Fostering a Knowledge-Based Economy: The Role of Advanced LMIS in Realizing Qatar's Vision 2030

The Need for Advanced Labor Market Information Systems

Labor Market Information Systems (LMIS) generate and analyze a variety of information on labor market demand and supply, especially skills, and provide vital insights for employment, education, and immigration policies. However, traditional LMIS are limited in their ability to respond to the rapidly changing labor market dynamics of recent years in a timely manner due to limited data sources, integration challenges, lack of resources, and inadequate communication among stakeholders (1, 2, 3).

New technologies enable real-time data automation, advanced analytics, integrated platforms, and interactive interfaces. This facilitates data collection, analysis, and distribution to help overcome these challenges. A well-designed advanced LMIS provides enormous value, including detailed intelligence that identifies region-specific skill demands and emerging occupations (4, 5, 6). Some examples of technologies that can be used to extend and improve the LMIS are listed below:

- **Natural Language Processing**: Used to extract and analyze skill demands and occupational trends from unstructured textual data (e.g., job postings and job descriptions). It is used in a complementary way to traditional survey methods and serves as a new method to extend labor market analysis (2, 5, 6).
- **API Integration**: Allowing developers to directly access the data set and integrate it into other applications and/or services. Users can then share labor market data through open Application Programming Interface (APIs) (6, 8, 9).
- **Web Scraping**: Known as a technology that automatically collects information from the entire Internet (e.g., job portals and company websites) and converts unstructured data on the Internet into structured data that can be stored in databases (6).
- **Predictive Analytics**: Use of technologies such as big data analysis, machine learning and natural language processing (NLP) enable the uncovering of current trends and the estimation of future shifts (6, 10).
- **Cloud Platforms**: Serve as a central data repository for aggregating, producing, and distributing data such as job trends and initial carrier income in the LMIS. It will also be used to improve and expand the technical infrastructure (2, 6, 8).

- **Knowledge Graphs**: Structures and visualizes the entities associated with the labor market (e.g., jobs, skills, educational institutions, etc.) and their relationships. This allows information on market trends, demand for skills, and educational outcomes to be correlated and used for further analysis and decision-making (1, 11, 12).
- **Visualization Dashboards**: Provide visual displays of performance indicators and LMI (labor market information) to make data more accessible and in an intuitive, interpretable format so that even non-technical users can easily understand the information (9).
- **Conversational Interfaces**: Provides personalized career support and information 24 hours a day, 7 days a week, easing the burden on staff while ensuring quality interaction. In parallel, improving services in response to labor market trends and collecting data to help educators and other stakeholders understand employment trends (7, 10).

Such state-of-the-art technology can significantly overcome the limitations of traditional LMIS and the challenges currently faced by the labor market, bringing immeasurable value to all involved.

Therefore, in order to adapt to the rapidly changing recent labor market, countries need to develop an advanced LMIS with new technologies to provide timely and relevant information and support the formulation and implementation of effective employment policies. For countries that have not yet implemented LMIS, this is an opportunity to directly build an advanced system that leverages existing approaches and new technologies. For countries with traditional LMIS, modernizing their systems will provide an important springboard to respond quickly to change, develop a future-ready workforce, and ultimately attain more sustainable, equitable, and resilient socio-economy.

Advanced LMIS Critical for Realizing Qatar's National Vision

Qatar has an ambitious national vision to reduce its dependence on the hydrocarbon industry and transform itself into a citizen-centered, diversified, knowledge-based economy by 2030. This vision will be driven by investing in world-class infrastructure, building efficient public service delivery mechanisms, creating a highly productive skilled workforce, and developing entrepreneurship and innovation capabilities. This vision is elaborated comprehensively in the Qatar National Vision 2030, with the National Development Strategy outlining the specific goals and detailed implementation plans.

However, to successfully diversify beyond hydrocarbons, develop industries and human capital that are competitive on an international scale, and build a knowledge-based economy, multifaceted reforms and strategies must be effectively implemented. The complexities and challenges faced in this implementation cannot be overcome without access to robust, real-time labor market data and insights.

