. Figure 1 depicts the biggest obstacles impairing firm performance as reported by the World Bank Enterprise Survey for eight countries in the Arab region. According to the figure, political instability is at the top of the list. In the period between 2011 and 2023, many Arab countries grappled with heightened political unrest and violent conflicts that directly and indirectly affected most countries in the region. Evidence showed that political instability could impair sectoral and overall growth by fostering uncertainty, increasing risks and reinforcing risk-aversion. The reduced investor and consumer confidence subsequently limits investment and consumption spending.[19]

B. Infrastructure challenges

Infrastructure investment holds significant potential to support both immediate and medium-term economic growth and the demand for skills. According to a joint report by the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Children's Fund (UNICEF), and the World Bank in 2021, strengthening the infrastructure of education systems in the Arab region, including in terms of technology, is vital to ensuring sustainable and effective learning for all, especially at early development.[20] Research conducted in the Arab region demonstrates that a billion-dollar infrastructure investment can create 138,000 jobs in the short term and generate an additional 442,000 induced jobs in the long term.[21] Additionally, investing specifically in rural infrastructure is crucial for bolstering the overall income of rural populations. The presence of insufficient rural infrastructure, as well as low levels of education, science and technology, have been shown to contribute to lower productivity in rural areas.[22]

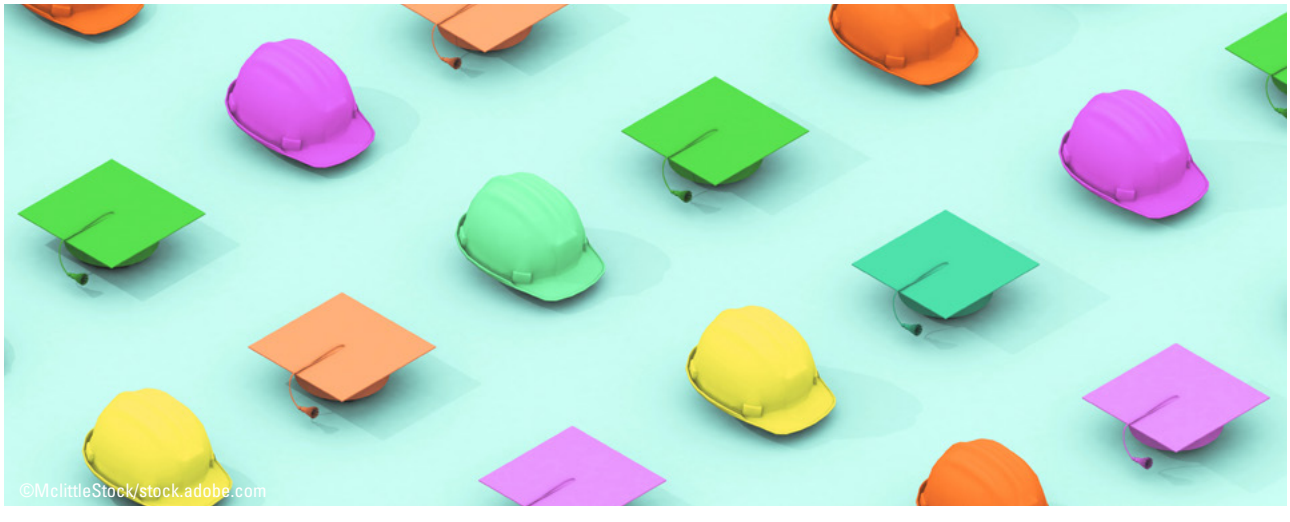
Investments in technology infrastructure within the Arab region vary significantly among countries,[23] with some performing exceptionally well and others lagging behind. The Gulf subregion, which encompasses Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates, has emerged as a leader in the region by dedicating substantial resources to digital infrastructure, 5G and the cloud. In North Africa, local countries are actively striving to leverage their demographics and limited financial resources to advance their digital landscape. In contrast, the Levant subregion, including Iraq, Lebanon and the Syrian Arab Republic, faces the most pronounced technology gap and lags behind both the Gulf and North Africa.

The business landscape of the Arab region is also affected by inadequate technology infrastructure. Startups, which can be key drivers of economic growth and job creation, frequently face hurdles in scaling because of the absence of an enabling digital ecosystem. This starts with electricity outages, unreliable Internet connectivity, limited access to cloud services, and lack of tech-talent. Based on the World Enterprise survey in 2020, almost 36 per cent of businesses in the manufacturing private sector face electricity outages on a regular basis in the Arab region.

C. Labour market inefficiencies and education mismatch

Informal employment is prevalent throughout the Arab region, accounting for 68 per cent of total employment, with even higher rates in Yemen (78 per cent) and Morocco (81 per cent).[24] Most formal workers are concentrated in the public sector, while formal private employment represents only a small fraction of total employment in the region. The formal private sector in many Arab economies faces significant challenges that hinder additional job creation.

The state of employment in the Arab region, while distressing on its own, is closely interwoven with skill mismatch. At its core, skill mismatch portrays a considerable divide between the skill sets offered by the workforce and the competencies sought after by employers. This disconnect can be attributed to two primary factors: first, an inadequate demand for specific skills within the market; and second, the inefficacies in the learning-to-earning transition which often falls short of providing the requisite skill training. Both factors demand a deeper exploration, which will be delved into in the sections that follow. Consequently, the persistent prevalence of skill mismatches can inhibit innovation and economic diversification, thereby limiting the resilience and adaptability of the economy in the face of changing global trends and market dynamics. To illustrate the skill mismatch scenario in the Arab region, we use Iraq as an example in the box. The analysis can be expanded to other countries if more data become available.

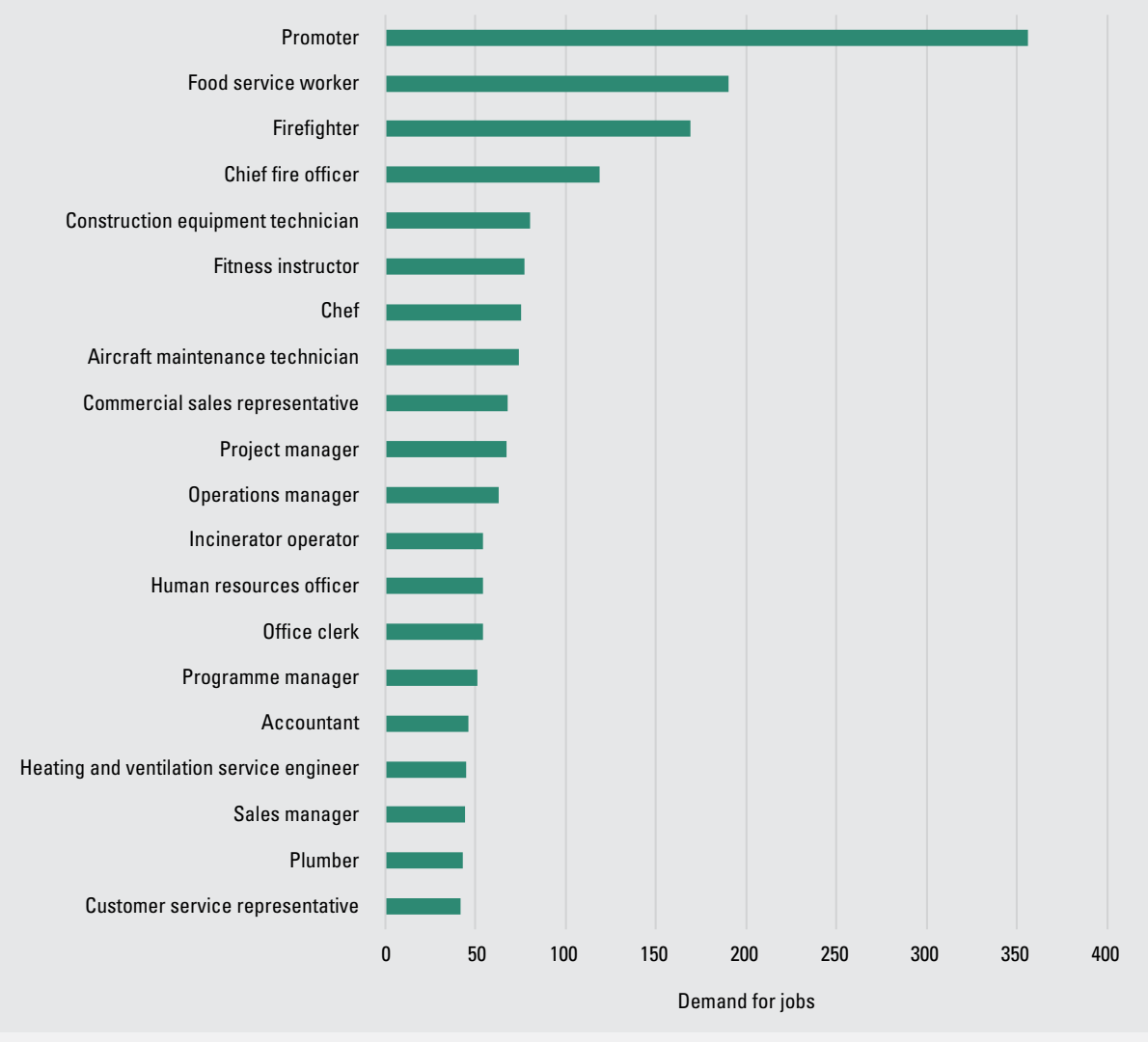


Informal employment is prevalent throughout the Arab region, accounting for **68%** of total employment

Box. **Labour market inefficiency:** evidence from Iraq

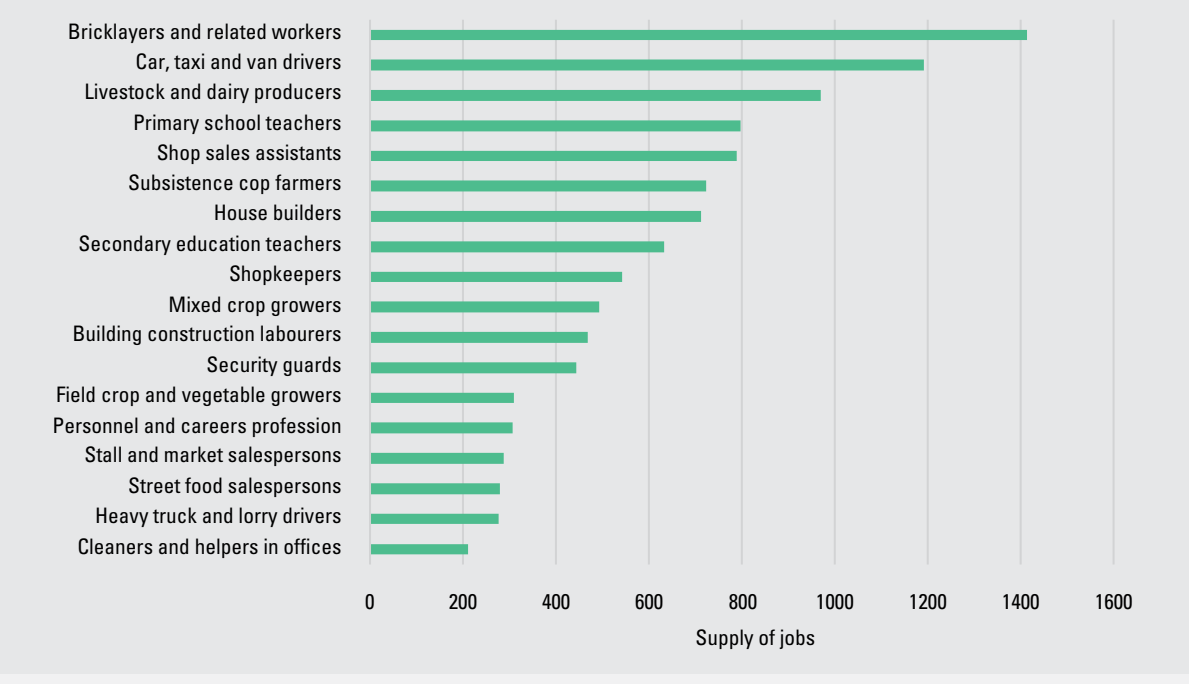
The labour market in Iraq exhibits a significant disparity between the demand and supply[a] of both occupations and skill levels. Analysis from the ESCWA Skills Monitor and the World Bank Labour Force Survey for Iraq in 2021 indicates that the most sought-after occupations in Iraq are primarily concentrated in the ISCO 3-digit categories as shown in box figure 1. Box figure 2 provides a visual representation of the current job landscape, revealing that most positions still fall within traditional sectors and are considered traditional jobs. These occupations represent traditional roles that are not automated or aligned with the jobs associated with the fourth industrial revolution.

Box figure 1. **Top demanded occupations in Iraq**



Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor, 2021.

Box figure 2. **Top supplied occupations in Iraq**



Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor and the Labour Force Survey, 2021.

Box figure 3. **Top demanded and supplied skills in Iraq**

Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor and the Labor Force Survey, 2021.

At the skill level, soft skills are highly sought after in both the top demanded and supplied jobs in Iraq, indicating their importance in the labour market. Among these soft skills, communication skills are consistently ranked as the top skill on both the demand and supply sides. This emphasizes the significance of effective communication abilities in various job roles within the country.

However, there exists a significant unalignment between the demanded and supplied skills in Iraq, as illustrated in box figure 3. A considerable proportion of skills are not adequately available on either side, highlighting a skill gap that needs to be addressed. This can hinder the overall productivity and competitiveness of the workforce in Iraq. Even within the skills that are present on both the demand and supply sides, there are noticeable differences in the percentages, further underscoring the need to focus on bridging the gap between the two. This suggests that, although some skills are being supplied, there might not be enough workers possessing those skills to meet the demand. This calls for targeted efforts to align the skills of job seekers with the requirements of employers, promoting a more balanced and effective labour market.

[a] The demand side was estimated using the ESCWA Skills Monitor. The numbers reflect the demand for each occupation from the total jobs in the virtual job market in 2021. The supply side was estimated using the Labour Force Survey for Iraq in 2021. The numbers reflect the supply of each occupation from the total occupations specified in the survey. The occupations of the unemployed were derived from the Labor Force Survey (LFS), while the skills associated with each occupation were obtained from the ESCWA Skills Monitor (ESM). It is assumed that the most-demanded skills for each occupation, as outlined in the skill profile, are considered fundamental prerequisites for the job. It is further assumed that the unemployed within a specific occupation possess experience and, consequently, possess the requisite skills. At the aggregate level, a comparative analysis was conducted by juxtaposing the most prevalent skills among the unemployed with the country's most demanded skills.

To critically analyse the congruence between the skills fostered in academic setups and those necessitated by employers, a detailed comparison between university-supplied and market-demanded skills was undertaken. The analysis concentrated on a selection of programmes from two eminent universities in the Arab region, distinguished for their focus on subjects intimately related to the fourth industrial revolution, which marks a significant juncture in technological progression.

1. Computer and communication engineering

The computer and communication engineering (CCE) programme at the selected university in Lebanon presents an impressive array of courses recognized on an international scale for their relevance to the field. However, upon closer examination of the alignment between the skills cultivated through these courses and the proficiencies sought in the Lebanese virtual job market, a noticeable disparity is observed. The findings reveal that a sizeable portion of the top 20 in-demand skills for professions associated with this domain within the Lebanese virtual job market do not directly correspond with the skills acquired through the programme.

The objective of this analysis is to highlight the differences based on collected data, and not to evaluate educational programmes at large, as some of the skills are either substitutes or complements to each other.

The skills that did exhibit compatibility include Python, Object Oriented Programming (OOP), and the C# programming language. It is, however, observed that the foremost proficiencies sought after in the job market encompass JavaScript, structured query language (SQL), HTML, and debugging. To illustrate this further, a specific example was taken to assess the skills match between the programme and two specific roles in this field: machine learning engineer and big data engineer. The analysis unveiled that a considerable proportion of the sought-after skills – such as TensorFlow, PyTorch, DevOps, Apache

Hadoop, and Java – remain conspicuously absent from the curriculum, while Python, C#, algorithms, and deep learning matched between the programme and the market.

It is worth noting that a number of well-established Arab students are migrating to the United Arab Emirates. Hence, it becomes pertinent to juxtapose the skills instilled by the educational programmes against the skills stipulated by the virtual job market in the United Arab Emirates. The data elucidated that while skills like Python, C#, algorithms, machine learning, deep learning, artificial neural networks, and data structures displayed alignment, other pivotal skills, including Java, Microsoft Azure, Unit Testing, and Unix Shell, failed to find representation within the educational curriculum.

2. Degree in AI and data science

A professional diploma in AI and data science consists of seven courses only, but the skills acquired are relevant to the jobs demanded in the job market.

