Labour market information and an assessment of its applications: a series of international case studies

Research report

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Please note that the views expressed in this report are those of the authors' and do not necessarily reflect those of the people interviewed as part of this research, or those of the Department for Education.

Acknowledgments

Acronyms

ABS	Australian Bureau of Statistics
ACSF	Australian Core Skills Framework
AITSL	Australian Institute for Teaching and School Leadership
ALMP	Active labour market programme
ANZSCO	Australian and New Zealand Standard Classification of Occupations
API	Application Programming Interface is an interface that enables data to be made accessible to developers through a set of functions and procedures. It allows the data to feed into another application or service.
ASC	Australian Skills Classification
BA	Federal Employment Agency (Bundesagentur für Arbeit), Germany
BiBB	Federal Institute for Vocational Education and Training (Bundesinstitut für Berufsbildung), Germany
BICS	Business Insights and Conditions Survey, Scotland
BMAS	Federal Ministry for Labour and Social Affairs (Bundesminiterium für Arbiet und Soziales), Germany
BMBF	Federal Ministry of Education and Research (Bumdesministerium für Bildung und Forshung), Germany
BMO	Besoins en Mains D'œuvre (labour requirements), France
BMWK	Federal Ministry for Economic Affairs and Climate Action (Bundesministerium für Wirtschaft und Klmiaschutz), Germany
CASD	Le Centre D'acces Securise aux Donnees (secure data hub), France
CATI	Computer-aided Telephone Interview
CCA	Chamber of Trade (Les cadres communautaires d'appui), France
CCI	French Chambers of Commerce and Industry (CCI de France), France
CEDEFOP	European Center for the Development of Vocational Training (Centre Européen pour le Développement de la Formation Professionnelle)
CEP	Prospective Study Contracts (Contrat d'Études Prospectives), France
Céreq	Centre for Studies and Research on Qualifications (Centre d'études des Recherche sur les emploi et qualification), France
CICA	Career Industry Council of Australia
CLMI	Centre for Labour Market Information, Statistics Canada
CNRACL	The National Pension Fund for Local government agents, France
COE	Council for Employment (Conseil d'Orientation pour l'Emploi) part of France Stratégie, France
COPS	ESDC's Canadian Occupational Projection System

DARES	Organisation of the Directorate for the Animation of Research, Studies and Statistics, Organisation de la direction de l'animation de la recherche, des études et des statistiques, France
DESE	Department of Education, Skills and Employment, Australia
DGEFP	General Delegation for Employment and Vocational Training (La délégation générale à l'emploi et à la formation professionnelle), France
ECLAC	Economic Commission for Latin America and the Caribbean
EDUFI	National Agency for Education, Finland
EFAM	Expert group for labour market issues in Sweden
ELMLP	Education and Labour Market Longitudinal Platform (LMIC), Canada
ELY Centres	Centres for Economic Development, Transport and the Environment, Finland
EPRI	Education Policy Research Initiative, Canada
ESCO	European Skills, Competences, Qualifications and Occupations
ESDC	Employment and Social Development Canada
ESDC Taxonomy	Skills and Competencies Taxonomy of Employment and Social Development, Canada
Etalab	Public data base on labour market data (data.gouv.fr).
ETF	European Training Foundation
FLMM	Forum of Labour Market Ministers, Canada
FPR	Production des Recherche, France
FSC	Future Skills Centre/Centres des Competénces futures
GPEC	Prospective Management of Jobs and Skills (Gestion Prévisionnelle de l'Emploi et des Competénces), France
GWS	Institute of Economic Structures Research, Germany
HESA	Higher Education Statistics Agency, UK
HIE	Scottish Enterprise, Highlands and Islands Enterprise, Scotland
HRSDC	Human Resources and Skills Development Canada
IAB	German Institute for Employment Research (Institut für Arbeitsmarkt- und Berufsforschung), Germany
IFAU	Institute for Evaluation of Labour Market and Education Policy (Intitutet för Arbetsmarknads- och Utbildningspolitisk Utvärdering), Sweden
IMT en ligne	Emp loi- Québec (Province) LMI Online, Canada
INSEE	The National Institute of Statistics and Economic Studies (L'Institut National de la Statestique et Des Études Économiques), France
IRCANTEC	Institution for Supplementary Retirement for Non-Tenure State and Public Authority Agents, the Public Supplementary Pension which applies to employees of the State civil service, local authorities, and hospitals as well as other public employers.
ISCO-08	International Standard Classification of Occupations, endorsed by ILO in 2008

IVI	Internet Vacancies Index, Australia
JEDI	The Jobs and Education Data Infrastructure, powers online tools: Job Switch, Jobs Hub, Your Career, Australia
Job Active	An Australian-Government funded network of organisations that are contracted by DESE to deliver employment services to unemployed jobseekers on income support payments and employers.
Job Bank	ESDC's main LMI portal, including job board and other labour market information, Canada
LEO	Learning and Education Outcomes data, UK
LFS	labour force survey
LMI	labour market information
LMIC	Labour Market Information Council (Canada)
LMIS	labour market information system
MEAE	Ministry of Economic Affairs and Employment (työ- ja elinkeinoministeriö), Finland
NACE rev 2	Statistical classification of economic activities (2002)
NCI	National Careers Institute, Australia
NCRIS	National Collaborative Research Infrastructure Strategy, Australia
NCVER	National Centre for Vocational Education Research, Australia
NEIS	New Incentive Scheme, Australia
NERO	Nowcast of Employment by Region and Occupation, Australia
NIER	National Institute of Economic Research (Konjunkturinstitutets), Sweden
NOC	National Occupational Classification, Canada's national system for describing occupations, Canada
NLP	natural language programming
NRS	National Records of Scotland
NSAP	National Stakeholder Advisory Panel (LMIC), Canada
NSC	National Skills Commission, Australia
NUTS	Nomenclature of territorial units for statistics is a hierarchical system for dividing up the economic territory of the EU and the UK. For more information see NUTS 2021 classification
NWS	National Skills Strategy (Nationale Weiterbildungsstrategie), Germany
O*NET	Occupational Information Network (United States)
OaSIS	ESDC's Occupational Skills and Information System, Canada
OECD	Organisation for Economic Cooperation and Development
OKM	Ministry of Education and Culture (opetus- ja kulttuuriministeriö, OKM), Finland
ONS	Office for National Statistics, UK Statistics Authority
OPQM	Observatories of prospects of trades and qualifications (Observatoires Prospectifs des Métiers et des Qualifications), France

OREF	Regional Employment and Training Observatories (Observatoires Regionaux de l'Emploi et de la Formation), France
PES	public employment service
PGPA Act	Public Governance, Performance and Accountability Act 2013, Australia
PIAAC	The OECD's Programme for the International Assessment of Adult Competencies
Placement en ligne	Emp loi- Québec (Province) labour market information site, Canada
POEM	Employment policies (Politique de l'emploi), France
PSIS	The Post-secondary Student Information System, which includes records of college and university students' programs, credentials, and fields of study, Canada
QAA	Scotland Quality Assurance Agency, Scotland
QuBe	project focusing on qualifications (Qu) and occupations (Be) in the future, Germany
RAIS	The Registered Apprenticeship Information System, which includes records on registered apprentices and trade qualifiers in apprenticeship programs, by designated trade, Canada
REC	French Employment and Skills Network (Réseau Emplois Competénces), France
REOS	Recruitment Experiences and Outlook Survey, Australia
RNCP	National Directory of Professional Certifications, France
ROME	Operational Directory of Trades and Jobs (Répertoire opérationnel des métiers et des emplois), France
RSA	Regional Skills Assessments, Scotland
RTO	Registered Training Organisation, Australia
SA1/SA2	Statistical Area Level 1/Statistical Area Level 2 (used in Australia)
SABS	Scottish Annual Business Statistics, Scotland
SALM	Small Area Labour Markets (used in Australia)
SAWEE	Swedish Agency for Work Environment Expertise, Sweden
SCB	Statistics Sweden (Statistikmyndigheten), Sweden
SCQF	Scottish Credit and Qualification Framework, Scotland
SDS	Skills Development Scotland
SFC	Scottish Funding Council, Scotland
SLAED	Scottish Local Authorities Economic Development, Scotland
SLS	The Scottish Longitudinal Study, Scotland
SPE	French public employment service (Service Public de l'emploi), France
SPIE	Public Service of Integration and Employment (Service public de l'insertion et de l'emploi), France
SPREE	Structure Preserving Estimation method, Sweden
SQA	Scottish Qualification Agency, Scotland
STC	Statistics Canada

Swedish ESF Council	Council for the European Social Fund in Sweden
T1FF	The T1 Family Files, which are tax files that include information on labour and non-labour income, industry of work (3-digit NAICS), the North American Industry Classification System), as well as indicators such as Employment Insurance and social assistance support. (Canada)
UCAS	Universities and Colleges Admissions Service, UK
URSSAF	National insurance contribution by employees and employers, France
VET	vocational education and training

Executive summary

Many countries over recent years have invested in their labour market information system (LMIS) to serve an array of policy interests and support a range of stakeholders and users. LMIS have been defined as having three main functions:

- Responsible for labour market analysis;

- Responsible for monitoring and reporting on employment and labour policies;

- Provides a mechanism to exchange information or coordinate different actors and institutions that produce and utilize labour market information and analysis' (Sparreboom, 2013, p. 258).

LMIS bring together various available data on labour market demand and supply, particularly on skills. Data have traditionally included administrative and survey data, but new big data analytics offer possibilities to enhance and enrich existing data and current LMIS.

The UK government and various agencies have been expanding and experimenting in the way data are collected, analysed, and disseminated by exploring and taking advantage of opportunities presented by advances in technology, data linking and big data analytics. The Department for Education and its newly formed Unit for Future Skills have, in particular, been looking at ways to improve England's LMIS, namely the data infrastructure around skills and jobs. The aim of which is to enable actors in the skills system to make informed decisions and therefore help people attain fulfilling jobs and improve the nation's productivity.

The Unit for Future Skills commissioned the Institute for Employment Research at the University of Warwick to provide a comprehensive overview of the different approaches to gathering and using labour market information (LMI) and intelligence. Overall, the **aim** was to explore international LMIS to investigate practice around gathering, processing, analysing and disseminating LMI and intelligence, and how it is used to identify skills supply and demand – and mismatches – in both the present and future. It focused on:

- What LMI is collected, by whom, from what sources, and how?

- How LMI is processed, analysed, and used to identify and project future skills needs?

- Whether LMI is disseminated to the various actors involved, and if so, how do they use it to inform skills policy and delivery?

- How effective are these information systems at informing skills policy and delivery decisions?

- What are the important factors within the organisational infrastructure that contribute to strengths and weaknesses of these systems?

- What lessons, principles, or ideas can be applied from the case studies to the England context?

A case study design **methodology** was adopted for this research which included a combination of desk research and interviews. Seven international case studies were undertaken with Australia, Canada, Finland, France, Germany, Scotland and Sweden. An eighth case study was undertaken drawing together international practice around using big data in national LMIS. In total, 44 interviews were undertaken with policy makers, LMIS experts and a range of stakeholders. Three workshops with a total of 55 participants were organised to review findings and discuss transferability of practice to the England context.

An **analytical framework** was used to gather information and data on each country LMIS studied. The framework comprised the following dimensions of analysis: organisation and management of LMIS; resourcing of LMIS; stakeholder engagement in LMIS; plus dissemination. An assessment of the LMIS examined in terms of informing policy, stability and transferability of LMIS approaches and learning was also undertaken.

Operation and structure of international LMI systems: main findings

Organisation and management of LMIS

The organisation and management of LMIS were examined in terms of the legal and institutional framework in operation. It is important to note that in the countries studied all had established systems with well-developed processes for collecting, analysing and disseminating LMI. It was, therefore, expected that legislation and frameworks would be embedded within the overall national systems examined. As part of understanding the foundation of LMIS in different national contexts, the management and organisation of LMIS were examined together with associated vision and strategy documents.

A combination of institutions with legal responsibilities, e.g., ministries/departments, statutory bodies, government departments/units, organise and form a constituent part of the LMIS. Where there is collaboration and cooperation between these institutions to support data collection, sharing and dissemination, this produces a strong and coherent LMIS (e.g., in Australia there is a shared data infrastructure, and in Finland there is close collaboration in data collection and interpretation at a local and regional level). For example, collaboration was found to take place in local and sectoral forums, as well as through legislated partnerships. This benefits stakeholders who can not only access current, high-quality information, but can also feed into the data and analyses to improve understanding and support translation of information into intelligence (e.g., in Scotland regional forums review LMI and contextualise for the local context).

Where legislation is in place, it serves to manage the LMIS, guide data collection and dissemination, and set out resourcing which creates a stable LMIS.

There are number of examples (e.g., Germany, Sweden) where the public employment service (in the UK this would be the Department for Work and Pensions) is a key player in terms of data collection, analyses and dissemination to policy makers. These data are useful within a LMIS as it can provide current data on demand and supply.

Those countries studied with a clearly documented strategy developed in collaboration with a range of institutions were found to have improved data systems, particularly around innovations in data collection (e.g., in Sweden vacancy and skills data are regularly being collected from employers). The vision of LMIS, when in place, is to improve the quality, currency and coverage of data collection, and ensure it is accessible and aligns to stakeholder needs. Dissemination plans are often at the heart of vision statements with a focus on end-users in the LMIS. Plans are variously centred on dashboard and application developments such as in Scotland.

Resourcing of LMIS

The resourcing of LMIS was broadly examined with a focus on funding arrangements in place for establishing and maintaining the LMIS, as well as methods and expertise used in developing and disseminating data.

All of the countries studied have allocated budgets from central government for their LMIS, but those with longer-term funding tend to have more detailed work plans and established systems of data collection and dissemination, which enable innovation to enhance the functionality of the LMIS. Examples of this include Canada analysing online job vacancy data, Sweden enabling access to data using application programming interfaces (API) and France developing apps for users. Often the innovation or experimental data collection itself is developed with limited, short-term funding, or drew upon other national funding sources to resource such as in Sweden who are drawing on alternative funds to pilot data collection from educational institutions.

Methodologies of LMIS

Across the countries studied a range of data science **methods and techniques** are being used, with quantitative methods (including labour econometrics and modelling) being common across all. Qualitative methods are less evident in the countries studied and more likely to be used for horizon scanning, feedback and validation of quantitative analyses, understanding occupational skills requirements, and for contextualising LMI, particularly at the local level. For example, local forums in Finland and Scotland comprising a range of stakeholders are brought together to examine and contextualise LMI to improve understanding and decision making. Multimethod approaches to data collection and analyses provide a richer, or more nuanced, understanding of the labour market as seen in Australia's system.

New techniques for data collection and analysis are being used across the countries studied with web scraping and natural language programming (NLP) now common to enhancing data available (e.g., Australia, Canada, Germany, Sweden). These advances

are also enabling new methodological techniques (e.g., nowcasting in Australia and Germany) and dissemination possibilities (e.g., in terms of dashboards, accessible repositories and application developments in Australia and France).

There is great interest in skills taxonomies, but significant resourcing is needed to ensure a taxonomy is relevant, current and useable.

Australia and Canada were the only countries studied that have had recently developed and embedded national skills taxonomies within their LMIS. New techniques around big data had supported the development and/or refinement of a skills taxonomy. Other countries studied were in the process of developing a taxonomy (as reported in Sweden). Skills taxonomies were noted as a particular challenge by many but considered a crucial part of understanding skills demand and supply.

Data are being stored in repositories and being made accessible via customisable dashboards and/or through APIs to some extent in all the countries studied (e.g., France and Australia have established repositories, and APIs are driving applications benefiting end-users and key stakeholders in the LMIS).

Stakeholder engagement in LMIS

Cooperation, collaboration and engagement with stakeholders in the countries studied were analysed, including the processes for feedback and validation. It was important to examine whether, and if so, how stakeholder needs are integrated into the LMIS. Stakeholders are broadly defined here to include: policy makers, education and training providers, public/private employment services, career guidance and counselling services, researchers/analysts, local authorities, trade unions, sectoral bodies and professional associations. In some instances, stakeholders include end-users in a LMIS (such as young people, the unemployed, recipients of employment services, etc.) who may use the LMI and intelligence disseminated in the LMIS.

Cooperation and collaboration between the various stakeholders in the countries studied is seen as a key mechanism that needs to be in place to support communication, enable feedback and share knowledge. When in place, it supports the development and maintenance of a coherent LMIS as stakeholders are actively invested in enhancing the system. This can lead to enhanced data collection (such as having shared taxonomies enabling opportunities for data linking in Australia and Canada) and data sharing, allowing for minimal duplication (such as in Australia, Finland and Germany). In Australia and Canada, a collaborative approach to the development of a national skills taxonomy ensured that it was embedded across the LMIS and used as a standard classification to collect data.

Where stakeholders feed into LMIS, they had an important role in transforming and translating LMI into intelligence. Stakeholders were found to support understanding, provide contextualisation and validate data and analyses (e.g., in Finland and Scotland sectoral and occupational forecasts were validated at a regional and local level by

experts). In many instances, labour market and sector experts provided knowledge to support data collection methods and analyses.

In the majority of the countries studied cooperation and collaboration between the various stakeholders was ad hoc and undertaken for particular purposes, such as validating data or reviewing a tool or application.

Dissemination

An analysis of LMIS dissemination activities was undertaken for each country studied focusing on the presentation, customisation and interpretation of LMI.

Technical advances in terms of data collection and analyses, alongside more data becoming accessible has resulted in greater dissemination opportunities for the countries studied. New data infrastructures are key to these opportunities (e.g., in Australia, the Jobs and Education Data Infrastructure (JEDI) powers a number of online careers tools). National LMIS have been enhanced by these advances in terms of what, how and when data can be made accessible. Within an LMIS, the target audience(s) and the purpose of making data available should be clearly defined in order to ensure the LMIS is both relevant and useful.

Dashboards displaying data from the LMIS are increasingly being used to make data accessible in all the country case studies. They are supporting greater dissemination opportunities in terms of how data are visualised and how a user can personalise and customise what and how data are shown.

There was little to no training identified in the countries studied to support stakeholders in the interpretation of LMI and data. Where training was in place, this tended to be ad hoc and on a needs only basis. Canada was in the process of launching a certified LMI training course and the only country studied where this type of support was being made available.

Comparative overview of international LMIS

A comparative overview of the dimensions (namely: organisation, resources, stakeholders, and dissemination) and particular characteristics identified in the countries studied was undertaken. It suggested that certain features are present in developed and established LMIS but were not necessarily common across the countries studied. In combination, these arguably provide a foundation in which countries can build upon to enhance their LMIS. Stakeholders suggested that these characteristics were key strengths of their LMIS and arguably enhanced their LMI and intelligence. These included:

- Coordination between actors in terms of data collection and dissemination to ensure a coherent and consistent system;

- Forums and expert panels (at local or sectoral level) convened to interpret and contextualise data and support horizon scanning to understand future occupational and skills demand;

- Support and training in the interpretation of LMI for education and training institutions, employers and end-users in an LMIS is provided; and

- A national skills taxonomy has been developed and embedded within and across the LMIS to provide a framework in which data can be collected, analysed and presented.

Enhancing LMIS with big data and new techniques to obtain data on emerging skills needs

The study reviewed new techniques and processes for obtaining data on emerging skills needs. Three international cases are presented which illustrate how these techniques are being applied to understand skills in the labour market. Each offer new data and intelligence:

- In the first case study, job vacancy data are analysed to understand occupational distribution and identify skills demands;

- In the second, data from job vacancies and jobseekers' profiles are analysed to understand skills supply, demand, and mismatches in the labour market;

- In the final case study, patent data and bibliographic data are analysed to identify emergent skills in particular sectors.

The aim of these new techniques was to enhance or complement existing approaches to understanding and analysing skills.

Surveys, official statistics and quantitative forecasts can provide the broad quantitative framework for thinking about current and future skill needs. While new techniques offer something new to skills analysis, being able to identify the scale and structure of skill demands still relies on more traditional approaches, such as sample surveys. As such new techniques should be seen as a complement rather than a substitute to more traditional approaches.

The advantages of these new techniques are that they provide substantial detail on the skills required in particular occupations or jobs, which would otherwise be too difficult to collect and analyse via other means. Data collected are often timely reflecting a current picture of the labour market. Significantly, new techniques are able to identify the emergence of new clusters of skills, which might suggest new types of occupations or skills that are beginning to emerge.

However, these new techniques also have weaknesses as they are relatively untested and are subject to further development, as such: the accuracy and representativeness of

data are difficult to determine, because an estimate of the total number of vacancies is yet to be produced; and processes are complex and open to error. The means that the validity and coherence of results need to be checked by various stakeholders.

Key to developing these techniques to enhance a LMIS is to ensure approaches are transparent and open, so results are credible but also that there is opportunity for shared learning to improve approaches.

Recommendations

In summary, all countries studied have made significant progress in terms of improving data quality, granularity, timeliness, customisation and accessibility. Innovations in terms of methodology and dissemination provide interesting examples of potential future enhancements to England's LMIS. Based on the lessons, principles, and ideas evident in the case studies, a number of recommendations are identified that can be applied to the England context, and potential partners to take forward the recommendations are proposed (shown in brackets).

1. Maintain stable resourcing of LMIS from central government, in terms of clear commitments and regular investment, to establish a coherent system which can manage shifting priorities and the needs of policy makers and other key stakeholders.

2. Strengthen collaboration and cooperation between departments, governmental bodies, regional and sectoral bodies to provide a strong foundation for England's LMIS; with clear responsibilities for data collection, data sharing and dissemination.

3. Review current data and indicators in LMIS to identify what data are needed, at what level, and for what purpose before committing resources (DfE, ONS, DWP, MCA, LEP, sectoral bodies and associations, employers).

4. Implement a co-ordinated multi-method approach to data collection that includes combining more traditional approaches to data collection with data garnered using big data techniques (DfE, ONS, MCA, LEP, sectoral bodies and associations, employers).

5. Embed qualitative data and intelligence into a future system, alongside the mass collection of quantitative data made possible by technical advancements, as it provides invaluable insights in terms of anticipating skills (DfE).

6. Invest in underpinning technological infrastructure (including portal, dashboards and APIs) to drive data collection, analysis and dissemination (central Government, DfE).

7. Ensure capability and capacity to innovate in England's LMIS by investing in a programme of innovations (such as web scraping, application of big data techniques, and the development of experimental datasets) to drive enhancements in England's LMIS (DfE, ONS).

8. Put in place a programme of work to develop a national skills taxonomy that builds on existing taxonomies and current data in the LMIS to be embedded across the LMIS (ONS, DfE).

9. Liaise with counterparts in other countries (such as the US, Canada and Australia) to learn from their experiences in developing national skills taxonomies (DfE).

10. Develop and provide training (in the form of micro-credentials) for stakeholders working in education and training institutions, employers, and other end-users of LMI on how to interpret LMI (DfE, National Careers Service, Career Development Institute (CDI), Association of Graduate Careers Advisory Services (AGCAS), Careers England).

11. Develop a national data repository to power dashboards with regional and local LMI interfaces aimed at policy makers and educational planners to ensure dissemination is consistent across regions and local areas (ONS).

12. Strengthen collaboration and cooperation between key actors in LMIS by establishing a dedicated LMI policy forum with representation from national, regional and local stakeholders (DfE, DWP, MCA, LEP).

1. Introduction

The UK government and various agencies have been expanding and experimenting in the way data are collected, analysed and disseminated by exploring and taking advantage of opportunities presented by advances in technology, data linking and big data analytics. The UK Department for Education and the newly formed Unit for Future Skills have, in particular, been looking at ways to improve England's LMIS, namely the data infrastructure around skills and jobs. The aim of which is to enable actors in the skills system to make informed decisions and therefore help people attain fulfilling jobs and improve the nation's productivity. The UK Department for Education and the Unit for Future Skills commissioned the Institute for Employment Research at the University of Warwick to provide a comprehensive overview of the different approaches to gathering and using labour market information (LMI) and intelligence.

1.1.   Research context

Many countries over recent years have invested in their LMIS to serve an array of policy interests and support a range of stakeholders and users. LMIS have been defined as having three main functions:

- 'Responsible for labour market analysis;

- Responsible for monitoring and reporting on employment and labour policies;

- Provides a mechanism to exchange information or coordinate different actors and institutions that produce and utilize labour market information and analysis' (Sparreboom, 2013, p. 258).

It comprises: the collection and compilation of data and information; analytical capacity and tools; and institutional arrangements and networks (Sparreboom, 2013). LMIS bring together available data on labour market demand and supply, particularly on skills. Data have traditionally included administrative data, economic data, surveys of population, tracking studies, employee and employer surveys, sectoral studies, qualitative assessments, quantitative forecasts, and foresight work. Increasingly, however, there are examples of how technology and new big data analytics offer possibilities to enhance and enrich existing data and current LMIS (see for example Cedefop's Skills-OVATE (p. 61), Canada's Labour Market Information Council dashboards (p. 121), ETF's Future of Skills studies (p. 69), and Sweden's Jobtech initiative (p. 187)). Within the current climate, the importance of accessing up-to-date data is essential for those in strategic decision-making roles. The Covid-19 pandemic has highlighted how official data can be limited by the time lag from collection to dissemination, so it is not seen by some stakeholders as timely. This was highlighted by recent research on the LMIS for careers in England (Barnes & Bimrose, 2021) and the LMIS in Scotland (Barnes et al., 2021).

Providing information to a range of users (e.g., policy makers, practitioners, students, education and training providers, employers, careers guidance and counselling practitioners, etc.) is not straightforward. Hence the importance which has been attached to translating LMI into what is sometimes referred to as labour market intelligence e.g., the process of interpreting the data in such a way that it allows the user to readily act upon it. This highlights a number of challenges for LMIS in terms of making data accessible, understandable, appropriate and usable. Dissemination and visualisation of information and intelligence are key to addressing these challenges. Countries need to consider the specificities of the information or data to be provided to particular user groups to help ensure that data requirements are satisfied. However, training users and supporting them to access LMI and intelligence, as well as interpreting it also needs to be considered as part of an LMIS (Alexander, McCabe & De Backer, 2019; Bimrose, 2021).

The purpose of this research was to provide a comprehensive overview of the different approaches to gathering and using LMI and intelligence. The overall aim was to explore international LMIS to investigate practice around gathering, processing, analysing and disseminating labour market data and intelligence, and how it is used to identify skills supply and demand – and mismatches – in both the present and future. The research provides insights into how LMI and intelligence is used by different actors and stakeholders within these international contexts, as well as an assessment of the strengths and weaknesses of LMIS, the important contextual factors impacting on this, and lessons that could be applicable to England. The use of LMI and intelligence is explored in terms of how it informs policy, and the funding, delivery, and individual choices related to skills training.

1.2. Aims and objectives

The aims of the research were to identify international case studies and examine their systems and organisational infrastructure to understand:

- What LMI is collected, by whom, from what sources, and how?

- How LMI is processed, analysed, and used to identify and project future skills needs?

- Whether LMI is disseminated to the various actors involved, and if so, how do they use it to inform skills policy and delivery?

- How effective are these information systems at informing skills policy and delivery decisions?

- What are the important factors within the organisational infrastructure that contribute to strengths and weaknesses of these systems?

- What lessons, principles, or ideas can be applied from the case studies to the England context?

1.3. Approach to the research

A case study design methodology was adopted for this research which included a combination of desk research and interviews. Seven international case studies were undertaken in Australia, Canada, Finland, France, Germany, Scotland and Sweden. An eighth case study was undertaken drawing together international practice around using big data in national LMIS. For each case study, desk research was undertaken which included a review of national platforms, Ministry websites, LMIS reports and products, and policy documents. Several LMIS experts and stakeholders were interviewed to gain a deeper insight into national LMIS and how they operated and fed into policy developments. A minimum of five interviews were undertaken in each country. In total, 44 interviews were undertaken variously with representatives from national Ministries, statistics agencies, skills and education authorities/institutions, public employment service providers, career guidance and counselling experts and association representatives, labour market researchers and economists, and academics using data from the LMIS as well as those providing their expertise.

All the data were thematically analysed using an analytical framework developed for this research. It was based on the research questions and frameworks used in previous research (see Barnes & Bimrose, 2021; Cedefop, 2020a, 2020b). Table 1 details the framework in terms of dimensions of analysis with examples of the elements examined for each country studied.