Over the past decade, Qatar has introduced several key and innovative reforms and initiatives across areas such as education, sustainable development, labor regulation, and e-governance. However, disparities and mismatches continue to persist, revealing ongoing significant challenges in various aspects as follows:

- Mismatch of skills of new graduates and employees against constantly evolving labor market demands due to industrial restructuring driven by digital transition.
- Uneven technology adoption and digital capabilities across sectors, across industries, and between local and international companies.
- Lack of legislation to attract high-skilled expats with world-class skills to compensate for the serious digital skills shortage.
- Insufficient growth of green industries, implementation of renewable energy, and sustainability practices to achieve Qatar's environmental goals.
- Lack of adequate legal protection and social safety nets due to the fact that gig workers are not defined in Qatar's labor law.
- Freeing migrant workers, who make up the bulk of the labor force, from exploitation and guaranteeing their rights and living conditions.

To address these complex and diverse challenges quickly and to develop an optimal skilled workforce that is aligned with Qatar's development goals, specific real-time labor market data and insights on local requirements and respective industries are needed:

- Ongoing monitoring of key economic and social outcomes and indicators combined with early identification of geographic, sector, and occupational skills mismatches including skill shortages, qualification mismatch, skill gaps.
- Forecast emerging skills gaps and reasonable future labor market trends in terms of human capital needs to enable decisions on educational priorities, immigration policies, and workforce training initiatives in line with changing labor market demand contexts.
- Identify the multifaceted impacts of LMIS practices, including new policies, reforms, and government interventions, on the labor market using data benchmarking, and seek to continuously improve the quality and applicability of labor market information.
- Comparing key indicators of labor market data, such as employment measures, employment-related variables, unemployment, and labor productivity, with regional peers and global standards through clearly defined taxonomies and classifications.

Without these real-time, granular information and actionable insights, Qatar will struggle to develop an evidence-based strategy that realizes its national vision. Therefore, implementing an advanced LMIS is critical for Qatar..

How LMIS Can Resolve Pressing Issues in Qatar's Labor Market

Advancing Localization and Education Reforms

Education is essential to producing talented Qatari professionals who meet the demands of the labor market. Qatar has made significant financial investments in the education sector, a major education reform, and a mandatory assignment of citizens to the private sector for Qatarization. While some progress has been made, global PISA rankings, the skills of graduates and labor market needs, and the employment preferences of Qataris in the public sector indicate that there are still gaps. Measures are needed to close these gaps:

- Regularly assess labor market needs and employability of graduates, the extent of skills imbalance, and skill levels, and improve educational strategies as appropriate.
- Institutionalize industry-academia-government partnerships to promote public-private collaboration to align education and training with dynamically changing labor market demands.
- Provide targeted incentives, campaigns, and visible role models to encourage youth participation in increasingly vital STEM fields.

Sophisticated analysis assessing graduate outcomes and the demands of a dynamic labor market will provide the information and actionable insights essential for effective education reform. Further transformation of a targeted education system is essential to realize Qatar's national vision.

Responsibly Assimilating Technology

Strategic adoption of emerging technologies and accelerated industrial automation are essential for diversifying Qatar's economy and enhancing its industrial competitiveness. Qatar boasts a strong digital infrastructure and government support for technology adoption. However, the technology maturity of the workforce is uneven and skill gaps between sectors still exist. Building an agile and innovative digital ecosystem requires a coordinated strategy focused on:

- Attract highly skilled technical experts from abroad and promote the professional development of local talent.
- Incentivize R&D initiatives to foster high potential technology startups in strategic sectors of digitization.
- Enact digital transformation policies to promote innovation along with protecting data security, ethics, and social welfare.
- Developing education and training programs tailored to specific technology needs and readiness for adoption in priority sectors through industry-academia-government partnerships.

- Utilize data and competitive benchmarking to identify initiatives that will have the greatest impact on economic diversification and guide the optimal allocation of investments in technology.

With prudent planning based on analysis of real-time, accurate labor market information, the new technology assimilation could bring enormous economic and human resource development benefits to Qatar.