The findings indicate that out of all the skills demanded in the Lebanese virtual job market in relevant fields, the only skill that matches with the curriculum is Python. Other demanded skills, such as SQL, JavaScript, Cascading Style Sheets (CSS) and debugging, do not match. Machine learning and big data engineer jobs are taken as examples within the Lebanese job market. The results show that the skills that match between the educational curriculum and the job market are machine learning, Python, and deep learning. Other demanded skills in the job market, such as Apache Hadoop, Java, Microsoft Azure, and TensorFlow, are not provided in the curriculum. Broadening the perspective to the virtual job market in the United Arab Emirates shows that the skills expected for the same positions, such as those of Python, machine learning, data science, and deep learning, are included in the curriculum. Nevertheless, there is a disparity in the inclusion of other crucial skills, such as Algorithms, TensorFlow, C#, Apache Hadoop, and Java, within the educational offerings.

3. Data analytics

While it is important to mention that obtaining a minor in data analytics requires the completion of eighteen credits (six courses) only, the programme is still expected to equip students with sufficient and necessary skills for the labour market.

The results infer that the skills demanded in the Lebanese virtual job market and the skills that are provided by the programme do not match. In other words, the programme does not contain any of the skills demanded in the Lebanese virtual job market in the relevant fields, such as knowledge in SQL, JavaScript, CSS, debugging, HTML, and others. Contrary to the Lebanese market, the skills of data analysis and information systems, which are included in the educational programme, are both within the

top 20 most demanded skills in the virtual job market in the United Arab Emirates.

Data analysis is the only skill that is offered in the programme and is required of a machine learning expert in Lebanon. Predictive modelling is the only skill that the programme offers and is required of a machine learning expert in the United Arab Emirates. Moreover, statistical hypothesis testing is the only skill offered by the course programme that is demanded from a big data engineer in Lebanon and the United Arab Emirates.

4. AI and data science certification

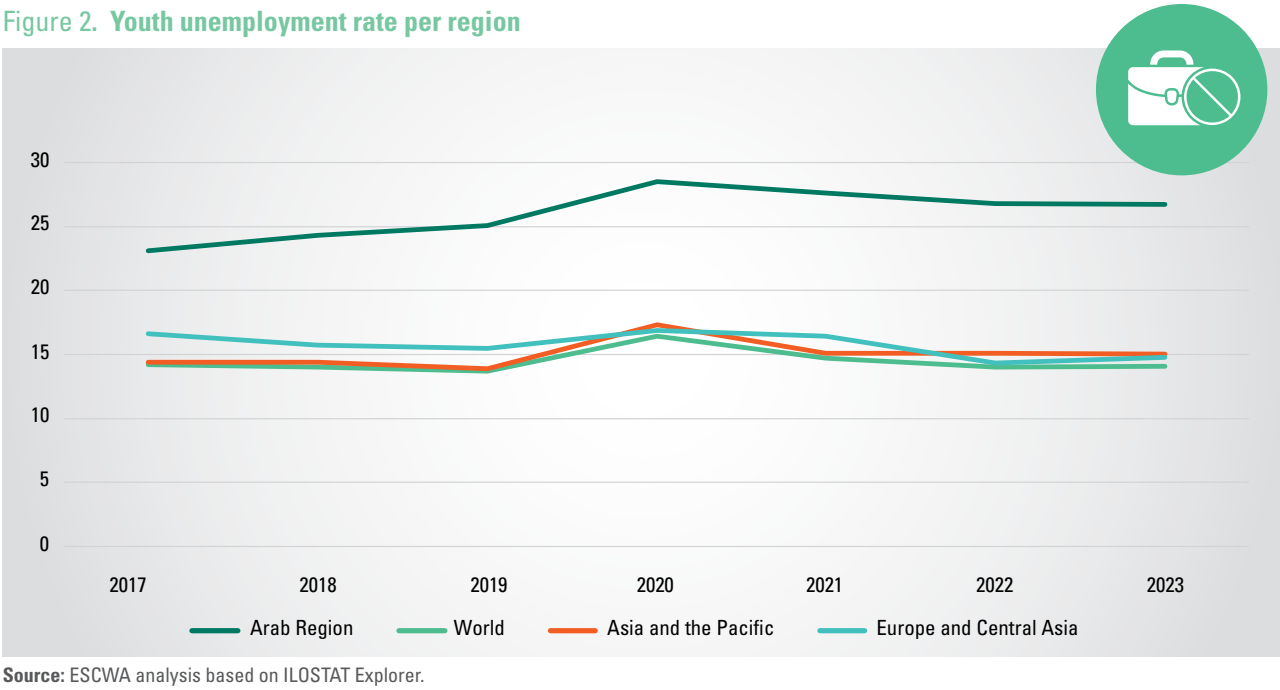
The certificate in AI and data science is eight weeks long with only nine credits, but it is still expected to equip students with the fundamental skills in AI and data science.

The results infer that there are no intersections or overlaps in the skills that are demanded in the virtual job markets in both Lebanon and the United Arab Emirates, such as SQL, JavaScript, CSS, and debugging, and the skills that are provided in the programme.

The programme equips students with several skills (machine learning, algorithms and AI) that are demanded from a machine learning expert in Lebanon. In the United Arab Emirates, the programme encompasses machine learning, AI, algorithms, and deep learning skills that are also required of a machine learning expert. Algorithms is the only skill that is covered within the programme and is required from a machine learning expert in Lebanon and the United Arab Emirates.

The process of skill alignment involved extracting course descriptions from the official academic catalogues of the respective universities via web scraping. These descriptions provided insights into the acquired skills within the identified programmes. Subsequently, the university programmes were cross-referenced with the appropriate International Standard Classification of

Figure 2. **Youth unemployment rate per region**



Source: ESCWA analysis based on ILOSTAT Explorer.

Education (ISCED), a framework used for structuring educational programmes and associated qualifications based on designated levels and fields of study. This facilitated the correlation of the educational programmes with the pertinent skills sought by the virtual job market, as outlined in the ESCWA Skills Monitor. Thus, the outcome of this methodological approach enabled the delineation of skills relevant to the sought-after jobs and the subsequent correspondence between the skills fostered within the educational programmes and those demanded within the virtual job market landscape.

The excessive supply of labour and the above mismatch issues are fuelling unemployment in the Arab region, which continues to struggle with a persistently high unemployment rate, the primary cause of which can be traced to the inadequacy of the education and training systems in providing the skills needed in the labour market. The high youth unemployment rate in the Arab region, estimated at 26 per cent in 2023, has been one of the highest rates in the world for over three decades (figure 2).

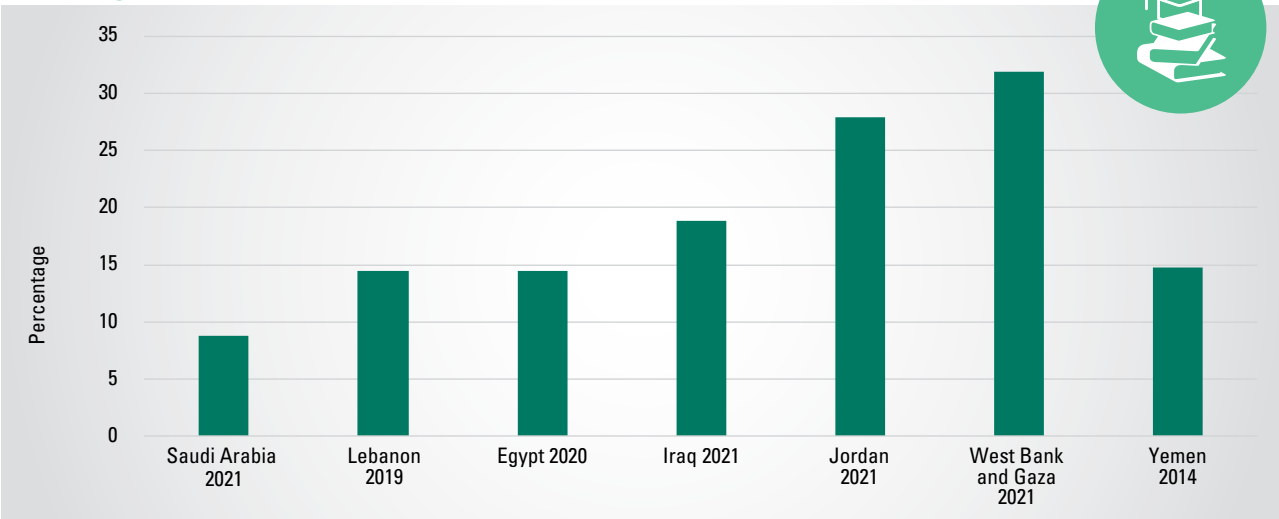
The Arab region presents a particularly stark case when it comes to the growing problem of youth unemployment. An alarming trend has emerged showing that the region's youth unemployment rates are the highest across the globe. A retrospective look reveals that, in the span of a mere decade, this rate surged from around 22 per cent in 2010 to an unsettling 27 per cent by 2023. It is important to mention that gender disparities are significantly evident in the youth unemployment rates, as highlighted by ILO.[25] The youth unemployment rate in the region for women was at around 44 per cent in 2021, compared to almost 23 per cent for young men. The obvious gender divide extends beyond youth unemployment to the rates of youth not in employment, education or training, labour force participation, and employment-to-population ratios. It is also crucial to emphasize that the education and training systems in the region are not gender-responsive. A significant factor contributing to the consistently elevated levels of unemployment among young women is their preference, often influenced by family expectations, to choose academic paths with limited job prospects in the job market, such as languages and arts. Young women are less likely to pursue careers in the fields of science, technology, engineering and mathematics.[26]

Compounding this problem is the pervasive nature of long-term youth unemployment in specific countries. To illustrate, Tunisia sees 37.9 per cent of its young people mired in unemployment in 2023. The situation is also grim in Morocco and Egypt, with these countries recording protracted youth unemployment rates of 31 per cent and 18 per cent, respectively. Over time, many of these unemployed young people might become disillusioned, ceasing their job search efforts entirely.

Contrary to unemployment in other regions, which tends to affect individuals with lower educational levels,[27] unemployment in the Arab region impacts young people across various educational levels. In fact, even the young people who pursue high levels of education are likely to face the "dead end of unemployment", which refers to a situation where individuals

The region's youth unemployment rates are the highest across the globe. This rate surged from around 22% in 2010 to an unsettling 27% by 2023

Figure 3. **Unemployment rate with advanced education in Arab countries (Percentage of total labour force)**



Source: World Bank. Unemployment by level of education (percentage). Gender Data Portal.

Note: Advanced education refers to short-cycle tertiary education, a bachelor's degree, master's degree, doctoral degree, or an equivalent education level according to ISCED, 2011.

invest in education to access better jobs, yet do not reach their desired employment outcome, which is illustrated in the high rate of unemployment with advanced education in selected Arab countries (figure 3). Most young people have expressed concerns regarding the educational quality in their countries.

According to the World Economic Forum, the percentage of university graduates out of the total number of unemployed people in 2017 in the Arab region is significantly higher than other regions, accounting for almost 30 per cent of the total unemployed in the region.[28] Even the employed tend to be in casual or informal jobs that require low productivity and provide few opportunities to enhance their skill set. This shift towards informal employment also includes the emergence of the gig economy, which consists of web-based platforms and location-based applications to perform local, service-oriented tasks, such as cleaning houses or driving.[29] Based on a report published by ILO, UNICEF and the European Training Foundation (ETF),[30] as of 2023, around 75 per cent of the working youth in the region are in informal, low-wage jobs with restricted opportunities for career growth. Such jobs may fall under the gig economy and are typically on a short-term and payment-by-task basis.[31] Despite being characterized with flexibility, they notably lack stability and job security.[32] Hence, the issue does not lie in attaining higher levels of education alone but also in acquiring the appropriate knowledge that aligns with the demands of the labour market.

Consequently, this suggests that there is a shortage in skilled labour who are adapting to future skill-reliant jobs. Thus, reskilling and upskilling initiatives for the Arab labour force, especially females, are essential to meet labour market demands and harness the full potential of individuals.[33] According to the Future of Jobs Report 2020 by the World Economic Forum,[34] it is estimated that, by 2025, around 50 per cent of the global workforce will require reskilling, which reinforces the notion that the global labour market, including the Arab market, has to adapt accordingly in order to meet the evolving demands of the global economy.

Unless substantial and strategic interventions are put into play, this unemployment crisis is set to exacerbate. ESCWA-ILO predictions indicate that, if left unchecked, the number of unemployed individuals in the region could escalate from 14.3 million in 2019 to an overwhelming 17.2 million by 2030. This looming scenario underscores the pressing need for holistic measures to revamp the region's employment landscape, from educational reforms to industry-specific initiatives.

While the prevalence of a skills mismatch situation can be attributed to the educational and training systems that do not equip individuals with the required skills, it is also explained by the inability of Arab economies to generate jobs that match with the existing skills. The lack of demand for skilled professionals in the region can lead to a "brain drain" as talented individuals seek better opportunities abroad. This can result in a loss of valuable human capital, which is essential for sustained economic growth and innovation.

Many workers in the Arab region who cannot find a job in their area often possess an advanced level of education. The World Economic Forum 2017 report on "The Future of Jobs and Skills in the Middle East and North Africa" shows that high-skilled employment in the Arab region amounts to around 21 per cent, which is slightly lower than the world average. Nevertheless, the fact that middle and low-skilled roles account for most of the jobs (79 per cent) gives rise to the possibility of a brain drain.[35] In 2019, most of the young people between the ages of 18 and 29 expressed their contemplation of emigrating, primarily with the intention of securing a job.

For a comprehensive understanding of the employment situation for skilled individuals, figure 4 provides a detailed comparison between four representative countries of the Global North and four diverse Arab countries, shedding light on the disparities in the share of high-skilled employment across the Arab countries compared with the Global North countries. Despite the United Arab Emirates having the highest share of high-skilled employment (36.6) among the Arab countries, it still falls behind the United States, which has the lowest share of high-skilled employment (42.2) among the selected Global North countries.

Figure 4. **Share of high-skilled employment of selected countries**

Source: World Economic Forum, 2017. The Global Human Capital Report 2017.
Note: The choice of countries is to offer a representative overview and convey a broad idea of the larger context.

Emigration is usually a decision that is made when young people are left with no better alternative in their home country. As previously mentioned, the "dead end of unemployment" is common in the Arab region, affecting young people regardless of their educational or skill level. The scarcity of employment opportunities within the region may push labour in the Global South to seek jobs elsewhere, mostly in the Global North. According to the Migration Policy Institute, the Arab region in 2020 contributed 16.5 million migrants globally, excluding the 14.1 million migrants who remained within the region.[36] Germany serves as an example of a country currently witnessing a labour shortage across a variety of occupations, ranging from high-skilled roles such as computer scientists to low-skilled positions such as agricultural workers. This highlights the possibility of young people immigrating to countries such as Germany when their home country does not provide them with suitable job opportunities. In fact, Germany has become the second-largest destination for migrants, hosting over 16 million international migrants.[37] A study conducted by Beyer in 2016 further confirms the significant contributions made by immigrants to the German economy.[38]

According to the World Bank, the Arab region is projected to have 160 million potential digital users by 2025.[39] If those skills are not fully harnessed, valuable human capital will be lost as skilled and educated professionals leave their home countries to seek better prospects abroad. In other words, as skilled individuals emigrate, their home countries miss the potential contributions they could have made towards economic growth as well as the positive spillover effects. The latter refers to the contributions the highly educated individuals make, not only through their own work, but also by sharing their knowledge and skills and creating an environment that encourages innovation and productivity.[40]

Therefore, the emigration of skilled labour worsens skill diversification in the region, leading to a narrower range of expertise and skills in the market, which would consequently hinder investments and growth opportunities. This conclusion is also supported by a study by Di Maria and others, which states that migration had statistically significant effects on both the overall level of human capital and the specific types of skills acquired in the sending countries.[41]

D. Weak technical and vocational education and training systems

The technical and vocational education and training (TVET) systems of many low- and middle-income countries fail to align with the skills required by the labour market and are ill-prepared for the expected surge in demand for TVET in the near future. This issue becomes more pressing in light of the dynamic labour markets, the evolving skill demands resulting from globalization, the technological advancements, and the demographic shifts. Megatrends, such as globalization, technological change, demographic shifts, and climate change, are expected to persist in their impact on the required skills and the broader employment landscape. Indications point to the possibility of increasing disparities in labour market outcomes because of the interconnections between these trends.[42] As such, it is imperative to enhance the performance of TVET to ensure seamless transitions into the job market, particularly as global youth unemployment, at 16 per cent in 2022, remains higher than the overall unemployment rate.[43] Transforming

65% of the top 20 demanded soft skills in the United Arab Emirates are included in the course programmes offered by ACTVET

TVET systems in low- and middle-income countries is feasible by harnessing new data and technologies and drawing lessons from past experiences, including those from the COVID-19 pandemic. To achieve this, TVET must establish stronger connections with the labour market, involve the private sector in identifying and delivering necessary skills, and emphasize workplace learning. Governments can contribute by reducing the social stigma surrounding TVET and creating pathways to connect it with general education tracks supported by national qualification frameworks.