Table 1 Analytical framework to examine national LMIS

Dimensions of analysis	Elements examined
Organisation	
Legal and institutional framework	Examines regulatory frameworks, legislation and policy
Management and control	Examines role and responsibilities of different actors (such as ministries, key institutions and bodies, social partners, experts, employers, researchers, trade unions), and how they coordinate
Vision and strategy	Examines whether LMIS is responding to advances in big data analytics, new data collection techniques, technological advances in data processing and dissemination
Resources	
Funding	Examines how LMIS is funded from data collection and analysis to dissemination
Data	Examines: what data are collected (including disaggregation) and for what purposes; data disaggregation's and currency; how are skills demand

Dimensions of analysis	Elements examined
	and supply data linked; whether international data are used
Methods and expertise	Examines: who collects data; the approaches and techniques in data collection; whether there are innovative approaches to data collection; how data are integrated from different sources and what taxonomies are used; whether forecasting and projections are used (timeframe)
Accessibility	Examines what data are used to inform policy and what data are made publicly available
Stakeholders	
Cooperation and engagement	Examines how stakeholders work together in the LMIS (e.g., to collect and bring data together, provide access to data, interpret and disseminate data)
Feedback and validation	Examines what mechanisms are in place to validate and improve LMIS, and how stakeholders provide feedback on LMIS
Integration and stakeholder needs	Examines how stakeholders feed into LMIS, data collection and analyses
Dissemination	
Dissemination	Examines who data are aimed at; how data are disseminated and the different channels and platforms where data are disseminated (drawing out national, regional and local examples)
Presentation	Examines how data and analyses are presented for non-technical/specialist users
Customisation	Examines how LMIS responds to customisation needs of different stakeholders
Interpretation	Examines who is involved in the interpretation and dissemination of data and whether they receive support and training in the interpretation of data
Assessment of LMIS	
Informing policy	Examines how those involved in the LMIS use data to inform skills policy and delivery decisions; and whether data are useful for this purpose
Stability	Assesses whether LMIS is developing or more established, well-funded and maintained, and its currency
Transferability of LMIS	

Dimensions of analysis	Elements examined
Key learning/transferability	Draws out key learning, innovative practice and techniques to determine what lessons, principles, or ideas can be applied from the case studies to the England context

To compliment the research, two workshops were organised to review and refine the preliminary findings with international experts and stakeholders involved in national LMIS. In total, there were 41 workshop participants representing all the case study countries; their comments and suggestions were used to refine the research findings presented in this report. A third workshop, with 14 participants, was organised with UK government stakeholders to discuss the research findings and transferability to the England context.

For more detail on the approach to the research see Annex 1: Methodology.

1.4. Structure of the report

After this introduction, a synthesis of the evidence on the operation and structure of international LMIS is presented. Within this section, evidence is presented for the organisation and management of LMIS, resourcing of LMIS, stakeholder engagement in LMIS and dissemination – based on the analytical framework applied in this research. Country examples are used to illustrate current practice and activity with links to the detailed case studies in Annex 2. This section finishes with a comparative overview of the countries studied and a summary drawing out the strengths and weaknesses of LMIS.

The third section discusses how LMIS can, and are, being enhanced with big data and new techniques. Three international cases are presented to highlight current approaches and methodologies. The advantages and limitations of big data and new techniques are summarised.

The final section of this report summarises characteristics of developed LMIS assessing whether each characteristic is established, being developed or weak in each country case study. The current England context is also assessed to highlight possible elements that could be developed or enhanced in the future. Evidence on key learning from the development of the international countries studied are drawn together to provide examples and recommendations for the England LMIS.

Annex 1 describes the research methodology in detail. Annex 2 includes an in-depth case study for each country studied.

2. Operation and structure of international labour market information systems

This section of the report draws together the evidence from the seven international country case studies. The detailed country case studies are presented in Annex 2: International LMIS case studies. Evidence is presented for each dimension of the LMIS (namely: organisation and management of LMIS, resourcing of LMIS, stakeholder engagement in LMIS and dissemination). Where relevant interesting practice or innovative examples from the international country cases are included. This section concludes with an overall comparative assessment of the LMIS studied and a summary of each dimension examined.

2.1. Organisation and management of LMIS

In this sub-section, the legal and institutional framework for the LMIS is examined. It is important to note that the countries examined in this research all had established systems with well-developed processes for collecting, analysing and disseminating LMI. It was, therefore, expected that legislation and frameworks would be embedded within the overall national systems examined. As part of understanding the foundation of LMIS in different national contexts, the management and organisation of LMIS were examined together with associated vision and strategy documents.

Key insights

- A **combination of institutions with legal responsibilities**, e.g., ministries, statutory bodies, government departments/units, **organise and form a constituent part of the LMIS**. Where there is collaboration and cooperation between these institutions to support data collection, sharing and dissemination, this produces a strong and coherent LMIS (e.g., Australia, Finland). This benefits stakeholders who can not only access current, high-quality information, but can also feed into the data and analyses to improve understanding and support translation of information into intelligence (e.g., Scotland).

- Where **legislation** is in place, it **serves to manage the LMIS**, guide data collection and dissemination, and set out resourcing which creates a stable LMIS.

- There are number of examples (e.g., Germany, Sweden) where the public employment service (in the UK this would be the Department for Work and Pensions) is a key player in terms of data collection, analyses and dissemination. These data are useful within a LMIS as it can provide current data on demand and supply.

- **Strategy documents**, when in place and developed in collaboration by the range of institutions involved in the LMIS, **set out plans** for data collection, **and initiatives** to improve the capacity and capability of data collection and analyses.

- The **vision** of LMIS, when in place, is to **improve the quality, currency and coverage of data collection**, and ensure it is accessible and aligns to stakeholder needs. This can lead to an improved LMIS in terms of innovations in data collection (e.g., Sweden). Dissemination plans are often at the heart of vision statements with a focus on end-users in the LMIS.

Across all the countries examined, legislation and policies were in place to support the management and organisation of the LMIS. Generally, legislation is an instrument in which to set out jurisdictional responsibilities. Legislation was found to variously set out the responsibilities of different ministries/departments and government agencies which in turn informed the LMI to be collected and the analyses needed. In Canada and Sweden, legislation is in place which sets out requirements on who should supply data, timing of data delivery and in what form data should be provided. For the most part, the LMIS is seen as a mechanism to collect evidence to inform policy development, particularly to improve education, skills and migration policy. So, funding and resource allocations are often set out in legislation linked to these policy areas.

In some countries, legislation served to set up and establish research institutions and agencies to serve the LMIS. The legislation variously describes the responsibilities of these institutions and agencies to collect, analyse and disseminate data for particular stakeholder groups. Therefore, a combination of institutions with legal responsibilities were found to operate in the countries studied. In some instances, this resulted in complex systems where agencies and institutions have overlapping responsibilities (e.g., France). Where agencies and institutions had clearly defined roles and cooperated in terms of data collection, sharing and dissemination, a more coherent LMIS was evident (e.g., Finland, Germany). Across several countries examined the public employment service (PES) was found to be a key player in terms of data collection, analyses and dissemination. In the UK, the Department for Work and Pensions collects data but it is often not publicly available. The PES was seen as being able to access data on labour market demand and supply – in terms of numbers registering as unemployed, participating in training or an active labour market programme, or as returning to the labour market. Germany and Sweden are two examples in which the PES has a significant role in their national LMIS not only in terms of data collection but also dissemination.

The range of ministries/departments, governmental bodies and agencies involved in national LMIS are key as they provide strategic leadership and direction resulting in a more coherent LMIS. Where strategy documents were in place for those key stakeholders in the LMIS, they set out plans for data collection, and initiatives to improve capacity and capability of data collection and analyses. Forward-looking (vision) documents complemented strategy with proposals and ideas to improve the quality, currency and coverage of data collection, with dissemination and accessibility central to ideas. For some, this focused on end-users in the LMIS and was about ensuring LMI aligned to stakeholder needs, which can be varied and complex. Where these were in part of the LMIS, there was evidence of innovations in data collection and/or dissemination taking place as seen in Canada and Sweden.

2.2. Resourcing of LMIS

In this sub-section, the resourcing of LMIS is broadly examined. The funding arrangements in place for establishing and maintaining the LMIS, as well as details of the main components of data in the LMIS were reviewed. Resourcing was also examined in terms of the methods and expertise used in developing and disseminating data. Plus, information around the capability of the LMIS to ensure data are made accessible and tools (or applications) are used to make data available to policy makers and others were examined.

Key insights

- All of the country LMIS studied have **allocated budgets** from central government, but those with longer-term funding tend to have more detailed work plans and established systems of data collection and dissemination. This enables innovation to enhance the functionality of the LMIS. Examples of this include Canada analysing online job vacancy data, Sweden enabling access to data using application programming interfaces (API[1]) and France developing apps for users in France).

- Often the innovation or experimental data collection itself is developed with **limited, short-term funding**, or drew upon other national funding sources to resource (e.g., Sweden).

- Across the countries studied a **range of data science methods and techniques** are being used, with quantitative methods (including labour econometrics and modelling) being common across all countries studied. Qualitative methods are less evident in the countries studied and more likely to be used for horizon scanning, feedback and validation of quantitative analyses, understanding occupational skills requirements, and for contextualising LMI, particularly at the local level (e.g., Finland, Scotland). Multimethod approaches to data collection and analyses provide a richer, or more nuanced, understanding of the labour market.

- **New techniques for data collection** and analysis are being used across the counties studied with web scraping and natural language programming (NLP) now common to enhancing data available in the LMIS (e.g., Australia, Canada, Germany, Sweden). These advances are also enabling new methodological techniques and dissemination possibilities.

- There is great interest in **skills taxonomies**, but it is recognised that significant resourcing is needed to ensure a taxonomy is relevant, current and useable.

- Australia and Canada were the only countries studied that have had recently developed and embedded national skills taxonomies within their LMIS. New techniques around big data had supported the development and/or refinement of a skills taxonomy. Other countries studied were in the process of developing a taxonomy (e.g., Sweden). Skills taxonomies were noted as a particular challenge by many but considered a crucial part of understanding skills demand and supply.

- **Data are being stored in repositories** and being made accessible via customisable dashboards and/or through APIs to some extent in all the countries studied.

2.2.1.   LMIS funding

All of the countries studied have allocated budgets from central government. Whilst allocations are publicly available, it is often challenging to identify how budgets are shared across institutions and agencies operating in the countries studied. An allocated budget from central government enables an established system of data collection and dissemination to be developed and maintained. This in turns can provide a basis for innovative in terms of data collection, analyses and dissemination. For example, in Sweden the collection of job vacancy data from employers is enabling new analyses and a current understanding of labour and skills demand at a regional level (see Germany – Resources). In Canada, for example, the recent collection and analysis of online job vacancy data disseminated through customisable dashboards is similarly creating an enhanced understanding of labour and skills demand (see Canada – Resources). In France, funding is being used to develop apps supporting the dissemination of LMI to end-users in the LMIS (see France – Dissemination).

Those countries with longer-term funding (not more than 5 years in all instances) tended to have detailed work plans. It was noted that those institutions and agencies using experimental data or developing beta versions often had short-term or limited funding for this work until the concept was proven or validated by stakeholders. There were instances where funding was being accessed from non-governmental budgets. In Sweden, for example, Jobtech (part of the Swedish PES) was drawing upon innovation funding to develop new products with educational agencies to try and address their data needs. The involvement of education institutions in data collection and dissemination is not common practice across the LMIS, but in Sweden it is seen as essential to addressing the mismatch between supply and demand within the country (see Sweden – Resources). In Australia, Finland and Scotland educational institutions are involved in data collection, which feeds into the LMIS to support supply and demand policy and planning.

2.2.2.   Data and taxonomies

In the countries studied, quantitative data are mainly collected and provided as part of the LMIS. These are often large datasets collected using a range of techniques. Common quantitative data include national census, and individual and employer surveys. Across all LMI studied the data were collected on the following indicators: demographic, economic, education, un/employment, earnings and hours, industry and occupation, qualification, skills and tasks, business demographics, plus recruitment and vacancy. The level of which data are disaggregated in each country studied varied with all providing (to some extent) data disaggregated at geographical, industrial, occupational, and

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[1] An application programming interface (API) is an interface that enables data to be made accessible to developers through a set of functions and procedures. It allows the data to feed into another application or service.

qualification level. In Sweden, population tracking provides a unique dataset on individuals which includes demographic, education, and employment data (see Sweden – Resources). These tracking data feed into the LMIS and used to inform education, migration and labour market policies. Quantitative data are used in forecasting and projections, but also to feed into websites, dashboards and tools (See Figure 4 Example of QuBE data portal results, Germany). Most countries studied have regular publication plans where data are analysed, interpreted and published. Ad hoc studies on sectors and regions were also noted to be common.

Qualitative data are not a significant part of most of the LMIS studied. Where qualitative data are collected usually through stakeholder consultations and forums, it is used to contextualise data and/or support the interpretation of data (see Figure 16 Screenshot from Occupational Barometer, Sweden). It is commonly used to understand occupational skills requirements and future skills needs. There were some examples where qualitative data are used to feedback and validate quantitative sectoral and/or occupational projections. For example, in Scotland, national projections are considered broadly correct but at a regional or local level they can be difficult to understand. Qualitative data are, therefore, used to contextualise projected trends and assess appropriateness to regional and local level. Qualitative data, in this instance, takes the form of local knowledge and understanding of industries and businesses. It is provided by those working in local authorities and agencies, local businesses, and local educational institutions. A similar approach was noted in Finland in the production of their occupational barometer (see Example 5 Occupation Barometers (Ammattibarometri), Finland).

Whilst most countries undertake employer skills surveys to understand labour market demands, legislation was reported in Canada and Sweden to regulate the data submitted by employers on vacancies and skills. These employer data were viewed as a primary mechanism of understanding labour and skills demand with legislation regulating the timing of data submissions, format and classifications used. This approach to collecting regular data from employers was considered by LMIS representatives as one approach to gathering current data on labour market demands, which, during the pandemic, was considered essential. An alternative approach to gathering demand side data on the labour market is through the application of big data techniques to collect, classify and analyses data from job vacancy advertisements (see Figure 6 Screen shot of Job Bank, Canada; Figure 10 Occupational distribution of job vacancies and change in the number of vacancies in the EU (Q1 2021 – Q4 2021) provided by Cedefop-OVATE). This is discussed later in Section 3.

There were some examples of countries drawing upon data from other (external) providers as part of their LMIS, such as data from EuroStat, the Organisation for Economic Cooperation and Development (OECD) and Cedefop. In the EU, countries use the same approaches and methodologies to ensure data are comparable; this is considered particularly helpful when reviewing progress towards some indicators, such as employment and unemployment rates, or particular age groups.

In all the countries studied, occupational and industry classifications are common and the basis for data collection. Several LMIS stakeholders talked about the challenges in variously linking occupation, skills, tasks, and qualification/education. The benefit and value of a skills taxonomy embedded within a LMIS was recognised by many. The US O*NET taxonomy and the European Skills, Competences, Qualifications and Occupations (ESCO) classification developed by the European Commission were the only two taxonomies being used in the countries studied.[2]

Two approaches to develop country-specific taxonomies were found. Australia and Canada drew upon the O*NET taxonomy and the ESCO classification as a basis for developing their own national skills taxonomy. These taxonomies were combined with other data in order to contextualise and develop the taxonomy appropriate to their own country context; these approaches are presented next.

Example 1 Australian Skills Classification

The Australian Skills Classification (ASC) is a skill-based approach, containing three categories of skill: core competencies (sometimes called foundation skills or employability skills), specialist tasks (the work activities a person undertakes specific to a job); and technology tools (a technology, such as a software or hardware, used within an occupation). The ASC also groups similar skills together into skill clusters, and these clusters are further grouped into 29 skills cluster families. The ASC is powered by the Jobs and Education Data Infrastructure (JEDI) (data engine) and includes modified information from: the O*NET Resource Centre[3;] Australian Bureau of Statistics data; and Trending and Emerging Skills Flag data from Emsi Burning Glass; and National Skills Commission (NSC) Analysis using data records provided by Emsi Burning Glass.

In March 2021, the NSC released the BETA version of the ASC, providing for the first time in the Australian context, a universal taxonomy of skills enabling identification of skills that underpin Australian jobs. The second release (2.0) brings the dataset out of BETA status, focuses more heavily on expansion, and brings the ASC more closely into alignment with ANZSCO in terms of structure and coverage. ASC 2.0 release added over 500 new profiles (made up of new ANZSCO 4-digit unit group or 6-digit occupation profiles) over 1,000 trending or emerging digital skills flags were added to profiles (adding a dynamism to the Classification). These are not only skills relating to software and digital tools, but include digital skills relating to project management, communication and collaboration, science and mathematics, engineering and creative design.

The interactive online interface allows exploration of the Classification through either an occupation or skills lens. With the occupation lens, the Classification now contains over

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[2] Other skills taxonomies that are available include: Singapore's Skills Framework which provides information on sector, career pathways, occupations and skills required by role; and Nesta's skills taxonomy developed through the classification of data gathered from job vacancies, UK.
[3] This includes O*NET 21.2 Database and O*NET 23.1 Database by the US Department of Labor, Employment and Training Administration (USDOL/ETA), which the NSC uses under the CC BY 4.0 license.

1,100 profiles outlining skills data for ANZSCO 4-digit unit groups and 6-digit occupations, as well as for occupation specialisations,[4] where information on core competencies, specialist tasks and technology tools are available for most of these profiles (specialisations and 'not otherwise classified' (NEC) are more limited in detail). The interface highlights the interconnections and potential transferability between Australian occupations by outlining the tasks required to undertake them, and showing which other occupations utilise each of these. The interface also allows users to explore the data through the lens of skills, independent of the occupations they are connected to. Relevantly, the NSC recently worked with the ABS to include some of the NSC's previously identified emerging occupations for inclusion in the ANZSCO.

The NSC has responsibility for the Skills Priority List (SPL), which uses ASC, a detailed annual list of shortages for nearly 800 occupations at the national, state and territory level. The list is developed after wide consultation with stakeholders, is published on the NSC website and is reviewed and updated annually. The evidence supporting the SPL includes labour market analysis, employer surveys, stakeholder consultation with industry bodies and federal and state/territory government agencies. Providing a single source of advice on occupations 'creates a direct line of input for stakeholders and ensures greater consistency and better targeting of resources across the various policy responses implemented by government' (NSC, 2021). Data from the SPL are also available through customisable dashboards (see Figure 1).

Figure 1 Example from Skills Priority List, Australia

Source: Skills Priority List Occupation Reports, National Skills Commission – Australia

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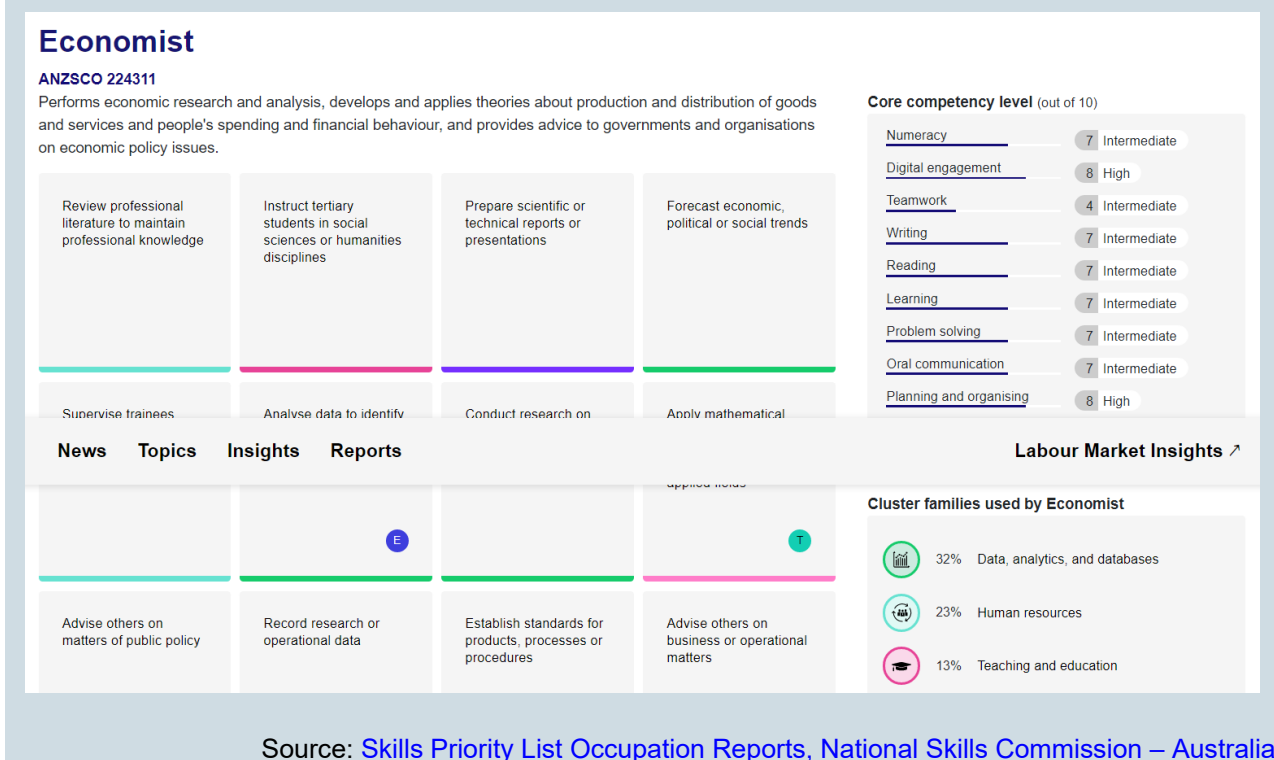
[4] Specialisations are commonly used titles which refer to a subset of jobs belonging to an ANZSCO 6-digit occupation, p. 7.

Another example of a recently developed taxonomy that is widely used was from Canada. In order to complement other federal, provincial, and territorial employment programming efforts around skills identification and utilisation, the Employment and Social Development Canada (ESDC) developed a Skills and Competencies Taxonomy to help facilitate a Pan-Canadian dialogue on skills. It also fed into the development the Occupational Skills and Information System (OaSIS), which (at the time of writing) was due to launch in September 2022.

Example 2 The ESDC Skills and Competencies Taxonomy and The Occupational Skills and Information System, Canada

The ESDC Skills and Competencies Taxonomy aims to improve the comparability and application of skills concepts throughout occupations and sectors (see Figure 2). The taxonomy is comprised on hundreds of occupational descriptors used in the labour market to describe job requirements and/or individuals' personal characteristics. Each descriptor is associated with one of the seven main categories of the Taxonomy (skills, personal abilities and attributes, knowledge, interests, work context, work activities, or tools and technology (see Figure 2).

The taxonomy was developed based on internal products (including the Career Handbook, Skills and Knowledge Checklist, and Essential Skills profiles), the US O*NET system, and a variety of other national and international competency-based frameworks (a list of resources used to develop the taxonomy is on ESDC's website).

The taxonomy is a tool used by labour market analysts, employment counsellors and employers, as well as jobseekers. Importantly, the taxonomy was used as the framework for developing the Occupational and Skills Information System (OaSIS), which will capture most descriptors in the taxonomy for around 900 occupations.

Figure 2 Overview of the skills and competencies taxonomy, Canada
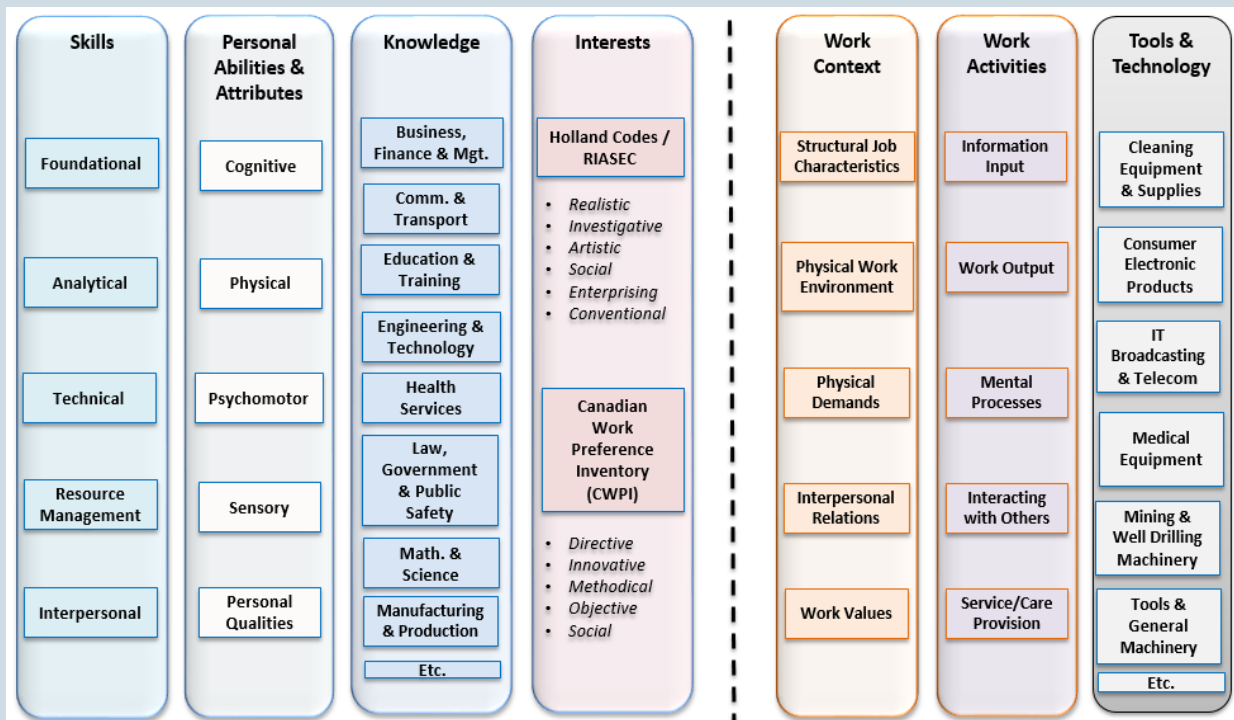
The Occupational Skills and Information System (OaSIS)

ESDC recently developed a Canadian version of the US O*NET – the Occupational Skills and Information System (OaSIS). OaSIS was developed according to a set of principles and guiding framework, including ensuring that every occupational profile developed adheres to the skills taxonomy; developing a new Canadian rating guide to measure and assess skill descriptors and help transpose O*NET data to the Canadian labour market context; and informing and maintaining profiles via a network of stakeholders, including those involved in other national skills-related activities (LMIC, 2022).

The US O*NET was used as a starting point to construct OaSIS, however the differences in concordance between the US and Canadian labour markets saw ESDC decide to create their own version. Since the O*NET database classified occupations differently than in Canada, drawing on O*NET required mapping from one classification to another.

There were many more modifications made to customise O*NET to the Canadian labour market than initially anticipated, as for most occupations, there is no one-to-one mapping from the Canadian National Occupational Classification (NOC) to the US SOC used in O*NET (LMIC, 2020). For instance, Statistics Canada and ESDC developed two concordances: one from Statistics Canada's mapping of the Canadian NOC (4-digit level) to the US SOC (6 digit-level) to develop statistical indicators; and the other from ESDC's mapping of the Career Handbook (5-digit NOC) to O*NET-SOC (8-digit level) to create occupational profiles using a skills lens (LMIC, 2020). In some cases, the skills profile of

O*NET for one US occupation applies to several Canadian occupations and in others, several O*NET profiles apply to one Canadian occupation. While for 62 Canadian occupations (representing 10% of total employment) at the 5-digit level, there is a gap in matching O*NET skills-related data.

OaSIS also uses a different ratings system based on the availability of different information in Canada, where OaSIS uses a 5-point rating scale for all competence descriptors in terms of generic and specific tasks. To develop OaSIS, ESDC consulted with a range of Canadian and international experts (see Canada – Resources).

While still in the development phase, OaSIS now has around 200 competences for 900 occupations. While the full Canadian NOC has 500 occupations, in OaSIS some occupations are divided to make them more specific. With the new NOC 2022, Statistics Canada (STC) will move to 5-digit and OaSIS codes to 7-digits. Results are validated against O*NET as a comparator.

The development of OaSIS is a good example of how stakeholders can be engaged to provide feedback on tools. The ESDC is currently working on validating the data in OaSIS, as well as developing further tools to present the information on the ESDC website.

The development of national skills taxonomies was found to be the top reported challenge by LMIS stakeholders. The examples from Australia and Canada highlight the resourcing required, the range of data sources used and the benefits of embedding a taxonomy in the LMIS to inform the structure of data collected. The taxonomies were noted to be beneficial in helping to understand skills demand, supply and mismatch, whilst those stakeholders working in education and careers suggested that taxonomies are useful to help clients understand transferability of skills. The countries studied reported challenges in linking occupation, skills, tasks and qualification/education; a missing element of most. Overall, there is great interest in skills taxonomies, but it is recognised that significant resourcing is needed to ensure a taxonomy is relevant, current and useable.

2.2.3.   Methods and expertise

It was evident across most of the countries studied that a range of methods were being applied from traditional econometric modelling and approaches for developing forecasts and projections, to new methods using natural language programmes (NLP) and big data techniques to link datasets and create new datasets. The overall aim of testing new methodologies and techniques was to enhance existing approaches and available data.

One example of how experimental data using new techniques is feeding into a national LMIS is from Australia.