Creating an Impactful, Sustainable Green Economy

Qatar aims to expand the adoption of renewable energy, sustainable infrastructure, green mobility, and circular economy principles in the context of its National Vision 2030. However, progress to date falls far short of achieving this sustainability goal, and a significant acceleration of efforts is needed:

- Solar power currently contributes only 7% of peak electricity demand, and the government has set a goal of meeting 30% by 2030. Grid integration and storage remain obstacles to increasing a stable supply of renewable energy.
- Recycling and waste management have made temporary progress driven by FIFA World Cup initiatives, but conservation behavior and sustainable consumption habits remain difficult to instill.
- Sustainable initiatives have the potential to create "green" jobs, but aggressive economic planning is essential to develop an internationally competitive industry for the inescapable post-hydrocarbon era.

Specific priorities include setting short-term carbon emission and renewable energy generation milestones, strengthening R&D and training in strategic sectors, and developing a national conservation awareness campaign to raise citizen awareness.

Responsible Evolution of the Gig Economy

On-demand digital platform-based transportation, delivery, and in-home service platforms are rapidly emerging in Qatar, offering flexible economic opportunities. However, as in many other countries, the lack of labor law provisions for this nascent sector has also created challenges, including lack of social security, income uncertainty, and ambiguity in employment status:

- There are virtually no reliable statistics on gig workers, but the proliferation of digital platforms is indicative of the rapid expansion of the gig economy.
- The unclear employment classifications allow platformers to bypass traditional labor protections and benefits provided by labor laws.
- Problems reported by delivery drivers include excessive long hours, nonpayment of wages, exclusion from health care and retirement plans, and income insecurity.

Beyond basic protections, innovative solutions such as portable benefits, which protect the well-being of employees in non-traditional occupational forms, can promote equitable and sustainable growth. Formalizing appropriate worker classifications can also provide essential rights and social safeguards under labor law.

Upholding the Rights of Migrant Workers

Low-cost migrant workers now make up over 94% of Qatar's labor force making them essential to underpin Qatar's economic expansion. However, they have traditionally been subject to exploitation through the kafala sponsorship system.

Despite progressive labor law reforms that have officially ended the kafala system, problems persist: forced labor, delayed payment of wages, lack of access to justice, unsafe living conditions, and exclusion from social protection. Stronger supervision, harsher penalties for violators, combating entrenched prejudices, and human-centered reforms focused on improving immigrant welfare are essential.

Nuances Around Persistent Labor Market Challenges

There continues to be a fundamental mismatch between the skills of graduates and those demanded by a competitive, knowledge-based economy. Heavy reliance on low-cost, temporary migrant workforce also contributes to the human capital gap. Local talent shortages exacerbate barriers to expanding the availability of professional private sector employment for the citizens.

Targeted nuanced strategies are imperative, spanning:

- Incentives and training programs specific to priority subsectors and occupations.
- Development and retention of highly skilled locals through educational reforms.
- Differentiated incentive structures by the private sector to hire, retain, and promote locals.
- Deep cooperation among government, industry, and academia to agilely tailor education, training, and skills to labor market demands.

Global Best Practices for Advanced, Insight-Driven LMIS

International case studies show proven approaches with technology implementation to build an advanced LMIS:

- **Australia (3, 6)**

  In recent years, there have been significant progress in the quality and timeliness of data in the Labor Market Information System (LMIS) in Australia. This progress has relied heavily on technological innovation and the development of data infrastructure. At its

heart is the Jobs and Education Data Infrastructure (JEDI), which serves as the platform for the labor market tools available online. It gathers information from a variety of data sources to provide insights that reflect real-time labor market trends.

Technological Innovations:

Labor Econometrics and ABS Data: Utilizing traditional labor econometrics methods, we analyze labor market trends and changes based on Australian Bureau of Statistics (ABS) data.

CGE modeling and nowcasting: We use Computable General Equilibrium (CGE) models to forecast the economy and estimate current market trends in real time through nowcasting.

Using Tableau: Partially automate the data analysis process with data visualization tools such as Tableau to enable rapid monthly reporting and visual presentation of data.