Of particular concern is the subpar quality and secondary status of TVET institutions in the Arab region, often characterized by outdated equipment, curricula and teaching methods. These institutions tend to lack practical applications and real-world experiences. They also suffer from a shortage of well-trained instructors and trainers, as well as inadequate teacher training. Ideally, TVET curricula should remain forward-looking and keep pace with technological advancements. However, TVET graduates often find their skills insufficient and must seek further training or retraining to secure employment. Unfortunately, opportunities for such upskilling and reskilling are limited and fragmented in most countries. Even when training funds are available through levies, the options are often constrained.[44]

Only a limited number of TVET institutions in specific countries within the Arab region actively collaborate with the private sector through initiatives such as internships and dual training programmes. In the upcoming section, two notable examples from Lebanon and the United Arab Emirates will be examined to illustrate how TVET training programmes are aligned with labour market demands and the skills sought in online job markets.

A direct link will also be established between the skills imparted by these programmes and the skills currently in demand within the online job markets from the ESCWA Skills Monitor. As more data becomes accessible on TVET programmes across the region, the analysis can be expanded to include additional countries.

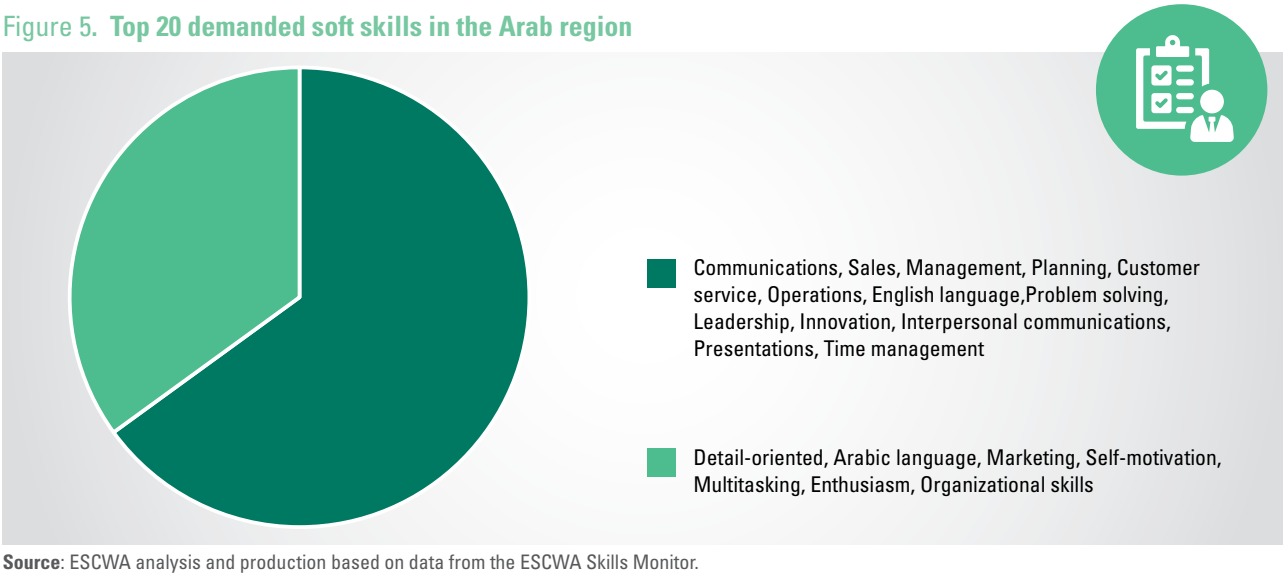
The United Arab Emirates is actively taking steps to align its TVET programmes with the demands of the labour market. One such initiative is the Abu Dhabi Centre for Technical and Vocational Education and Training (ACTVET) course finder, a tool available on the ACTVET website, designed to assist individuals to enrol in courses that are relevant to their career aspirations and are in line with the job market demands of the United Arab Emirates. The courses offered are of diverse categories, including management and business services, electrical and electronic devices, information and communications technology (ICT), first aid, 3D printing, and robotic technology. Courses within the various categories cover a multitude of skills, many of which are in high demand in the online job market. To illustrate, 65 per cent of the top 20 demanded soft skills in the United Arab Emirates are included in the course programmes offered by ACTVET. These soft skills span crucial areas such as communications, sales, management, planning, customer service, operations, English and Arabic language proficiency, problem solving, and more (figure 5).

Furthermore, 50 per cent of the top 20 demanded hard skills in the United Arab Emirates online job market are also covered by these programmes. These hard skills include finance, accounting, restaurant operation, business development, marketing, selling techniques, key performance indicators, invoicing, auditing, financial statements, and more (table 1).

It is worth noting that many other soft and hard skills, while not among the top 20, are also addressed by the course offerings. These consist of soft skills such as teamwork, Microsoft Office, Microsoft Excel, and research, as well as hard skills such as procurement, safety training, business strategies, and risk management.

In Lebanon, in alignment with the TVET national strategy for 2018–2022,[45] a variety of training programmes were conducted across sectors, encompassing car maintenance and repair, motorcycle maintenance and repair, mobile phone maintenance, ICT positions, hairdressing, manicurist roles, plumbing, and painting. Figure 6 depicts the most sought-after low-skilled jobs in the online job market in Lebanon. The orange bars signify the demand for low-skilled jobs in the online job market, where the TVET training programmes focus their efforts. The yellow bars illustrate the areas of overlap within the top 20 demanded jobs and the TVET training programmes.

Figure 5. **Top 20 demanded soft skills in the Arab region**



Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.

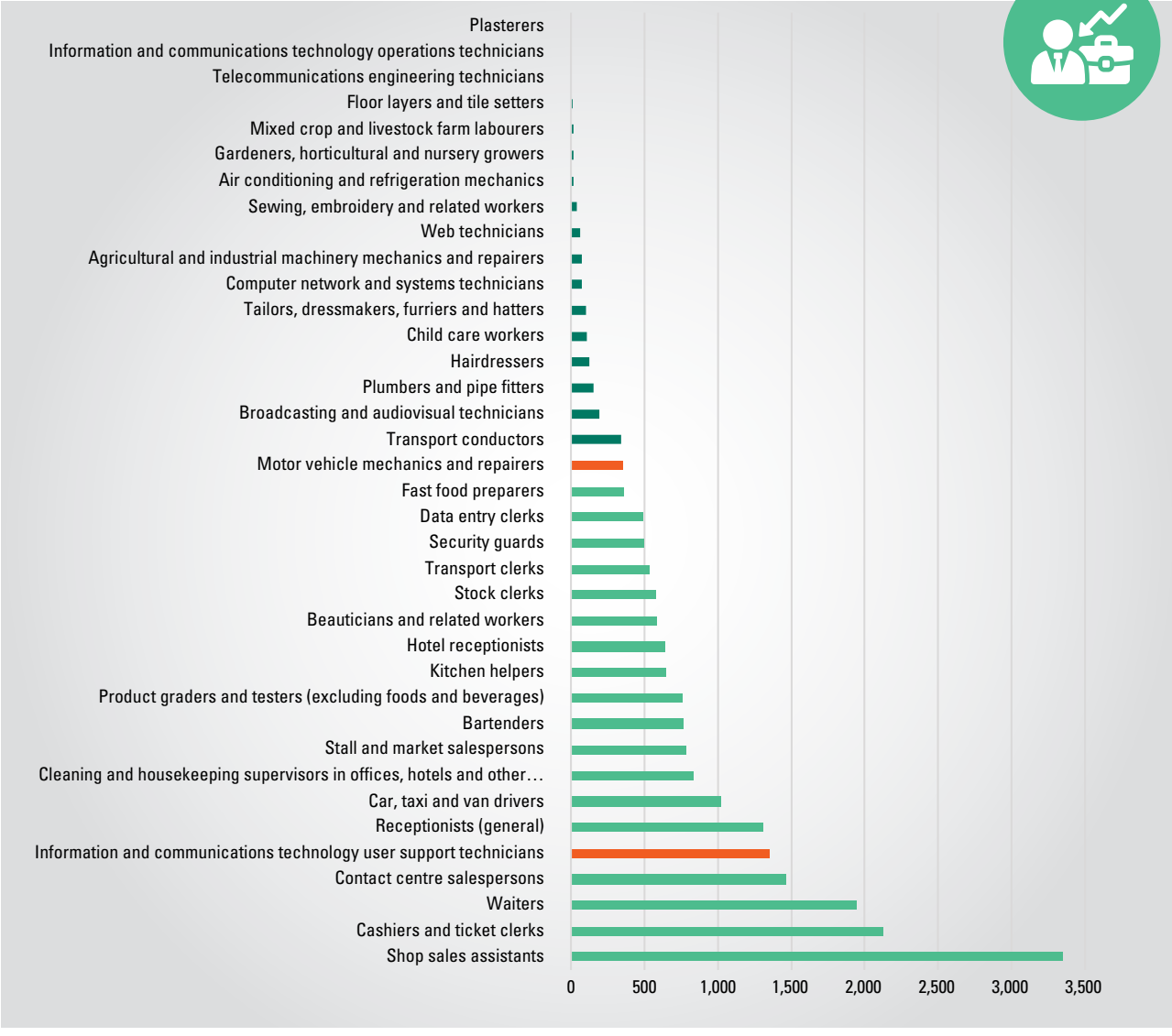
It is important to highlight that the jobs featured on the ESCWA Skills Monitor mirror the preferences of employers, whereas the jobs offered through training programmes cater to occupations that can be pursued through self-employment. Consequently, the findings reveal a disparity between the most sought-after jobs in the online job market and the occupations offered by training programmes, except for those related to ICT and motor vehicle mechanics and repairs.

Table 1. **Top 20 demanded hard skills in the Arab region**

Ranking	Hard skills
1	Finance
2	Accounting
3	Restaurant operation
4	Business development
5	Marketing
6	Selling techniques
7	Key performance indicators
8	Invoicing
9	Auditing
10	Financial statements
11	Housekeeping
12	Computer science
13	Project management
14	Data analysis
15	Corporate social responsibility
16	Construction
17	Purchasing
18	Customer relationship management
19	Strategic planning
20	Front office

Source: ESCWA Skills Monitor.

Figure 6. **Demand on low-skilled jobs in Lebanon**



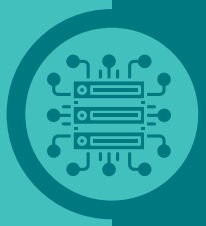
Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.

Note: The dark green color refers to demand for low-skilled jobs in the Lebanese online job market, where the TVET training programmes focus their efforts. The orange color refers to overlap within the top 20 low-skilled demanded jobs in the Lebanese online job market and the TVET training programmes.

2. ESCWA Skills Monitor and the overall market demand

Key messages

The Arab region is experiencing a **shift** in demand towards skills related to the **fourth industrial revolution**.



The increase in demand on **skills** related to **computer science**, **data analysis** and **various programming languages** is making the Arab region more **competitive** in the global market, in terms of **technological advancements**.

Some **skills** are more likely to be **automated** or **augmented** by **AI**, and are, therefore, **less sustainable** in the long term.

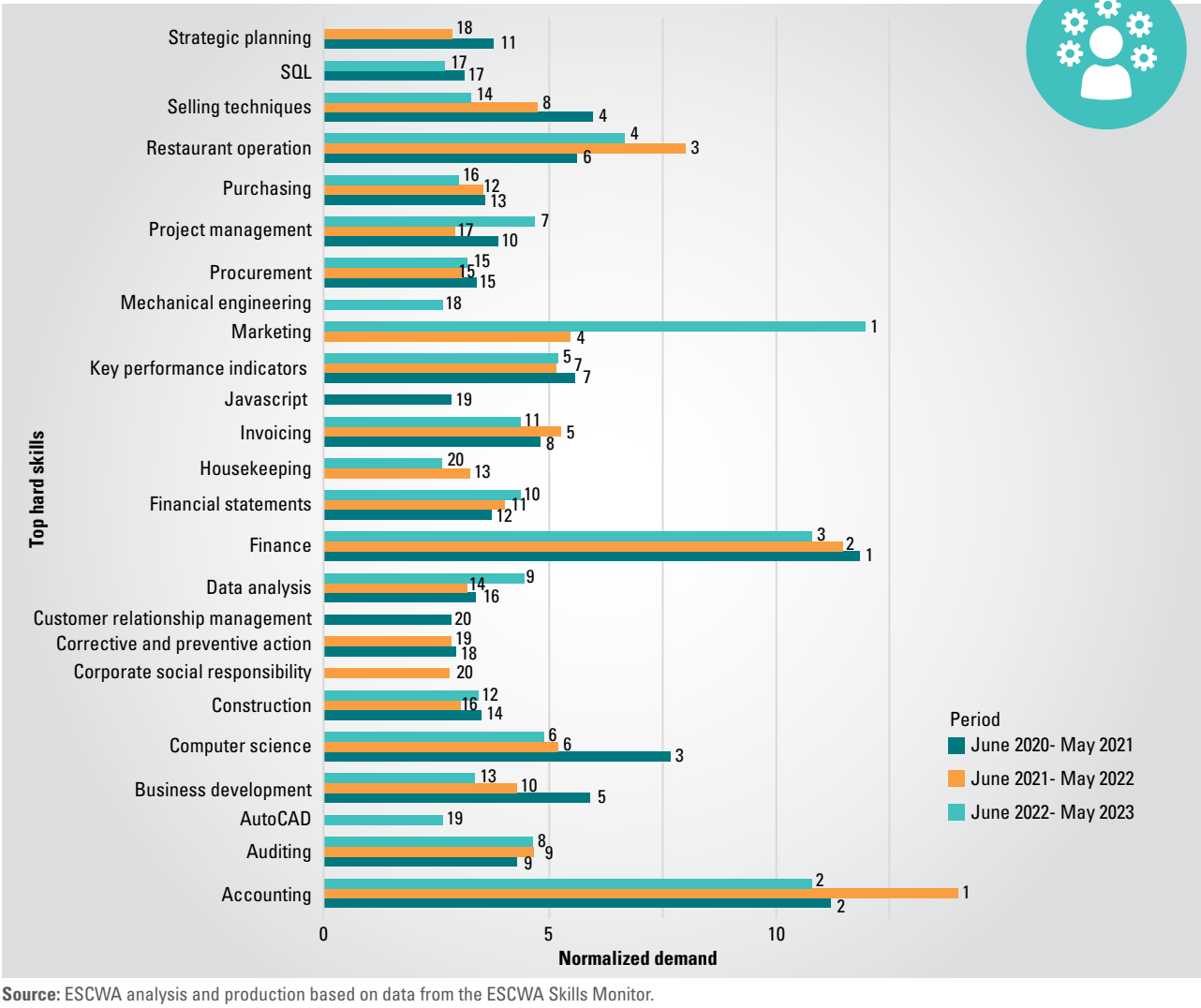
2. ESCWA Skills Monitor and the overall market demand

Before touching on the topic of skill diversification, chapter 2 discusses the overall demand of skills in the Arab region with the help of the ESCWA Skills Monitor. The monitor is a machine learning-powered platform that captures demanded skills by scraping online job postings in the Arab region. More than 2.8 million job postings have been recorded and analysed in the monitor since 2020. The ESCWA Skills Monitor scrapes vacancies and job descriptions from approximately ninety online job hubs in the region, and subsequently uses a set of deep learning and natural language processing algorithms to classify the contexts of job descriptions into a job title and a skill taxonomy.

For each vacancy scraped, the job title is classified into an existing category of the International Standard Classification of Occupations (ISCO-08) and into a normalized job title in the occupation taxonomy of the European Skills, Competences, Qualifications and Occupations (ESCO) framework with a custom-built text classification algorithm.[46] In addition to job title classification, the monitor uses a named-entity-recognition (NER)-based algorithm to classify skills into an existing skill taxonomy created by Lightcast. The Lightcast taxonomy splits skills into three different types that involve hard (specialized) skills, soft (common) skills and certifications.[47] Hard skills are abilities primarily applicable to a specific group of occupations or are necessary for performing a particular task. Examples include "Python" or "Accounting". Soft skills are found across a broad range of occupations and industries, such as "Communication" or "Microsoft Excel". Certifications are official recognitions granted by industrial or educational authorities, representing specific qualification standards. The certification data are omitted in this analysis due to data quality issues.

Using data from the ESCWA Skills Monitor, the annual top 20 hard skills in demand in the Arab region's virtual labour markets between June 2020 and June 2023 are identified, as depicted in figure 7. The bars represent the normalized demand of each skill in each period, and the number attached at the top of each bar indicates the ranking of the skill in that period. A total of sixteen skills appeared in the top 20 list for all three periods, indicating a steady and invariant domination of these skills in the Arab region's virtual market. These sixteen demand-dominant skills include many traditional skills such as accounting, auditing, finance, construction, and restaurant operation. However, computer science and data analysis, two skills with strong information technology and emerging industry focus, were also found in the list of dominant skills.