Example 3 Nowcast of Employment by Region and Occupation (NERO), Australia

Nowcast of Employment by Region and Occupation (NERO) is a new experimental (BETA version) dataset developed and funded by the National Skills Commission (NSC) that complements existing sources and provides experimental estimates that seek to balance the need for accuracy, granularity, frequency and timeliness. The NSC uses data records provided by parties listed in the Nowcasting methodology. It provides timely estimates on employment in 355 occupations (ANZSCO 4-digit level) across 88 regions in Australia. The NERO dashboard visualises output from developing experimental monthly nowcasting estimates of the occupational (ANZSCO 4-digit) employment by region (at Statistical Area Level 4), or over 31,000 series in total (see Figure 3). The NERO dashboard can be searched either by occupation or by region, and the data are downloadable in several formats.

Figure 3 Screenshot of NERO projections visualised, Australia
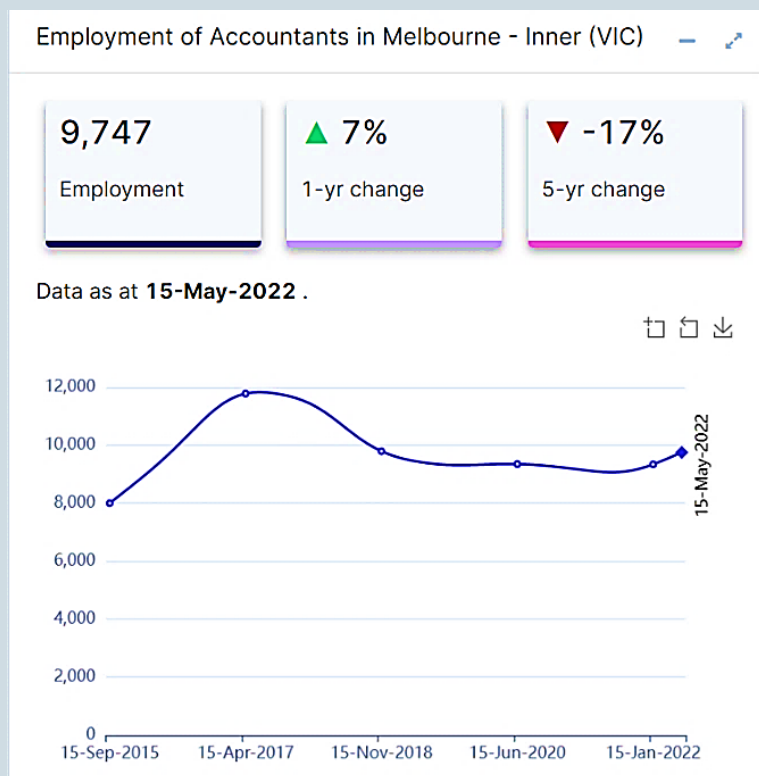
Source: NERO dashboard, Australian National Skills Commission – Australia

A range of data sources were used as modelling inputs for NERO.[5] Supervised machine learning techniques such as random forest, gradient boosting and linear regressions were used to train models to find patterns that can be used to predict the 'now'. Many

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[5] These include: ABS Labour Force Survey Total employment by region; ABS Labour Force Survey Occupational employment; ABS Census Occupational employment by region; ABS Weekly Payroll Jobs by industry and region; BS National Accounts Gross State Product; NSC Internet Vacancy Index Online job advertisements by region and occupation; Burning Glass Online job advertisements by region and occupation; DESE jobactive job placements by occupation and region; Home Affairs Skilled Visa holders by occupation and state/territory.

variations of models were tested and combined into a stacked model. The NERO estimates are smoothed to provide an indication of long-term trends in local labour markets.[6]

Until now, these types of data were only available every five years as part of the Australian Bureau of Statistics (ABS) Census of Population and Housing. With NERO, the estimates are produced monthly. NERO has been developed using the emerging methodology of 'nowcasting' that draws upon both traditional and real-time data, as well as big data techniques, such as machine learning, to estimate trends that are more timely, more detailed and are available frequently.

NERO estimates are broadly consistent with the publicly available labour force survey (LFS) data produced by the ABS (see details on the Nowcasting Methodology and blog). As the NERO estimates are experimental in nature, it is anticipated that they may be revised in 2022. Interpreting raw predictions from NERO is not recommended at this stage, however during the uncertainty of the Covid-19 pandemic, insights from NERO helped identify some shorter-term employment shocks, such as those arising from lockdowns.

Further exploration of new techniques that are being used to enhance LMIS are presented in Section 3.

2.2.4.   Accessibility

Technical advances have increased the capability of LMIS to ensure data are open and accessible. These have often been the result of governmental commitments for transparency and enabling access to government data for all. Open data policies were found in Australia, Canada, France and Scotland. National Data Strategies were found to be in place which are setting out how data should be made accessible and in what format. National statistical agencies are not only the main data collectors in the countries studied, but they were found to have responsibility for managing how and in what format data are made open to all as part of national policy/strategy. Therefore, in some countries studied data repositories are being created to ensure stored data are accessible and usable (see for example Canadian Open Data portal and the French Open Platform for French Public Data which provide access to several datasets on the economy and labour market which are free for individuals to use). In Germany, the QuBE[7] data portal enables users to not only access data, but also customise and visualise the occupational long-term projections data (see Figure 4).

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[6] The NSC is exploring other approaches to better reflect short-term dynamics in its NERO experimental estimates.
[7] QuBE is an acronym for the two key variables for which forecasting data is available: Qualifikation (qualification) and Beruf (occupation).

Data repositories are now common in established LMIS mainly because of advances in how data can be stored, linked and accessed. There is also a better understanding of what data formats are transportable enabling greater opportunities for sharing and linking data.

Figure 4 Example of QuBE data portal results, Germany
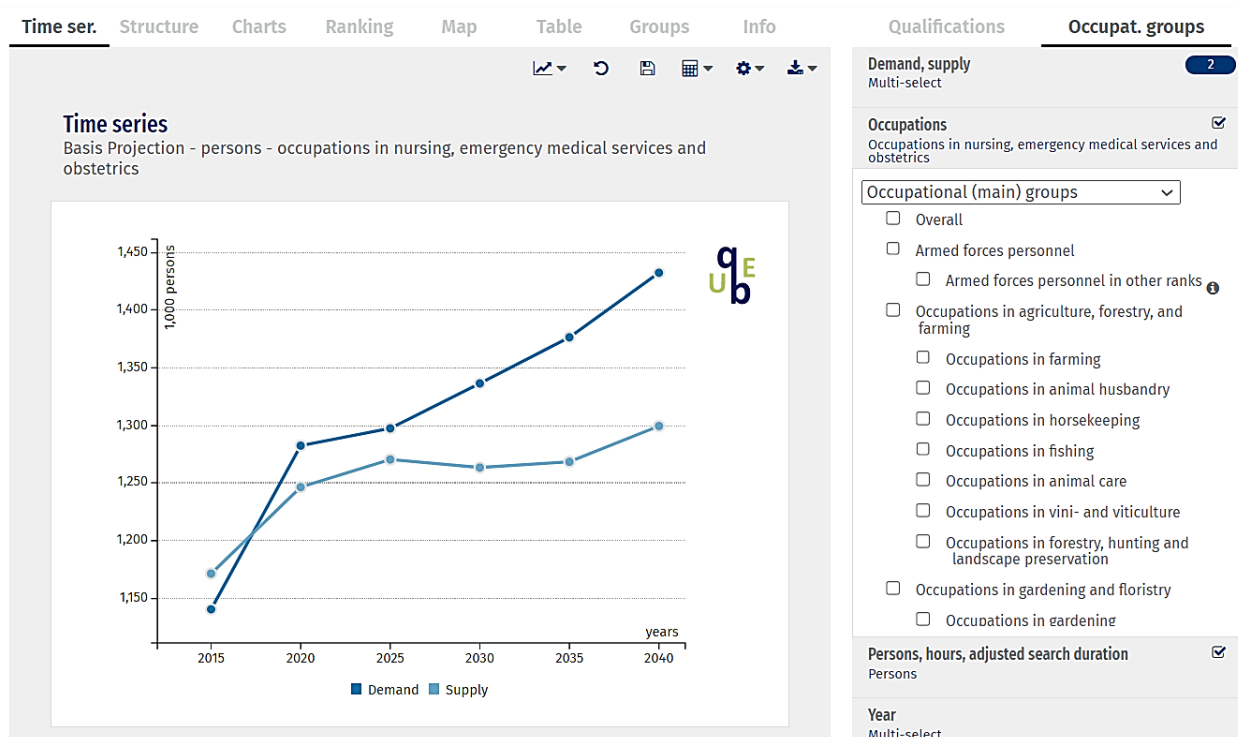
Source: Federal Institute for Vocational Education and Training (Bundesinstitut für Berufsbildung, BIBB) – Germany

Data repositories are increasingly be used to enable others to access data in the LMIS through purpose-built interfaces and APIs. Repositories were found to be variously used to power data dashboards, data visualisations and other applications aimed at users. Particular examples are noted in France and Australia where applications and websites powered by these repositories had been developed for end-users in a LMIS (see Example 6 Jobs and Education Data Infrastructure (JEDI), Australia).

Across several of countries studied new techniques are being applied in data collection and used to construct new datasets (these processes and techniques are explored later, see Section 3). One example from Canada illustrates how the LMIS is evolving using technical advances to create new datasets from web scraping and combining it with existing data to feed into services for jobseekers, employers and those supporting individuals transitioning in the labour market.

Example 4 Job Bank, Canada

Managed by the ESDC on behalf of the Canada Employment Insurance Commission, Job Bank is Canada's national employment service, available as a website and mobile app. Users have access to a variety of products and services, free of charge. Job Bank is a program that sets policy and operational guidelines while maintaining a central IT system to authenticate both employers and jobseekers' profiles (ESDC, 2021).

While the Job Bank job board has been in existence for many years, in 2009, ESDC had several different websites containing learning and labour market information, including the former Job Bank website, the Working in Canada website (LMI for new arrivals to Canada) (ESDC, 2017). In 2014, the ESDC began to consolidate learning and labour market information activities with the aim of creating a single integrated website for dissemination of LMI. It drew together from 14 difference sources including ESDC, Statistics Canada, sectoral councils, provincial and territorial governments and private jobs boards (see Figure 5 which shows the evolution of the consolidation process).

Figure 5 Consolidation of learning and labour market information in Canada
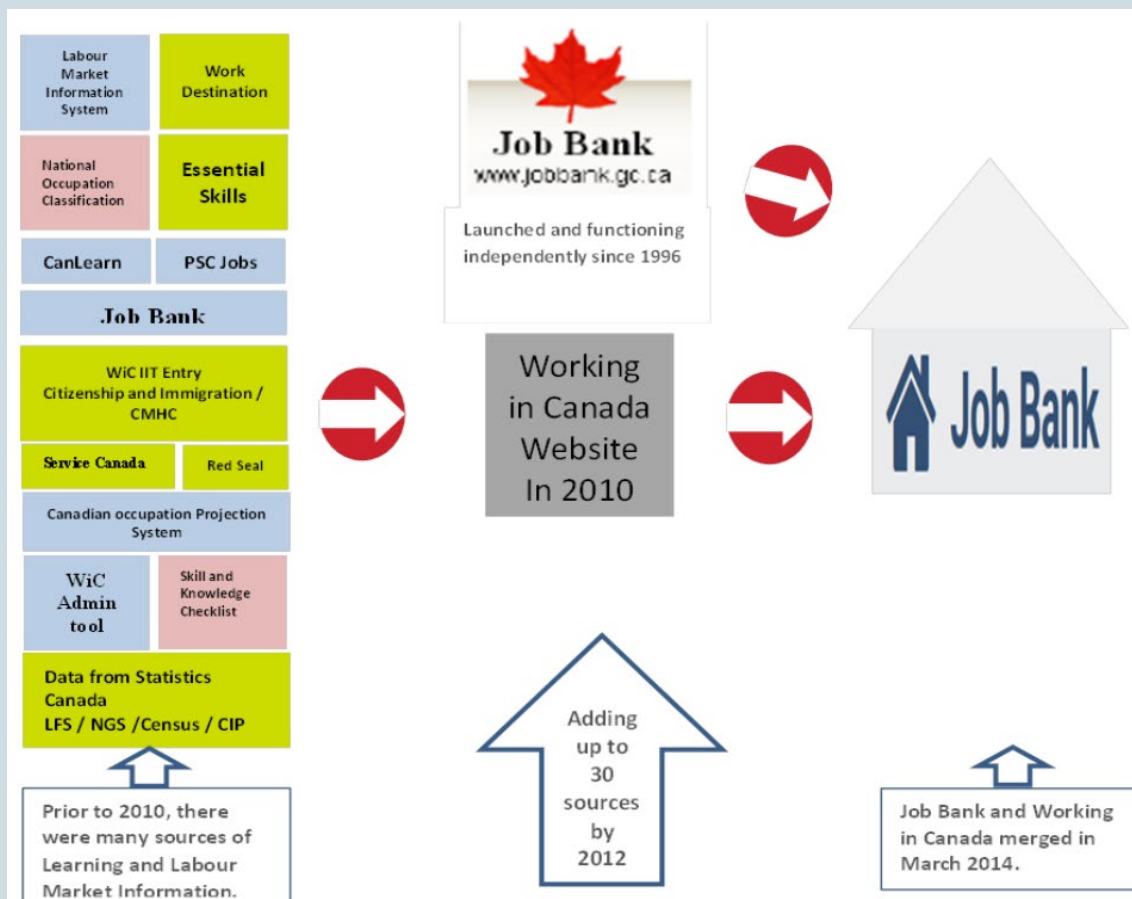
Source: ESDC (2017, p. 3), n.b. figure created by ESDC for the purposes of their report.

In addition to merging the two main websites, they added new tools and information to create the current version of Job Bank (ESDC, 2017). The infrastructure from the Working in Canada website was used in combination with the branding from Job Bank.

The new consolidated website provides a wide range of information and assistance for job searching, recruitment, career exploration, and LMI (ESDC, 2017). The key products available on the Job Bank website can be grouped into three main categories:

Job Bank for jobseekers enables access to available jobs and opportunities to showcase their qualifications, work experience and education. Includes job search functionalities, job alerts function, resume builder and job match function.

Job Bank for employers enables employers to post job advertisements, and employers receive suggested candidates with a match score through the Job Match service.

Job Bank for Canadians is aimed at those interested in LMI. It provides information on wages by sector, career outlooks (see Figure 6) and educational requirements through online tools such as: explore the market, choose a career, occupational reports and wage reports (ESDC, 2021).

Tools available on Job Bank include: [Job Search](#), [Job Match](#), [Job Bank for Employers](#), [Explore Careers](#), and [Labour Market Trends](#) (explore by [occupation](#), by [wages](#), by [prospects](#), or by [news and reports](#)).

In 2013, efforts commenced to increase the level of collaboration with private and non-private sector platforms to increase the number of job postings displayed on the Job Bank online platform (ESDC, 2021). Job Bank now works with [other private and public sector job boards](#), who send their jobs to help jobseekers find job postings in one place, and Job Bank shares its job postings with other job boards to help optimise employer reach. Since 2015, the provinces and territories have been working in partnership with ESDC to promote the use of Job Bank products and services and to validate job postings from their respective jurisdictions (ESDC, 2021).

Figure 6 Screen shot of Job Bank, Canada

Economist in Canada

People working as an economist have different job prospects depending on where they work in Canada. Find out what the future holds for them in your province or territory. These prospects are applicable to all Economists and economic policy researchers and analysts (NOC 4162).

Note: These employment prospects were published in December 2021 based on the information available at the time of analysis. The next update will be in December 2022. To learn more, see our FAQs. You can also find additional information on the Canadian Online Job Posting Dashboard.

| ☰ Summary | ▤ Description | $ Wages | ☑ Prospects | ▤ Jobs | ☑ Requirements | ☰ Skills | 🔍 Search |

Job opportunities over the next 3 years

Explore future job prospects by province and territory.

Location	Job prospects
Alberta	⭐⭐⭐ Good
British Columbia	⭐⭐⭐ Good
Manitoba	⭐⭐⭐ Good
New Brunswick	⭐⭐☆ Fair

Job Bank's Job Match service, available to jobseekers and employers is free of charge. It uses a matching algorithm, where jobseekers must specify the official language of their choice (English or French) and the distance they are willing to commute. Information on the jobseeker's experience, education, skill level and qualifications/credentials enable an algorithm to assign a matching score (score ranges from 1 to 5, where 1 is a 'poor' fit and 5 is a 'best' fit). The Job Match service uses 8 'soft' criteria: experience, education, skill level, skill type, credentials, asset language, max experience and max skill type. The algorithm has continued to evolve, including being adjusted based on user behaviours such as acceptance or rejection of viewing previous job matches (ESDC, 2021).

The use of artificial intelligence (AI) and machine learning for the purposes of matching is a rapidly evolving field. In that context, the Job Match service has been subject to several iterations since its introduction in April 2015. These improvements include changes to the matching algorithm with the inclusion of user feedback, such as including icons to show if: a jobseeker is Canadian and eligible to work in Canada; a jobseeker self-identifies as Indigenous, Veteran, visible minority or person with a disability. There was also an option for jobseekers to describe their career goals, a new field for employers to suggest new job titles, a mechanism to help employers find the right NOC for their job postings, and an option to restrict criteria to better align jobseekers with job requirements (ESDC, 2021).

While Job Bank operates in a competitive sector, it offers a free service where matching does not prioritise job postings to generate advertising revenue and provides equal access to jobseekers without service or subscription fees. Relative to other job boards, Job Bank is the only bilingual platform, requires salary or wage information, and does not use cookies to share information about jobseekers with third parties. In addition, a major strength of Job Bank is the use of fixed skills, job descriptions and position titles based on the NOC (not free text) (ESDC, 2021).

In terms of timeliness of LMI, Job Bank was used during the Covid-19 pandemic to help connect recently laid off workers to vacant positions for essential services in key industries like healthcare, agri-food and agriculture, retail and wholesale, food services, or public safety and law enforcement (ESDC, 2021). Job Bank sent nearly 1.5 million emails to Canada Emergency Response Benefit applicants connecting them with jobs in their communities, supported job searching during the receipt of the Canada Emergency Student Benefit and assisted Canada Emergency Response Benefit recipients with simplified employment insurance and other temporary recovery benefits (ESDC, 2021).

2.3. Stakeholder engagement in LMIS

This sub-section sets out details around cooperation, collaboration and engagement with stakeholders in the countries studied, details of processes for feedback and validation, as well as whether, and if so, how stakeholder needs are integrated into the LMIS. Stakeholders are broadly defined here to include: policy makers, education and training providers, public/private employment services, career guidance and counselling services, researchers/analysts, local authorities, trade unions, sectoral bodies and professional associations. In some instances, stakeholders include end-users in a LMIS (such as young people, the unemployed, recipients of employment services, etc.) who may use the LMI and intelligence disseminated in the LMIS.

> **Key insights**
>
> - **Cooperation and collaboration** between the various stakeholders in the LMIS is seen as a key mechanism that needs to be in place to support communication, enable feedback and share knowledge. When in place, it supports the development and maintenance of a coherent system as stakeholders are actively invested in enhancing the LMIS. This can lead to enhanced data collection and sharing (e.g., Australia, Finland, Germany).
>
> - Where stakeholders feed into LMIS, they had an important role in transforming and translating LMI into intelligence. Stakeholders were found to support understanding, **provide contextualisation and validate data** and analyses (e.g., Finland, Scotland). In many instances, labour market and sector experts provided knowledge to support data collection methods and analyses.
>
> - In the majority of the countries studied cooperation and collaboration between the various stakeholders was ad hoc and undertaken for particular purposes, such as validating data or reviewing a tool or application.

Cooperation and collaboration are key elements of a well-functioning LMIS as mechanisms are in place to support communication, enable feedback, and share knowledge and data. Across the countries studied, some examples were found where collaboration and cooperation between and amongst stakeholders was central to the LMIS, in for example Finland, Germany and Scotland. Stakeholder engagement in these instances evidenced how they are involved in the development and maintenance of the LMIS. It is argued that cooperation and collaboration can create a coherent system for a number or reasons. First, stakeholder roles in collecting, sharing and disseminating data can be defined to avoid overlap and duplication. Second, a common format in which data should be collected can be agreed, which enables greater transportability and opportunity to link data. Finally, stakeholder collaboration enables learning and knowledge to be shared to enhance understanding of data analyses. However, stakeholder cooperation

and collaboration were not common practice, and, in some instances, it was ad hoc rather than established and part of accepted practice.

Across the majority of the countries studied, there was little evidence of processes to gather feedback, or monitor and validate LMIS outputs. It was not usual for feedback and validation to be captured and used to improve systems and dissemination of LMI. Where it is captured, it tends to be on specific products or tools. However, in the development of methods, techniques and products, expert and user feedback were seen as key to the process. Across the majority of countries studied, labour market and sector experts provided knowledge to support data collection methods and analyses.

Where stakeholders feed into LMIS, they had an important role in transforming and translating LMI into intelligence. They were found to support understanding, provide contextualisation and validate data and analyses. For instance, in Scotland, it is usual practice for local and regional stakeholders to meet to review national data and analyses on labour market demand and supply in order to contextualise the data for their local area. The aim was to ensure policy and planning met local needs and was based on evidence.

A further example of how stakeholders are engaged in the LMIS supporting and providing insights into occupational needs at a local level is from Finland (see Example 5).

Example 5 Occupation Barometers (Ammattibarometri), Finland

The Occupation Barometers (Employment Outlook by Occupation, Ammattibarometri) estimate the demand of approximately 200 occupations, and the balance between supply and demand for next six months These forecasts are based on interviews with employers and employees, visits to the employers, and quantitative data from the barometers produced at a national level (see Figure 7). Each of the Centres for Economic Development, Transport and the Environment (ELY) across the country involve regional stakeholders in producing short-term outlooks for key occupations and workforce availability. Stakeholders including employers and employees directly feed into the forecasts. The qualitative assessments of occupations are produced and published twice a year.

Figure 7 Example of Ammattibarometri (occupational barometer), Finland

Occupation	Estimated demand for workforce, next six months			Estimated balance between supply and demand for workforce, next six months			Balance between supply and demand for workforce in selected Employment and Economic Development Offices
	Jyv	Jäm	Ään	Jyv	Jäm	Ään	
1112 - Senior Goverment Officials	Jyv	Jäm	Ään	Jyv	Jäm	Ään	In balance
1120 - Managing Directors and Chief Executives	Jyv	Jäm	Ään	Jyv	Jäm	Ään	Surplus of job seekers
1211 - Finance Managers	Jyv	Jäm	Ään	Jyv	Jäm	Ään	In balance
1219 - Business Services and Administration Ma...	Jyv	Jäm	Ään	Jyv	Jäm	Ään	In balance
2113 - Chemists	Jyv	Jäm	Ään	Jyv	Jäm	Ään	Surplus of job seekers
2120 - Mathematicians, Actuaries and Statistic...	Jyv	Jäm	Ään	Jyv	Jäm	Ään	Surplus of job seekers
2131 - Biologists, Botanists, Zoologists and R...	Jyv	Jäm	Ään	Jyv	Jäm	Ään	Surplus of job seekers
2132 - Farming, Forestry and Fishers Advisers	Jyv	Jäm	Ään	Jyv	Jäm	Ään	Surplus of job seekers
2133 - Environmental Protection Professionals	Jyv	Jäm	Ään	Jyv	Jäm	Ään	Surplus of job seekers
2142 - Civil Engineers	Jyv	Jäm	Ään	Jyv	Jäm	Ään	In balance
2144 - Mechanical Engineers	Jyv	Jäm	Ään	Jyv	Jäm	Ään	Surplus of job seekers
2145 - Chemical Engineers	Jyv	Jäm	Ään	Jyv	Jäm	Ään	In balance
2149 - Engineering Professionals Not Elsewhere...	Jyv	Jäm	Ään	Jyv	Jäm	Ään	Shortage of job seekers
2151 - Electrical Engineers	Jyv	Jäm	Ään	Jyv	Jäm	Ään	In balance
2152 - Electronics Engineers	Jyv	Jäm	Ään	Jyv	Jäm	Ään	In balance
2153 - Telecommunication Engineers	Jyv	Jäm	Ään	Jyv	Jäm	Ään	Shortage of job seekers
2161 - Building Architects	Jyv	Jäm	Ään	Jyv	Jäm	Ään	In balance
2163 - Product och Garment Designers	Jyv	Jäm	Ään	Jyv	Jäm	Ään	Surplus of job seekers
2166 - Graphic and Multimedia Designers	Jyv	Jäm	Ään	Jyv	Jäm	Ään	Large surplus of job seekers
2211 - Generalist Medical Practitioners	Jyv	Jäm	Ään	Jyv	Jäm	Ään	Serious shortage of job seekers
2212 - Specialist Medical Practitioners	Jyv	Jäm	Ään	Jyv	Jäm	Ään	Serious shortage of job seekers
2221 - Nursing Professionals	Jyv	Jäm	Ään	Jyv	Jäm	Ään	In balance

Source: Occupational barometer – Finland

The Occupation Barometer provides occupational and skills anticipation data to a range of stakeholders in the LMIS with the aim of improving the match between vacancies and jobseekers. By providing local labour market occupational forecast data, the aim is also to promote occupational and regional mobility.

2.4. Dissemination

In this sub-section, LMIS dissemination activities are examined focusing on the presentation, customisation and interpretation of LMI.

Across all the countries studied there are a range of approaches to dissemination. Dissemination of LMI and intelligence are mostly through electronic publications with analyses completed for specific purposes, such as forecasting sectoral trends, evidencing labour market changes, evaluating the impact of a training programme within an area, etc. These publications and analyses are often linked to policy. A number of LMIS actors and stakeholders were found to be translating and interpreting data into intelligence for employers, education and training institutions, careers guidance and counselling services and end-users in the LMIS. The aim was to support education and labour market planning and policy.

A significant shift towards interactive and customisable data dashboards was noted across the countries studied. These dashboards provide greater granularity of visualised data and, in some instances, enable data and/or visualisations to be downloaded and used. Dashboards, powered by repositories, are increasingly being used to make data accessible. Data repositories, as a central source of data, are therefore proving invaluable within LMIS as they enable data to feed into a range of websites, tools and applications not just dashboards (see Section 2.2.4 for more discussion and exemplar data repositories).

One example from Australia illustrates how a data engine (or portal) that brings a range of data together is being used to feed into a range of online websites and tools for end-

users in the LMIS. Dissemination opportunities have expanded because of the Jobs and Education Data Infrastructure (JEDI) data engine. JEDI arguably creates a powerful example of what dissemination is possible when founded upon a strong data infrastructure which brings together a range of data and draws upon technical advances in big data analysis and linking.

Example 6 Jobs and Education Data Infrastructure (JEDI), Australia

JEDI is considered a 'flagship' enabler of intelligence on Australia's labour market, workforce changes and current and emerging skills needs, provides a 'real-time' view of the Australian labour market drawing data from multiple sources into its data engine, and translating these data into insights for different users. JEDI powers several online tools to support individuals navigate the labour market. These include:

JobTrainer: targeted at 17-24 year olds, it maps skills in demand by employers to qualifications and courses. Collaboration between the Australian Government, National Careers Institute (NCI) and MySkills. The Australian Government NSC has partnered with participating state and territory governments to establish the JobTrainer Fund, which funds training places for those aged 16 or older, leaving school, looking for work or wanting to reskill or upskill in an in-demand industry. JobTrainer provides access for eligible people to free or low-fee vocational education and training (VET) courses, including accredited diplomas, certificates or short courses. The aim is to prepare individuals for work in fast-growing industries that need skilled workers, including health, aged care and disability support, digital skills and trades.

Job Switch: this service and portal is a new service that helps individuals explore and find jobs they may already have the skills for. It is powered by JEDI.

Jobs Hub: this portal assists individuals find jobs in demand in their location matching their skills. It has sections where individuals can check current job vacancies (with filters by region and/or industry), check jobs in demand by location, find information about starting your own business, Covid-19 support, and information to help job search. It also has links to jobs in sectors with known labour shortages (such as care and support; construction; contact and call centres; defence; hospitality and tourism; retail; and logistics/warehousing/transport). The Jobs Hub also provides links to other websites, including a Mature Age Hub, Digital Training for jobseekers, Job Jumpstart (job search tips); Job Outlook[8]; NEIS (an active labour market programme (ALMP) for new business start-up assistance); Job active (jobs board and registration for MyGov career profile[9]);

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[8] Job Outlook will be decommissioned mid-2022. The occupation profiles have moved to the Labour Market Insights website.
[9] Jobactive for jobseekers seeking work or training opportunities (and links to targeted ALMPs such as those for youth, mature workers, persons with disabilities, seasonal farm workers). Employers can advertise vacancies as well as obtain information about training providers, to help them source potential job candidates, and find out details about opportunities to host interns. Jobactive is a government-funded network of over 1,700 providers across Australia, who are contracted to by the Department of Education, Skills and Employment (DESE), to deliver employment services to unemployed jobseekers on Government income support payments and employers.