Big Data and Machine Learning:. Use big data techniques and machine learning methods (e.g., random forests, gradient boosting) to identify patterns from large data sets and make more accurate labor market forecasts.

Improvements related to organizational operations, policy development, and quality of service delivery:

JEDI: Providing online career tools for jobs and education through the development of JEDI. The combination of traditional LMI data sources and experimental data sets improves the timeliness of information.

Informing policy and strategy: LMIS provide guidance for policy decisions on skills migration, job training incentives, and allocation of funds for training.

Engaging Stakeholders: NSC and NCI promote the delivery and use of LMI through cooperation with government departments related to education, skills, and employment, educational institutions, and the private sector that provides employment and training.

Implementing User Feedback and validation: NSC conducts feedback surveys to measure LMI user satisfaction and continually improves its offerings.

The above improvements in technological tools, along with improvements in organizational operations, policy development, and quality of service delivery, have resulted in the advancement of Australia's LMIS. It is now able to provide real-time labor market data, supplying faster and more accurate information to local and international users. In addition, the accurate classification and analysis of data using ANZSCO's 4-digit codes forms an important foundation in the evolution of Australia's LMIS.

- **South Korea (4, 8)**

  The Korea Labor Market Information System (LMIS) is an advanced platform that provides a wide range of employment information and labor market analysis, focusing

on job matching to meet the needs of workers and employers. Korea's national employment portal Work-net exemplifies the evolution of basic LMIS capabilities into an advanced, integrated ecosystem over 20 years.

Technological Innovations:

Mobile and Big Data Services: Work-net has introduced mobile and big data services following technological advancements. This has increased the flexibility for users to access the site from anywhere, as well as the ability to efficiently process and deliver large volumes of job postings.

Introducing Chatbots and AI: Job matching using chatbot services and AI has enhanced the user experience along with the enhanced capability to quickly connect job seekers with the most relevant jobs.

Expanded Use of Open APIs: Open APIs promote accessibility and dissemination of information by providing labor market information to a large number of educational institutions and companies.

Data validation: Multi-step validation process is in place to ensure the accuracy of job postings, which ensures that only reliable information is provided through the system.

Improved technical infrastructure: the use of a cloud system for data storage on the platform allows for more efficient use of resources. The system can be expanded in the future.

Improvements related to organizational operations, policy development, and quality of service delivery:

Establishment of information hubs and improvement of technical infrastructure: Streamlining the information flow between various data sources and systems to enhance the foundation for service delivery.

Improved interoperability and creation of a master database: Improved data interoperability with other systems and the creation of a master database have centralized information on employment, skills, and job training. Users benefit from improved searchability and convenience.

Engaging Stakeholders: Cooperation with local governments and private sector has resulted in more localized services, with more job openings and job training information available in each region, and more options for users.

User feedback: User feedback contributes directly to service improvements and is used to increase customer satisfaction.

As described above, Korea has evolved from a basic offering of traditional web services to an LMIS with flexibility and advanced technology to meet the diverse challenges faced by users, such as mobile applications, big data, and AI-based services. In addition, the implementation of open APIs enhances connectivity with various stakeholders, including

educational institutions and private companies, and promotes information sharing and transparency in the labor market both locally and internationally.

- **Finland (6)**

  Finland's LMIS focuses on taking into account demographic changes and their impact on the labor market, anticipating the demand for skills into the future, and strengthening the ability of the education and training system to develop needed skills. The system is characterized by high national educational attainment and participation in lifelong learning.

  Technological Innovations:

  Utilizing the MITENNA Model: MITENNA model forecasts the future demands of the labor market and translates this into estimates of education provision. Through this model, gaps between education and labor market needs are identified and appropriate education programs and policies are developed.

  VOSE Project: VOSE has developed a model to predict future occupational competencies and skill needs. The model provides a means to identify specific skill needs at various levels of education, including vocational, technical college, and university education, and is incorporated into the qualitative forecasting process.

  Integration of Regional Forecasting: At the regional level, the National Education Department (EDUFI) regions combine national forecasts with their own regional development estimates to forecast educational needs. This provides the information needed for strategic regional planning and policy development.