Figure 7. **Top 20 demanded hard skills in the region by period**

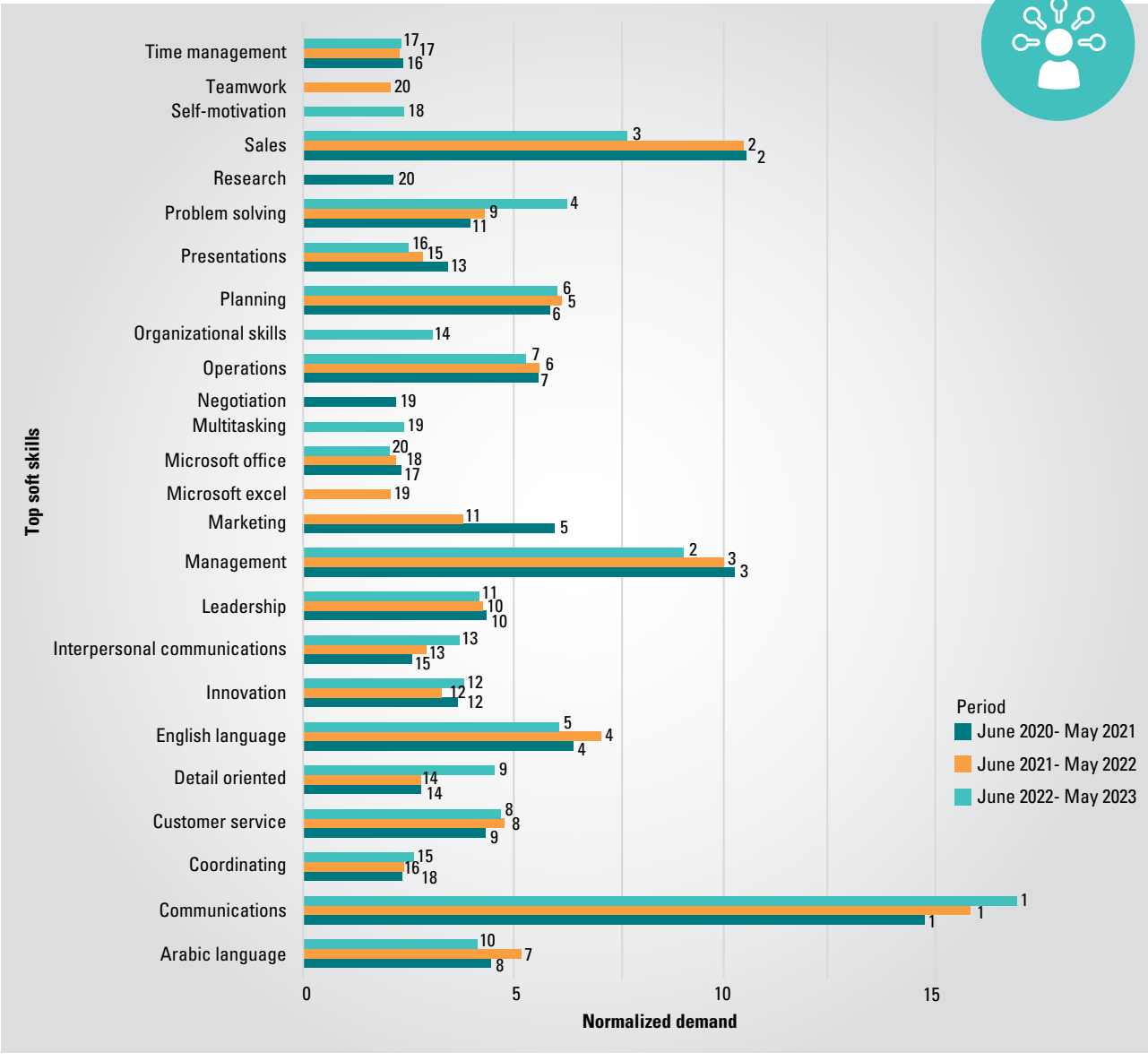


Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.
Note: The number attached at the top of each bar indicates the ranking of the skill in that period.

There has been a surge in the need for hard skills relevant to the fourth industrial revolution[48] in the online job market, such as computer science, which ranked third in the most recent period (June 2022 – June 2023) and has shown a steadily increasing pattern in demand across the periods studied. Several coding skills, including SQL and JavaScript, appeared in the top 20 list in at least one period studied. Figure 7 showcases the Arab region's recognition of the importance of hard skills related to the fourth industrial revolution. This shift in demand signifies the region's willingness to adapt to new technological advancements and maintain competitiveness in the global market.

Similarly, figure 8 illustrates the annual top 20 soft skills in demand in the Arab region from 2020 to 2023. The format of the figure is the same as that of figure 7. Arabic and English consistently remain the top two language skills required in the region. There are twenty-five distinct soft skills in the list, with seventeen of them appearing in the top list of all three periods, indicating an even stronger level of dominance in the demand for skills compared to the scenario of the hard skills in the market. The skill of communications remains the most demanded soft skill across all periods observed, with sales and management occupying the remaining spots of the top three demanded soft skills in the region.

Figure 8. **Top 20 demanded soft skills in the region by period**



Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.
Note: The number attached at the top of each bar indicates the ranking of the skill in that period.

Problem solving, an important soft skill that relates to many technical and analytical occupations, has become more popular over time, with its ranking improving from the eleventh to the fourth in three years.

Finally, the skills with the highest increase and decrease in demand are showcased, as observed in the online labour market of the Arab region. The data are compiled using the yearly-aggregated skill observations for 2021 and 2022. Table 2 illustrates the results. From the table, a set of programming and analytics-related skills experiencing a significant increase in demand is observed. Meanwhile, several traditional skills, such as restaurant operation, selling techniques, and housekeeping, witnessed a significant decrease in demand in 2022, compared to 2021.

Table 2. **Top 10 skills witnessing an increase or decrease in demand between 2021 and 2022**

Ranking	Skills witnessing an increase in demand	Skills witnessing a decrease in demand
1	Marketing	Strategic planning
2	Presentation skills	Restaurant operation
3	Sales prospecting	Selling techniques
4	SQL (programming language)	Corrective and preventive action (CAPA)
5	Data analysis	Professional services
6	Social work	Safety training
7	Python (programming language)	Housekeeping
8	ESPRIT AutoCAD	Corporate social responsibility
9	Bilingualism (French/English)	Business development
10	Agile methodology	Construction

Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.

A. Skill sustainability and AI augmentation

Skill sustainability measures if a skill can consistently remain in demand in a rapidly changing market. In an era where AI continues to make significant impact, all skills and jobs are subjected to automation or augmentation by existing AI patents to a certain extent. Thus, identifying skills more likely to be affected in the AI automation and augmentation process informs us which skills are more likely to be replaced in the future, and are thus not considered sustainable. Although the skills most augmentable by AI are prone to be replaced, the skills least likely to be augmented or automated by AI patents are not necessarily sustainable, as many of them are manual labour skills that are prone to other forms of automation on top of the AI patents covered in this report. This analysis aims to use a quantitative approach to identify the less-sustainable skills by focusing on skills most likely to be automated or augmented by AI.

The skills in this analysis are gathered from the ESCWA Skills Monitor. For each job posting, there is a measure of how many tasks within the job, identified from job descriptions, can be automated or augmented by AI. This AI augmentation score ranges from 0 to 1, with the value indicating the percentage of tasks that existing AI patents can augment. The Qatar Computing Research Institute developed the AI score methodology used here.

Out of 2.8 million job vacancies observed in the ESCWA Skills Monitor, the AI scoring algorithm was able to assign a score to about 1.5 million job postings. The average AI score observed among the postings was around 0.31. This means that for the 1.5 million jobs analysed for this purpose, an average of 31 per cent of the job tasks could be augmented by existing AI patents. The first quartile, the median, and the third quartile lie at 0.24, 0.3, and 0.36, respectively, meaning that for approximately half of the jobs studied, around 25–35 per cent of the job tasks can be augmented. Although the highest value, which is 0.86, is quite extreme, half of the observations (from the first quartile

to the third quartile) are clustered within lower values between 0.24 and 0.36, implying that around half of the vacancies observed have an AI augmentation potential between 24 and 36 per cent. To understand the relationship between skills and the AI score, data consisting of 1.4 million job descriptions[49] were extracted in the database. Then, a numeric field was generated for each job-skill pair representing the presence (1) or absence (0) of each skill in a job's description.

A set of methods was implemented to tackle technical difficulties encountered in the analysis.[50] For the analysis below, the skills are aggregated to the ESCO job family level, and the explanatory skill variables are constructed as the ratio between the number of times the skill is observed and the demand of the ESCO occupation. A statistical learning method called Least Absolute Shrinkage and Selection Operator (LASSO) regression is used in this analysis. LASSO regression performs feature selection by shrinking the coefficients of irrelevant features to zero. By cross-validating the model, the optimal regularization parameters are identified, and the coefficient estimates are generated. From the 4,718 skills analysed in the data, the LASSO method identified 221 non-zero estimates. The magnitude and sign of these 221 coefficient estimates indicate how much and in what direction a skill affects the AI score.

Skills with positive coefficients are associated with a higher likelihood of that job being automated or augmented by AI. The results are shown in table 3, which reports the twenty skills with the highest coefficients recorded in the LASSO regression, among the skills demanded more than 10,000 times[51] in the economy.

Table 3. **Skills and AI augmentation**

Ranking	Skill name	Coefficient (percentage)	Demand of skill
1	Business strategies	0.3417	10,177
2	Data analysis	0.2434	18,768
3	Prioritization	0.2173	12,148
4	Strategic planning	0.1956	18,531
5	Analytical skills	0.1785	23,732
6	Decision-making	0.1624	25,495
7	Market research	0.152	10,035
8	Forecasting	0.134	18,948
9	Budgeting	0.1248	20,582
10	Verbal communication skills	0.1175	32,923
11	Presentations	0.1137	57,512
12	Financial statements	0.1114	25,688
13	Project management	0.1018	19,963
14	Negotiation	0.0874	36,835
15	Key performance indicators	0.0595	33,532
16	Influencing skills	0.0536	23,673
17	Risk management	0.0516	12,893
18	Customer relationship management	0.0515	13,711
19	Research	0.0483	36,852
20	Computer science	0.0402	42,826

Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.

B. Linkages between skills and Sustainable Development Goals

The SDGs are a set of seventeen interconnected goals adopted in 2015 by member countries of the United Nations, providing a shared blueprint for peace and prosperity for people and the planet. The Arab region, in line with all United Nations member States, is committed to these Goals. According to the ESCWA report on the "Progress towards the Sustainable Development Goals in the Arab Region" of 2023, while the Arab region has demonstrated efforts towards achieving several Goals, none of these Goals are entirely on track. Notable efforts have been made in the areas of SDG 3 (good health and well-being), SDG 4 (quality education), SDG 7 (affordable and clean energy), and SDG 11 (sustainable cities and communities). However, these Goals have yet to reach their respective thresholds. Conversely, progress towards SDG 8 (decent work and economic growth) has been stagnant, and there has even been a setback in SDG 2 (zero hunger), attributed to factors such as the COVID-19 pandemic and regional conflicts.

In the current situation, it is uncertain if the Arab region will meet all SDGs by 2030 without implementing substantial, concrete measures. Effective monitoring is possible for only ten out of the seventeen Goals due to the availability of quantifiable targets and data, with only half of the Arab countries possessing data for at least two years. The remaining Goals face the challenges of inadequate indicators and data, which impede effective monitoring. In terms of SDG targets, of the 169 targets, 109 have quantifiable regional targets in the Arab region, given the availability of adequate data. However, the levels of progress across these targets are mixed; while twenty targets are in progress, sixteen have regressed, and they need to be put back on track.

The report underscores the need for the Arab region to enhance data availability and timeliness by reinforcing country data information systems. Such an investment could improve the ability to monitor progress, thereby increasing the probability of achieving the SDGs by 2030. It is evident, however, that a significant push is required to address the Goals and targets currently off track or to make sufficient progress. The skills monitor, a crucial tool in this endeavour, can potentially augment the Arab region's capacity to track and measure progress. It could offer valuable insights into understanding the interplay between skills and sustainable development, informing policy decisions, and helping prioritize interventions in achieving the SDGs.

In this case, the ESCWA Skills Monitor offers insights into how the demanded skills are linked to the context of SDGs through a regular expression method. In this part of the analysis, ESCWA first identifies a set of key words and phrases for each SDG, using the list of keywords produced by the University of Auckland in 2021.[52] ESCWA then analyses the job description of each job vacancy to see if it is linked to any SDG. The results of this analysis are shown in figure 9.

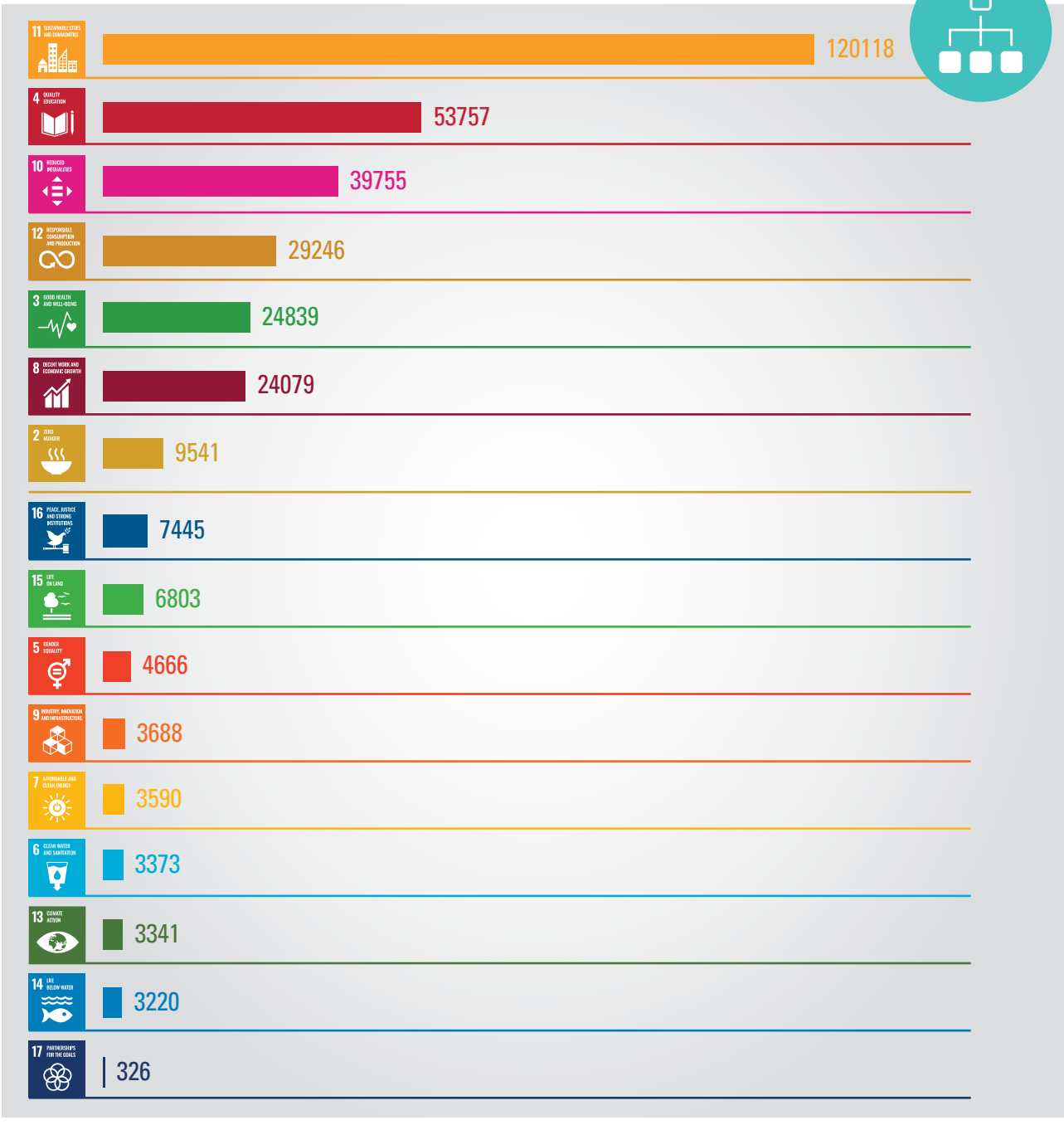
In terms of the linkage between the job market and the SDGs, the Arab region's skill demand is positively correlated to the areas in which the region has exerted significant efforts. Three Goals out of the four (SDGs 3, 4 and 11) that are most on track as identified in the SDG report are also the three of the four most observed items according to our text analysis of the region's job market.

Within these most relevant SDGs, ESCWA also extracted the most frequently matched phrases.[53] For SDG 3, the most frequently caught phrases included vaccines, medicines,

health care, and mental health. For SDG 4, the phrases included equal opportunity, professional development and education quality.

However, the available jobs in the virtual job market within the region exhibit limited correlation with SDG 1, aiming to eradicate poverty, SDG 13, promoting climate action, and SDG 5, advocating gender equality.

Figure 9. **Linkage between demanded jobs and SDGs**



Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.

3. Assessing skill diversification

Key messages

The United Arab Emirates has a notable advantage in **skill mobility**. **Saudi Arabia** and **Egypt** also exhibit **relative advantages** in skill mobility, likely due to their market size. In contrast, countries such as **Bahrain**, **Kuwait** and **Oman** have **lower skill mobility** measures, indicating a relative **disadvantage**.