[MySkills](#) (NCI's information about training options) and [CourseSeeker](#) (NCI's information about higher education study options, including short courses).

[Your Career](#) – the NCI developed a new portal bringing together, in one location, careers information, advice and support for Australians of all ages and at all stages of their career.

Figure 8 Example of Job Switch powered by JEDI, Australia

In Scotland, Skills Development Scotland enables data to be accessed and visualised in dashboards using Microsoft Power BI (see Scotland – Dissemination). The regional skills assessment data matrix is aimed at regional and local stakeholders, policy makers, education planners and local employers (see Figure 9). The data matrix enables the user to customise the data (and visualisations) by selecting a range of indicators which are thematically organised. To support users in accessing, interpreting, and using the data, Skills Development Scotland provides online materials and ad hoc support.

Figure 9 Regional Skills Assessment Data Matrix, Scotland
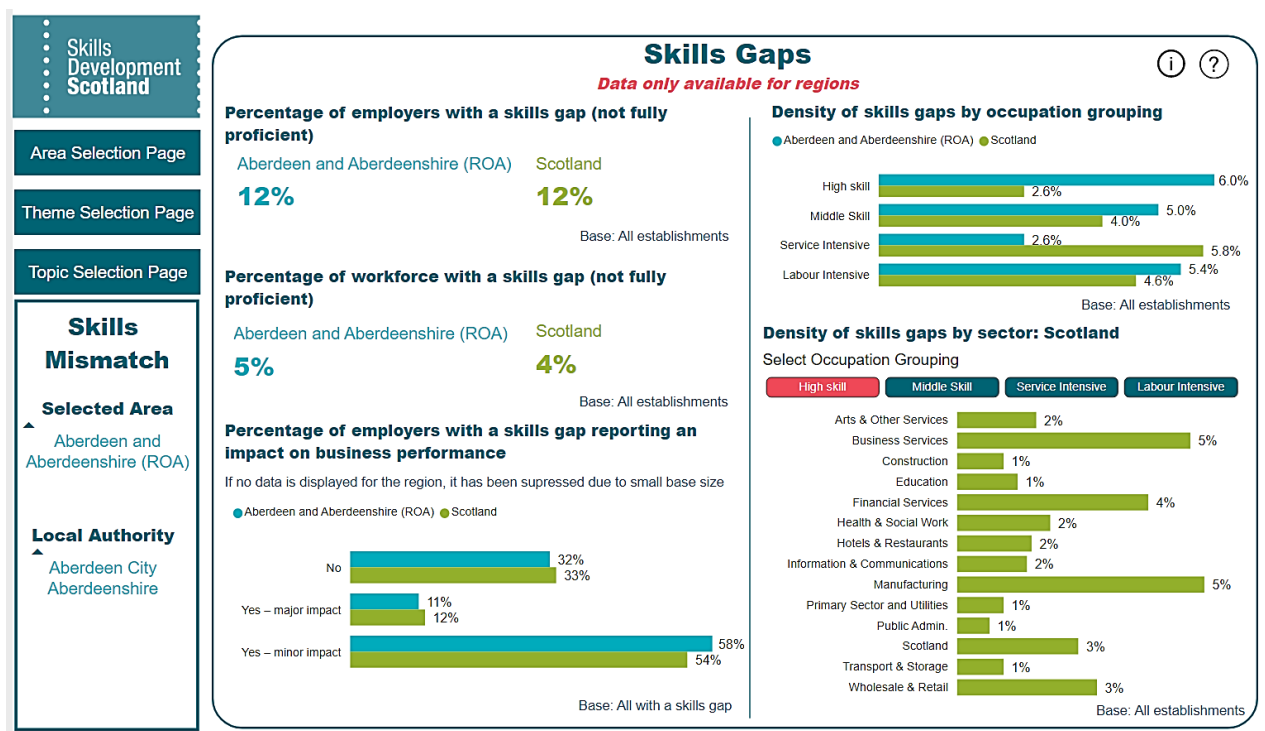
Source: Regional Skills Assessments, Skills Development Scotland – Scotland

A shared weaknesses of the countries studied is the provision of support for users to understand what data are available and how to interpret these data. There was little evidence of national training programmes on LMI for stakeholders or end-users within an LMIS. The training was reported to be ad hoc in the countries studied. In Canada, however, the LMIC has been organising training webinars with the Canadian Education and Research Institute for Counselling (CERIC) and, at the time of writing, it was launching a certified training course on LMI aimed at careers guidance counsellors. This was developed in response to feedback from users.

A benefit of dissemination by traditional reports and publications has been that labour market intelligence, qualitative interpretations and/or contextualisation of LMI and data have been provided to support users understand and use the LMI. With advances in technology, it is possible for text to be automatically generated in online dissemination of LMI. In Sweden, this approach has been piloted. It was reported that automatically generated text still needs manual checking, which is a resource intensive approach. This is one example of how technical advances can support LMIS, but approaches and techniques still need to be developed to improve outputs.

2.5. Comparative overview of international LMIS

The countries examined as part of this research were selected as they had well-developed and established LMIS. It was, therefore, anticipated that for each LMIS

studied, the dimension of analysis as identified in the analytical framework (see Approach to the research) could be explored and approaches evidenced.

Table 2 provides a comparative overview of the dimensions (namely: organisation, resources, stakeholders, and dissemination) and particular characteristics identified in the countries studied. It suggests that certain characteristics are present in developed and established LMIS but were not necessarily common across the countries studied. In combination, these arguably provide a foundation in which countries can build upon to enhance their LMIS. Stakeholders suggested that these characteristics were key strengths of their LMIS and arguably enhanced the LMI and intelligence. These included:

- Coordination between actors in terms of data collection and dissemination to ensure a coherent and consistent system;

- Forums and expert panels (at local or sectoral level) convened to interpret and contextualise data and support horizon scanning to understand future occupational and skills demand;

- Support and training in the interpretation of LMI for education and training institutions, employers and end-users in an LMIS is provided; and

- A national skills taxonomy has been developed and embedded within and across the LMIS to provide a framework in which data can be collected, analysed and presented.

Table 2 Comparative overview of international LMIS

	Characteristic of LMIS	Australia	Canada	Germany	Scotland	France	Sweden	Finland
Organisation								
Legal and institutional framework	Established whole country approach with legislation in place	x	x	x	x	x	x	x
	Legislation and data collection frameworks in place	x	x	x	x	x	x	x
	Legislation sets out data requirements from employers		x	x			x	
Management and control	Coordination between actors in terms of data collection and dissemination	x		x			x	x
Vision and strategy	Forward looking plan or strategy for LMIS		x				x	

	Characteristic of LMIS	Australia	Canada	Germany	Scotland	France	Sweden	Finland
	Using big data techniques and NLP	x	x				x	
	Taking advantage of technological advances to enhance LMIS (in terms of approaches and/or dissemination)	x	x	x	x	x	x	x
Resources								
Funding	Government funds LMIS	x	x	x	x	x	x	x
	Long-term funding in place	x	x	x			x	x
	Other sources of funding utilised						x	
Data	Established data collection processes in place	x	x	x	x	x	x	x
	Data from a range of sources are being used	x	x	x	x	x	x	x
	Disaggregated data are available	x	x	x	x	x	x	x
	Data are current	x	x	x	x	x	x	x
Methods and expertise	PES is a key player in data collection, analyses and/or dissemination			x		x	x	x
	Innovative approaches to data collection and analysis are being used		x				x	
	Quantitative techniques, labour econometrics and modelling are being applied in LMIS	x	x	x	x	x	x	x
	Qualitative data techniques are embedded in LMIS	x	x		x			x
	Use of foresight to project skills	x	x					x
	Use of horizon scanning to forecast occupations and skills	x	x	x			x	
	National skills taxonomy embedded across LMIS	x	x					
Accessibility	Data informs policy and strategy	x	x	x	x	x	x	x
	Data repositories part of LMIS	x	x	x	x	x	x	x
	Open data policy	x	x		x	x		
Stakeholders								

	Characteristic of LMIS	Australia	Canada	Germany	Scotland	France	Sweden	Finland
Cooperation and engagement	Cooperation and collaboration between stakeholders is apparent	x	x	x	x	x	x	x
Feedback and validation	Forums and expert panels convened to interpret data	x	x	x	x			x
	Stakeholders feed into the LMIS to improve LMIS products and tools		x	x			x	
Integration and stakeholder needs	Stakeholders feed into LMIS, data collection and analyses	x			x		x	x
Dissemination								
Dissemination	LMIS part of support services – targets stakeholders	x	x	x	x	x	x	x
	LMIS part of support services – targets end-users of LMIS	x	x	x	x	x	x	x
Presentation	Reports common feature of disseminating data and intelligence in LMIS	x	x	x	x	x	x	x
	Data dashboards being used	x	x	x	x	x	x	x
	Use of technology key feature in dissemination	x	x	x	x	x	x	x
Customisation	Data are customisable	x	x	x	x	x	x	x
Interpretation	Data interpretation undertaken for policy makers and other stakeholders	x	x	x	x	x	x	x
	Training in the interpretation of LMI	x	x		x			

2.6. Summary: Assessment of international LMIS

The following draws out the key elements, strengths and weaknesses of the countries studied.

Organisation, legislation and management

In terms of organisation, all the countries studied had some regulatory frameworks and/or legislation in place, which described the main actors in the LMIS and their role and responsibilities. This is seen as a key feature of established LMIS. In most countries studied, this legislation delegated responsibility to a national statistical agency or institute

as the primary producer of official statistics. These data are analysed, published and presented directly to policy makers and other LMIS stakeholders. The agencies were found to be enabling access to data for others to use.

Across the countries studied, LMI and intelligence are being used to inform policy, particularly around employment programmes, educational planning, skills development, and delivery decisions. LMI, particularly around skills, was being used to inform migration policy in Australia and Sweden.

Across the countries studied a wide range of actors with varying roles and responsibilities were noted to be involved in the LMIS. In all cases, there were several actors and stakeholders involved in collecting, analysing, and producing data in the LMIS. LMIS are complex systems, which can be further complicated when there is a lack of collaboration and cooperation between actors and stakeholders. Roles and responsibilities can be duplicated. National leadership which coordinates activity of devolved actors and stakeholders to ensure a holistic and consistent LMIS was identified as ideal. Many of the countries studied were working towards coordinating activity.

Resources – Funding, data, methods and expertise

In all the countries studied the LMIS were funded by government. One concern is that LMIS and their funding can be unstable due to government changes and shifting priorities. This instability can result in changing roles and responsibilities of actors, as well as how data are collected, disaggregated, presented and/or made accessible. In some instances, new approaches are piloted and then withdrawn. Investment and resources were seen to be important for innovation in LMIS. Overall, in the countries studied, the LMIS can be considered relatively stable.

Across all the countries studied there is a wealth of data available. Broad, national level data are considered useful for informing policy and target setting but more nuanced LMI and intelligence is needed for regional and local level planning. Whilst data are mainly quantitative, actors and stakeholders were found to be translating and interpreting data into intelligence for others. Qualitative data was seen as an essential part of an LMIS as it provides an improved understanding of particular data and contexts. At the heart of a well-functioning LMIS is one that applies a range of methods and techniques in its data collection and analyses.

Many of the countries studied were trying to enhance the LMI using technology and big data techniques in the collection, analysis, and dissemination of data. Much of this work was focused on understanding current and future skills demand and supply. Some countries studied had turned to web scraping vacancy data and were experimenting with new techniques to classify and analyse these data. Vacancy data are seen as a good source of current information. It is suggested that there is still much to learn from those using experimental data (such as Nowcasting, web scraping, skills classification, etc.).

The pandemic, it was noted, has shifted user demand and expectations around data and intelligence requirements. Stakeholders interviewed suggested that there is a greater emphasis from those in an LMIS on identifying specific skills requirements. This is a particular challenge in the absence of a shared understanding of skills. Evidence based skills taxonomies developed in collaboration with stakeholders and embedded across an LMIS provide a structure in which data can be collected, classified and presented. It arguably forms part of coherent LMIS.

Stakeholder – Cooperation and engagement

In several countries studied, stakeholder cooperation and engagement was evident but for most this was not significant and seen as a particular weakness. In instances where local stakeholders engage with those producing national level data, this resulted in regionally contextualised data. These data are more meaningful and understandable, and so may be more likely to be acted upon. Occupational and skills data can be challenging to understand so expert interpretation was seen to help inform local initiatives and strategies to support the functioning of the labour market. A strength of LMIS was identified as those that enable cooperation and engagement between stakeholders. Arguably in an ideal LMIS, stakeholders work together in the LMIS to collect and bring data together, as well as provide access to and interpretation of data. It could be suggested that this is important as LMIS shift away from policy makers being their primary audience.

Across the countries studied, little evidence was found on the mechanisms to validate and improve the LMIS in terms of the data collected and presented, as well as the tools used to disseminate the data. In a few countries studied (e.g., Finland, Scotland), data validation was undertaken by specialist forums. A strength of an LMIS should be one that validates data and acts upon feedback.

Dissemination – Presentation, customisation and interpretation

Across all the countries studied, a range of websites, applications and tools are being used to disseminate data and intelligence. There is evidence that end-users are increasingly been seen as a key stakeholder in LMIS in terms of dissemination with more LMI websites and applications being targeted at them. For the most part, stakeholders and end-users have little opportunity to feed into an LMIS. As more data becomes available it was suggested that there is a notable challenge in making it available and getting it to the right users. Overall, it was suggested that a balance needs to be found between the level of data required and how to make it accessible and user-friendly.

Digital tools are enabling better dissemination of data as well as enabling data to be customised. Data dashboards are commonly being used to facilitate access to data for specific stakeholders. Customisation of data is considered an easy solution to meeting stakeholder requirements. However, as found, this requires comprehensive data repositories to be available to power dashboards and other digital dissemination tools.

Most participants reported that there is much good data being produced, but that it is not always publicly available for some stakeholders and end-users. It was reported that data are sometimes just available to policy makers. Others provided an alternative perspective suggesting that there should be a concern about whether and how data will be interpreted and used. A few suggested that data can easily be misinterpreted so providing guidance and interpretation is essential to ensure it is used appropriately to inform, for example, decision making and policy planning.

Support with interpreting data is regarded as the weakest part of all the countries studied. This can, however, be considered difficult to achieve as more data are becoming publicly available with little consideration on its purpose and role within a LMIS. Offering training to those disseminating data to end-users is possible. End-users will continue to need support in understanding data and intelligence and what it means to them.

3. Enhancing LMIS with big data and new techniques to obtain data on emerging skills needs

This section of the report reviews new techniques and processes for obtaining data on emerging skills needs. Three international cases are presented which illustrate how these techniques are being applied to understand skills in the labour market: first, job vacancy data are analysed to understand occupational distribution and identify skills demands; second, data from job vacancies and jobseekers' profiles are analysed to understand skills supply, demand, and mismatches in the labour market; and finally, patent data and bibliographic data are analysed to identify emergent skills in particular sectors. The aim of these new techniques is to enhance or complement existing approaches to understanding and analysing skills.

Key insights

- There are **several different approaches to measuring individuals' skills** such as educational attainment, training, work experience, etc. In the past this has relied upon surveys that are costly and time consuming, but significantly do not provide the granular information required.

- Surveys, official statistics and quantitative forecasts can provide the broad quantitative framework for thinking about current and future skill needs.

- While new techniques offer something new to skills analysis, **being able to identify the scale and structure of skill demands still relies on more traditional approaches**, such as sample surveys. As such new techniques should be seen as a complement rather than a substitute to more traditional approaches.

- The **advantages of these new techniques** are that they **provide substantial detail on the skills required** in particular occupations or jobs, which would otherwise be too difficult to collect and analyse via other means. Data produced on labour supply, demand and mismatch can complement more traditional approaches to understanding skills. Plus, they provide relevant data to those with an interest in understanding how skills demand is changing where, to date, there has been a shortage of robust information. Relevantly, skills data can be disaggregated by occupation or job; and data are timely.

- Significantly new techniques are able to identify the **emergence of new clusters of skills**, which might suggest new types of occupations or skills that are beginning to emerge.

- These **new techniques also have weaknesses** based on the fact that they are relatively untested and are subject to further development, including: the accuracy and representativeness of data are difficult to determine because an estimate of the total number of vacancies is yet to be produced; processes are complex and open to error; plus, the validity and coherence of results need to be checked by various stakeholders.

- Key to developing these techniques to enhance LMIS is to ensure approaches are **transparent and open**, so results are credible but also that there is opportunity for shared learning to improve approaches.

3.1. The role of text mining in skills analysis: summary of the results from three cases

Text mining techniques provide the means to identify the specific skill needs in the labour market. It provides a basis for moving away from broad-based measures of skills such as

those which rely on occupation or level of education. Typically, text mining techniques have been applied to collecting detailed data on employers' skill demands from job vacancy platforms, though they are not necessarily limited to this source of data. To illustrate the gains to be obtained from using big data analysis, three cases are provided.

1. **Skills OVATE** – Cedefop's skills database derived from collating information on job vacancies from each EU member state and extracting, and classifying, the skills sought. Data are analysed to understand occupational distribution and identify skills demands. The data are obtained from recruitment websites across Europe to indicate the specific skills in demand for a particular occupation. ESCO provides the means of classifying detailed information on skills. Skills-OVATE, by concentrating on mainstream job recruitment websites across Europe is able to provide an indication of the scale of demand for particular skills by country, occupation, sector, and over-time.

2. **ECLAC** (Economic Commission for Latin America and the Caribbean) databases obtained by gathering metadata of job vacancies and jobseekers' profiles from different websites and providing insights into the share of jobseekers and job vacancies by sector, skills, and country. Data from job vacancies and jobseekers' profiles are analysed to understand skills supply, demand, and mismatches in the labour market. ECLAC provides an example of where supply-side data is also collected. For the most part, the supply-side is captured by information from those individual jobseekers who provide information on their level of qualification, years of work experience, and sector of employment. It is included as an example because it illustrates the way in which supply-side data has been categorised.

3. **European Training Foundation** (ETF) analysis of patent and scientific literature databases to identify emerging skill needs in particular sectors in relation to drivers of change (mainly that of technological change). This approach provides an example of a future oriented approach to identifying emerging skill needs combining patent data with data collected from more traditional methods. An example is provided on identifying emerging skill needs in the agri-tech sector in Israel (see ETF, 2021). It is included as an example because it provides an illustration of how text mining can be extended beyond collating information from job vacancy websites to look at other sources of data which contain information about current or emerging skill needs.

Skills-OVATE provides an example of how job vacancy websites can be used to provide a detailed insights into skill demand. It provides almost real-time quantitative information on the skills required in occupations where occupation can be potentially disaggregated to ISCO 3- or 4-digit levels. The ETF's approach shows how text mining can be extended beyond job vacancy platforms to look at how groups of technologies are affecting the demand for skills. While it does not provide information on the scale of demand for specific skills, it is able to identify the specific skills associated with specific types of technological change at the sectoral level. Because the analysis uses patent data it is

able to indicate those skills which are likely to be increasing in demand over the next two to three years given that patents tend to be registered to protect inventions which are just about to come on stream. ECLAC is included because it has attempted to include supply-side data in its analysis. The supply-side data consists of qualification level, years of labour market experience and sector of employment. It does not identify the extent to which jobseekers possess the specific skills which employers demand.

There is the potential to extend the analysis of the supply side using text mining techniques. If individuals submit their CVs to an online job portal, then there is the potential to match the skills of those looking for jobs to the skills which are specified in job advertisements. Ultimately this is dependent upon being able to identify those skills which are essential to obtaining a job. While it is feasible to match the skills of jobseekers to those specified in job advertisements would appear, for the time being, to be a work in progress. That said, detailed analyses of skills demand side are increasingly available which is a useful resource for, say, those involved in designing the provision of vocational education and training courses and programmes.

3.2. Context for new methods to understand emerging skills

Skill proves to be a difficult concept to both define and measure (Attewell, 1990). Economics, in the guise of human capital theory, tend to view skill as the accumulation of education, training, and work experience which obtains a monetary reward in wages. An individual's wage represents the return on their investment in skills or the marginal utility of an additional skill however defined (Becker, 1962; Schulz, 1959, 1962). From a measurement perspective, the precise definition of which skill or skills provide any marginal utility has been sidestepped (Green, 2013). Instead, attention has focused on years of education, qualification, and occupation as proxy measures of human capital. Over much of the latter half of the 20th century the evidence indicated relatively high returns to additional years of school, levels of education, or working in a managerial or professional occupation, leading many countries to increase participation levels in higher education.

During the 21st century the monotonic relationship between level of educational attainment and wage returns would appear to have stalled. The evidence initially indicated relatively high returns to STEM and ICT qualifications, but even here the relationship appears to be becoming more nuanced. Evidence from the USA suggests that employers may be less willing to invest in the development of their ICT employees than in the past preferring instead to replace them with the next tranches ICT graduates existing university (Deming & Noray, 2020). The wage return to studying ICT is thereby lowered. The point here is that using qualification levels, years of educational attainment, or occupation are no longer adequate measures of skill if the interest is in understanding the demand for skills. There needs to be a more precise measure of skill. Initial moves in this direction were made with the skills requirement approach pioneered in the Skills in

Britain series of surveys (Felstead et al., 2007) and then further developed in surveys such as the OECD's PIAAC (OECD, 2019) and the European Skills and Jobs Survey (Cedefop, 2015; Pouliakas, 2018).

The skills requirement approach sees a job as range of tasks which necessitate the use of specific skills which can be measured with respect to their level, importance, and frequency of use. In the surveys mentioned above, questions are asked about a range of different tasks and the skills, both cognitive and non-cognitive, to develop a much more detailed picture of the skills people require in different jobs. The skills requirements approach has been able to provide a much more nuanced understanding of skills demand than had been available hitherto. Because the skills requirement approach to date has relied upon sample surveys, data collection proves to be both costly and time consuming. Added to this, data analysis takes time to complete. That said, the analyses produced have a vitally important role to play in that they can quantify the demand for skills – albeit at a fairly high level of aggregation and, in doing so, provide a framework of sorts in which other types of data analysis can be conducted. This is especially relevant to the use of data science techniques where detailed information is collated but it is sometimes difficult to gauge the scale or importance of particular skills.

Data science techniques, principally that of natural language processing (NLP) or text mining to the analysis of skills demand, provides granular information on, for example, the skill demands required to carry out specific tasks in a job, or the skills associated with the introduction of a specific new technology. Text mining provides the capability to identify new skills or new jobs in way that was previously out of the skills researcher's reach because of the amount of time and effort required to manually extract and code information. While data science offers something new to skills analysis, being able to identify the scale and structure of skill demands still relies on more traditional approaches, such as sample surveys. As such it should be seen as a complement rather than a substitute to more traditional approaches (Chiarello et al., 2021). How this has been achieved to date is explained in more detail in the following sections.

3.3. The use of natural language programming in skills analysis

Advances in programming and computer power provide the opportunity to extract and structure data from a range of sources previously outside the scope of social science research. For example, it is now possible to extract structured data from thousands of websites, bibliographical databases, and so on in a relatively short space of time by using algorithms based on NLP techniques. Text mining techniques are then used to extract the data from various sources of text. The use of NLP and text mining are now being increasingly used to extract information on skills. Possibly the most common application of NLP and text mining in skills research is that of obtaining data from

recruitment/vacancy websites to identify the jobs and associated skills which are in demand.

An introduction to text mining techniques can be found in Cedefop's guide to using big data and artificial intelligence in skills research (Cedefop, 2021). It outlines the way in which big data techniques can be used to rapidly extract a wide range of information from a huge range of sources in a short space of time. This is undertaken by developing algorithms that can analyse textual sources of data by:

- Splitting any text into its basic components;

- Extracting those entities which the programmer considers important; and

- Establishing relationships and correlations between terms in a way which distinguishes a trend from noise.

As alluded to above, this provides the opportunity, amongst other things, to:

- Rapidly analyse vast amounts of data;

- Identify less obvious or hidden patterns by connecting pieces of information scattered among many different and unconnected sources;

- Generate standardised and reliable results.

There are three sequential steps to be undertaken in using big data techniques in skills analysis (or any analysis for that matter):

1. Data retrieval, the collation and importing of data to be processed;
2. Data transformation where unstructured data are made structured; and
3. Data analysis whereby trends and relationships between terms are identified.

The three most common means of data retrieval are:

- Web scraping to extract structured data from websites. Web scraping implies that data are already in a structured form on the web page and can be extracted by knowing the exact position of the information;

- Web crawling where robot or crawler is programmed to browse web portals and systematically download their pages. Web crawling is a main component of web scraping where relevant pages are collated for later processing;

- Application programming interface access that provides bulk downloading of information and online content from websites. An API is not always available – because, for instance, the website owner does not want the material to be downloaded – which means some other less reliable means of downloading information needs to be used such as web scraping.

Data transformation takes place through:

- Tokenisation where text is split into single words (tokens);

- Stemming which removes common suffixes from words;

- Lemmatisation which grammatically links words to the dictionary form of text (e.g., with reference to the declination of verbs, the use of superlatives, etc.);

- Part speech tagging where words are tagged with reference to their role in a sentence – for example, whether they are acting as a noun or verb for the most part.

Once the data have been transformed, algorithms then analyse the data to find correlations and associations. This can be based on the use of clustering techniques which explores the occurrence and co-occurrence of key words and the semantic relationships. An alternative, more structured approach, is to use named entity recognition where there is an entity, such as 'location' and 'Peru' would be a type of 'location'. Potentially there are trade-offs depending upon the degree of structure or supervision contained in the algorithms used to analyse the data.

Although NLP and text mining provide the means to massively extend the analysis of skills demand to identify specific skills, or clusters of skills, which are sought in the labour market, there are limited to consider. These include:

- Misgivings about the representativeness of data. While the use of big data techniques can be extended across a huge number of sources, it is sometimes difficult to be sure about the population being sampled and the extent to which the data obtained are representative of that population;

- Related to the above point, more accessible sources of data are, by definition, more likely to be analysed thereby introducing a potential bias into the results;

- There is a danger that some of the relationships, associations, and trends are statistical artefacts which are unrelated to skill demand;

- The relative importance of pieces of information are difficult to weigh up. For instance, job vacancies in the UK tend to contain a relatively long list of skills required compared with adverts in other parts of Europe for the same job. It is difficult to be sure whether these additional skills are necessary or are of much importance to the job compared with other ones.

The limitations of using big data techniques in skills research reiterates the point made earlier that it needs to be seen as a complement to other kinds of skills analysis. To illustrate the gains to be obtained from using big data analysis, further details of the three cases mentioned above are provided in the sections that follow.

3.3.1. Case 1 Analysis of data retrieved from recruitment websites across the European Union – Cedefop's Skills OVATE database

It is evident that different tools are being developed in collating, managing big data for labour market analysis. One major project is the "Skills-OVATE: Skills Online Vacancy

Analysis Tool for Europe" launched by Cedefop in 2018.[10] The main purpose of the OVATE is to offer detailed and updated information on jobs and skills in demand across 28 European countries derived from data posted on vacancy portals.[11] OVATE is not simply about providing information on vacancies. It provides the basis for identifying (and classifying) the specific skills or competences required within particular jobs creating a skills clusters linked to occupation – a type of taxonomy. Achieving this goal required the standardisation of vacancy information, which varies in its detail across countries, presented in different languages. Details on the methodological steps taken has been presented in various reports (Cedefop, 2019) and workshops.[12] As Cárdenas-Rubio (2020) has noted, many big data initiatives provide little detail on the methods used for collecting and standardising the data. Cedefop, in contrast, has been transparent in its use of methods. For example, it has undertaken statistical tests to determine the representativeness of OVATE data (e.g., the degree to which data results could be used to draw conclusions about the total number of vacancies for a specific country) and these have been made publicly available (Beręsewicz & Pater, 2021). OVATE's main results for each country are publicly available on a series of dashboards.[13]

To produce estimates of skills demand the following steps were undertaken by Cedefop.

- **Data ingestion**: Online vacancy data are dispersed across many websites. In order to efficiently obtain representative information job portals were selected on the basis of the frequency and regularity of vacancy updates, territorial coverage, and data structure (e.g., structured information is available on the skills required to fill a job). Approximately 300 sources (mainly job portals) across Europe were selected for inclusion in the data collection phase.[14] The number of sources tend to reflect the size of the country: from around 100 in Germany to two in Malta. Different methods to collate the data: web scraping, web crawling and direct access via an API. These methods all use algorithms that automatically collect information from the internet (in this case, job portals). The method used depended upon data accessibility, website structure, etc.). The algorithms perform a search of each job vacancy posted and download the full details attached to it.