  Skill Classification: Skill classifications have been developed with reference to ESCO and O*NET to identify new demands, such as digital skills.

  Improvements related to organizational operations, policy development, and quality of service delivery:

  Policy Planning and Organizational Role: The Ministry of Education and Culture (OKM) and the Ministry of Economy and Industry (MEAE) are responsible for coordinating the education system and the labor market, and establishing education and labor market policies based on changes in labor demand. This includes the use of the MITENNA model for skills forecasting and the provision of specific courses and programs, education funding, and adult training.

  Skills Forecasting Systems and Processes: Through skills forecasting forums and regional-level forecasting processes, MITENNA forecasts education and skills needs based on technological change and changing labor demand. This leads to planning to address regional needs, which includes the participation of various stakeholders and the implementation of education and training plans at the regional level.

  Stakeholder Involvement: The skills forecasting process involves a variety of stakeholders, including employers, labor unions, educational institutions, and

researchers, and regional consultations and sector committees provide multiple perspectives. In this way, LMIS builds a broad understanding of the needs of the labor market and education system to support effective policymaking.

Finland's LMIS uses advanced economic forecasting and education supply models to predict current and future labor market demand for skills and to adapt policies and education programs. Strong collaboration and use of data among government agencies, local governments, and other stakeholders play an important role in responding to labor market dynamics and meeting the education and job training needs of the citizens. The progress of the Finnish LMIS is supported by these measures and continuous feedback mechanisms.

- **United States- California (3)**

  California's integrated LMIS system links together data, services and users across multiple digital platforms.

  Technological Innovations:

  CalJOBS System: California's CalJOBS is an advanced online resource. The system facilitates the process of navigating the state's workforce services by allowing job seekers to search for jobs, build resumes, and access career resources. Employers can use the system to locate qualified candidates and gather information about education and training programs.

  Improvements related to organizational operations, policy development, and quality of service delivery:

  Partnerships: In California, the Employment Development Department (EDD), the California Workforce Development Board, and 49 workforce development boards that operate more than 200 occupational centers across the state work closely together. These agencies play a central role in providing employment services and analyzing labor market needs, helping to improve the quality and efficiency of services.

  Labor Market Information Department (LMID): LMID is the official source of labor market information in California, providing information to help users understand market trends and make appropriate career decisions. It collects, analyzes, and publishes critical economic data, including labor force trends, industry outlooks, occupational distribution, employment projections, and wage information that workers and businesses need to make informed decisions about the labor market. With this information, LMID contributes to California's economic development by providing useful data and insights to individuals and organizations making decisions about the labor market.

  These technical and organizational improvements have created the foundation for an efficient and effective California LMIS to meet the needs of the labor market and support the economic development of the state and the career advancement of workers.

- **Canada (6)**

The Labour Market Information System of Canada (LMIS) is operated in cooperation with the national Employment and Social Development Department (ESDC) and Statistics Canada. Canada has invested heavily in technology to transform its well-established LMIS from reliance on traditional surveys to an integrated real-time data system.

Technological Innovations:

Implementing a foundational LMI framework: Streamlining data collection and measurement of national occupational and competency information. These frameworks include the National Occupational Classification (NOC), the national standard for Canadian occupations, and the classification of skills and competencies developed to improve the comparison and application of skill concepts across occupations and sectors.

Development of the OaSIS system: The Occupational and Skills Information System (OaSIS), being developed by Employment and Social Development Canada (ESDC), will help users understand the competency descriptors used in hundreds of occupational profiles across Canada. OaSIS provides information on various measurement dimensions such as profile proficiency, frequency, importance, and duration.

Utilization of advanced data science methods: Canadian LMIS utilizes a variety of data science methods, including traditional methods of labor economics, CGE modeling, and big data analysis. This includes a combination of quantitative and qualitative methods and takes into account current, emerging, and future skill demands. Web scraping and taxonomy (methodological aspects) and interactive portals and mobile apps (presentational aspects) play an important role in data production.