The analysis of **future-oriented skills** shows the average share of future-oriented skills across occupations observed in the online market in each economy. **Morocco** and **Tunisia** lead with the **highest** percentages, while **Kuwait** lags with the **lowest**.

More even **skill distributions** across skill categories are observed in Egypt, Saudi Arabia and the United Arab Emirates, whereas **Bahrain** scores the **lowest** in this criterion.

3. Assessing skill diversification

Skill diversification is related to economic diversification, which affects the economy through two main channels. Firstly, economic diversification involves the expansion of sectors that contribute to the country's employment and production. Without a diverse range of skills, the region may struggle to adapt to changing economic conditions and to innovate new products and services.[54] Secondly, economic diversification in international trade activities expands the export base. Once the range of products and industries expand in the region, a corresponding set of new skills becomes needed.

At the core of skill diversification lies the pivotal role of human capital.[55] As individuals enhance their human capital through a wide range of competencies, they equip themselves with a diversified skill set. This interconnectedness between human capital and skill diversification resonates within the domain of innovation, exemplified by concepts such as regional innovation systems (RISs) and their relationship with human capital. Doloreux and Parto, in 2005, present a review of studies that highlight the significance of RIS within the dynamic landscape of the learning economy. An RIS is a platform composed of various actors, such as firms, research institutions, universities, Government agencies, and intermediaries, which interact for the generation, dissemination and application of knowledge.[56] Human capital plays a vital role within RIS as individuals add their knowledge and expertise to the innovation system.[57] Additionally, regions with a strong focus on education, training and skill development further amplify the impact of human capital, exhibiting higher levels of innovative activities.[58]

Other studies, such as work done by Chesbrough and others,[59] also discuss the role of human capital but in the process of open innovation, where organizations seek external knowledge and expertise to push their innovation efforts. The book of Chesbrough and others underscores that skilled individuals contribute to the flow of knowledge within collaborative networks, enhancing the overall innovation level in the economy. The integration of external human capital through open innovation helps organizations enhance resource allocation and innovation cycles by leveraging a broader pool of external knowledge.

The existing literature examined the role of knowledge spillovers in the geography of innovation. A notable work in this regard is by Jacobs,[60] as highlighted by Ikeda's discussion,[61] with Jacobs emphasizing

the importance of interactions among educated or experienced individuals within a certain geographic area in fostering innovative activity and economic growth. Regions characterized by a diverse population holding a wide array of knowledge, skills and preferences (for instance, cities) contribute to discovering and diffusing knowledge. Chang and others indicate that knowledge spillovers, particularly in the form of human capital, are recognized as the driving force behind sustained economic growth and development.[62] This implies that human capital spillovers are not solely present, but even more evident in regions with higher levels of technology.

Tajoli and Felice claim that engaging in global value chains, particularly for those importing inputs from more advanced economies, correlates positively with a country's innovation outcomes.[63] Furthermore, global value chain involvement requires enriching the nation's human capital.[64] Since global value chain firms need skilled workers for their standards, they tend to invest in their workers' skills.[65] Although human capital and skills play a more vital role in the value-added activities of developing nations, Wang and Thangavelu emphasize that both developed and developing countries significantly depend on human capital and skills to sustain their competitiveness in value-added activities.[66]

In the context of knowledge spillovers in the geography of innovation, the literature indicates that firms in close physical proximity are more prone to experience these knowledge-sharing effects. Geographical location has become a crucial determinant in understanding innovation and technological progress, as it plays a pivotal role in facilitating the exchange of ideas and information among firms.[67] The concept of innovation clusters further accentuates the significance of location, shedding light on the intricate dynamics of competition and the role of proximity in gaining competitive advantage. While globalization has diminished the conventional reasons for clustering, contemporary perspectives emphasize the enduring importance of clusters in today's intricate and knowledge-oriented economy. These clusters necessitate a redefined approach to national and local economies, requiring innovative strategies from businesses, Governments and institutions to enhance competitiveness.[68]

Going back to the concept of diversity itself, in literature, the diversity of an item often leads to two types of interpretations. Firstly, diversity can refer to observing a variety of items of interest. For example, Hidalgo and Hausmann defined the product diversity of a country as the number of various products the country exports.[69,70] Secondly, a diversity measure can also refer to the balance of the inner components of the item considered. For example, Fiszbein used the Hirschman-Herfindahl index of the shares of each product in gross agricultural output to measure agricultural diversity.[71]

A. Skill Demand Diversity Scores

This section uses the skill demand data observed in the ESCWA Skills Monitor to construct a skill demand diversity measure. Each constructed measure is then used to rank countries analysed based on the skill demand diversity observed in the online market. The skill diversity measure in this report covers both types of interpretations, variety and balance of inner components, as defined at the end of the prior section. Two additional components are introduced to measure the mobility of skills and the future aspect of the skills in an economy. SDDSs are constructed as a collection of indicators consisting of four main components: skill variety (V), skill mobility (M), a measure of future-oriented skills (F), and the balance of the skill distribution in each economy (E), to accommodate consideration from the perspectives above.

For statistical representation, eleven countries, namely, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia and the United Arab Emirates, which recorded more than 30,000 vacancy observations in the ESCWA Skills Monitor database, were included. The selection of the 30,000-observation threshold considers both the aggregate size of the market and the coverage of distinct types of occupations in the online market. The technical annex attached at the end of the report shows a more detailed view of how the components of the SDDS are sampled and constructed.

The first metric, skill variety, was built upon the skill taxonomies of Lightcast. Skill variety refers to the number of distinct skills observed on the demand side of an online market. A distinction must be made between two relevant measures: quantity (number of skills observed) and variety (number of distinct skills). The former metric refers to the aggregated appearances of all skill observations, while the latter refers to the number of distinct skills found in the market demand. For example, between June 2020 and July 2023, in the Arab region, the record of the skill quantity metric in the ESCWA Skills Monitor is over six million. The skill variety metric (V), however, is around 18,000, combining hard (specialized) and soft (common) skills.

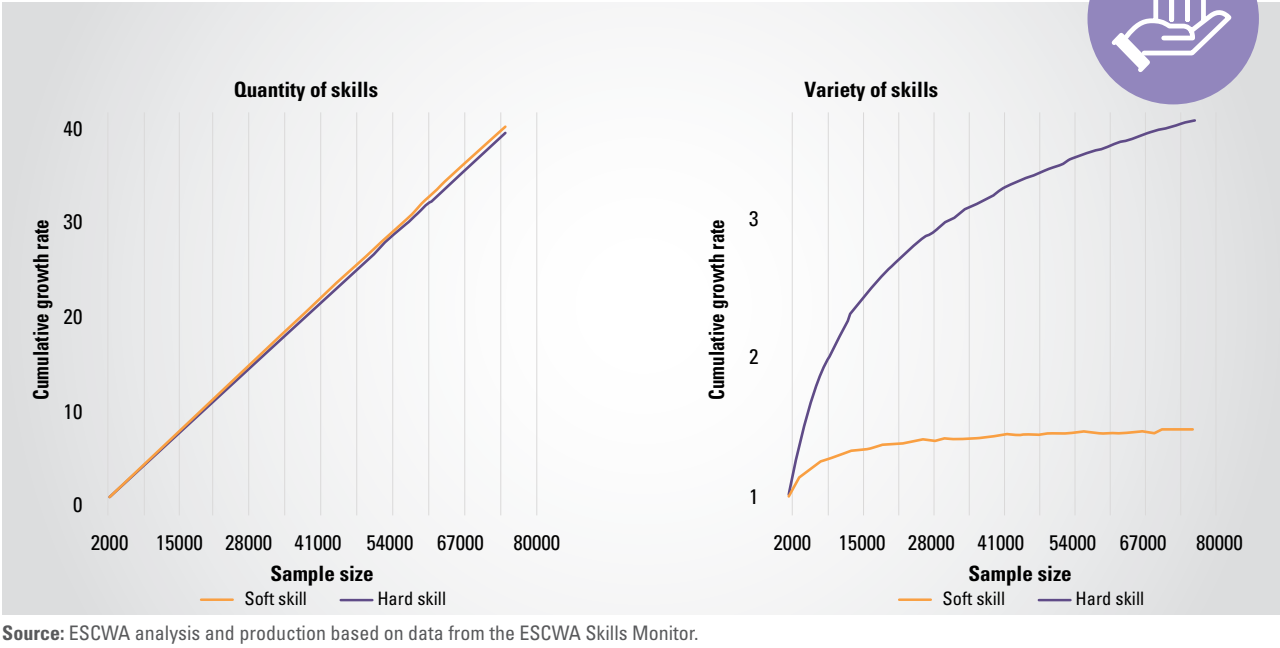
The quantity of skills observed in each occupation is omitted from the SDDS collection. This is because the quantity of skills demanded in a market does not necessarily reflect skill diversity the way, for example, the number of distinct skills demanded per occupation would. Figure 10 describes the difference between these two measures. As seen in the left panel of the figure, the quantity of skills has a strong linear relationship with the demand in the market. Meanwhile, skill variety and demand, as shown in the right panel, exhibit a different form of positive increment relationship. Theoretically, a weak positive increment in skill variety is always observed when a new vacancy is considered, with the increment equal to zero if all skills demanded by a new vacancy have already been observed in the market. This explains the growth relationship between the two variables in the right panel. Unlike the growth pattern shown in the left panel, skill variety grows concavely (increasing at a decreasing speed) with the increments of demand.

Between June 2020 and July 2023, in the Arab region, the record of the skill quantity metric in the ESCWA Skills Monitor is over 6 million

To account for skill variety, the number of distinct skills observed in each country by 31 July 2023 is calculated. The results are shown in table 4.

The skill variety measure cannot be constructed based on cumulative observations due to the concave growth relationship between the demand and number of distinct skills. To facilitate a meaningful comparison, the two data columns in table 4 are used as coordinates and plotted in a 2-D space. In the same space, an estimated function that mimics the increment process between distinct skills and vacancy demand is plotted, based on the aggregate data in the ESCWA Skills Monitor. The plotted figure is shown in figure 11, and details of the function construction can be found in the technical annex.

Figure 10. **Growth of skill quantity and variety in demand by sample size**



Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.

Table 4. **Cumulative skill variety per country by 31 July 2023**

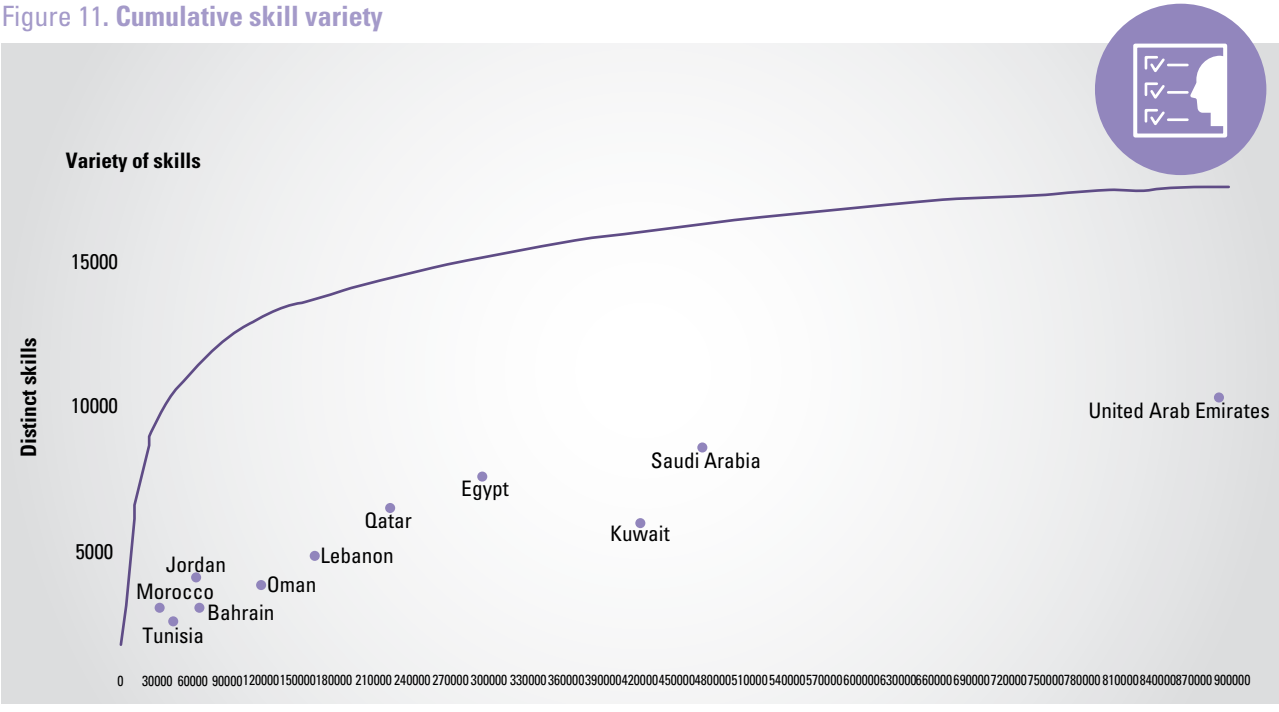
Country	Observed market size	Number of distinct skills
United Arab Emirates	889,374	10,290
Saudi Arabia	472,237	8,571
Egypt	292,885	7,520
Qatar	218,335	6,449
Kuwait	420,918	5,898
Lebanon	156,374	4,810
Jordan	60,717	4,087
Oman	112,595	3,858
Bahrain	63,110	3,009
Morocco	33,071	2,987
Tunisia	42,670	2,569

Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.
Note: Countries are ranked by the number of distinct skills observed in the market.

The skill variety measure is calculated as the reverse vertical distance between the country dots and the blue line in figure 11. A country is ranked higher than the others if its dot is closer to the blue line. The ranking of countries in the skill variety measure is shown in table 5.

The analysis has shown that Morocco's online labour market exhibits the most substantial demand for distinct skills, conditional on its market size. Egypt, Jordan, Saudi Arabia, and the United Arab Emirates also exhibit strong demand for skill variety. In comparison, Kuwait, Lebanon and Oman have relative disadvantages in this measure.

Figure 11. **Cumulative skill variety**



Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.

Table 5. **Ranking of countries in the skill variety measure**

Country	Market size	Number of distinct skills	Distance (ranking)
Morocco	33,071	2,987	6,773 (1)
United Arab Emirates	889,374	10,290	7,298 (2)
Jordan	60,717	4,087	7,323 (3)
Egypt	292,885	7,520	7,651 (4)
Saudi Arabia	472,237	8,571	7,778 (5)
Tunisia	42,630	2,569	7,859 (6)
Qatar	218,335	6,449	7,997 (7)
Bahrain	63,110	3,009	8,502 (8)
Lebanon	156,374	4,810	8,896 (9)
Oman	112,595	3,858	9,176 (10)
Kuwait	420,918	5,898	10,179 (11)

Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.

Table 6. **Average ESCO coverage by each skill per country**

Country	Number of distinct ESCO job titles observed in the market	Mean ESCO coverage per skill	Mean percentage coverage per skill (ranking)
United Arab Emirates	2,676	12.82	0.47 (1)
Saudi Arabia	2,524	9.69	0.38 (2)
Egypt	2,291	8.66	0.37 (3)
Qatar	2,179	6.40	0.29 (4)
Kuwait	2,442	5.88	0.24 (9)
Lebanon	1,754	4.88	0.28 (5)
Jordan	1,731	4.78	0.28 (5)
Oman	2,214	3.91	0.18 (11)
Tunisia	1,307	3.65	0.28 (5)
Morocco	1,304	3.60	0.28 (5)
Bahrain	1,633	3.24	0.20 (10)

Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.

The second measure proposed is skill mobility (M). A skill is considered more mobile if it is demanded in more ESCO job titles. The analysis of skill mobility is restricted to the hard skills demanded in the market since the soft skills are considered to be prevalent across different occupations. A skill encompassing many job titles indicates that it is easy to transfer this particular skill between different occupations. A market with a sizeable number of mobile skills means that the barrier to occupation-based skill set transformation is lower than the other economies within the occupations connected by this group of mobile skills. The average ESCO coverage of a skill per country is shown in table 6.

The first data column of table 6 shows how many distinct ESCO job titles are observed in each country based on data extracted from the ESCWA Skills Monitor. The second data column shows each country's mean ESCO job title coverage per skill. The United Arab Emirates tops the chart by having an average of 12.82 ESCO occupation coverage of each distinct skill demanded. Bahrain only has an average of 3.24 ESCO occupation coverage for each distinct skill demanded. The two columns of data discussed above are significantly positively correlated. In the last column, the first data column is used as a denominator of the second data column, so a percentage coverage measure is obtained. The percentage measure shows that Egypt, Saudi Arabia and the United Arab Emirates have relative advantages in skill mobility compared to the others countries (attributed to their market size), while a considerable number of countries studied have a skill covering 0.28 to 0.29 per cent of their observed ESCO job titles on average. These countries include Jordan, Lebanon, Morocco, Qatar, and Tunisia. Bahrain, Kuwait and Oman show a relative drop-off in this skill diversity measure.