- **Pre-processing**: Once data have been downloaded it needs to be cleaned with duplicate job advertisements removed.[15] Some of the information downloaded via the algorithms is not relevant, such as details of the company with the vacancy, which means it needs to be deleted from the dataset.[16]

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[10] See: https://www.cedefop.europa.eu/en/tools/skills-online-vacancies
[11] The UK was initially included in OVATE. However, due to the Brexit results data for the UK was collected and analysed up to 2019.
[12] See: https://www.cedefop.europa.eu/en/news/setting-infrastructure-collect-vacancies-skills-analysis
[13] A pre-defined graphical user interface, usually composed of different panels that show key indicators from a database.
[14] These sources include private job portals, public employment service portals, recruitment agencies, online newspapers and corporate websites.
[15] Details on this de-duplication process are not provided.
[16] Details on this de-duplication process are not provided.

- **Information extraction**: In this step, vacancy data are organised according to a pre-defined structure. Job titles are coded according to the occupation / job being advertised (using ISCO-08), sector (NACE rev. 2), and region (NUTS-2). The skills information is coded according to the classification of skills provided by ESCO and O*NET. The coding of data is undertaken mainly using machine learning models which match the content of job postings with each respective classification.[17] Statistical tests and manual checks are then executed to determine the accuracy of the classification.[18] Experts review the outcomes and propose amendments which are then incorporated in the machine learning process to improve classification accuracy. Although the machine learning process provides a means of structuring a vast amount of information, there is still an important role to be played by manually classifying data in order to improve the machine learning process.

Based on the above steps, Cedefop has developed a large and structured database on the skills required in jobs derived from analysis of online vacancies. Table 3 summarises the information contained in the database.

Table 3 Basic data structure of Cedefop's Skills OVATE database

Variable	Definition
Occupation	ISCO-08
Countries	27 European countries
Region	NUTS-2 classification
Sector	NACE rev. 2. Classification
Skills	ESCO
	O*NET
Contract type	Unlimited duration; Self-employed; Limited duration; apprentice or trainee
Working hours	Full time; part-time
Time	Q4 2020 to date

Source: Cedefop-OVATE

As noted above, these data are available via data dashboards. It is also possible, at varying levels of data disaggregation, to produce bespoke tables and figures. By way of

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[17] Supervised machine learning methods consist of a training database (data that were previously and correctly classified) and association algorithm methods that can automatically detect patterns in data. Based on these two inputs, the computer "learns" association rules to classify new data. For instance, for coding the job titles into the corresponding occupational groups, Cedefop has used around 70,000 vacancies (previously coded by a group of experts) and different associated algorithms for each country to fit the machine learning model. Of the sample this comprised: 60% for the machine training; 20% for performance testing; and 20% for evaluation of accuracy (quality measure).

[18] These statistical tests consist of comparisons between output produced between the testing and evaluation databases.

illustration, Figure 10 depicts part of the information currently available on the dashboards (in this case, data at ISCO 3-digit level). In Figure 10 the panel on the left shows the distribution of vacancies by occupation (software and application developers and analysts record the highest share of vacancies). The panel on the right shows the change in the number of vacancy postings between 2021 Q1 and 2021 Q4 to reveal that growth was highest for aircraft controllers and technicians, waiter and bartenders, and food preparation assistants.
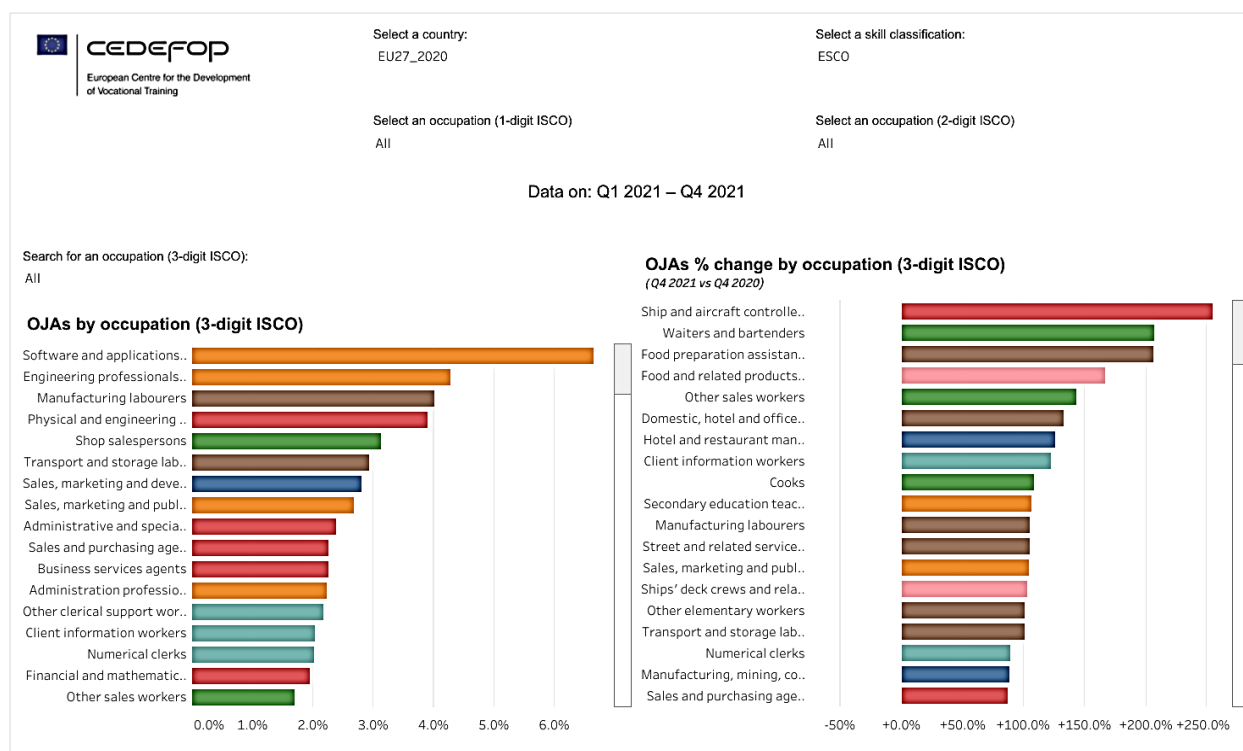
Figure 10 Occupational distribution of job vacancies and change in the number of vacancies in the EU (Q1 2021 – Q4 2021) provided by Cedefop-OVATE

Source: Cedefop-OVATE

Related to the crucial point of the accuracy and representativeness of the data, Eurostat has conducted tests on the vacancy data collated by Cedefop to determine the coverage and representativeness of these online job advertisements (Beręsewicz & Pater, 2021). The main results of these tests showed that (at this stage) OVATE vacancy cannot be used in estimating the total number of vacancies in most European countries. That said, the vacancy dataset seems to be representative in four countries (including Czechia, Latvia, Bulgaria, and Sweden) and three NACE sectors (agriculture, hunting and forestry, administrative and support service activities, and arts, entertainment and recreation). The main limitations of these data are related to the way in which the data are scraped and consolidated (e.g., scraping of outdated job advertisements, duplicates, etc.). As highlighted by Beręsewicz and Pater (2021), the OVATE vacancy data should be used to indicate the skills associated with particular jobs rather than as a guide to determine the number of vacancies in Europe. OVATE is a work in progress that has already provided

key information on skills demand across European countries. As it further develops more information will be included such as wages and other non-skill requirements.

3.3.2. Case 2 Economic Commission for Latin America and the Caribbean (ECLAC) analysis of job vacancy data

ECLAC is a United Nations regional commission with the purpose of promoting economic cooperation and contributing to the economic development of Latin America and the Caribbean. Since December 2019, ECLAC has coordinated actions in collecting and analysing online labour market data for 33 countries (Hilbert & Lu, 2020).[19] Like Cedefop's Skills-OVATE, the project is designed to collect a large amount of LMI from various international online labour market platforms active in the ECLAC region. However, it also provides insights into the demand for, and supply of, labour. ECLAC has developed a comprehensive methodology to collect, standardise and analyse labour information from different countries and languages. Details of the methodology can be found in Hilbert and Lu (2020). It is the focus on the demand and supply sides which differentiates it from Cedefop's Skills-OVATE. For example:

- From the **supply side**, ECLAC collects, on a daily basis, online postings by scraping three websites: Profdir, Freelancer and Upwork. On these websites, jobseekers present their profile information such as profession or job expertise, hour rate, country of residence, skills, etc. Employers use these websites to scan, select and contact the workers according to their requirements.[20] [21] The supply-side information on the ECLAC website consists of that on qualification level, years of labour market experience, and sector of employment.

- For the labour **demand side**, six sources are used for collecting and analysing information: Bumeran, CaribbeansJobs, CaribbeanJobsOnline, JobisJob, CompuTrabajo, Profdir, Freelancer and Upwork.[22] [23]

The data collection of both sides of the labour market allows ECLAC to calculate the measurement of occupational mismatches (over-supply or scarcity of workers) for a specific region, skills and sector. This type of approach is quite unique. Consequently, the ECLAC project serves as an example of using online sources to generate information on skill mismatches.

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[19] Countries included in ECLAC: Bolivia; Colombia; Ecuador; Peru; Caribbean: Antigua and Barbuda, Bahamas, Barbados, Cuba, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago; Central America: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama; North America: Mexico; South America: Brazil, Paraguay, Suriname, Venezuela; Southern Cone: Argentina, Chile, Uruguay
[20] Information about who accepted a specific job (job match) is not available.
[21] These websites also post job vacancies.
[22] Freelancer and Upwork are platforms focused on freelance jobs.
[23] Bumeran, CaribbeansJobs, CaribbeanJobsOnline, JobisJob, CompuTrabajo and Profdir cover a wide variety of jobs. The information from these platforms is considered domestic labour market information.

The ECLAC has conducted the following steps:

- **Selection of websites:** ECLAC selects websites that provide the maximum amount of information for all countries within its scope rather than collecting information from most available sources in each country. ECLAC decided to exclude sources that only have information for a single country (national websites) and instead considered the main international ones active in the region. This approach reflects the fact that ECLAC's budget is relatively restricted. As Cárdenas-Rubio (2020) notes there is a trade-off between the number of online sources selected and the time/effort required to build a database. As more sources are considered an increase in human and computational capabilities is required to process and standardise each source. Moreover, the risk of collecting duplicate information increases as more sources are added. The quality of these kinds of data depends on a variety of aspects such as the coverage (number of observations and variables available) of the sources selected, the algorithms used to collect and standardise the information, and the periodicity of the data collection, etc. Ultimately, ECLAC creates a comparative perspective across countries in the region.

- **Data collection:** The methods used to automatically collect data are APIs and web scraping. Via these methods, ECLAC collects the metadata from each source.[24] In this case, the metadata refers to the global content of each labour market platform. The metadata are aggregated figures of the available information on each website. This information also can be disaggregated accordingly categories predefined by the platform owner. For instance, with the metadata, it is possible to know the total number of vacancies or workers available in each region with some disaggregation at the sectoral or job position level. Consequently, ECLAC does not collect the most detailed micro-data (e.g., detailed information of each worker profile and job advertisement such as job description, worker's portfolio, etc.). The collection of the metadata significantly reduces the computational and time resource involved. Moreover, this approach is less invasive for the platform administrator since it does not load the website with many requests.[25] With this approach it is possible to have measure of the number and share of workers and job advertisements by countries and other labour market characteristics. It is not, however, possible to analyse more detailed LMI for each worker or job announcement such as the specific skills demanded or offered, detailed occupational information (e.g., at the ISCO 4-digit level), etc.

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[24] Metadata is a set of data that describes and summarises other data. For job platforms, the metadata corresponds to the summarised information on each website's home screen. The home screens usually describe the platform content, such as the total number of vacancies/jobseekers available by different categories such as region, sector, skills, etc. This summarised information is the metadata of the job platforms and is the one that ECLAC uses to conduct the corresponding labour market analysis.
[25] To obtain the microdata, it is necessary to click on each worker's profiles and job announcement. These requests could saturate the platform and the website administrator could ban the web scrapers.

- **Standardisation:** Given that the ECLAC only collects metadata, the standardisation process of the information consists of a harmonisation of the pre-defined categories available in each source. These pre-defined categories vary across websites. For instance, all websites present aggregated information (e.g., number of job announcements) by sector. The sectoral categories differ between websites. One website might call one sector "Administration, Accounting, Finance" and another website might use a different but similar category such as "Administration/Office" and "Accounting/Finance" categories. Consequently, ECLAC manually mapped all these labels and grouped them into a harmonised classification. These tasks have been initially conducted for the sector and the skill variables, but other efforts have started to take place to standardise other variables, such as the occupation using ISCO at the 3-digit level. Other text mining procedures were also conducted to clean and organise the data from the different platforms.

- **Analysis and visualisation:** With these data, ECLAC has divided the results into two groups: The freelancing labour market and the domestic labour market. The freelancing labour market corresponds to an analysis of the two largest freelancing platforms: Freelancer.com and Upwork.com. As previously mentioned, these platforms are focused on freelancing jobs. Jobseekers and job announcements are not constrained to a territorial boundary. These platforms allow ECLAC to conduct an analysis of freelancing supply (e.g., share of jobseekers by regions, sectors, hourly rates and payments and some profiles' characteristics) and demand (by sectors and regions). Given that these platforms provide information on the labour supply and demand, ECLAC combined these data to provide a measurement of mismatch by sectors and regions.[26] By doing so, ECLAC was able to estimate a substantial over-supply of professionals in "Sales & Marketing" and an undersupply of professionals in "IT, Networking and Software" and "Design, Media, Engineering & Science". The largest mismatches tend to be in Caribbean and Central American markets. The domestic labour market demand analysis focuses on the share of job vacancy postings by sector and region. ECLAC measured domestic supply with reference to educational attainment and work experience such that the mismatch between supply and demand by sector and region could be estimated. Results suggest an over-supply of "Administration, Financing" and "Management, Consulting", and an under-supply of "Commerce and Sales" and "Media, Marketing and Communication" workers. Finally, the main results are available through an interactive dashboard.

An example of the information on labour demand available is shown in Figure 11 and labour supply in Figure 12. Figure 11 shows that the highest share of vacancies posted in

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[26] The method used is Jensen-Shannon divergence which compares two probability distributions (e.g., labour supply and demand distributions) and estimates the divergence among these shares. The larger the divergence, the higher the mismatch.

the data collected corresponds to commerce and sales industries, followed by media marketing and communication and social service, catering and entertainment.
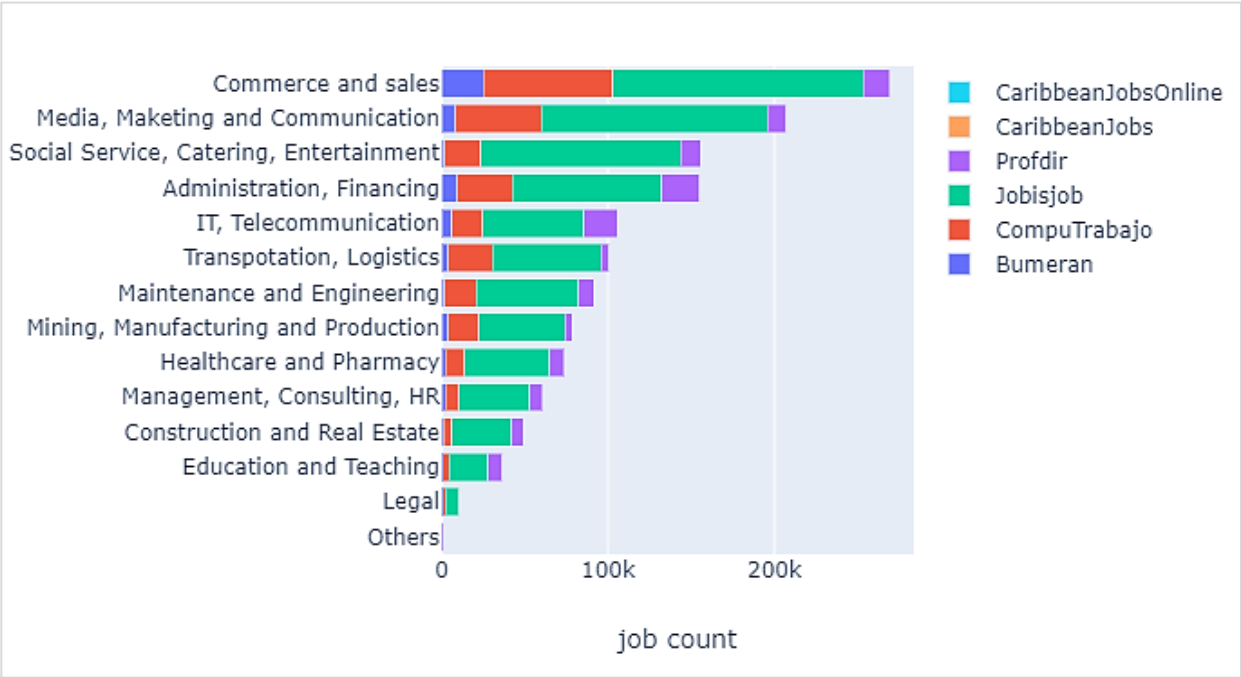
Figure 11 ECLAC estimates of labour demand by industry and source of job advertisement

Figure 12 ECLAC estimates of labour supply by education attainment
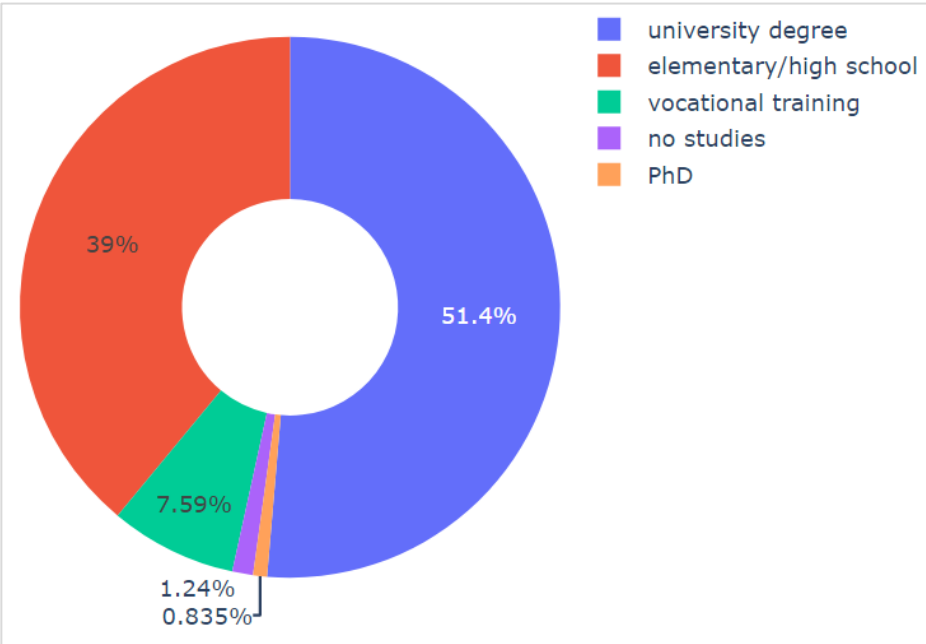
Figure 12 shows the percentage of jobseekers by their education attainment classified by: university degree, elementary/high school, vocational training, no studies and PhD.

The approach adopted by ELAC is unique in that it collects data on labour supply and demand which supports an analysis of mismatch. Figure 13 provides an example of the mismatch in labour demand by country.

Figure 13 ECLAC estimates of absolute labour demand and labour demand divided by population
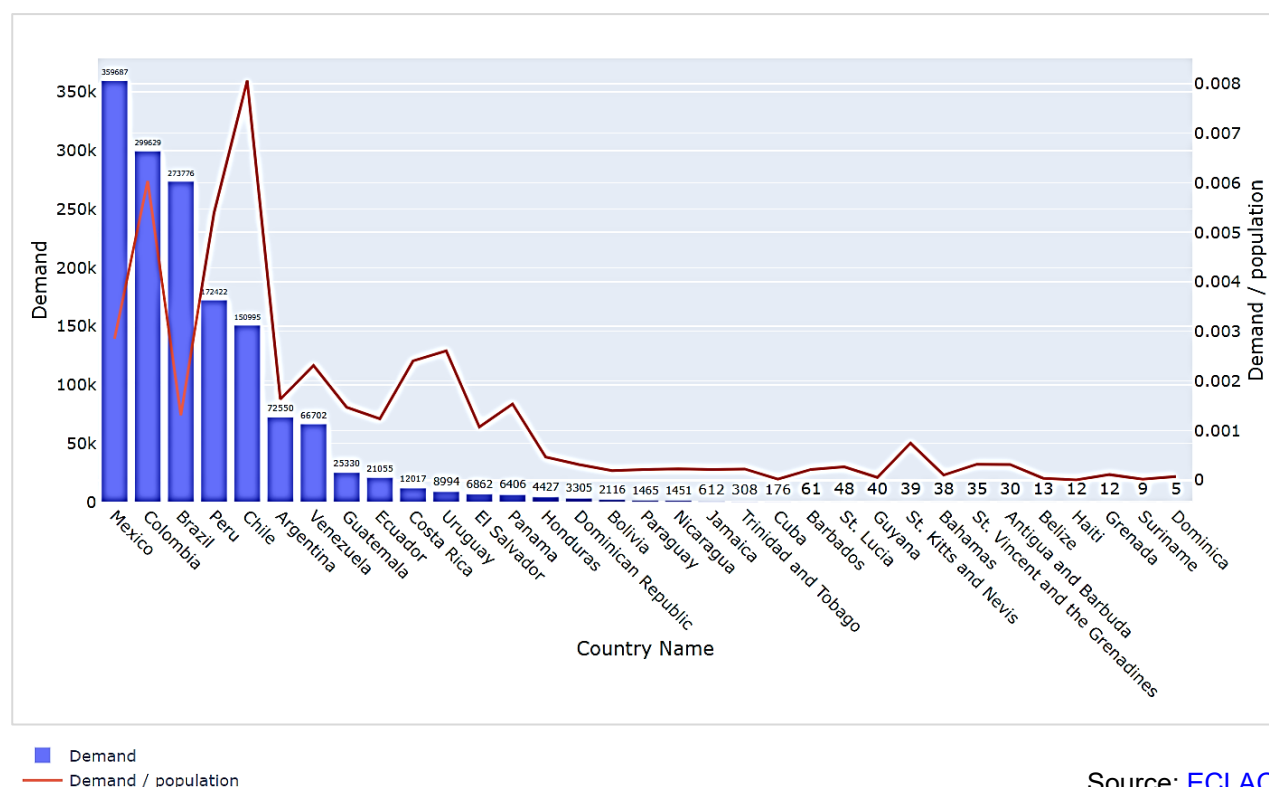
3.3.3. Case 3 Big data analysis of patent data and bibliographic databases to identify emerging skill needs – EFT mixed methods approach

The ETF developed a methodology for identifying the emerging skill needs in its partner countries' key sectors. This case explains how emerging skill needs in Israel's agri-tech sector were identified using the ETF methodology. This was a mixed methods approach which combined more traditional approaches to the identification of skill needs (literature review, analysis of trends in skill demand, interviews with key stakeholders, etc.) with big data analysis of patent data and scientific papers. In essence it used text mining and NLP algorithms to identify drivers of skills change derived from the analysis of patent data and scientific papers. The scientific papers identified the drivers, and the patent data identified the specific technologies associated with the drivers. Searches were then made of databases (such as ESCO, O*NET, and vacancy boards) to identify the skills which are associated with the various technologies. The results were validated in a final workshop with key stakeholders from the sector. The example below is drawn from the analysis of the agri-tech sector in Israel (ETF, 2020). In summary the methodology

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progress from identifying drivers of change, the technological changes / technologies associated with those drivers, and from there identification of the skill associated with those technologies.

The drivers of change in the agri-tech sector in Israel were identified as (ETF, 2020):

- New varieties of plants;

- Horticulture, viticulture and floriculture;

- Irrigation systems;

- Pesticides;

- Microbiology;

- Biochemistry;

- Harvesting, transport and storage devices;

- Dissemination and substance distribution devices;

- Animal entrapment or removal devices;

- Sensors and measuring devices;

- Fertilisers;

- Soil processing devices;

- Monitoring devices;

- Measurement devices and biochemical tests;

- Data analysis;

- Water treatment.

For the most part this related to: regulation, government support for the sector, globalisation, consumer awareness, climate change and aridity, contamination, plant diseases, and waste management. Key technologies were also referenced, in particular the increase in robotics, automation and sensing technologies. There was emphasis on technologies / tools related to biochemistry involved in producing a range of agricultural products.

The information derived from the analysis of the drivers of skill change was then used to identify emerging skill needs. In the second phase of text mining, skill needs associated with each driver / technology was identified by using a semantic algorithm to extract information from databases such as ESCO, the O*NET taxonomy and other sources. Each occupation in the ESCO database includes a description and a list of competences, skills and knowledge considered relevant (either essential or optional) for that occupation. The semantic algorithm looks for matches of each technology with all the concepts associated with that occupation. When a match is found, the occupation is associated with the technology. The entire procedure is automated using ESCO's API,

which allows occupational data to be downloaded. If an occupation was affected by technology at any level, then the text mining found it. If no match was found in ESCO or O*NET due to emerging (future) jobs or new skills needs, other approaches, e.g., connecting the new competences through Wikipedia – were used to try to identify them. In this way the analysis is not limited to identifying skills contained in databases which code historical (albeit recent) data.

In some cases, because ESCO's descriptions of skills may not take into account recent technological developments, certain associations may be missed. Links might be expected to be missing more frequently in the case of low-skilled occupations simply because technology has little impact on the skill content of that particular job (other than, perhaps, to substitute it). To some extent, this needs to be explored through other methods (such as the interviews with stakeholders). Soft skills too may also be under-reported because the focus is very much on technologies. It is, however, possible to explore soft skills through other means such as interviews with sector experts, employers, and so on.

The text mining analysis of emerging skill needs indicated that there will be a high demand for professional / associate professional occupations such as *Electrical Engineers, Sensor Engineers, Water Plant Technicians, Biochemical Engineers, Sensor Technicians, and Agronomists*. At the skilled trades / assembler level the evidence points to a demand for people to work in a variety of skilled jobs such as *Horticulture Workers, Pesticide Sprayers, and Pest Management Workers*. It is possible to look in more detail at the skills required in the jobs mentioned above. This is perhaps the main benefit of using the big data approach.

In Figure 14, the horizontal axis lists four ESCO occupations which have been identified as being matched to the various technologies (and other changes) which are likely to affect the sector in the future. This is matched on the vertical axis with the competences ESCO assigns to each occupation. It reveals the transversal nature of some skills. For example, the *Electrical Engineer* is required to have knowledge and competences related to range of technologies, ranging from control systems to sensors to robotics. On the other hand, the traditional agronomist requires a much more unique set of skills.

Figure 14 Skills demand in selected occupations in the agriculture sector in Israel
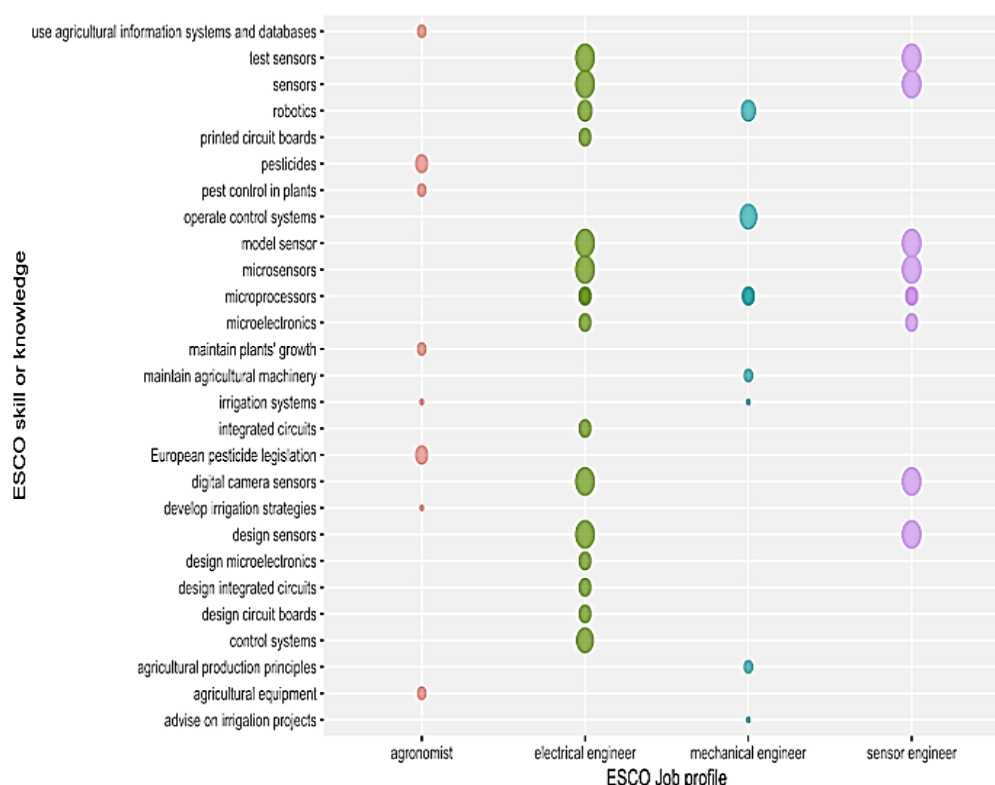
As noted above, the approach adopted by the ETF is a mixed methods one which combines more traditional approaches to identifying skill demand with that of big data analysis. Using this mixed methods information on the specific skill sets which are emerging in response to technological changes affecting a particular sector are identified. Because patent data are used, it is possible to obtain an indication of the skill needs which are likely to come on stream over the short- to medium-term. Companies typically register a patent to protect their intellectual property at the point of introducing it into their products or production processes. In this way it provides an insight into likely future changes. At the same time there is recognition that big data approach cannot address every issue relating to skill demand at the sectoral level. In many respects, the methodology is designed to enhance more traditional approaches which review the literature and provide various statistical series to derive their conclusion. Often the level of aggregation in these types of analysis are at a high level such that one is, for example, drawing conclusions about a fairly broad occupational group (such as professionals). The big data enhances this approach by providing information about the fine detail – e.g., the skills required in a particular job, or the cluster of skill needs which are likely to arise in relation to a specific technology.