Improvements related to organizational operations, policy development, and quality of service delivery:

System and Process Alignment: Canada is improving the alignment of its LMIS systems and processes. This includes the development of skill and competency classifications, enhanced collaboration among stakeholders, and cooperation with the National Statistics Office to close information gaps. This will facilitate the comparison of skills across different occupations.

Improved Access and Engagement: Investments have been made to increase the accessibility of LMIS and improve engagement. For example, ESDC's LMI could be consolidated on the Job Bank website for easy access by the general users.

Effective collaboration with stakeholders at the local level: Quebec collects detailed data on the labor market through a network of experts at the local level and uses this data to formulate education and immigration policies. This enables policies to be tailored to the specific needs of each region.

Strategic Goal and Plan: The Labour Market Information Council (LMIC) seeks to develop innovative LMIS and promote benchmarks and guidelines to improve the quality and

applicability of LMI. This strategic goal contributes to the overall effectiveness of the LMIS.

These improvements are the basis for making Canada's LMIS more accessible, more closely aligned with the needs, circumstances, and interests of its users, and more user-friendly.

Implementing a Advanced LMIS in Qatar - Key Considerations

There are issues to consider when a country like Qatar, which does not have an LMIS, attempts to implement an advanced system from the ground up. The implementation of the emerging technologies that support an advanced LMIS must be balanced with the variation in digital fluency among users.

Addressing Concerns for Smooth Adoption
Several concerns require proactive mitigation:

- Developing data science, AI, and analytics skills through a comprehensive digital professional development program across academia, government, and industry.
- Creating protocols and frameworks for interagency data sharing, coordination, and use, with reference to leading practices in pioneering countries, tailored to the Qatari context.
- To construct a user-friendly interface and customizable analytics tool that leverages conversational AI such as Chatbot. This will allow stakeholders without technical expertise to access insights.
- Planning for transition assistance and change management for public sector roles affected by automation associated with technology implementation. At the same time, minimize job losses through worker reskilling.
- Implementing robust cybersecurity initiatives to maintain privacy as increasing data collection and integration.
- Establishing clear governance and supervisory mechanisms from the beginning to allow for effective cross academic, government, and industry coordination.

Strategic Steps Toward Digital Empowerment
While Qatar has a well-developed infrastructure, its response to digitalization has been uneven. A balanced approach can facilitate the adoption of advanced LMIS:

- Making it customary to build digital skills from early education through launching or updating training programs for data analytics, AI literacy, and cybersecurity skills acquisition.

- Initiating a small-scale LMIS pilot focused on priority issues to demonstrate its benefits and allow for phased implementation to eventually build a comprehensive LMIS.
- Filling niche skill gaps by temporarily expanding the highly skilled expats quota while strengthening the localization program through educational reforms.
- Providing extensive on-the-job training and support to users on emerging technologies such as machine learning and data visualization.
- Evaluating the results of LMIS through benchmarking and other means. Refine the system based on lessons learned and ensure continuous improvement.

High Value Use Cases for Implementing an Advanced LMIS in Qatar

---

Based on Qatar's strategic economic and social priorities, some potential high-value LMIS use cases include:

- Identifying priority sectors and employers with the largest skills mismatches between available Qatari talent and required competencies to focus specialized reskilling programs.
- Using GIS, identify priority regions and industries for Qatarization policy through mapping the distribution of Qataris and their employment status by industry. It will also visualize the gap between skill demand by region and worker skills, providing a geographic indication of the need for education and training.
- Creating models of optimal countries of origin for each sector to facilitate the attraction of high-skilled expats to meet the demand for high-skilled jobs in priority economic sectors such as ICT, health care, and education.
- Utilizing business intelligence tools to analyze online job data, we identify gaps between the skill sets of new graduates and the dynamic skill demands of the labor market on a job-by-job basis. With the timely information gained from this process, institutions can tailor their curricula to labor market demand, new graduates can learn the skills required for employment, and employers can use this information to train their workforce.
- Evaluating the impacts of policies such as payroll subsidies, training taxes, and localization ratios on labor force localization in private sector industries. To collect and analyze relevant large-scale data, discuss forecast scenarios with a expert team, and work with local stakeholders to incorporate feedback to simulate long-term labor market trends. This will allow projections of how policy adjustments will affect labor force localization goals.
- Monitoring key indicators (renewable energy generation, traffic modal split, water use per capita, recycling rate, etc.) in line with the sustainability goals of the Qatar National Vision 2030.