In addition to the variety and mobility measures, the future perspective of the currently demanded skills in each economy is also considered. For this purpose, a subset of skills was manually inspected and selected as future-oriented. The choice of skills was guided by the definition of the fourth industrial revolution, and the interplay between the fourth industrial revolution and a set of currently pressing topics, namely, environment, health care and equality, covered by the SDGs of the United Nations. Future-oriented skills are chosen based on the utilized Lightcast skill taxonomy hierarchy.

Table 7. **Lightcast skill subcategories selected for the identification of future-oriented skills**

Country	Subcategories
Analysis	Business intelligence; business intelligence software; data analysis; data science; data visualization; image analysis; mathematical software; mathematics and mathematical modeling; natural language processing; statistical software; statistics
Business	Process improvement and optimization
Design	Animation and game design; creative design; digital design; graphic and visual design; graphic and visual design software; industrial design; user interface and user experience Design
Economics, policy and social studies	Economics; policy analysis, research, and development
Energy and utilities	Clean energy; energy efficiency; energy management; nuclear energy; solar energy; water energy; wind energy
Engineering	Aerospace engineering; automation engineering; automotive technologies; electrical and computer engineering; engineering, scientific, and technical instruments; geological engineering; hardware description languages; imaging; optical engineering; process engineering; robotics; signal processing; simulation and simulation software
Environment	Air quality and emissions; climate change; ecology; environment and resource management; environmental engineering and restoration; environmental geology; environmental regulations
Finance	Cryptocurrency; electronic trading; financial accounting; financial advisement; financial analysis; financial modeling; financial risk management; financial trading
Health care	Clinical informatics; health information management and medical records; home health care and assisted living; immunology; medical imaging; mental and behavioural health specialties; mental health diseases and disorders; mental health therapies; neurology; nuclear medicine; nutrition and diet; public health and disease prevention; speech language pathology
Information technology	Agile Software development; anti-malware software; Apache; application programming interface; artificial intelligence and machine learning; augmented and virtual reality; backup software; blockchain; C and C++; cloud computing; cloud solutions; collaborative software; computer hardware; computer science; configuration management; cybersecurity; data collection; data management; data storage; database administration; databases; distributed computing; extensible languages; geospatial information and technology; integrated development environments; Internet of Things; iOS Stack; IT Automation; Java; JavaScript and jQuery; Microsoft development tools; mobile development; network protocols; network security; networking hardware; networking software; operating systems; Oracle; other programming languages; PHP; query languages; SAP; search engines; servers; software development; software development tools; software quality assurance; system design and implementation; systems administration; telecommunications; test automation; version control; video and web conferencing; virtualization and virtual machines; web content; web design and development; web services; XML
Marketing and public relations	Digital marketing; social media; web analytics and SEO
Public safety and national security	Intelligence collection and analysis; safety and surveillance technology
Science and research	Bioinformatics; biology; biotechnology; chemistry; earth and space science; medical science and research; neuroscience; physics; research methodology; science software
Transportation, supply chain and logistics	Air transportation

Source: ESCWA analysis and Lightcast skill taxonomy.

Lightcast's skill taxonomy contains over 30,000 unique skills, which can be categorized into 33 main and 445 subcategories. The 33 main categories here include business, IT and engineering. We used the more refined subcategories of the taxonomy to select future-oriented skills, with 144 subcategories and 6,900 skills in total, within 14 categories chosen for this purpose. The list of subcategories selected to identify future-oriented skills can be found in table 7. Of the 6,900 skills selected, only 1,465 are in the ESCWA Skills Monitor dataset. This is less than 10 per cent of the total variety of skills in the region. The sum of the proportions of these skills in each economy was then separately calculated and used as the future skill proportion component.

The statistics of this component are shown in table 8.

Table 8. **Future aspect of the demanded skills across occupations**

Country	Future aspect (ranking) (percentage)
Morocco	25.70 (1)
Tunisia	25.13 (2)
Egypt	19.00 (3)
Jordan	15.19 (4)
Lebanon	14.48 (5)
Oman	13.58 (6)
Saudi Arabia	12.35 (7)
United Arab Emirates	10.63 (8)
Bahrain	10.83 (9)
Qatar	10.52 (10)
Kuwait	7.33 (11)

Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.

Table 9. **Skill balance across occupations**

Country	Entropy score (ranking) (percentage)
Saudi Arabia	56.63 (1)
United Arab Emirates	56.09 (2)
Egypt	56.07 (3)
Qatar	50.83 (4)
Morocco	50.53 (5)
Jordan	50.01 (6)
Tunisia	48.90 (7)
Lebanon	46.68 (8)
Oman	46.17 (9)
Kuwait	44.46 (10)
Bahrain	40.89 (11)

Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.

Table 8 shows the mean percentage of future-oriented skills across occupations observed in the online market. Morocco and Tunisia have the highest percentage, which is around 25 per cent of skills. Egypt also has a significant advantage over the remaining countries. The lowest percentage is observed in Kuwait.

The final component of the composite indicator considers the balance of skills observed across its categories. To measure balance, the Shannon entropy term (E) is borrowed from information theory, which penalizes the imbalanced distribution of skills across distinct categories. The logarithmic component in the entropy serves as the penalty of the imbalance here.[72] The statistics can also be understood as how close the country is to the equal distribution of skills across the skill categories in each occupation. The entropy statistic is shown in table 9.

Table 9 shows that Saudi Arabia, the United Arab Emirates and Egypt are the countries in which more even skill distributions across skill categories are observed. Bahrain scores the lowest in this criterion, with its skill distribution significantly more uneven across the Lightcast categories.

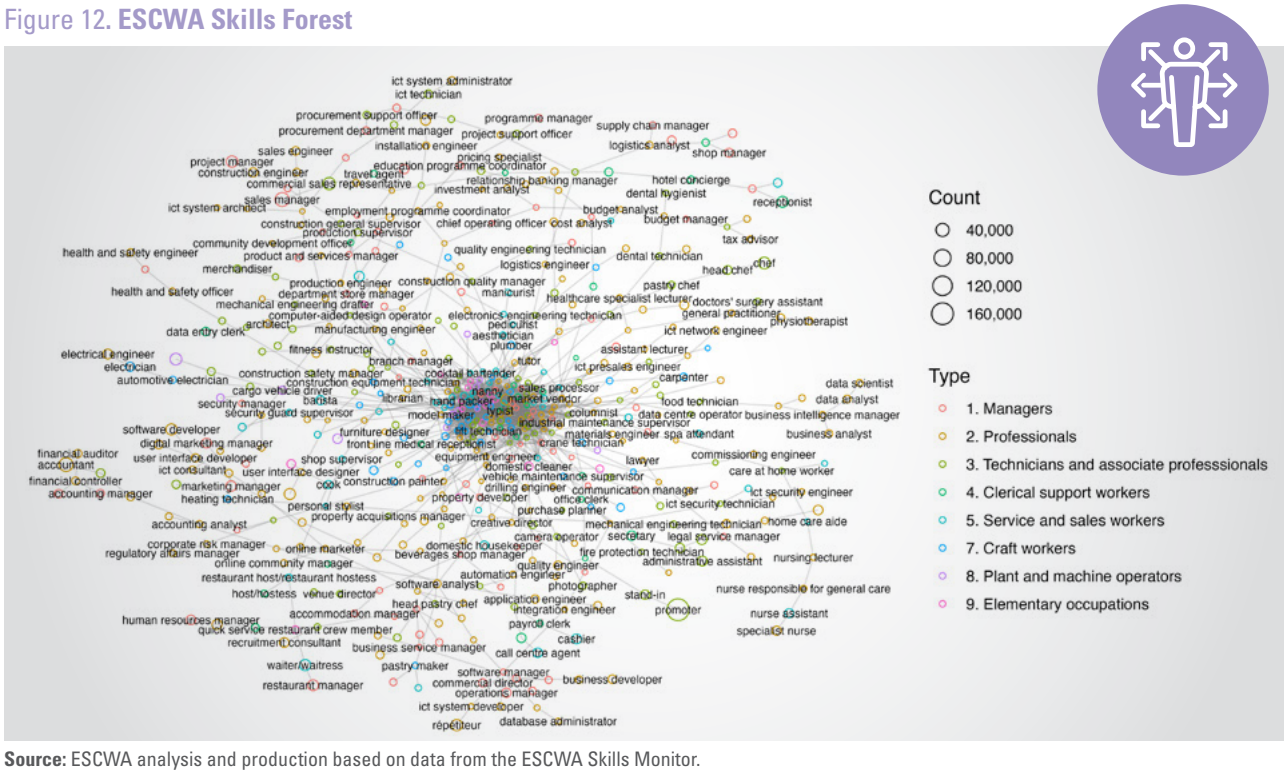
Lightcast's skill taxonomy contains over 30,000 unique skills, which can be categorized into 33 main and 445 subcategories

B. ESCWA Skills Forest

The ESCWA Skills Forest for the region (as depicted in figure 12) provides an overview of the demanded skills in the market, showcasing the proximity between various jobs (ESCO-normalized, represented as nodes) based on their skill similarity. The branches connecting the nodes in the forest indicate the degree of skill similarity[73] between the corresponding job pairs. The central area of the forest, which is densely populated, represents the "core of the forest". It signifies the highest interconnectedness among the demanded jobs in the virtual market via shared skills. Thus, workers reskilling and upskilling in the core area is comparatively easier than in the peripheral areas. In figure 12, the Arab region is represented as having a single core. Fourth industrial revolution jobs tend to be positioned either at the edge of the core or on the periphery.

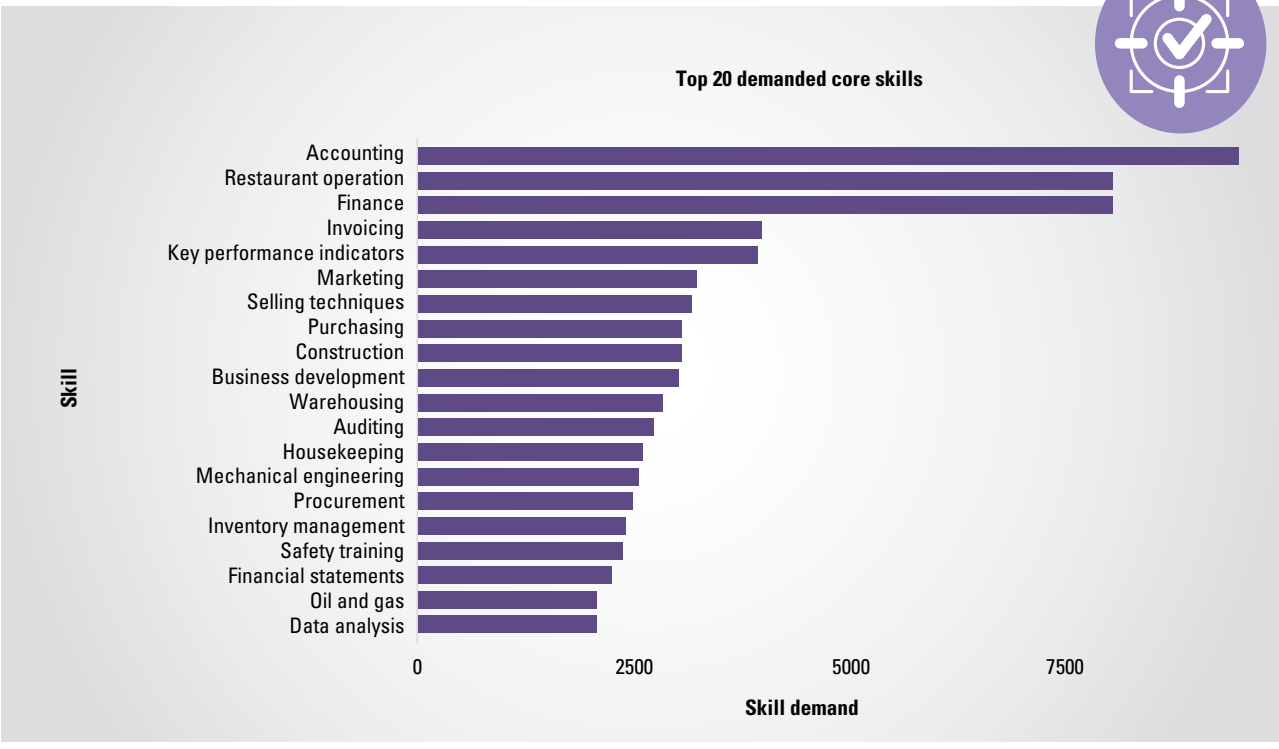
The forest is compiled in a way that the nodes with more connections to other nodes are more likely being placed centrally.[74] Thus, for the core of the forest in the middle, the core occupations of the forest and the set of skills associated with this aggregation of occupations can be identified. This set of skills identified can be referred to as the core skills in the forest (figure 13).[75] The core skills in the Arab region are traditional industry-oriented skills, and the existence of fourth industrial revolution-related skills is not shown in the figure. Although it can be noticed from the skill demand that there is a significant market for IT, digital and technological skills, the findings in the forest show that these skills are not well spread in the demand of the labour market. This means that these future-oriented skills are clustered on their own on the periphery and are not well connected to vacancies in other clusters.

Figure 12. **ESCWA Skills Forest**



Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.

Figure 13. **Core skills in the ESCWA Skills Forest**



Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.

C. Future skills: skills related to AI and generative pre-trained transformers

Among the innovative technologies, generative pre-trained transformers (GPT) and associated AI technologies have gained significant attention since the introduction of ChatGPT to the public at the end of 2022. Understanding the prevalence and demand for skills related to GPT in the job market is an important perspective for understanding the quality of skills demanded in the Arab region. In this context, the present analysis aims to identify the occupations in which knowledge and skills in GPT and related AI technologies are explicitly demanded. For this reason, an analysis of the large dataset of the ESCWA Skills Monitor was conducted, filtering data and using observations in 2023 only.

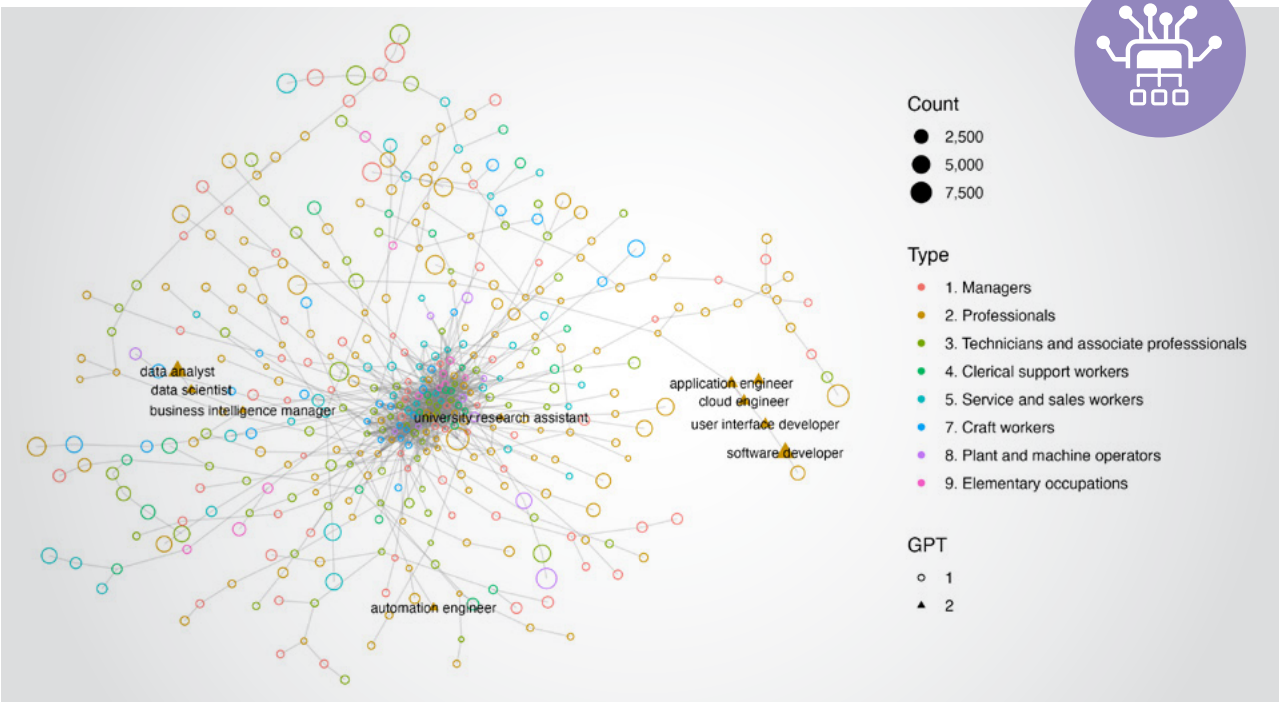
To identify the descriptions mentioning GPT-related technologies, regular expression pattern matching was used. The list of GPT-related phrases included "ChatGPT", "generative AI", "OpenAI", "transformers in AI", "natural language processing", and a variety of other phrases associated with GPT and AI technology. The job descriptions were then analysed and classified by their occupation titles. For each occupation, the percentage of job descriptions that mentioned at least one of the GPT-related phrases was calculated. An occupation here is defined as an ESCO normalized title. Occupations in which GPT-related technologies were mentioned in at least 5 per cent of the job descriptions were identified as being significantly associated with these technologies. In total, 298 ESCO normalized titles with at least one opening that mentions AI and GPT contexts were observed. Out of the 298 titles observed, the data were further restricted to those with GPT-relevant mentions more than ten times per ESCO title, leaving 12 observations.