3.4. Summary: Advantages and limitations of big data and new techniques

Analytical robustness

Whilst there was evidence from the LMIS studied that NLP and text mining was being used, it was often in development and results presented as experimental data. Vacancy data scraping and analysis undertaken by Australia, Canada and Sweden is similar in process to that undertaken by Cedefop's OVATE work presented in Case 1. Cases 2 and 3 present alternative approaches to understanding labour supply, demand and mismatches. As these are recent pilots, they are yet to be undertaken elsewhere.

In summary, consideration is given to the advantages and limitations of the three cases outlined. The examination of these data is based on the quality framework and guidelines provided by the OECD (2011, pp. 7-10), which indicates that any data should be evaluated considering the following dimensions:

- 'Relevance – Degree to which the data serves to address the purposes for which they are sought by users. It depends upon both the coverage of the required topics and the use of an appropriate concept.

- Accuracy – Degree to which the data correctly estimate or describe the quantities or characteristics they are designed to measure.

- Credibility – Refers to the confidence that users place in those products based simply on their image of the data producer […] This implies that the data are perceived to be produced professionally in accordance with appropriate statistical standards, and that policies and practices are transparent. For example, data are not manipulated, nor their release timed in response to political pressure.

- Timeliness – Reflects the length of time between their availability and the event or phenomenon they describe but considered in the context of the time period that permits the information to be of value and still acted upon.

- Accessibility – Reflects how readily the data can be located and accessed.

- Interpretability – Reflects the ease with which the user may understand and properly use and analyse the data. The adequacy of the definitions of concepts, target populations, variables and terminology, underlying the data, and information describing the limitations of the data, if any, largely determines the degree of interpretability.

- Coherence – Degree to which they (data) are logically connected and mutually consistent.'

Table 4 provides a synthesis of the assessment.

Table 4 Advantages and limitations of big data approaches

Dimensions	Advantages	Limitations
Relevance	Granular data on the labour demand. In the past, these kinds of data were difficult to collect via traditional means.	The relevance could be affected by changes in the way job vacancy websites are managed. There are limited data on future skill needs, though patent data provides a promising approach here.
Accuracy	Provides highly disaggregated data on skill needs. It potentially allows data needs to be observed in sectors of the economy which are relatively small and sometimes ignored in skills surveys.	There remain concerns about the representativeness of the data analysed, especially that related to obtaining data from vacancy websites, which results in uncertainty over the quantification of skill demands
Credibility	Approaches tend to be well documented with publications on methodologies and results readily available.	Methodologies are still under development in some instances
Timeliness	Results can be produced quickly as the algorithms have already been developed and can be re-run.	There are still some delays in publishing results because of the need to validate findings.
Accessibility	Results are available through user-friendly and interactive platforms.	Accessing the micro-data is not always readily available and / or limited to only certain users.
Interpretability	Some materials (e.g., research papers) are publicly available to interpret the data correctly. Dashboards also contain information on how to interpret data.	The use of online platforms for labour market analysis is relatively new and complex. Some concepts, terminology etc., are still under construction.
Coherence	Analyses show internal connections and consistency.	It needs to be borne in mind that this is an area of analysis which is relatively new. The extent to which it can be combined with

		other types of skills analysis to provide a more holistic, coherent picture of the labour market is only just becoming apparent.

All three approaches provide detailed information on skills demand which would otherwise be too difficult to collect and analyse via other means. In particular both the Cedefop and ETF approaches provide substantial detail on the skills required in particular occupations or jobs. In this respect they are providing **relevant data** to those with an interest in understanding how skills demand is changing. As noted in the introduction this is one area where, to date, there has been a shortage of robust information.

One of the main criticisms of the use of big data analysis is the **accuracy** of their results. As noted above, Eurostat assessed the representativeness of the Skills-OVATE data and concluded that these data cannot be used, as yet, to estimate the total number of vacancies. To some extent, this is not necessarily the aim of big data analysis which is to identify the specific skills that are in demand within occupations or jobs. Plus, it aims to identify the emergence of new clusters of skills, which might suggest new types of occupations or skills that are beginning to emerge. The cases of big data analysis provided here provide that kind of information at a granular level.

The transparency and openness with which all the methodological steps and analysis are carried out ensures the **credibility** of the results. A major benefit of all three approaches is their **timeliness.** The analysis has the potential to be readily repeated. The algorithms for collating the data and carrying out the analysis can be re-run as new data become available. This can certainly be carried out in a timelier way than, say, waiting for the release of new official statistics or conducting a sample survey. In many respects this is because the data are readily **accessible**. And as noted above, the results are available on various platforms in the case of Skills-OVATE and ECLAC. It is possible to access the Cedefop Skills-OVATE database through a 'Datalab', so long as certain access criteria are met.

Interpretation of the results is provided on the platforms used to disseminate the results to a variety of end-users. In addition, the ETF approach involved hosting validation workshops to check the findings with various stakeholders to ensure that the results are both valid and presented in a way that makes sense to the sector. This also plays a role in checking the **coherence** of the results. The coherence of the results across all three approaches has been undertaken by ensuring that skill related to a specific occupation. For instance, Skills-OVATE data reveals that skills related to the development of software and applications tend to be in higher demand in jobs such as software and applications developers, database and network professionals, etc. It needs to be observed that at

more disaggregated levels the likelihood of finding a degree of incoherence is likely to increase.

The Supply-side

The examples cited above provide, for the most part, a detailed assessment of those skills either currently or likely to be in demand in the future. Only ECLAC has sought to address the supply-side. Ideally, from the demand side an indication is required of the skills considered essential to meet the requirements of a particular job. From the supply side, an indication is required of the extent to which people possess the essential skills. A match between the two is potentially feasible. As the three cases described above indicate, identifying the skills required in a particular job using text mining techniques is well advanced. In contrast, the analysis of the supply side is much less so. Where available it tends to rely on highly aggregated measures such as qualification level rather than specific skills. This simply tells you that there are, for example, more people available with a given level qualification than people with that qualification. Given that people often upload their CVs to job vacancy websites this potentially provides a store of information on the specific skills an individual possesses. It provides a basis for comparing the skills available from jobseekers to the information on skills sought contained in employers online job adverts. While this is potentially feasible it has not been possible to identify examples of this being fully developed in practice.[27] It is also worth bearing in mind that there are likely to be a range factors, such as proximity of the job to the jobseeker's location and expected salary levels that need to be taken into account if the supply of, and demand for, skills is to be successfully undertaken.

Complementarities with other types of skills analysis

Thinking more generally about the contribution big data analysis can make to skill analysis it is apparent that it has many complementarities with more traditional approaches. Surveys, official statistics and quantitative forecasts can provide the broad quantitative framework for thinking about current and future skill needs. These tend to provide results at an aggregate level typically using occupation as a proxy measure for skill. Big data analysis can begin to identify the specific skill needs required within occupations / jobs at a highly disaggregated level. It can also reveal the way in which skills are clustered which may indicate that new types of jobs are emerging (which fall outside of existing classifications). As noted in the introduction, to date the level of disaggregation provided, and the interrogation of manifold databases which provide the means of providing a highly disaggregated view of skills demand, has traditionally been out of the reach of skills researchers. The resources required to do so were just too great (and would take too much time to complete thereby compromising the timeliness factor). Big data has been able to fill a major information gap. This provides an important

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[27] Given that many online job portals seek to match jobseekers to jobs available on the portal, it may be that at least some of the analysis matching demand and supply is already being undertaken by the companies that own the portals.

information for those responsible for the design of education and training courses. It needs to be borne in mind that big data approaches are relatively new and are subject to further development designed to overcome some of the limitations outlined above.

4. Conclusion and recommendations

This section brings together the evidence on the characteristics of developed LMIS based on the case study research. A qualitative assessment of each characteristic by country is presented including an assessment of the England context. In analysing the evidence for each country, LMIS was reviewed in terms of what learning and practice could be transferred to the England context. It takes into consideration country context, how the LMIS informs policy and how stable it is. Based on the lessons, principles, and ideas evident in the case studies, a number of recommendations are identified that can be applied to the England context and potential partners to take forward the recommendations are proposed.

4.1. Assessment of characteristics of developed LMIS

The research has identified several key characteristics of established international LMIS. It should be noted that the characteristics were evident in each country but in some, they may be more prominent and in others developing or becoming embedded within the system. Each characteristic is listed, and a qualitative assessment has been made for each country context and the England LMIS (see Table 5). A basic assessment indicates whether a characteristic is: established, an opportunity for further development, or weak. For each characteristic, lessons for England, in the way of recommendations, are provided.

Table 5 Qualitative assessment of LMIS characteristics by country

LMIS characteristic	England	Australia	Canada	France	Finland	Germany	Scotland	Sweden
Established whole country approach with legislation in place to support LMIS	✓✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓
Established data collection processes are in place and data from a range of sources are being used in the LMIS	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Coordination between actors in terms of data collection and dissemination to ensure a coherent and consistent system	✓	✓✓✓	✓✓	✓	✓✓✓	✓✓✓	✓✓	✓✓✓
Quantitative techniques, labour econometrics and modelling are being applied in LMIS, supplemented by more qualitative approaches to enhance understanding of labour market demand and supply at a more disaggregated level	✓	✓✓	✓✓	✓✓	✓✓✓	✓✓	✓✓	✓✓
Technological advances to enhance LMIS (in terms of approaches and/or dissemination) are being applied	✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓	✓✓	✓✓	✓✓✓
Data held in repositories to power data dashboards and other applications	✓✓	✓✓✓	✓✓	✓	✓	✓✓	✓✓	✓✓
Reports are a common feature of disseminating data and intelligence in LMIS, but the use of technology is now common to dissemination approaches which is enabling greater access to and customisation of data.	✓	✓✓	✓✓	✓	✓✓	✓✓	✓	✓

A national skills taxonomy embedded within and across the LMIS provides a framework in which data can be collected, analysed and presented	✓	✓✓✓	✓✓✓	✓	✓	✓	✓	✓
LMIS is informing policy and strategy	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Cooperation and collaboration between stakeholders are apparent	✓	✓✓✓	✓✓	✓	✓✓✓	✓✓	✓✓	✓✓✓
LMIS is seen as an integral part of support services in the labour market – targeting stakeholders and end-users of LMIS	✓✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Forums and expert panels (at local or sectoral level) are convened to interpret and contextualise data and support horizon scanning to understand future occupational and skills demand	✓	✓✓	✓✓✓	✓	✓✓✓	✓✓	✓✓✓	✓
Training in the interpretation of LMI to support stakeholders working with education and training institutions, employers and end-users in an LMIS	✓	✓✓	✓✓✓	✓	✓✓✓	✓✓	✓✓	✓

Key = ✓✓✓ well-established; ✓✓ opportunity for further development; ✓ weak

4.2. Insights from developed LMIS and recommendations for England

In summary, all the counties studied have made significant progress in terms of improving data quality, granularity, currency, customisation and accessibility. Innovations in terms of methodology and dissemination provide interesting examples of potential future enhancements to England's LMIS. These are considered for the England context and recommendations highlighted. Potential partners to take forward the recommendations are proposed and shown in brackets.

4.2.1. Organisation and management of LMIS

Countries have either moved toward **a whole country approach** to support LMIS, or they have aspirations to do so. While all the countries studied have allocated budgets from central government, those LMIS with longer-term funding tend to have detailed work plans and established systems of data collection and dissemination. Strategy documents, when in place, set out plans for data collection, and initiatives to improve the capacity and capability of data collection and analyses. While innovations in data collection and dissemination are at the heart of vision statements. However, innovation and experimental data collection and dissemination were found to have limited, short-term funding, or draw upon other national funding sources to resource.

A number of countries (e.g., Australia, Canada, Finland, Germany) point to the need for **significant investment in LMIS** so that data infrastructures can be established in order to deliver a programme of data-driven analytical research.

Where **collaboration and cooperation** to support data collection, sharing and dissemination between key actors, stakeholder and institutions was reported, there is a strong and coherent LMIS (e.g., Australia, Finland). This benefits stakeholders who can not only access current, high-quality information, but can also feed into data and analyses to improve understanding and support translation of information into intelligence (e.g., Scotland). There are a number of examples (e.g., Germany, Sweden) where the public employment service is a key player in terms of data collection, analyses and dissemination. These data are useful within a LMIS as it can provide current data on demand and supply.

The LMIS in England is well established and high-quality data are available from key actors and stakeholders. The system has, however, been susceptible to shifting government priorities and resourcing. This has mostly been seen at the local level with actor and stakeholder roles and responsibilities changing. As a result, the boundaries between LMIS actors and stakeholders have become blurred, with roles and responsibilities less defined as those involved are variously collecting, storing, analysing

and disseminating data. At a regional and local level, there is little consistency in what data are made available, how it is presented and who it is targeted at.

> **Recommendation 1:** Maintain stable resourcing of LMIS from central government, in terms of clear commitments and regular investment, to establish a coherent system which can manage shifting priorities and the needs of policy makers and other key stakeholders.
>
> **Recommendation 2:** Strengthen collaboration and cooperation between departments, governmental bodies, regional and sectoral bodies to provide a strong foundation for England's LMIS; with clear responsibilities for data collection, data sharing and dissemination.

4.2.2. Data

Data from a range of sources are being used in the LMIS of each of the case study countries.

Australia (see Example 3) and Germany (see Figure 4) provide interesting examples of how **experimental data** are enhancing their LMIS including the use of nowcasting to provide an understanding of short to medium term forecasts. This type of approach could be adopted to extend current data collection in England's LMIS.

Examples from the countries studied illustrate how **connecting various sources of data** can improve the quality and timeliness of LMI. An example of where this works well is the Australian Jobs and Education Data Infrastructure (see Example 6 Jobs and Education Data Infrastructure (JEDI), Australia), which powers a range of online LMI tools.

In Germany, it was noted that while **harmonising datasets** at the outset takes time, it was reported to save time at a later stage with data matching as seen in QuBE. Constructing and integrating the occupational flexibility matrix (berufliche Flexibilitätsmatrix, see A2.5 Germany – Resources) is considered a unique selling point in Germany as it is based on actual data rather than models that may have to be built. This has been made possible through new questions in the micro-census introduced two years before QuBE started and the coding of the text-based data to the most detailed level of the occupational classification. Providing data on the number of people and their desired working hours allows for another angle in the interpretation of the data.

There needs to be recognition in the value of using a **multi-methods approach to data collection** in a LMIS, which makes use of a relatively wide range of data and expertise. This would address challenges in being able to identify skill needs in areas with relatively small populations where quantitative data are scarce. Strengths of the Australian, Finnish and Swedish LMIS is their use of a wide range of data sources and collaboration between stakeholders. In Australia, their multi-methods approach (including surveys of

employers, nowcasting and international data) and approach to innovation is a strength of the LMIS (see A2.1 Australia).

A multi-methods approach includes qualitative data and intelligence from forums and expert panels convened at local and sectoral level. Employers and trade unions should have a much greater opportunity to feed into England's LMIS. These forums would support the interpretation and contextualisation of data at a disaggregated level and support horizon scanning to understand future occupational and skills demand. This presents one possible approach to understanding local labour markets where quantitative data are limited, as highlighted in Finland.

As there is potential for more data to become available in the LMIS, there is a need to be **clear on what data are needed and for what purpose** before committing resources. A review of current data and indicators is needed to determine what is already collected and available. This would need better coordination between actors at national, regional and local level involved in the collection, analysis and dissemination of data to ensure a coherent and consistent system. In Sweden and Finland, there is good coordination and collaboration between actors and stakeholders at the national and regional level.

To ensure a coherent and consistent LMIS in England, devolved authorities working with statistical institutions need clear and detailed guidance on what data needs to be gathered, and how it can be interpreted to improve understanding and strategy at the local level. There may also be scope to involve providers of employment services in data collection, analysis and dissemination at the local level.

Recommendation 3: Review current data and indicators in LMIS to identify what data are needed, at what level, and for what purpose before committing resources (DfE, ONS, DWP, MCA, LEP, sectoral bodies and associations, employers).

Recommendation 4: Implement a co-ordinated multi-method approach to data collection that includes combining more traditional approaches to data collection with data garnered using big data techniques (DfE, ONS, MCA, LEP, sectoral bodies and associations, employers).

4.2.3. Methodologies

It was evident across most LMIS studied that **a range of methods were being applied** from traditional economic modelling techniques and approaches for developing forecasts and projections, to new methods using natural language processing (NLP) and big data techniques to link datasets and create new datasets. The overall aim of testing new methodologies and techniques was to enhance existing approaches and available data.

Quantitative methodologies are being supplemented by more qualitative approaches to enhance understanding of labour market demand and supply at a more disaggregated

level. Where used, the qualitative methods are more likely to be used for horizon scanning, feedback and validation of qualitative analyses, understanding occupational skills requirements, and for contextualising LMI, particularly at the local level.

Investment in innovations (such as web scraping, application of big data techniques, and the development of experimental datasets) have been proven to be successful in driving enhancements in the LMIS. From Australia, for example, the Nowcast of Employment by Region and Occupation (NERO) is a new experimental dataset developed by the NSC (see Example 3). NERO complements existing LMI data sources and provides experimental estimates that seek to balance the need for accuracy, granularity, frequency and timeliness. NERO uses nowcasting methodologies to provide monthly estimates on employment in 355 occupations (ANZSCO 4-digit level) across 88 regions in Australia. A range of data are used as modelling inputs and supervised machine learning is used to train models to find patterns. Until now, these types of data were only available every five years as part of the ABS Census of Population and Housing. With NERO, the estimates are produced monthly. The NERO dashboard visualises output and can be searched either by occupation or by region. The data are also downloadable in a number of formats which supports differing user requirements.

Technical advances have increased the capability of LMIS to ensure **data are open and accessible**. These have often been the result of governmental commitments for transparency and enabling access to government data for all.

To develop and adapt new techniques to enhance existing data collection and the LMIS overall, there needs to be **capability and capacity in the LMIS to innovate**. This also requires adequate investment from the onset with commitment to fund longer-term when the value of innovations is evidenced.

Recommendation 5: Embed qualitative data and intelligence into a future system alongside the mass collection of quantitative data made possible by technical advancements as it provides invaluable insights in terms of anticipating skills (DfE).

4.2.4. Technological advances

Technological advancements to enhance LMIS (in terms of approaches and/or dissemination) were found to play an important role in terms of data collection and analysis, dissemination and accessibility. These advancements provide the capability to identify new skills or new jobs in way that was previously not possible due to the resourcing required to manually extract and code information.

New techniques for data collection and analysis are prevalent with web scraping and natural language programming (NLP) now common to enhancing data available in LMIS (see Sections 3.2.1 and 3.2.2 for more information on different methodologies). Examples from Canada (see Example 4) and Europe (see Section 3.2.1) highlight the

potential of big data techniques in terms of web scraping job vacancy information and the data this provides to understand occupational skills, current skills demands and the short-to medium-term trends. These new techniques provide detail on the skills required in particular occupations or jobs, which would otherwise be too difficult to collect and analyse via other means. Overall, they should be seen as a complement rather than a substitute to more traditional approaches to data collection. This is illustrated by the three international cases presented in Section 3 that detail the techniques used to obtain data on emerging skills needs.

New data infrastructures are key to reaping the benefits of these technological advancements in terms of what, how, and when data can be made accessible. There is also better understanding of what data formats are transportable enabling greater opportunities for sharing and linking data.

Data repositories are now common in established LMIS mainly because of advances in how data can be stored, linked and accessed. These repositories are being made accessible via customisable dashboards and/or through application programming interfaces (API). For example, portals with online data repositories were used to enhance the LMIS in Germany (the QuBE data portal) and Canada (see Example 4).

Regional and local data repositories are an invaluable resource for a range of stakeholders, but these need resourcing to ensure consistent data are provided and made accessible. It is suggested that a national repository and platform is developed that includes disaggregated data. Regional stakeholders should be able to draw upon this technology, creating their own regional and local interface. Australia's new Labour Market Insights portal is another good example of what is possible to develop and how these feed into a range of websites and tools for end-users in their LMIS.

Recommendation 6: Invest in underpinning technological infrastructure (including portal, dashboards and APIs) to drive data collection, analysis and dissemination (central Government, DfE).

Recommendation 7: Ensure capability and capacity to innovate in England's LMIS by investing in a programme of innovations (such as web scraping, application of big data techniques, and the development of experimental datasets) to drive enhancements in England's LMIS (DfE, ONS).

4.2.5.   Taxonomies

The **development of a national skills taxonomy with crosswalks** (to education and occupation) to be applied across data collection and production is considered key to enhancing an LMIS in terms of understanding current and future skills demand. Existing national data sources have been found to be useful in the development of a skills taxonomy especially in the creation of a common language for the taxonomy. Australia

and Canada were the only countries studied that have had recently developed and embedded national skills taxonomies within their LMIS.

Australia provides an established approach to developing a skills taxonomy using data already available in its LMIS (see Example 1). The Australian Skills Classification (ASC) is a universal taxonomy of skills enabling identification of skills that underpin Australian jobs. Powered by JEDI, the ASC includes modified information from the US O*NET Resource Centre, ABS data and trending and emerging skills data from Emsi Burning Glass. The ASC has three categories of skills (core competencies, specialist tasks and technology tools). The ASC also groups similar skills together into skill clusters and skills cluster families. The interactive online interface allows exploration of the Classification through either an occupation or skills lens. The ASC has been applied as a lens for a range of research, including international collaborative research to estimate digital skills (see Hope et al., 2022) as well as research internal to government to compare the skills profile of registered unemployed jobseekers with the skills of the employed population.

Whilst in Canada, the **shared skills taxonomy is embedded across and within the LMIS** guiding the format of data collection, analyses and presentation (see Example 2). For instance, the standardised skills descriptors in the taxonomy provide a structure in which employers are required to deliver data for the Job Bank portal. This is enabling an enhanced understanding of skills demand and supply over time.

England's LMIS could be enhanced by a national skills taxonomy. This taxonomy needs to be developed building on existing taxonomies and using current data in the LMIS and should be embedded within and across the LMIS to provide a consistent framework in which data can be collected, analysed and presented. Whilst the taxonomy development and maintenance should be led by one actor in the LMIS, it should be developed collaboratively with a range of actors and stakeholders. Using the skills taxonomy as a foundation, crosswalks to education, qualifications and occupations need to be developed to support understanding of career pathways.

Whilst England can draw upon the established skills taxonomies in other countries, developing its own national taxonomy will require significant resourcing. Importantly, collaboration across key actors and stakeholders is required to ensure it is relevant and understandable and to ensure it is embedded across the LMIS. A particular challenge noted was identifying who should drive the taxonomy development. A further challenge is ensuring taxonomies are adaptable responding to evolving occupations.

Recommendation 8: Put in place a programme of work to develop a national skills taxonomy that builds on existing taxonomies and current data in the LMIS to be embedded across the LMIS (ONS, DfE).

Recommendation 9: Liaise with counterparts in other countries (such as the USA, Canada and Australia) to learn from their experiences in developing national skills taxonomies (DfE).

4.2.6.   Stakeholder engagement

While LMIS is seen as an integral part of support services in the labour market, **cooperation and collaboration between stakeholders** is required to support communication, enable feedback and share knowledge. When in place, it supports the development and maintenance of a coherent system as stakeholders are actively invested in enhancing the LMIS. There was little evidence that suggested cooperation and collaboration between the various stakeholders in many of the countries studied were established.

Across several of the countries studied, namely Australia, Canada, Finland and Sweden, there are established collaborations between key actors in the LMIS, policy makers and other stakeholders. In Finland, for example, local and sectoral forums are brought together on a regular basis to consider national data and skills forecasts, and interpret such data for their area (see Example 5). In the countries studied, **forums and expert groups** are organised at a sectoral, and regional and local level. These groups variously comprise employers, sectoral bodies, trade unions, education and training institutions and employees. The role of these forums is to ultimately enhance understanding and interpretations of data, as well as produce their own data. Stakeholders that feed into their LMIS transform and translate LMI into intelligence, which was found to support understanding, provide **contextualisation and validate data** and analyses (e.g., Finland, Scotland). This is absent in England's LMIS.

In terms of applicability to this approach to England, there are a range of forums which could be used to consider analyses of future skill needs relating to the labour market for those making their initial transition into the labour market and experienced workers. In Finland, for example, regional and local agencies conduct their own analyses of emerging skill needs which leads to local policy making. While in Swedish, cooperation at the national level extends effectively to many policy domains through, for instance, the development of youth training initiatives bridging employment and education, and the collaboration of ministries/departments, national agencies and social partners to address skills pressures coming from large migration flows. Where the approach in Sweden is particularly valuable is in being able to obtain data and views from a wide variety of sources. By engaging stakeholders in the anticipation process, they are likely to act upon the analyses produced, then there is a greater likelihood of capturing their commitment to using the information in practice.

In addition to strengthening collaboration and engagement with stakeholders in the LMIS, **training for non-specialists in the interpretation of LMI and intelligence** was identified as a gap that needed addressing (e.g., Australia, Canada). In Canada, in recognition of the need to provide non-specialist users with training in how to use LMI, the LMIC was collaborating with the Canadian Career Development Foundation (CCDF) to develop four micro-credential courses in LMI. The training is aligned to the CCDF

competency framework. At the time of conducting this case study research, it was expected that the courses would go live in the 2022 Canadian fall.

Across the other countries studied, there was little to no training identified to support stakeholders in the interpretation of LMI and data. While it was recognised that there are some very specialised data that can only be interpreted by statisticians, there is also a wide range of data that is useful to support stakeholders working with education and training institutions, employers and other end-users of an LMIS, such as jobseekers. Any such training for non-specialists needs to include understanding the range of data available and how this can be interpreted to regional and local contexts, as well as understanding skills data. This training should be part of professional development activities particularly for those working in the careers and education sectors.

Recommendation 10: Develop and provide training (in the form of micro-credentials) for stakeholders working in education and training institutions, employers, and other end-users of LMI on how to interpret LMI (DfE, National Careers Service, Career Development Institute (CDI), Association of Graduate Careers Advisory Services (AGCAS), Careers England).

4.2.7. Dissemination and interpretation

Across all the countries studied there are a range of approaches to dissemination. Dissemination of LMI and intelligence are mostly through electronic publications with analyses completed for specific purposes, such as forecasting sectoral trends, evidencing labour market changes, evaluating the impact of a training programme within an area. These publications and analyses are often linked to policy.

While electronic reports are a common feature of disseminating data and intelligence in LMIS, the use of technology is now common to dissemination approaches which is enabling greater access to and customisation of data.

In particular, a particular shift towards **interactive and customisable data dashboards** was noted across the countries studied. These dashboards often provide greater granularity of visualised data and, in some instances, enable data and/or visualisations to be downloaded and used.

Powered by repositories, as a central source of data, dashboards are therefore proving invaluable within LMIS as they enable data to feed into a range of websites, tools and applications not just dashboards. One example from Australia, the Jobs and Education Data Infrastructure (JEDI) data engine, creates a powerful example of what dissemination is possible when founded upon a strong data infrastructure which brings together a range of data and draws upon technical advances in big data analysis and linking (see Example 6).

A number of LMIS actors and stakeholders were found to be translating and interpreting data into intelligence for employers, education and training institutions, careers guidance and counselling services, and end-users in the LMIS. For example, Skills Development Scotland (SDS) enables regional skills data to be accessed, customised and visualised in dashboards using Microsoft Power BI (as shown in Figure 9). To support users in accessing, interpreting, and using the data, SDS provide online materials and ad hoc support.