Conclusion

Qatar faces significant challenges in developing a sustainable, diversified economy and a globally competitive local workforce. As this report outlines, the implementation of an advanced LMIS using new technology can provide real-time insights essential for the formulation of evidence-based economic and social policies. This is implicated that the implementation of an evolutionary LMIS is essential to strategically build an optimally skilled workforce that is essential to realizing Qatar's national vision by 2030.

References

---

1. Groot, M.D., Schutte, J., & Graus, D. (2021). Job Posting-Enriched Knowledge Graph for Skills-based Matching. *ArXiv, abs/2109.02554*. https://doi.org/10.48550/arXiv.2109.02554
2. Alibasic, A., Upadhyay, H., Simsekler, M.C.E. et al. Evaluation of the trends in jobs and skill-sets using data analytics: a case study. J Big Data 9, 32 (2022). https://doi.org/10.1186/s40537-022-00576-5
3. Kjartan Sorensen and Jean-Michel Mas. (2016). A ROADMAP FOR THE DEVELOPMENT OF LABOR MARKET INFORMATION SYSTEMS. FHI360. https://www.fhi360.org/sites/default/files/media/documents/resource-lmis-system-roadmap.pdf
4. B. Panth and R. Maclean (eds.), (2020). Anticipating and Preparing for Emerging Skills and Jobs, Education in the Asia-Pacific Region: Issues, Concerns and Prospects 55, https://doi.org/10.1007/978-981-15-7018-6_33
5. Ketamo, H. & Passi-Rauste, A. (2019). Headai together with The World Bank: Labor market analysis and curriculum gap assessment using big data in Kenya. Final report for the World Bank project.
6. Barnes, Sally-Ann and Hogarth, Terence and Wright, Sally and Baldauf, Beate and Cárdenas-Rubio, Jeisson and Ragnarsdottir, Hrafnhildur and Elmezraoui, Wafaa, Department for Education (DFE), corp creator. (2023) Labour market information and an assessment of its applications: a series of international case studies : Research report : February 2023. https://dera.ioe.ac.uk/id/eprint/39710
7. CiCi, the 24/7 careers chatbot. 2021. OECD. 16/05/2023. https://www.oecd.org/stories/odicy/practices/cici-the-24-7-careers-chatbot-9ccfd77d/
8. Toward a World-Class Labor Market Information System for Indonesia. (2021). Mauro Testaverde and Josefina Posadas. World Bank Group. World Bank Group's Social Protection & Jobs Global Practice. https://openknowledge.worldbank.org/bitstream/handle/10986/35378/Toward-a-World-Class-Labor-Market-Information-System-for-Indonesia-An-Assessment-of-the-System-Managed-by.pdf?sequence=1&isAllowed=y
9. Edgardo Greising, Shutong Ding and Weichen Lei. (2023). Room document*: 27. Labour Market Information Systems (LMIS): Maximizing the potential of labour market data and analysis for effective policymaking. International Labour Organization.

https://www.ilo.org/wcmsp5/groups/public/---dgreports/---stat/documents/meetingdocument/wcms_896178.pdf
10. Stefano Scarpetta. (2023). Artificial Intelligence and Labour Market Matching. DIRECTORATE FOR EMPLOYMENT, LABOUR AND SOCIAL AFFAIRS EMPLOYMENT, LABOUR AND SOCIAL AFFAIRS COMMITTEE. OECD SOCIAL.
11. Wenliang Cheng et al. A Knowledge Graph Based Framework in Relationship Modelling and Real-time Monitoring of Market Participants. 2020 J. Phys.: Conf. Ser. 1682 012026. https://doi.org/10.1088/1742-6596/1682/1/012026
12. Dorodnykh, N., & Yurin, A. (2023). Knowledge Graph Engineering Based on Semantic Annotation of Tables. Computation, 11(9), 175. https://doi.org/10.3390/computation11090175