Data analysts and data scientists are the two normalized titles that record the most mentions of the AI and GPT contexts, and they are the only two job titles recording more than one hundred records in the AI/GPT context. In the data analyst occupation, relevant context is observed in 165 descriptions, and the respective number for data scientists is 131. The third-highest ranked occupation in the list is software developer, which only has 42 records relevant to the context.

To showcase occupations identified from the process above, a subskills forest was created using data from 1 January to 31 July 2023 only, and each identified occupation was annotated in the forest (figure 14). The identified occupations that involve descriptions of AI/GPT-related skills include data analyst, cloud engineer, software analyst, automation engineer, data scientist, and others. In total, ten out of twelve ESCO normalized titles that contain a significant proportion of AI/GPT contexts in their job descriptions are observed in the forest. All of the ten included occupations are in the periphery region of the forest.

Data analysts and data scientists are the two normalized titles that record the most mentions of the AI and GPT contexts

Figure 14. **ESCWA Skills Forest 2023 with AI/GPT occupations annotated**



Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.

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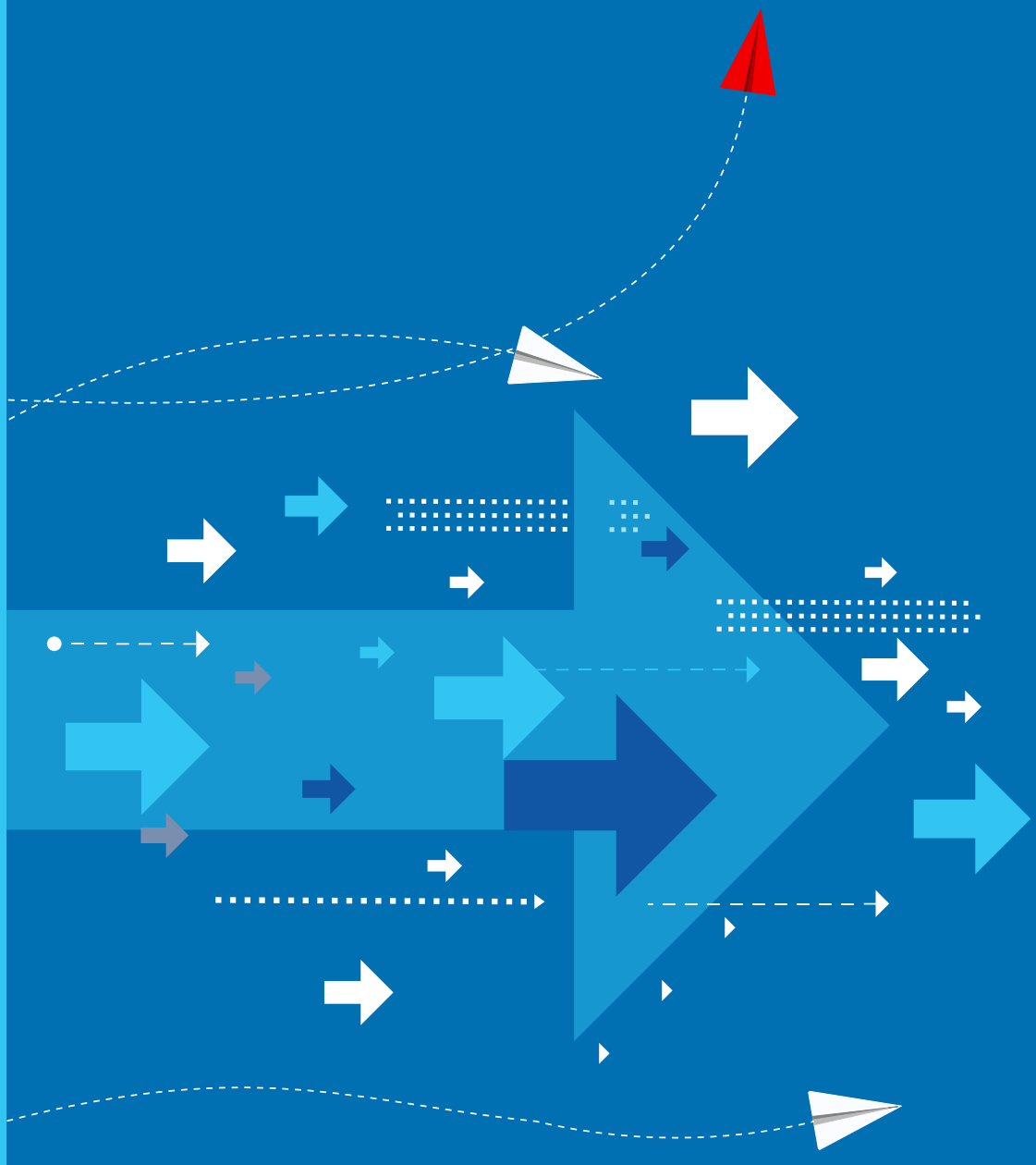
4. The way forward



4. The way forward

The rapid integration of technologies such as AI is reshaping employment and the labour market, underlining the need to adapt through skill diversification. Amid all the political instability, the Arab region stands at a critical turning point that necessitates a shift towards economic diversification for long-term prosperity. At the core of this transformation is the need for a diversified skill set that sets the foundation for economic resilience, competitiveness and inclusive growth. To enhance economic resilience in the Arab region, a direct link between skill diversification and economic sustainability must be established. An economy that fosters diverse skill sets among its workforce is more flexible, adaptive and prepared to manage economic shocks. This is particularly vital for the Arab region, which has historically been reliant on oil and gas revenues. A diverse economy, supported by a skilled and multifaceted workforce, can pivot more easily in response to global economic shifts. Economic resilience is underpinned by the capacity of Arab countries to anticipate, prepare for, respond to, and recover from adverse situations. In the context of skills, this means investing in a wide range of skill sets that can ensure steady economic growth, even in the face of challenges. For instance, as the global economy evolves, sectors such as renewable energy, digital technology and e-commerce are gaining prominence. A skilled workforce in these sectors ensures that the region is not left behind in global economic shifts.

Diversified skills also lead to innovation, which is a key driver of economic growth. When individuals possess a varied set of skills, they bring different perspectives and approaches to problem-solving, leading to more innovative solutions. This innovation further propels economic growth by creating new sectors and employment opportunities. Investing in continuous learning and training programmes is therefore imperative. The Arab region can introduce re-skilling and upskilling programmes that focus on future-oriented skills, ensuring that the workforce is prepared for the jobs of tomorrow. Additionally, creating avenues for lifelong learning will guarantee that the workforce remains relevant, adaptive and ready to meet the demands of a constantly changing global market.

Skill diversification can also lead to greater economic inclusivity. By broadening the skill base, more segments of society, including women, marginalized communities and people with disabilities, can participate in the economy. Inclusive growth ensures that the benefits of economic progress are shared more widely across society, leading to greater social stability and cohesion. Below are key action points for policymakers that could enhance skill diversification in the Arab region:

Prioritizing economic growth is instrumental for skill diversification. Skill diversification, as a concept, has been the subject of significant research, especially concerning its impact on economic stability and growth. Economic diversification is defined as a mechanism for countries to protect themselves from the vulnerabilities associated with overreliance on a single sector or industry.[76] Extending this to the realm of skills, skill diversification ensures a resilient and adaptable workforce. A primary benefit of a diversified skill set lies in fostering innovation. Several studies have emphasized the positive relationship between

workforce diversification and innovative outputs. For instance, in their groundbreaking paper, Parrotta and others found that firms with employees from varied backgrounds and skills tend to produce a higher number of innovations.[77]

Skill diversification aids in economic risk mitigation. The World Economic Forum, in its 2020 Future of Jobs Report, highlighted the rapid evolution of job roles due to technological advancements. The report argues that diversified skill sets within a country's workforce function as a buffer against widespread unemployment, especially when certain job profiles face redundancy.

Analysing the Arab region provides some fascinating insights. Several studies, such as those by Noland and Pack,[78] have documented the efforts of countries such as the United Arab Emirates and Saudi Arabia in diversifying their economies, moving away from oil dependency. This transition is supported by a parallel shift in skills, emphasizing sectors such as tourism, entertainment and technology. The success of such endeavours is evident in reports from institutions such as ILO, which highlight higher skill mobility in these countries compared to others in the region.

However, a group of countries, notably Jordan, Lebanon, Morocco, Qatar, and Tunisia, seem to be lagging, with skills concentrated around limited job families, as observed in the ESCO dataset.[79] Such limited skill diversity can hinder these countries from capitalizing on new economic opportunities. Strategic partnerships can be a game-changer in this scenario. By bringing together the strengths of public institutions, private enterprises, and international organizations, countries can collaboratively chart a roadmap for skill diversification. For instance, "Jordan 2025", a strategic collaboration mentioned in a World Bank report of 2016,[80] seeks to diversify the country's economy and skill set.

Addressing labour market informality: Addressing labour market informality is crucial for a variety of reasons. Firstly, it offers protection to workers, ensuring that they are not exploited through unfair wages, excessive work hours or unsafe working conditions. By transitioning into the formal sector, workers can access essential rights and legal protection. Additionally, such a shift ensures that employees receive social benefits, such as health insurance, pensions and unemployment allowances. As informal businesses often operate on smaller scales and may lack the resources or credibility to expand, combating informality can bolster economic growth and development. The following are key areas that should help in reducing informality:

Streamlined registration: Streamlining the registration process for businesses has emerged as an effective strategy for encouraging formalization, with countries such as India, Indonesia and Liberia leading by example. By simplifying the bureaucratic procedures, they have managed to reduce entry barriers, making it more appealing for firms to formalize.

Tax incentives: Offering tax exemptions or reduced rates can motivate businesses to register. For instance, Colombia and the Philippines have introduced tax incentives, which not only reduce the financial burden on businesses but also motivate them to register and operate within the formal sector.

Access to markets: Strengthening supply chains and fostering linkages between the informal and formal sectors can help businesses experience growth and integration into larger marketplaces. E-commerce platforms and the reduction of regulatory barriers further amplify this integration.

Public awareness: The importance of public awareness cannot be understated. Campaigns in countries such as Mexico, Pakistan and Peru have been successful in highlighting the myriad benefits of formalization.

Recognizing prior learning aids the transition from informal to formal sectors: Strategies include practical trade tests, vocational training and community-based programmes.

Rethinking higher educational programmes: The evolving dynamics of the global job market have brought into sharp focus the need to adapt and redefine our traditional educational frameworks. While these structures have long served as the backbone for intellectual and professional growth, there is an increasing realization that they might not be wholly adequate to prepare students for the real-world challenges of the 21st century. As the essence of professions and the nature of jobs transform, so must the approach to imparting education, as follows:

Skills in education: Incorporating diversified skills within the academic landscape is not just an option but a necessity. A diversified skill set ensures that students are ready to tackle the myriad challenges in the job market, not only making them employable but also valuable contributors to their chosen fields. Now more than ever, universities and educational institutions must be agile in recognizing and responding to the evolving demands of industries.

Aligning education with market demand: Lebanon stands as a testament to the importance of aligning academic curricula with market demand. Educational policymakers in the country are in active dialogue with industry leaders to tailor courses that are relevant to real-world requirements. An emerging trend in this direction is the rise of microcredentials. These shorter, more concentrated courses provide students with specific skills in a shorter time frame, ensuring they remain adaptable and relevant to market demands.

Technical and vocational education: The global emphasis on TVET is gaining momentum. As highlighted by SDG 4.3, there is a concerted push towards ensuring that a significant portion of young people is trained in essential vocational skills. TVET does not just bridge the educational-employment gap; it sets the foundation for an entrepreneurial mindset, catalysing job creation and market diversification.

Revamping TVET systems: This process necessitates substantial investments in various areas such as facilities, technology, curricula, and teaching staff, and carries the potential for substantial benefits if executed effectively. Regional TVET funding has already demonstrated its value by supporting temporary or pilot improvements to TVET systems, yielding positive outcomes. However, for long-term sustainability, it is crucial to integrate these financial allocations into national budgets. In addition, the development of TVET curricula should involve consultation with the private sector to align with market needs. To facilitate this, the ESCWA Skills Monitor can play a vital role in assessing labour market requirements and ensuring curriculum updates accordingly. Furthermore, students benefit from practical experiences gained through internships, apprenticeships and dual systems that strike a balance between classroom education and on-the-job training.

Mentioning that TVET should be a choice that students aspire to and actively pursue, rather than a route they attempt to escape from: Enhancing the reputation of TVET necessitates adequate funding, as Arab Governments typically allocate more resources to the more prestigious general education track and universities. Limited funding is the primary reason TVET institutions struggle to employ trained educators and provide up-to-date technology. Other areas of reform in TVET financing include decentralized skill planning and budgeting, establishing production and service centres at TVET institutes, and implementing performance-based budgeting. Simplifying the transition between education tracks, with a focus on strengthening the vocational pathway, involves better integration of TVET into general education, establishing connections with higher education and introducing career counselling for TVET students.

Coordination platforms: It is imperative to create platforms where academia, governmental bodies and the private sector can come together to exchange ideas, share challenges and co-create solutions. The "Josour" initiative by ESCWA is a prime example of this collaborative spirit. Aimed at bolstering employability within the Arab region, Josour acts as a nexus between educational institutions and businesses, fostering an environment of mutual growth and learning. In essence, the global educational landscape is at a pivotal juncture. With the rapid changes in the economy and job markets, the transition to a more skill-focused, market-aligned curriculum is not just beneficial, but imperative. Through initiatives such as microcredentials, TVET and platforms such as Josour, there is hope that students will not just be well-educated, but also well-prepared for the challenges and opportunities of the modern world. This holistic approach to education, grounded and aimed at holistic development, promises a brighter future for all.

Encouraging innovation and entrepreneurship: As the world rapidly changes, fueled by technological advancements, the onus is on countries to adapt and evolve. By embracing innovation and entrepreneurship, countries such as Saudi Arabia are positioning themselves at the forefront of this evolution. With strategic visions such as Vision 2030 and initiatives such as those by ESCWA, the path forward is clear: invest in the future by investing in innovation, entrepreneurship and skill development, as follows:

Innovation and entrepreneurship: Fostering innovative start-ups can rejuvenate the job market. A prime example is the Vision 2030 of Saudi Arabia. This ambitious framework is not just about diversifying the economy away from its traditional reliance on oil but also about harnessing the energies of its youthful population in entrepreneurial ventures. The core of the Saudi Vision 2030 is built around stimulating the private sector. Through its objectives, it explicitly emphasizes the role of start-ups in creating job opportunities and driving innovation. By fostering an environment where start-ups can thrive, Vision 2030 aims to elevate the private sector's contribution to the GDP, ultimately diversifying revenue sources and bolstering economic growth.

The Arab region is aware of technological advancements: ESCWA is actively highlighting the pressing need for countries in the Arab region to align their educational outcomes with market demands. The ESCWA Skills Monitor initiative points to a discernible shift in the job landscape, driven by rapid technological advancements. As technology permeates all sectors, from agriculture to fintech, there is a growing demand for skills that are not traditionally part of academic curricula. This potential skill gap poses a challenge, and the Arab region is making strides in bridging it by adapting to these technological advancements. Additionally, the ESCWA Josour initiative is particularly noteworthy. Translating to "bridges" in Arabic, the Josour initiative is designed to serve as a bridge between talent and opportunity. With a focus on the Arab region, this programme is about more than just skill development. It is about ensuring that individuals are prepared for an evolving job market, one that values adaptability and a diverse skill set. The Josour initiative takes a multi-pronged approach, addressing both the supply and demand sides of the job market. On the one hand, it focuses on enhancing the skill sets of individuals, ensuring they are attuned to market needs. On the other hand, it actively bridges private sector stakeholders with young talent, facilitating mutual growth.

Investing in sectors such as AI and renewable energy, and supporting start-ups through incubators, such as the Digital Incubation Centre in Qatar, boosts technological innovation and regional growth: By engaging multiple stakeholders, from academia and the Government to the private sector, these incubators aim to create a nexus of knowledge transfer. They foster an environment in which innovative collaboration is the norm, not the exception. Particularly worth noting is the emphasis such platforms place on addressing specific challenges. In a rapidly digitizing world, the digital skill divide is real. Recognizing this, platforms under initiatives such as those of ESCWA are emphasizing both language and technical training. By doing so, they are ensuring that the workforce is not just equipped to compete but to excel in a globalized, digitized economy.