Recommendation 11: Develop a national data repository to power dashboards with regional and local LMI interfaces aimed at policy makers and educational planners to ensure dissemination is consistent across regions and local areas (ONS).

4.2.8.　Informing policy and strategy

Across England and the countries studied broad, national level data are considered useful for informing policy and target setting. However, a continuing trend away from collecting and analysing data for policy, to collecting and analysing a range of data and intelligence for various purposes and stakeholders was observed. In particular, the countries studied identified the need for more nuanced LMI and intelligence for regional and local level planning.

In terms of lessons for England, one of the strengths of the Swedish system lies in its ministries having well-developed analytical infrastructures that allow them to make the best use of skills anticipation and assessment for education and employment policy. Cooperation at the national level extends effectively to many policy domains through, for instance, the development of youth training initiatives bridging employment and education, and the collaboration of ministries/departments, national agencies and social partners to address skills pressures coming from large migration flows.

Recommendation 12: Strengthen collaboration and cooperation between key actors in LMIS by establishing a dedicated LMI policy forum with representation from national, regional and local stakeholders (DfE, DWP, MCA, LEP).

5. References

Advisory Panel on LMI (2009). Working Together to Build a Better Labour Market Information System of Canada. (The Drummond Report). Final Report. May 2009. Advisory Panel on Labour Market Information, Canada.

Ahokas, J., Honkatukia, J., & Marttila, K. (2010). Forecasting Demand for Labour and Skills with an AGE-model in Finland. Government Institute for Economic Research – Finland.

Ahokas, J., Honkatukia, J., Lehmus, M., Niemi, M., Simola, A., & Tamminen, S. (2015). *Labour need in the Finnish economy in 2015-2030* (No. 181; VATT Surveys). State Economic Research Centre. Finland.

Alexander, R., McCabe, G., & De Backer, M. (2019). Careers and labour market information: An international review of the evidence. Reading: Education Development Trust.

Attewell, P. (1990). What is Skill?, *Work and Occupations* 17(4): 422-448.

Barnes, S-A., & Bimrose, J. (2021). Labour market information and its use to inform career guidance of young people. An overview of the Labour Market Information System for Careers Guidance in England. Coventry: Institute for Employment Research, University of Warwick.

Barnes, S-A., Bimrose, J., Brown, A., Kettunen, J., & Vuorinen, R. (2020). Lifelong guidance policy and practice in the EU: trends, challenges and opportunities. Luxembourg: Publications Office of the European Union.

Barnes, S-A., Hogarth, T., Cárdenas-Rubio, J., Wright, S., Hawthorne, M., Bosworth, D., & Bosworth, L. (2021). *Strategic, Accessible Labour Market Intelligence: Labour market demand and supply of skills* (Report 1). IER University of Warwick/Skills Development Scotland.

Becker, G.S. (1962). Investment in Human Capital: A Theoretical Analysis, *Journal Political Economy* 70(5): 9-49.

Beręsewicz, M., & Pater, R. (2021). *Inferring job vacancies from online job advertisements*. Publications Office of the European Union.

Bimrose, J. (2021). Labour Market Information for Career Development: Pivotal or Peripheral? In: Robertson, P., Hooley, T., & McCash, P. (eds.) *The Oxford Handbook of Career Development* (pp. 283-295). Oxford University Press: Madison Avenue, New York.

Bundeministerium für Arbeit und Soziales (BMAS) [Federal Ministry of Labour and Social Affairs] (2019). Methodische Erläuterungen zur BMAS-Prognose „Digitalisierte Arbeitswelt". Forschungsbericht 526/1M.

BMAS (2020). BMAS-Prognose Digitalisierte Arbeitswelt nach Arbeitsmarktregionen. Forschungsbericht 526/2 (Authors: Schneemann, C, Zirka, G., Kalinowski, M., Maier, T., & Krebs, B.). Germany.

BMAS (2021). Mittelfristprognose: Arbeitsmarktdynamik bis 2025. Forschungsbericht 526/4 (Authors: Zika, G., Hummel, M., Schneemann, C., Studtrucker, M., Kalinowski, M., Maier, T., Krebs, B., Steeg, S., Bernardt, F., Krinitz, J., Mönnig, A., Parton, F., Ulrich, P., & Wolter, M.I.). Germany.

BMAS & Bundesministerium für Bildung und Forschung (BMBF) [Federal Ministry of Education and Research] (2021a). Implementation Report. National Skills Strategy. Germany.

BMAS & BMBF (2021b). Themenlabore. Begleitpublikation zum Umsetzungsbericht der Nationalen Weiterbildungsstrategie. [Innovation Labs – Supplementary publication to the implementation report of the National Skills Strategy]. Germany.

Bonen, T., & Loree, J. (2021). How to Forecast Skills in Demand: A Primer. Future Skills Centre, Canada.

Box, G.E., & Tiao, G.C. (1975). Intervention analysis with applications to economic and environmental problems. *Journal of the American Statistical association*, 70(349): 70-79.

Bundesagentur für Arbeit [Federal Agency for Employment] (2021). Klassifikation der Berufe 2010 – überarbeitete Fassung 2020. Band 1: Systematischer und alphabetischer Teil mit Erläuterungen. Germany.

Bundesinstitut für Berufsbildung (BiBB) [Federal Institute for Vocational Education and Training] (2020). The sixth wave of qualifications and occupation projections from the year 2020. Germany.

Bundesministerium für Bildung und Forschung (BMBF) [Federal Ministry of Education and Research] (2022). Nationale Weiterbildungsstrategie – BMBF [National Continuing Education Strategy – BMBF]. Bildung, 28.02.2022.

Cárdenas-Rubio, J. (2020). *A web-based approach to measure skill mismatches and skills profiles for a developing country: the case of Colombia*. Editorial Universidad del Rosario.

Cedefop (2015). *Skills, qualifications and jobs in the EU: the making of a perfect match? Evidence from Cedefop's European skills and jobs survey.* Luxembourg: Publications Office

Cedefop (2017a). Skills anticipation in France. Cedefop Skills Panorama.

Cedefop (2017b). Skills anticipation in Finland. Cedefop Skills Panorama.

Cedefop (2017c). Skills anticipation in Germany. Cedefop Skills Panorama.

Cedefop (2017d). Skills anticipation in Sweden. Cedefop Skills Panorama.

Cedefop (2018). Mapping the landscape of online job vacancies. Background report: France. Thessaloniki, Greece: Cedefop.

Cedefop (2019). *Online Job Vacancies and Skills Analysis: A Cedefop Pan-European Approach.* Luxembourg: Office for Official Publications of the European Communities.

Cedefop (2020c). Skills forecast 2020: France. Cedefop skills forecast. Thessaloniki, Greece: Cedefop.

Cedefop (2020d). Inventory of lifelong guidance systems and practices – Sweden. Thessaloniki, Greece: Cedefop.

Cedefop (2021). *Understanding technological change and skill needs: big data and artificial intelligence methods. Cedefop practical guide 2.* Luxembourg: Publications Office.

Cedefop (n.d.). Matching skills. Inspiring policies for anticipating and matching skill needs. Sweden, country fiches. Thessaloniki, Greece: Cedefop.

Cedefop/ Hogarth, T., Aksen, M., & Varblane, U. (2020a). Strengthening skills anticipation and matching in Estonia: capitalising on OSKA's potential to realise national ambitions. Luxembourg: Publications Office of the European Union.

Cedefop/ Pouliakas, K., & Hogarth, T. (2020b). Strengthening skills anticipation and matching in Greece: labour market diagnosis mechanism: a compass for skills policies and growth. Luxembourg: Publications Office of the European Union.

Cedefop; Swedish National Agency for Education (2019). Vocational education and training in Europe: Sweden [From Cedefop; ReferNet. Vocational education and training in Europe database]. Thessaloniki, Greece: Cedefop.

Céreq (2017). Vision prospective partagée des emplois et des competénces: La filière numérique. Report of France Strategy/Reseau Emplois Competences.

Chiarello, F., Fantoni, G., Hogarth, T., Giordano, V., Baltina, L., & Spada, I. (2021). Towards ESCO 4.0 – Is the European classification of skills in line with Industry 4.0? A

text mining approach, *Technological Forecasting and Social Change*, 173. https://doi.org/10.1016/j.techfore.2021.121177

De Lazzer, J & Rengers, M. (2021). Impact of the coronavirus crisis on the labour market: experimental statistics based on data from online portals. Federal Statistical Office (Statistisches Bundesamt), Germany.

Deming, D., & Noray, K. (2020). Earnings Dynamics, Changing Job Skills, and STEM Careers. *Quarterly Journal of Economics*, 135(4): 1965-2005.

Department of Employment, Skills and Employment (DESE) (2021b). Data Strategy 2021-2022. Canberra, Commonwealth of Australia: Australian Government.

Department of Employment, Skills and Employment (DESE) (2022a) National Workforce Strategy 2022-2027. Canberra, Commonwealth of Australia: Australian Government.

Department of Employment, Skills and Employment (DESE) (2022b). Workforce Dashboard, D22/264269, 30 March 2022. Canberra, Commonwealth of Australia: Australian Government.

Department of Employment, Skills and Employment (DESE) (2021a). Department of Education, Skills and Employment Corporate Plan 2021-2022. 23 August 2021 (modified 8 October 2021). Canberra, Commonwealth of Australia: Australian Government.

Development Monitoring and Evaluation Office (DMEO) (2020). Labour Market Information Systems in Canada. DMEO, NITI Ayog, Government of India.

Economic Affairs Department (2011). How should the functioning of the labour market be assessed? Report from the Economic Affairs Department at the Ministry of Finance. Stockholm, Sweden.

ESDC [Employment and Social Development Canada] (2017). Evaluation of Learning and Labour Market Information as disseminated by Employment and Social Development Canada using a web-based consolidated approach. Final Report. June 2017. Evaluation Directorate, Strategic and Service Policy Branch, Employment and Social Development Canada SP-1155-11-17.

ESDC (2018). Career Handbook – Third Edition. Government of Canada.

ESDC (2020a). Canadian Occupational Projections System 2019 Projections: Industrial Outlook. Government of Canada.

ESDC (2020b). Canadian Occupational Projections System 2019 Projections: Imbalances between labour demand and labour supply 2019-2028. Government of Canada.

ESDC (2020c). Canadian Occupational Projections System 2019 Projections. Jobseekers 2019-2028. Government of Canada.

ESDC (2020d). Canadian Occupational Projections System 2019 Projections. Job Openings 2019-2028. Government of Canada.

ESDC (2021). Evaluation of the Job Match service connecting jobseekers to Canadian employers Final Report. Evaluation Directorate, Strategic and Service Policy Branch, Employment and Social Development Canada SP-1155-11-17. Government of Canada.

ETF [European Training Foundation] (2021). The Future of Skills: A Case study of the agri-tech sector in Israel. Turin: European Training Foundation

Felstead, A., Gallie, D., Green, F., & Zhou, Y. (2007). *Skills at Work in Britain, 1986 to 2006*. Oxford: ESRC Centre on Skills, Knowledge and Organisational Performance.

Finnie, R., Miyairi, M., Dubois, M., Bonen, T., & Amery, B. (2019). *How Much Do They Make? New evidence on the early career earnings of Canadian post-secondary education graduates by credential and field of study*. Ottawa, ON, Canada: Education Policy Research Initiative and Labour Market Information Council.

France Stratégie & DARES (2022). Métiers 2030. Quels métiers en 2030?. March 2022. France.

France Stratégie (2021). CSR, a European issue Contribution to the work of the French Presidency of the Council of the European Union March 2022 (Opinion). Platforme RSE (Responsabilité sociétale des entreprises), France.

Green, F. (2013) *Skill and Skilled Work: An Economic and Social Analysis*. Oxford: Oxford University Press.

Hanhijoki, I., Katajisto, J., Kimari, M., & Savioja, H. (2012). *Education, Training and Demand for Labour in Finland by 2025*. Helsinki: National Agency for Education

Hilbert, M. R., & Lu, K. (2020). *The online job market trace in Latin America and the Caribbean* (Project document LC/TS.2020/83). Santiago, Chile: Economic Commission for Latin America and the Caribbean (ECLAC).

Hooley, T., Percy, C., & Alexander, R. (2021). *Exploring Scotland's Career Ecosystem: Evidence to support the Career Review*. Prepared for Skills Development Scotland. Edinburgh, Scotland.

Hope, A., Yemm, N., Nguyen, G., Raza, A., Sparke, E., Buhagier, C., & Neuman, R. (2022). Digital skills in the Australian and International Economies. Canberra, Commonwealth of Australia: National Skills Commission.

Hummel, M., Bernardt, F., Kalinowski, M., Maier, T., Mönnig, A., Schneemann, C., Steeg, S., Wolter, M.I., & Zirka. G. (2021). Qualifikations- und Berufsprojektion bis 2040 nach Bundesländern Demografie und Strukturwandel prägen weiterhin die regionale Entwicklung der Arbeitsmärkte (IAB-KURZBERICHT 1/2021), Germany.

Joyce, S. (Hon) (2019). Strengthening Skills: Expert Review of Australia's Vocational Education and Training System. Canberra, Commonwealth of Australia: Department of the Prime Minister and Cabinet (The Joyce Review).

Köhne-Finster, S. Leppelmeier, I., Helmrich, R., Deden, D., Geduldig, A., Güntürk-Kuhl, B., Martin, P., Neuber-Pohl, C., Schandock, M., Scarlett Schreiber, R., & Tiemann., M (2020). Berufsbildung 4.0 Fachkräftequalifikationen und Kompetenzen für die digitalisierte Arbeit von morgen. Säule 3: Monitoring- und Projektionssystem zu Qualifizierungsnotwendigkeiten für die Berufsbildung 4.0. Wissenschaftliche Diskussionspapiere, Heft 214.

Leveälahti, S., Nieminen, J., Nyyssölä, K., Suominen, V., & Kotipelto, S. (2019). Competence structure 2035. Helsinki: National Agency for Education.

Lhommeau, B., & Rémy, V. (2020). Quels liens entre tension sur le marché du travail, difficultés de recrutement et efforts de recherche des employeurs? Travail at Emploi, 2020, No. 163, pp. 45-81

LMIC (2020). Job Skills Mapping: Building Concordance Between the US O*NET System and Canada's NOC. LMI Insight Report no. 35, September 2020. Canada.

LMIC (2021a). Searching for an OaSIS in the Work of Skills and Occupation Mapping. LMI Insights, no. 43, June 2021. Canada.

LMIC (2021b). Building a Decision-based Framework to Understand LMI Needs: An Insight Report from the Labour Market Council and the Future Skills Centre, July 2021, report funded by the Government of Canada's Future Skills Program. Canada.

LMIC (2021b). Searching for an OaSIS in the Work of Skills and Occupation Mapping. LMI Insight Report no. 43, June 2021. Canada.

LMIC (2022a). Challenges and Opportunities in Canada's LMI Landscape, LMI Insight Report, February 2022. Canada.

LMIC (2022b) Job Skills Mapping: Building Concordance Between the US O*NET system and Canada's NOC, LMI Insight Report no. 35, September 2020. Canada.

Mähönen, E., Alatalo, J., & Ylikännö, M. (2022). Short-term labour market forecast of the Ministry of Employment and the Economy, Spring 2022 Helsinki: Ministry of Economic Affairs and Employment - TEM analyzes 110/2022.

Ministry for Education and Cultural Affairs (2019). Anticipation of skills and education needs in Finland. Helsinki: OKM

Müller, D., & Wolter, S. (2020). German labour market data – Data provision and access for the international scientific community. *German Economic Review*, 21(3): 313-333.

National Careers Institute (NCI) (2020). National Careers Institute Ministerial Charter 2020-22. Canberra: Australian Government/NCI.

National Careers Institute (NCI) (2021). 2021-2023 Strategic Plan, National Careers Institute. Canberra, Commonwealth of Australia: Australian Government/NCI.

National Careers Institute (NCI) (n.d.) National Careers Institute Board Terms of Reference. Canberra, Commonwealth of Australia: Australian Government/NCI.

National Skills Commission (NSC) (2020a). Employer's Insights on the Australian Labour Market: Snapshot 2020. Canberra, Commonwealth of Australia: Australian Government/NSC.

National Skills Commission (NSC) (2020b). Emerging Occupations: How new skills are changing Australian jobs. Canberra, Commonwealth of Australia: Australian Government/NSC.

National Skills Commission (NSC) (2020c). *Labour Market Information Portal (LMIP) User Survey*. Internal report. Canberra, Commonwealth of Australia: Australian Government/NSC.

National Skills Commission (NSC) (2021a). Strategic Plan 2020-2022. Canberra, Commonwealth of Australia: Australian Government/NSC.

National Skills Commission (NSC) (2021b). Skills Priority List. Canberra, Commonwealth of Australia: Australian Government/NSC.

National Skills Commission (NSC) (2021c). Employers' Insights on the Australian Labour Market: Data Report. 27 July 2021. Canberra, Commonwealth of Australia: Australian Government/NSC.

National Skills Commission (NSC) (2021d). Recruitment Experiences and Outlook Survey Concepts, methods and questionnaire. November 2021. Canberra, Commonwealth of Australia: Australian Government/NSC.

National Skills Commission (NSC) (2021e). State of Australia's Skills 2020: now and into the future, 6 December 2021. Canberra, Commonwealth of Australia: Australian Government/NSC.

National Skills Commission (NSC) (2021f). Skills and jobs for the future – the Four Cs. Canberra, Commonwealth of Australia: Australian Government/NSC.

National Skills Commission (NSC) (2022a). National Skills Commission Orgaisational Chart. Canberra, Commonwealth of Australia: Australian Government/NSC.

National Skills Commission (NSC) (2022b). Employment Outlook: Industry and occupation trends of the five years to November 2026. Canberra, Commonwealth of Australia: Australian Government/NSC.

National Skills Commission (NSC) (2022c). Recruitment Insights Report – February 2022. Canberra, Commonwealth of Australia: Australian Government/NSC.

National Skills Commission (NSC) (2022d). Australian Skills Classification Release 2.0 Report – March 2022. Canberra, Commonwealth of Australia: Australian Government/NSC.

OECD (2011). *Quality Framework and Guidelines for OECD Statistical Activities*. Paris: OECD.

OECD (2016). Getting Skills Right: Sweden, Getting Skills Right. Paris: OECD Publishing.

OECD (2017). Getting Skills Right: France, Getting Skills Right. Paris: OECD Publishing.

OECD (2019). *The OECD (2019) Survey of Adult Skills: Reader's Companion*, Third Edition, OECD Skills Studies. Paris: OECD Publishing.

OECD/Arbetsförmedlingen/LEED (n.d.). Generation Shifts in the Swedish Labour Market, OECD Local Economic and Employment Development Working Paper Series. Paris: OECD.

Pouliakas, K. (2018). Risks posed by automation to the European Labour Market, In: Hogarth, T. (ed). *Economy, employment and skills: European, regional and global perspectives in an age of uncertainty* (pp. 45-74). Rome: Quaderni Series.

Post-16 Education (Scotland) Act 2013. London. HMSO. Available from: https://www.legislation.gov.uk/asp/2013/12/contents

Regeringskansliet (Government Offices of Sweden) (2017). För et hallbart digitaliserat Sverige – en digitaliseringsstrategi. Näringsdepartementet Diarienummer: N2017/03643/D. Sweden

Ritchie, J., Spencer, L., & O'Connor, W. (2010). Carrying out qualitative analysis. In: Ritchie, J., & Lewis, J. (Eds). *Qualitative Research Practice: A Guide for Social Science Students and Researchers* (pp. 219-262). London: Sage.

SCB (Statistikmyndigheten) (2018). Matchningen på arbetsmarknaden – sambandet mellan utbildning och yrke (Matching in the Labour market – the link between education and profession). Stockholm, Sweden: SCB Befolkning och välfärd.

Schultz, T.W. (1959). Investment in Man: An Economist's View, *Social Service Review* 33(2): 109-117.

Schultz, T.W. (1962). Reflections on Investment in Man. *Journal of Political Economy* 70(5): 1-8.

Scottish Funding Agency (2021a). College Leaver Destinations 2019-20 (SFC Statistics SFC/ST/07/2021). Edinburgh: Scottish Funding Agency (SFC).

Scottish Funding Agency (2021b). Higher education student and qualifiers at Scottish institutions 2019-20. (SFC Statistics SFC/ST/03/2021). Edinburgh: Scottish Funding Agency (SFC).

Scottish Government (2022a). National Strategy for Economic Transformation. Edinburgh: Cabinet Secretary for Finance and the Economy and Minister for Business, Trade, Tourism and Enterprise, The Scottish Government.

Scottish Government (2022b). Scottish Budget funding and expenditure for 2020-21: FOI release. Edinburgh: Financial Management Directorate, The Scottish Government.

Scottish Government (2022c). Life at age 14: initial findings from the Growing Up in Scotland study (Social Research series). Edinburgh: The Scottish Government.

Scottish Government (2021a). A Fairer, Greener Scotland: Programme for Government 2021-22. Edinburgh: The Scottish Government.

Scottish Government (2021b). Scotland's Labour Market: People, Places and Regions - Statistics from the Annual Population Survey 2020/21. Edinburgh: Cabinet Secretary for Finance and the Economy, Minister for Higher Education and Further Education, Youth Employment and Training, Minister for Just Transition, Employment and Fair Work, Scottish Government.

Scottish Government (2020). Scotland's Careers strategy: Moving Forward. Edinburgh: Minister for Just Transition, Employment and Fair Work and Fair Work, Employability and Skills Directorate, The Scottish Government.

Scottish Government (2018). Enterprise and Skills Board: strategic plan. Edinburgh: Economic Development Directorate and Chief Economist Directorate, The Scottish Government.

Scottish Government (2016). Scotland's Labour Market Strategy. Edinburgh: Economic Development Directorate, The Scottish Government.

Skolverket (2021). Lärarprognos 2021 Redovisning av uppdrag att ta fram återkommande prognoser över behovet av förskollärare och olika lärarkategorier (Teacher forecast 2021). Stockholm, Sweden.

Sparreboom, T. (2013). Labour market information and analysis systems. In: Cazes, S., & Verick, S. (eds). *Perspectives on Labour Economics for Development* (pp. 255-280). Geneva International Labour Office

Spector, S. (2021). Sweden: "Tightest Labour Market in a Decade", 20 October, *Sweden Macro*.

Steeg, S., Helmrich, R., Tobias, M., Schroer, J.P., Mönnig, A., Wolter, M.I., Schneemann, C., & Zika, G. (2022). Die Wasserstoffwirtschaft in Deutschland: Folgen für Arbeitsmarkt und Bildungssystem; eine erste Bestandsaufnahme. *BiBB Discussion Paper,* pp. 1 Online-Resource (30 pages).

Stops, M., Bächmann, A-C., Glassner, R., Janser, M., Matthes, B., Metzger, L-J., Müller, C., & Seitz, J. (2021). Extracting skill requirements from job ads "Machbarkeitsstudie Kompetenz-Kompass", IAB-Forschungsbericht, No. 7/2021, Institut für Arbeitsmarkt- und Berufsforschung (IAB), Nürnberg.

Taipale-Lehto, U., & Bergman, T. (2015) *Competence and Skills Needs in Services to Elderly*. Helsinki, Finland: National Agency for Education.

Tillväxtverket (2018). Regionala kompetensplattformar. Erfarenheter och resultat 2013–2017. Stockholm, Sweden: Swedish Agency for Economic and Regional Growth

Tuomi, I., Hautamäki, A., & Ketamo, H. (2021). Työmarkkinatieto digitalisoituvassa Suomessa (Labour Market information in a Digital Finland). Helsinki, Finland: Prime Minsters Office.

Wadensjö, E. (2022). *Svensk arbetsmarknadsstatistik – idag och i framtiden [Swedish labour market statistics – today and in the future].* Report submitted to Statistics, Sweden.

Wilson, R.A., Barnes, S-A., May-Gillings, M., Patel, S., & Bui, H. (2020). Working Futures 2017-2027: Long-run labour market and skills projections (Main report) (Research report DFE-RR970). London: Department for Education.

Wu, D., Ngai, L., Shamiri, S., Mcmillian, A., Shan, Y., Smith, T., & Lake, P. (2021) Finding NERO: A Nowcast of Employment by Region and Occupation. Blog, National Skills Commission website, 16 November 2021.

Young, H. (Improvement Service) (2022). Scottish Local Authorities Economic Development Indicators Framework Report 2020-21. Livingston, Scotland: Scottish Local Authorities Economic Development (SLAED).

Zirka, G. & Schnur, P. (eds) (2009). *Das IAB / INFORGE-Modell: Ein sektorales makroökonometrisches Projektions- und Simulationsmodell zur Vorausschätzung des längerfristigen Arbeitskräftebedarfs*. IAB-Bibliothek 318, Media GmbH.

Annex 1: Methodology

This annex details the research methodology which comprised desk research, expert and LMIS stakeholder interviews and workshops.

Inception and ethics

At the inception phase, the analytical framework was developed, and some initial desk research was undertaken on several countries with developed LMIS to test out the framework. The research protocols and tools (including interview guides, consent forms, and participant information leaflet) were developed. These formed the basis of an application to the University of Warwick's Humanities and Social Sciences Research Ethics Committee (HSSREC) for approval. To ensure that participants understand the nature and consequences of participating in the study, an information sheet and consent form were prepared and provided prior to the interviews. Participants were asked to give written consent to take part in the study. Electronic data will be anonymised, encrypted and used only as stated in the consent form. Full ethical approval was gained for the study.

Analytical framework

An analytical framework developed for this research was based on two frameworks used in previous research. The skills governance analytical framework was developed by Cedefop based on their review priorities (Cedefop, 2020a, 2020b) and was used to design their research questionnaires. The focus was on the foundations of skills governance systems, processes and sustainability in terms of the organisation, resourcing and reputation of national skills governance. The Cedefop review framework provided a foundation for developing the analytical framework used to examine the international case study countries LMIS. By drawing upon recent work examining the LMIS in England for careers, the analytical framework was further extended to include those stakeholders who collect, supply and bring data together as well as those interpreting and disseminating the data (Barnes & Bimrose, 2021). The final analytical framework presented in Table 1 (see Approach to the research) provides a holistic view in which to examine national LMIS.

International case studies

Previous research has indicated that national LMIS can be at different stages of development, as well as various stages of development for different geographical areas and user groups (see for example Barnes et al., 2020, Cedefop, 2020a, 2020b). This was taken into consideration in the final selection of the case study countries. The aim of the case studies was to draw out interesting practice within the LMIS and, significantly, provide deeper insights into its operation and functioning. The final list of seven case study countries were agreed in consultation with the Department for Education. Countries were selected based on knowledge of established systems, current initiatives and

innovations, the use of big data and where contexts had the potential to offer transferable learning to the England context. Interesting practice has been drawn out of the case study data which highlight different aspects of the national LMIS.

Interviews with LMIS experts and stakeholders

For each case study, a minimum of five semi-structured interviews were undertaken. In total 44 interviews were undertaken for this research. Interviewees were drawn from the range of known actors and stakeholders in an LMIS using our networks as well as through snowball sampling. Interviews were undertaken with national ministries/departments, statistics agencies, skills and education authorities/institutions, public employment service providers, career guidance and counselling experts and association representatives, labour market researchers and economists, and academics using data from the LMIS as well as those providing their expertise.

Potential interviewees were contacted by email and informed of the purpose of the research and the types of questions that would be covered. If they agreed to participate, a mutually suitable time for their interview was established and interviewees were sent an information sheet about the project and a participant consent form. Interviews were undertaken by telephone or MS Teams (as a university approved platform for research). With the consent of the interviewee, interviews were digitally-audio recorded. Interviews ranged from 45-120 minutes and strictly adhered to ethical protocols. The interviews were semi-structured using an interview topic guide.

Using notes taken during the interview, supplemented by the interview recording, the interviewer produced an extended summary of the interview, including verbatim quotes. All data were anonymised. Interviewees who wished to be acknowledged in the report have been listed in the acknowledgments.

Development of an interview topic guide

A comprehensive interview topic guide was developed based on previous research mapping and evaluating LMIS to build an investigative framework for each case study. The interviews were tailored to the interviewees' expertise and role in their national LMIS. The interview guide comprised questions based on the following themes:

- What Labour Market Intelligence (LMI) is collected in your LMIS, by whom, from what sources and how?

- How is LMI processed, analysed and used to identify and project future skill needs?

- How is LMI disseminated to the various actors involved in your LMIS? And how do they use this LMI to inform skills policy and delivery?

- How effective are these information systems at informing skills policy and delivery decisions?

- What are the important factors within the organisational infrastructure that contribute to strengths and weaknesses of these systems?

- What lessons, principles or ideas might be applied from your LMIS to the England context?

Data analysis

The interview summaries were analysed through a dialogical and iterative process, and then coded as conceptual frameworks (Ritchie et al., 2010). An agreed coding procedure was developed, and each interviewer engaged collaboratively in the data analysis. All interviews were analysed using this framework approach enabling data commonalities as well as important differences within and between respondents to be highlighted. Data were synthesised by theme.