Creating coordination platforms that foster the strategic empowerment of local science, technology and innovation ecosystems. Platforms engaging academia, Government and the private sector aim to foster knowledge transfer and innovative collaboration, with emphasis on language and technical training to bridge the digital skill divide. Examples consist of the following:

Innovation council in the Arab region: This proposes an inclusive council focusing on collaboration, innovative financing, talent retention, and addressing regional language demands.

ESCWA Josour initiative: Launched to enhance employability in the Arab region, this programme bolsters skill set development, prepares individuals for the evolving job market, and bridges private sector stakeholders with young talent.

UNESCO Science Park initiatives: Under the broader umbrella of SDG 9, the commitment of UNESCO to develop science parks globally stands as a testament to the role of infrastructure in promoting innovation. For instance, the Lund University Science Park in Sweden is not just a hub for technological advancements but also supports sustainable industries, facilitating sustainable economic growth in alignment with the goals of SDG 9.

Triple Helix Model: Etzkowitz and Leydesdorff's triple helix[81] is more than just a model for science, technology and innovation (STI) coordination; it is a blueprint for inclusive and sustainable industrialization. By emphasizing collaboration between universities, industries and Governments, places such as Silicon Valley are not just advancing technologically but are also ensuring that the benefits of this growth are shared inclusively, resonating with the aims of SDG 9.

World Bank support for innovation clusters: With initiatives such as the Beirut Digital District, the

World Bank is promoting innovation and facilitating the creation of infrastructure where such innovation can flourish. This ties back to the core elements of SDG 9, which underscore the necessity of infrastructure in promoting innovation and industry.

African Innovation Foundation: In a continent that is keen on achieving the SDGs, the foundation's emphasis on creating innovation hubs and labs ties directly to the focus on SDG 9. By providing African innovators with resources and mentorship, these platforms are laying the groundwork for resilient and sustainable industrial growth in the region.

National innovation systems (NISs): Countries such as Denmark, as highlighted by Lundvall's discussion on NIS,[82] are not just promoting innovation for its sake. The alignment of Government policies, research institutions and industries ensures that the country's industrialization is both inclusive and sustainable, in line with the aspirations of SDG 9.

Asian STI initiatives: The investment of South Korea in research hubs such as the Daedeok Innopolis is more than just a nod to innovation. By creating spaces where research institutes and tech companies come together, South Korea is building the infrastructure necessary for sustainable industrial growth, mirroring the objectives of SDG 9.

Annex
Construction of each indicator in the Skill Demand Diversity Scores collection

This annex discusses the sampling and construction of each component in the collection of the skill demand diversity measures.

Sampling

Since the ESCWA Skills Monitor collected skill demand data from the online market only, it is necessary to consider whether the monitor sample could represent each country's skill demand. The countries monitored by the ESCWA Skills Monitor consist of significantly different economies, indicating that the online demanded jobs may not represent the same picture across countries.[83] Table A1 illustrates the number of vacancies and the variety of ESCO-normalized titles by country, as recorded in the monitor. For the occupation column, the ESCO titles only recorded once in a country were omitted for robustness of results.

Table A1. **Demand and ESCO titles observed in the ESCWA Skills Monitor between 2020 and 31 July 2023**

Country	Demand	Occupation
United Arab Emirates	835,212	2,676
Kuwait	399,592	2,442
Saudi Arabia	398,844	2,524
Egypt	268,126	2,291
Qatar	196,171	2,179
Lebanon	153,156	1,754
Oman	91,315	2,214
Jordan	56,503	1,731
Bahrain	52,788	1,633
Tunisia	40,872	1,307
Morocco	30,977	1,304
Iraq	24,939	1,215
Somalia	14,025	956
State of Palestine	12,453	413
Sudan	11,683	817
Algeria	9,355	730
Syrian Arab Republic	7,742	697
Yemen	7,679	5894
Libya	7,234	553
Mauritania	701	120

Although an economy does not necessarily possess all types of normalized occupations, a significant deficiency in observed occupations indicates that the online market only represents a subsection of an economy. The number of normalized occupations is also heavily dependent upon the number of vacancies observed in the market. The team used its own discretion and decided to use 30,000 vacancy observations as a threshold to exclude all countries below the line out of the analysis. This decision leaves eleven out of twenty countries to analyse in this report, namely, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, and the United Arab Emirates.

Component construction

Variety

The strong positive correlation between skill variety and demand, as shown in the right panel of figure 10 in the report, indicates that the observed skill variety per occupation cannot be directly observed from the country aggregate of distinct skills accumulated. A component that is heavily affected by demand can only be compared when the impact of demand is held as a constant. To obtain the skill variety, while excluding the impact of demand, a two-step method was used as shown below:

1. Estimate an overall trend line between the number of distinct skills and vacancies observed in the ESCWA Skills Monitor.

2. Use the difference between the estimated number of distinct skills and the actual number of the metric as the measure for variety.

To facilitate the first step, the team started by segmenting the vacancy dataset into various sample sizes. For each sample size, multiple random samples were taken, and for each of these samples, the number of unique skills mentioned was calculated. To ensure accuracy and reduce variability, this process was repeated multiple times for each sample size, allowing for the computation of an average count of unique skills. The number of iterations for each sample size was designated to accommodate both the calculation feasibility and robustness of the results, accounting for potential fluctuations, especially in lower sample sizes. Detailed increment segregation and iteration times can be found in table A2.

The iteration results were also compiled multiple times using the same criteria and then manually checked by the author to ensure the fluctuations between each batch of results were minimal. For larger samples, especially for the sample sizes greater than 300,000, the iteration times were reduced to ensure feasible calculation. Although the limited iteration rounds could theoretically cause stability issues in the results, manual checks conducted by the team showed that this issue was not a concern in this context. Using the sample segmentation and iteration method above, the team was able to obtain 57 sample average observation points for the trend line estimation.

Once these 57 averaged counts for all the sample sizes were obtained, the number of job vacancies was plotted against the count of unique skills. To better represent the pattern across all sample sizes in the ESCWA Skills Monitor data, a locally estimated scatterplot smoothing (LOESS) regression was used. LOESS is a non-parametric method that fits multiple

Table A2. **Sample segmentation and iteration for the variety trend line estimation**

Sample size range	Increment	Number of iterations	Number of sample averages obtained
0–1,800	200	50	10
2,000–80,000	3,000	30	27
100,000–320,000	20,000	10	12
340,000–500,000	40,000	5	5
600,000–900,000	150,000	3	3

Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.

regressions in localized subsets to produce a smoothed curve. In LOESS regression, the objective is to estimate the value of the dependent variable for a given independent variable, making use of the weighted contributions of all data points. In our context, the independent variable is the number of job vacancies, while the dependent variable represents the number of distinct skills.

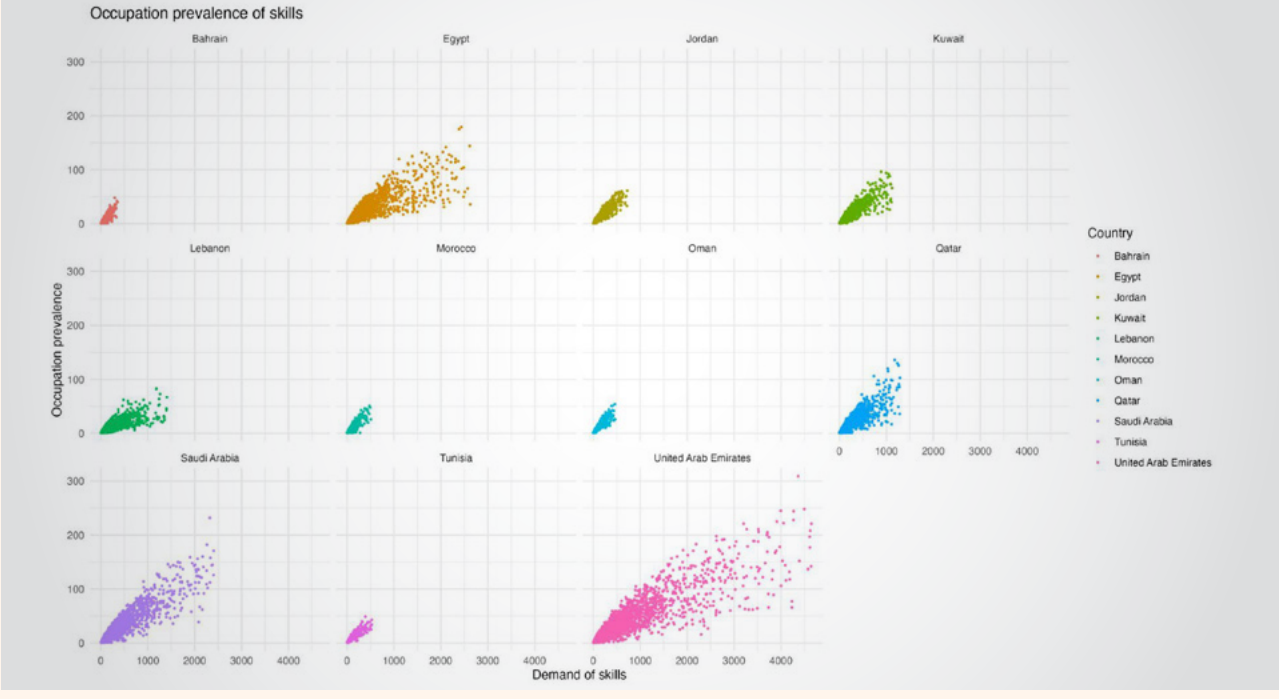
The LOESS estimate for the dependent variable is calculated as the weighted sum of all observed dependent variable values. The key component of the LOESS method is the determination of these weights, which are computed based on the proximity of each data point's independent variable value, to the point where the estimate is being made. Another fundamental parameter in the LOESS method is the span. It plays a significant role in determining the portion of the data that influences the local regression at any given point. The span's value can drastically alter the nature of the LOESS curve. Specifically, a smaller span renders the curve more sensitive to local data variations. In contrast, a larger span induces a smoother curve by diluting the influence of local fluctuations and focusing on broader trends. The span is chosen as 0.5 here in this analysis.

Finally, to quantify the variety measure for each country, we calculated the vertical distance between each country's data point and the LOESS curve. This distance represents how much the skill variety in a particular country deviates from the expected trend, given its number of job vacancies. The regional trend line naturally serves as an upper bound for each country, and the smaller the vertical distance is from the trend line, the more relative variety a country has in this study.

Mobility

The skill variety component indicates how many distinct skills are observed based on the occupations demand in the labour market. Skill mobility is a measure related to skill variety in a reverse way to study how many job families (defined by ESCO) are covered by each of the skills. To get an overall picture of the ESCO coverage of each skill in the countries, a scatterplot was created to show the relationship between the number of times each skill is demanded and ESCO coverage of each skill by country.

Scatterplot of skill demand and ESCO coverage



Source: ESCWA analysis and production based on data from the ESCWA Skills Monitor.

The figure shows that there is a strong positive correlation between occupation prevalence and demand for skills. To account for this, the total number of distinct ESCO occupations was used to correct the occupation prevalence observed on the vertical axis in the figure.

Indicator conditional on occupation

The last two components within the collection (future aspect and entropy) are calculated conditional on an ESCO occupation within the country first. The demand-weighted mean of values across occupations is used to calculate the component value for a country. Suppose X_{tc} is the indicator component for occupation t in country c, and the set stands for all occupations observed in country c. The component X_c is calculated as $X_c = \sum_{t \in T_c} \frac{D_{tc} X_{tc}}{\sum_{t \in T_c} D_{tc}}$, where D_{tc} stands for the demand of occupation t in country c. The skill diversity measure constructed this way can be interpreted as the average skill diversity of country c across its demanded occupations in the online labour market.

Future aspect

Similar to skill variety, the future aspect is calculated using $F_c = \sum_{t \in T_c} \frac{D_{tc}(F_{tc}/S_{tc})}{\sum_{t \in T_c} D_{tc}}$, so the results can be interpreted as the mean future-oriented skill percentage across demanded occupations.

Entropy

The final component of the composite indicator considers the balance of skills observed across its categories. To measure balance, the Shannon entropy term (E) is borrowed from information theory, which penalizes the imbalanced distribution of skills across different categories. The entropy of a vacancy t in country c is measured as $E_{tc} = -\sum_j p_{jtc} log(p_{jtc})$, where p_{jtc} refers to the percentage of skills demanded in occupation t in country c that falls under the skill subcategory j. It is the (discrete) expected value of the product between the percentage of skills and its logarithmic component. The upper bound of E_{tc} increases with the number of categories found in occupation t, thus creating different upper bounds for E_{tc} for the same occupation t across countries. To avoid the challenge in interpretation, we correct the E_{tc} term by $E_{tc}/log(445)$, where the number 445 stands for the number of skill subcategories that exist in the Lightcast skill taxonomy. Based on this correction and similar to the two other components, the entropy or the skill distribution balance component is constructed as $E_c = \sum_{t \in T_c} \frac{D_{tc}(E_{tc}/log(445))}{\sum_{t \in T_c} D_{tc}}$, which points to the mean entropy across observed occupations in country c.

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45. ILO, 2017.
46. The ISCO-08 job title taxonomy is a hierarchy created by ILO. The taxonomy classifies jobs into four different levels that encompass 436 unit groups, 130 minor groups, 43 sub-major groups, and 10 major groups. ESCO utilizes the same four-level hierarchy and further decomposes the 436 unit groups in ISCO-08 into 3,008 normalized titles.
47. The names of hard and specialized skills, and soft and common skills are used interchangeably in this report.
48. The fourth industrial revolution refers to a switch to a digital economy, and a process characterized by a fusion of technologies that is blurring the lines between the physical, digital and biological spheres (World Economic Forum, The Fourth Industrial Revolution: what it means, how to respond, 2016).
49. This number reflects the volume of vacancies the AI augmentation algorithm was able to assign a score to.
50. This includes reducing memory usage and computational time of the working machine when utilizing high-dimensional and sparse (most jobs only require a minor subset of all possible skills) matrix-form data.
51. There are 52 skills in the set of 221 non-zero coefficient skills which are demanded more than 10,000 times in the ESCWA Skills Monitor data.
52. The University of Auckland SDG Keywords Mapping.
53. Information shown here are the converted phrases from the semantic roots and expressions used in this exercise.
54. OECD and WTO 2019.
55. See World Bank, The Human Capital Project: Frequently Asked Questions.
56. Doloreux and Parto, 2005.
57. Cooke and others, 2000.
58. Asheim and others, 2003.
59. Chesbrough and others (ed.), 2006.
60. Jacobs, 1969.
61. Ikeda, 2020.
62. Chang and others, 2016.
63. Tajoli and Felice, 2018.
64. IMF, 2015.
65. Shrestha and Winkler, 2021.
66. Wang and Thangavelu, 2020.
67. Audretsch and Feldman, 2004.
68. Porter, 2000.
69. Hidalgo and Hausmann, 2009.
70. Diversity of products in the paper is calculated based on products the country has a revealed comparative advantage in.
71. Fiszbein, 2022.
72. Consider two scenarios: In scenario one, we have a more balanced distribution that includes three skills in programming, three skills in design, and two skills in marketing. In this case, $E \approx 1.08$ (using base 2 logarithm). In scenario two, we have six skills in programming, one skill in design and marketing each. Here, $E \approx 0.81$ (using base 2 logarithm).

73. The skill similarity is constructed as a normalized version of the Euclidean distance between two skill profiles in a metric space. The dimension of this metric space is determined by the variety of skills in an economy.
74. A force-directed algorithm called Graph OPT is used here.
75. Core skills are identified from the forest as follows: (1) ESCO job titles in the forest core are detected by evaluating the number of edges (links) associated with each ESCO node; and (2) the skills observed in the ESCO nodes placed in the core are aggregated to show the top 20 hard skills involved across these jobs.
76. Hesse, 2008.
77. Parrotta and others, 2014.
78. Noland and Pack, 2007.
79. European Commission, 2017.
80. World Bank, 2016.
81. Leydesdorff, 2012.
82. Lundvall, 2007.
83. The countries include Algeria, Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, State of Palestine, Qatar, Saudi Arabia, Somalia, the Sudan, Syrian Arab Republic, Tunisia, United Arab Emirates, and Yemen.

With the rapid integration of technologies like artificial intelligence in the labour market, the Arab region is at a critical turning point that requires a shift towards economic diversification. At the heart of this shift is the need for a diversified skill set that sets the foundation for economic resilience, competitiveness and inclusive growth.

The present report addresses the issues hindering economic diversification in the Arab region and the challenges that the region faces in the process of skills diversification. It showcases the most recent findings of the ESCWA Skills Monitor, highlighting the skills that are most in demand and those that are becoming obsolete while analysing whether the type of skills and jobs demanded in the region address the needs of the fourth industrial revolution and the new era. The report also introduces the Skill Demand Diversity Scores, which consist of four components that are used to assess the diversity of skill demand.

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