Workshops

Two online workshops will be organised as part of the research.

The aim of the first workshop was to review findings with expert participants and identify key learning from current LMIS and innovative practice. It was organised after the main data collection phase. Participants were drawn from the selected case study countries and included stakeholders and actors involved in their national LMIS. A background paper was provided to participants to ensure a shared understanding of the study, its scope and aims and the concepts used. The workshop included an open forum in which participants were encouraged to share their work, plus a facilitated discussion on:

- How is LMI and intelligence disseminated and used by those involved in the national LMIS?

- How are LMI and intelligence used to inform policy, particularly around skills, and delivery decisions?

- What do you think are the important elements of a good LMIS?

- What lessons, principles, or ideas can be applied to the England context?

Output from the workshop supported the drafting of conclusions and recommendations for the England context. In order to ensure international colleagues had the opportunity to participate in the workshop, the same workshop was delivered twice; once early in the morning and one later in the afternoon. In total, 41 participants representing all the country case studies attended the workshop. The third workshop was an internal departmental workshop. The aim of which was to review the research findings and discuss the conclusions and recommendations. The workshop was attended by 14 members of UK government and invited experts. Feedback and comments were used to revise the report.

Annex 2: International LMIS case studies

This annex provides a report on the LMIS of each country examined which includes the desk research and data from the interviews with national experts and LMIS stakeholders. For each country, a summary of the LMIS is provided first. This is followed by evidence on each dimension of the LMIS examined including the organisation of the LMIS, resources, stakeholder engagement and dissemination of the LMI. The final part of each country case study is a broad assessment of the LMIS focusing on how the LMIS is used in policy formation (particularly skills policy) and the stability of the LMIS.

A2.1 Australia

Summary

There has been significant progress made in recent years to improve the quality and timeliness of the Australian LMI and data. Consequently, there are a number of key learnings that may be of interest to England.

Arising from recommendations in the Joyce Review, the National Skills Commission (NSC) and the National Careers Institute (NCI) were established as part of measures announced in the 2019-20 Federal Budget measure, *Delivering Skills for Today and Tomorrow*. The NSC provides expert advice and national leadership on Australia's current, emerging and future workforce skills needs. It also plays a role in simplifying and strengthening Australia's Vocational Education and Training (VET) system. The NCI was established to provide access to authoritative and accurate careers information and support for people of all ages and career stages.

Having only been established several years ago, the NSC produces an extensive range of LMI products including intelligence on the country's labour market, a detailed analysis of occupations in current and future skills demand and intelligence about the current, emerging and future skill needs of the economy. This includes producing 5-year projections of the demand for skills based on the Australian Skills Classification (ASC), the Nowcast of Employment by Region and Occupation (NERO) estimates, and insights gathered from the Internet Vacancies Index (IVI) and Recruitment Experiences and Outlook Survey (REOS).

In order to produce their LMI insights, the NSC draws upon a range of both traditional and more experimental methodologies, including nowcasting. The majority of the data is quantitative, although some qualitative intelligence is used to overlay the quantitative data for specific purposes. Data is collected from a wide range of Australian and international sources, including surveys of employers and web-scraped job postings.

Technology plays an important role in the production of the Australian LMI, both in terms of methodology and presentation. The Australian Government has made a significant investment in its data infrastructure including development of the Jobs and Education Data Infrastructure (JEDI), which powers a range of online LMI tools. By investing in a data infrastructure and combining traditional sources of LMI data with more experimental datasets, the timeliness of LMI has been improved.

The LMI is used to guide Australian government policy initiatives, including targeting of skilled migration, apprenticeship incentives, and training funding.

While the main users of the LMI are other government departments, the NSC and NCI engage with other stakeholders including industry, education and training providers and employment services providers (outsourced PES providers).

While no formal training is provided to LMI users, the NSC recently conducted a survey of its users to capture and examine user feedback, including user satisfaction with various elements and contents, as well as ways to improve the NSC's LMIS. The information collected from this survey informed the design and development of the NSC's new integrated LMI website, to make it more accessible and interpretable.

Organisation

Legal and institutional framework

The three main institutions with legal responsibilities for the Australian LMIS are the [Department of Education, Skills and Employment](#) (DESE), the [National Skills Commission](#) (NSC) and the [National Careers Institute](#) (NCI).[28] The role of each is discussed, in turn.

The Australian [Department of Education, Skills and Employment](#) (DESE), formed on 1 February 2020 following a merger of the Department for Education and Department for Employment, Skills, Small and Family Business, has a broad remit including functional responsibilities in a number of areas related to the LMIS, including co-ordination of labour market research and creation and development of research infrastructure.

Arising from recommendations in the [Joyce Review](#), The [National Skills Commission](#) (NSC) was established as part of measures announced in the 2019-20 Federal Budget measure, [Delivering Skills for Today and Tomorrow](#). The NSC provides expert advice and national leadership on Australia's current, emerging and future workforce skills needs. It also plays a role in simplifying and strengthening Australia's Vocational Education and Training (VET) system, including responsibility to work out course subsidy

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[28] The DESE [Organisational Chart](#) shows the structure and relationship in the department, and with the NSC and NCI.

levels with State and Territory governments, and allocate Commonwealth VET funding on behalf of the Minister.

The National Skills Commissioner is a statutory office holder operating with the support of DESE, supported by a DESE First Assistant Secretary. The National Skills Commissioner was appointed under the National Skills Commissioner Act 2020 [Cth] 'to provide independent, trusted advice and leadership on Australia's labour market and current, emerging and future workforce skills needs to Government and the Australian public'.

The Joyce Review also recommended the establishment of a National Careers Institute (NCI) to improve careers advice across tertiary education, which was also established as part of the 2019-20 Federal Budget measure. Sitting within DESE, the NCI was established to ensure Australians have access to authoritative and accurate careers information and support, whatever their age or career stage. Funding for the NCI is appropriated by DESE.

Management and control

DESE coordinates labour market research and is responsible for providing research infrastructure. The annual Corporate Plan (DESE, 2021a) is the department's primary planning document, and sets the direction for how DESE will work, build capacity, and work to support Australia's economic growth in line with the Australian Government's key priorities. Corporate plans are a requirement under paragraph 35(1)(b) of the Public Governance, Performance and Accountability Act 2013.

The NSC, established on 1 July 2020, is enacted under the National Skills Commissioner Act 2020 [Cth] and led by the National Skills Commissioner, who is a statutory office holder operating with the support of DESE, supported by a DESE First Assistant Secretary. The Commission is supported by DESE and provides advice to the Australian Federal Minister for Employment, Workforce, Skills, Small and Family Business, and DESE Secretary.

The NSC is charged with providing independent expert advice and national leadership on Australia's labour market and current, emerging and future workforce skills needs. The NSC also plays a role in simplifying and strengthening Australia's vocational education and training system (VET). The NSC monitors, researches and analyses employment dynamics across different demographic groups, industries, occupations and regions. It also analyses how changes in the labour market will impact jobs and the economy's education and skills needs.

The NCI, which took effect on 1 July 2019, operates as a non-statutory, independently identified entity situated within DESE. The Minister for Employment, Skills, Small and Family Business is responsible for approving the establishment, governance and operations of the NCI through its Ministerial Charter (NCI, 2020), and the Minister appoints the chair and members of the Advisory Board and approves its Terms of Reference (NCI, n.d.). The DESE Secretary of Department is the relevant accountable

authority for the purposes of the Public Governance, Performance and Accountability Act 2013 (PGPA Act 2013). The Executive Director[29] reports to the Deputy Secretary Skills and Training.

The NCI is led by an Executive Director, supported by Deputy Executive Directors, with guidance from the Advisory Board. The NCI's Advisory Board guides the strategic direction of the NCI by providing independent and expert advice. The responsibilities of the Board are set out in the NCI Charter[30] and the Board's Terms of Reference[31]. Members of the Board represent a diverse cross-section of stakeholders from business, industry and the education sector.

Through the Secretary, the NCI is required to provide an update on its activities at least once a year to the Minister and government as its 'Annual Update'. Distinct from reporting to the department and the Strategic Plan, this 'Annual Update' focuses on key achievements against the NCI's functions and if applicable, any forward strategy linked to key achievements. The NCI Advisory Board endorses the report prior to it being provided to the Minister.

Vision and strategy

The DESE 2021-22 Corporate Plan (DESE, 2021a) states the Department's purpose is to 'contribute to Australia's economic prosperity and social wellbeing by creating opportunities and driving better outcomes for people, through education, skills and employment pathways.' In the portfolio area of skills, training and higher education, DESE supports participation in work and society through skills, training and higher education and workforce participation by supporting opportunities for upskilling and reskilling.

Relevantly, the DESE Corporate Plan mentions information and communications technology (ICT) and data and analytics as two key enablers. In particular, DESE's Data Strategy 2021-22 (2021b) sets the strategic direction of their data capability, with an implementation plan that sets out a range of initiatives to improve and build data analysis and management capacities. These include:

- Growing staff capability to use, manage, interpret and analyse data to make decisions;

- Delivering a program of data-driven analytical research to support education, skills and employment policy development;

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[29] The Executive Director is a Senior Executive Service (SES) officer and official of DESE, who may exercise certain powers delegated by the Secretary under the PGPA Act.
[30] The NCI's Ministerial Charter sets out the roles, functions and governance and accountability arrangements for the NCI for the period 2020-2022 (NCI, 2020).
[31] The Terms of Reference set out the NCI's purpose, responsibilities, membership, composition and appointment arrangements, arrangements for meetings, conduct, confidentiality and disclosure of interests and travel and remuneration.

- Connecting data to better understand education and employment transitions and lifelong learning through the Skills, Education and Employment integration platform;

- Sharing our data internally and externally for public benefit;

- Delivering innovative projects such as the new employment services model, which includes designing and implementing new data platforms, data management and governance processes and upskilling staff to use new data tools (p. 52).

Published in late March 2022, the DESE National Workforce Strategy 2022-2027 has five guiding principles: to use data to create transparency of the current and future workforce; to equip Australians with in-demand skills and focus employment services on outcomes; to remove barriers and disincentives to work; to activate industry to design and drive change; and to target migration to fill skills and labour gaps (DESE, 2022a). To achieve its objectives, DESE draws upon the work and advice of the NSC in responding to current, emerging and future workforce skills needs, and the NCI in assisting people at all career stages to navigate changing labour market and connect with training and work pathways.

The NSC produces its own planning documents, where the Strategic Plan 2020-2022 specifies a vision of shaping Australia's future workforce, with the purpose of trusted and independent intelligence on Australia's current and future skills, education and jobs (NSC, 2021a). The stated long-term goals of the NSC are as follows:

- To make an enduring and relevant contribution to LMI;

- To improve the accessibility and relevance of VET;

- To contribute to a labour market that effectively aligns skills needs with education and training.

The strategic direction of the NCI is outlined in the NCI's Strategic Plan, with five strategic priorities in relation to supporting the career services system (NCI, 2021). The NCI Charter, which took effect from 31 July 2020, sets out the following vision:

The NCI will be Australia's recognised, central careers body, simplifying and strengthening Australia's career development system, to address a fragmented and difficult to use career information and services landscape. The NCI will support Australia's education, training and employment systems by serving as the authoritative and trusted source for careers information (NCI, 2020).

The NCI's mission is to 'drive up the quality and coverage of career guidance, including improved accessibility of information about education pathways and employment outcomes, to ensure that people are maximising their workforce potential, including directing people towards jobs in demand.' In this mission, the NCI works closely with the NSC to provide individuals and organisations with accurate and up to date information on the labour market through the digital platform (JEDI) to inform their choices on learning,

training and employment, and it will provide individuals with industry-informed and contemporary career information that will assist them in developing and managing their own careers. The NCI Charter (NCI, 2020) identifies five key areas, roles or functions, as follows.

- Facilitating improved access to NSC data-driven career information through its digital platform.

- Strengthen partnerships between key stakeholders including: industry bodies; employers, schools; and other education providers, through its Partnership Grants programme, industry partnership arrangements and Employer Partnership Program.

- Building understanding and promoting the benefits of career and skills development and continuous learning through promotional activities, including the National Careers Ambassador, the Australian VET Alumni program and the VET Information Strategy.

- Celebrating excellence in skills, training and education, including through the delivery of the Australian Training Awards and associated scholarship programmes.

- Working with key careers sector stakeholders to create an evidence base of contemporary best practice to influence the sector's information and service offering.

Included among the NCI's strategic priorities in the 2021-23 Strategic Plan (NCI, 2021), is to:

- Tailor NCI services to all ages and stages underpinned by the latest data and research:
  - research the impact and influence of career life stages, behaviours and design information and digital tools to support people at their moments of career choice;
  - In partnership with the NSC, and other trusted sources, develop targeted information to help support people of all ages and stages of their career;
  - Build a comprehensive understanding of different cohort segments including vulnerable groups and regionally based people to develop targeted information and support;
  - Enhance NCI's presence in the community-based activities such as participation in careers exhibitions and job fairs across Australia (p. 5).
- Create user-centric and personalised technology solutions for careers information:
  - Enhance the [Your Career](#) website by building additional data driven features and content;
  - Consolidate careers websites to create a seamless journey for people seeking careers information;

- o Improve the [myskills website](#) to help people compare courses and training providers, make informed choices about VET, and develop a new secure registered training organisation (RTO) Portal;
- o Enhance the [training.gov.au](#) website to ensure the national register of RTOs and training courses are available to support VET professionals.

A key plank to its Charter, the NCI established the [Your Career](#) website, which is targeted towards jobseekers, as opposed to career development professionals or policy makers.

Resources

Funding

An initial amount of AUD$48.3 million was allocated in the Australian Government Federal Budget 2019-20 to establish the NSC, under the [Skills Package – Delivering Skills for Today and Tomorrow](#), with funding allocated for the five year period as follows: 2019-20 (AUD$12.2m), 2020-21 (AUD$12.1m), 2021-22 (AUD$11.7m) and 2022-23 (AUD$12.3m). This funding was in addition to a further AUD$41.7 million to pilot new industry-owned skills service organisation (SSOs) in growth areas of human services and digital technologies; AUD$42.4 million to establish the NCI and AUD$6.1 million for a VET Information Strategy to be implemented by the NCI.

The 2019-20 budget also included additional funding for JEDI to the amount of AUD$1.8 million, with $AUD 1.6 million in 2019-20 and AUD$0.2 million in 2020-21. After being established, ongoing costs for JEDI and LMI produced by the NSC and NCI are being funded from the DESE budget.

Data

The Australian LMIS includes intelligence on the country's labour market, a detailed analysis of occupations in current and future skills demand, labour market analysis to guide and manifest Australian government policy initiatives, including targeting of skilled migration, apprenticeship incentives, and training funding. The majority of the data are quantitative, although some qualitative intelligence is used to overlay the quantitative data for specific purposes (e.g., skills lens), where the data are collected from a wide range of sources, including surveys of employers and web scraping.

The NSC has three branches of work: labour market research and analysis; skills, intelligence and engagement; and pricing and performance. The Labour Market Research and Analysis monitor, research and analyse developments in the Australian labour market, including occupational, industry and regional labour market trends within industries and occupations, along with migration and international labour market issues. Every year, the Labour Market and Analysis team produces 5-year projections of the demand for skills based on the Australian Skills Classification (ASC). While the Skills,

Intelligence and Engagement team provide data and intelligence about the current, emerging and future skill needs of the economy. This includes development and updating of the ASC, where other research units within the NSC apply the ASC to specific analysis. The NSC produces data including:

- [Employment projections](#), providing a guide to the likely direction of the jobs market over the next five years, with projections by industry, occupational group and skill level;

- Economy-wide data on job vacancies in Australia through the [Internet Vacancies Index](#);

- [Nowcast of Employment by Region and Occupation (NERO)](#) is a new experimental dataset developed by the NSC that complements existing sources and provides experimental estimates of projected employment;

- Economy-wide data on job vacancies through the [Recruitment Experiences and Outlook Survey](#) (REO) of employers to identify pressure points for businesses trying to find employees;

- The Jobs and Education Data Infrastructure ([JEDI](#)), which powers online tools: [Job Switch](#), [Jobs Hub](#), [Your Career](#) (where data is produced by the NSC and hosted on the NCI portal);

- The [Australian Skills Classification](#), which identifies job skills and their transferability across careers. ABS labour force data and data from the data scraping of job vacancies (nowcasting – NERO) is one source of data used to develop and refine the ACS.

In addition to Australian data sources, a range of international data is used to help contextualise the Australian LMI. The main sources of international data include the following.

- Australia and New Zealand share common Australian and New Zealand Standard Classification of Occupations (ANZSCO) taxonomy. For example, NSC uses data produced by the New Zealand Accident Compensation Corporation (ACC) which produces occupational risk profiles.

- New Zealand data on the characteristics of jobs (using ANZSO) that is used on the New Zealand careers website is also used.

- US O*NET data is used, under a licensing agreement.

- Burning Glass (both Australian and international data used for NERO).

- European Skills, Competences and Occupations (ESCO) classification (used to inform development of the ASC).

NSC LMIS key data sources

Internet Vacancy Index (IVI) is a monthly count of online job advertisements compiled by the NSC, where data are delivered by occupational groups, skill level groups, state or territory and by regional areas. The IVI is the only publicly available source of detailed information of this kind in Australia.

The IVI data count job advertisements newly lodged on three major Australian online job boards (SEEK, CareerOne and Australian JobSearch) during the reference month. The job advertisements are coded to a fine level of detail by the NSC with data available by occupational groups (down to the 4-digit ANZSCO level or dropped if not able to be coded to this level due to insufficient information), skill level groups and by state or territory, as well as a best-fit regional geographical structure. The NSC does not scrape the vacancies data itself. The job agencies produce the data and forward it to the NSC for collation and analysis. Duplicate job advertisements are removed during the coding process before the job boards forward the data to the NSC.

In terms of scope, all job advertisements newly lodged on the contributing job boards for vacancies within Australia during the reference period fall within the scope of the IVI, where monthly results have been compiled into a time series from January 2006 (with the regional series added in 2010). A number of important conceptual limitations are noted, including that the IVI does not reflect the total number of job advertisements in the Australian labour market, does not take account of multiple positions being advertised in a single job advertisement, and may be slightly biased towards higher skilled positions. The NSC applies seasonal adjustment and trending to the IVI results to account for pronounced seasonal patterns within the Australian labour market and to reduce data volatility. Headline results are published on the NSC website, a monthly vacancy report is published and the underpinning data by detailed occupation, region, and skill level are downloadable (March 2006 onwards) from the website (see IVI methodology details such as how the data are compiled, a map of the regional structure (37 best-fit labour market regions) and notes on use and interpretation of data).

The Recruitment Experiences and Outlook Survey (REOS) surveys approximately 1,200 employers each month for the REOS to find out about their experience when recruiting staff, as well as whether they are expecting to increase staffing levels. The REOS is used to produce a report summarising key monthly trends (the Recruitment Insights Report[32]), together with a companion data file.

The REOS dashboard features monthly key indicators as follows: rates for recruitment activity; recruitment difficulty rate and expected to increase staff. The headline results are reported as percentages along with change on previous month. A brief overview of each of the three aspects is then featured, with graphs. A graph tracking the proportion of

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[32] For example, the February 2022 monthly Recruitment Insights Report is a 9 page report with key findings from the REO survey.

employers that were currently recruiting or who recruited in the past month (June 2020 – latest) show activity for all employers, employers in capital cities, and the remaining State areas. A graph tracking the proportion of recruiting employers with recruitment difficulty shows monthly activity (April 2020 – latest) for all employers, employers in capital cities, and the remaining State areas. The graphs and underpinning data can be downloaded in a range of formats, so that users can customise data. For example, it is possible to print and download charts, as well as the underpinning data used to produce the charts.

Data from the REOS is used to provide a short summary of staff changes over the previous month. As part of the REOS, and in response to various lockdowns that have occurred since the onset of Covid-19, employers are asked whether they currently have staff stood down or on reduced hours. REOS national results on the staffing outlook are also summarised. The dashboard also features 'spotlight' data on particular topics, for example in February 2022 the spotlight provides information about how REOS data are used to measure and interpret recruitment difficulty.

Links to PDF copies of the REOS monthly recruitment insights report and underpinning downloadable Excel data are provided in the dashboard. Links to Spotlight reports are provided, as well as links to the annual report on Employers Insights on the Australian Labour Market – 2020 (snapshot report[33], data report[34], and Excel data file). This is followed by a brief description of the methodology used by the NSC to monitor recruitment activity conditions across Australia.[35]

Jobs and Education Data Infrastructure (JEDI) (as discussed earlier) is considered a 'flagship' enabler of intelligence on Australia's labour market, workforce changes and current and emerging skills needs, provides a 'real-time' view of the Australian labour market drawing data from multiple sources into its data engine, and translating these data into insights for different user. JEDI powers several online tools to support individuals navigate the labour market: Job Trainer, Job Switch, Jobs Hub and Your Career.

The NSC produced Employment Projections to provide guidance on the likely future direction of the jobs market over the next 5 years, where the website currently shows data for the five years to November 2026. The website provides a simple description of the high-level projections. For example, the website summary currently provides three top-line results, where over the five years to November 2026:

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[33] Employers' Insights on the Australian Labour Market 2020 Snapshot is one page with infographics and links to full report

[34] The Employers' Insights on the Australian Labour Market 2020 data report is a 43 page report providing main findings from the REOS 2020 surveys, including the impact of Covid-19 on businesses, staffing changes over 2020, recruitment activity in late 2020 and technical notes.

[35] More information is available in the REOS Concepts Methods and Questionnaire.

- Employment is projected to increase across all 19 broad industries;

- Employment is projected to increase across all eight broad occupational groups;

- Nine in 10 new jobs are projected to require post-school education.

There are areas with more detailed data around industry projections and projections around jobs (occupations) and skill level projections. For each of the charts, it is possible to print and download, as well as access the underpinning data. There is also an option to convert the same data from a graph into a table.

The latest report on projections, the Employment Outlook (industry and occupation trends over the five years to November 2026), can be downloaded, where an 18-page report provides an overview of likely future employment trends across industries, occupations, states and territories, and regions. The 2021 NSC Employment Projections data can also be downloaded in Excel format, with projections by ANZSIC 06 Code industry, occupation by ANZSCO 4-digit code and by skill level[36]. For the employment projections, there is a brief description of the methodology used to produce the projections, which avoids technical (statistical) jargon.

The NSC also has a number of experimental datasets under development.

The Australian Skills Classification (ASC), as discussed earlier, is a skill-based approach, contains three categories of skill: core competencies (sometimes called foundation skills or employability skills), specialist tasks (the work activities a person undertakes specific to a job); and technology tools (a technology, such as a software or hardware, used within an occupation). The ASC also groups similar skills together into skill clusters, and these clusters are further grouped into 29 skills cluster families. The ASC is powered by JEDI and includes modified information from: the O*NET Resource Centre[37]; ABS data; and Trending and Emerging Skills Flag Data from Emsi Burning Glass; and NSC Analysis using data records provided by Emsi Burning Glass.

Nowcast of Employment by Region and Occupation (NERO) is a new experimental (BETA version) dataset developed by the NSC that complements existing sources and provides experimental estimates that seek to balance the need for accuracy, granularity, frequency and timeliness. It provides timely estimates on employment in 355 occupations (ANZSCO 4-digit level) across 88 regions in Australia.

The NSC produces quarterly Small Area Labour Markets (SALM) estimates of employment and the unemployment rates, available for Statistical Area Level 2s (SA2s)

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[36] The Australian Skills Classification, intended to be a 'common language' for skills, identifying the range of skills linked to occupations, and enables the exploration of the connections and transferability of these skills. There are 5 levels in the classification.

[37] This includes O*NET 21.2 Database and O*NET 23.1 Database by the US Department of Labor, Employment and Training Administration (USDOL/ETA), which the NSC uses under the CC BY 4.0 license.

and Local Government Areas (LGAs). The SALM estimates are synthetic, so care needs to be taken when interpreting the data (see SALM methodology[38] and guidance notes).

The National Centre for Vocational Education Research (NCVER) website includes a dashboard with data builder for statistics on VET courses, including government-funded VET courses, apprenticeships in schools, and student outcomes.

Separate to the job postings work of the NSC, NCVER has licensed access to Australian internet job postings data collected by Burning Glass Technologies on the number and types of jobs available, as well as the required and desirable skills requested by employers. NCVER has designed four products to demonstrate the utility of these data and the possibilities they offer for further research and analysis.

Methods and expertise

To produce its LMI, the NSC draws upon a wide range of data science methods and techniques, including methods traditional to labour econometrics using ABS data, projections using CGE models for projections, nowcasting, and surveying of employers. Moreover, a combination of quantitative and qualitative methods is used to consider current, emerging and future skill requirements.

A range of technological advances are used in producing data; methodological (such as nowcasting) and presentational (such as the interactive portals). The role of technology has become even more important in the context of Covid, as the NSC has adopted new technologies for data management, data analysis, data visualisation and data hosting. One example provided where technology has been used to improve the timeliness of reporting and improving data visualisation has been the use of Tableau (one of many data visualisation tools) to automate some aspects of the data analysis process to produce new insights. For example, Tableau is used by data analysts and non-technical staff to automate (using programming scripts) the headline monthly insights reporting. This has meant that the monthly reports can be produced very quickly after the ABS data is released (two weeks after data release). Tableau's data visualisation tools are also regularly used by non-technical staff to produce graphs, maps and images to better visualise the LMI.

Some of the methods and techniques used are briefly outlined.

- The REOS is a monthly Computer-Aided Telephone Interview (CATI) survey of 1,200 employers. The stratified survey sample is generated from a private sector company who maintains a register of Australian businesses.

- The ASC adopts a tasks-based approach, having customised, under license, the US O*NET, mapping tasks in Australian jobs (ANZSCO) in terms of their core

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[38] SALM estimates are based on the Structure Preserving Estimation (SPREE) methodology.

competencies, specialist tasks and technology tools. Natural language processing is among the techniques used to analyse the occupational data.

- The Internet Vacancy Index (IVI) uses big data scraping techniques to collate job vacancy data from the three largest online recruitment sites, mapping vacancies to ABS statistical regions, ANZSCO classification.

- NERO uses the emerging methodology of 'nowcasting' using both traditional and real-time data, as well as big data techniques, such as machine learning, to estimate trends. A range of data sources are used as modelling inputs. Supervised machine learning techniques such as random forest, gradient boosting and linear regressions were used to train models to find patterns that can be used to predict the 'now'.

- The SALM analysis uses Structure Preserving Estimation (SPREE) methodology to generate quarterly estimates of unemployment and the unemployment rate at the Statistical Area Level 2 and LGA levels (see SALM methodology[39]).

- Medium-term and point-in-time employment projections (five-year) are derived using a blend of two techniques, where the nature of both exercises means that there will be differences between them, including: best practice time series models that summarise the information that is in a time series are converted into a forecast; and where time series projections are made by combining forecasts from autoregressive integrated moving averages (ARIMA) and exponential smoothing with damped trend (ESWDT) models.

- CGE modelling work was undertaken in 2022 to better understand how structural changes in the economy may affect employment growth.

Accessibility

The NSC is focussed on making data available and accessible through their website. In general, the data on the NSC website is targeted at policy makers and researchers with a good understanding of LMI. In contrast, the data on the NCI website is targeted towards students and jobseekers.

The NSC recently conducted a survey of users to capture and examine user feedback, including user satisfaction with various elements and contents, as well as ways to improve the NSC's LMIS. The information collected from this survey helped inform the design and development of the NSC's new integrated website, to make it more accessible and interpretable. Four main user groups accounted for 80% of respondents: government (35%), employers/businesses (16%), education or training providers (15%) and job active/employment service providers (14%).

The vast majority of users reported positive sentiments about the [Labour Market Information Portal](#), with two thirds reporting the LMI portal to be 'very useful' or 'extremely

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[39] SALM estimates are based on the Structure Preserving Estimation (SPREE) methodology.

useful' for their specific needs. User feedback identified a number of aspects where the accessibility and presentation of LMI could be improved, such as:

- Reorganising LMI by theme and content page to make it easier for users to find specific information and navigate pathways to content and insights they may not have previously been aware of;

- Providing more granular regional data by promoting the existence of the SALM data;

- More 'storytelling' in how content is presented to cater to a less technical audience, such as providing short summaries of key content in the form of infographics, tables and charts, as well as more accompanying narrative explaining trends and issues;

- Providing interactive data displays and corresponding datasets to support users with more advanced data needs and skills;

- Improving visual appeal of the website my modernising the look and feel of key elements;

- Providing context/background to aid interpretation, including presenting historical context such as change over time, and making it easier to compare regional data with corresponding state/territory and/or national data;

- Providing detailed occupational information by publishing detailed occupational profiles that contain labour market indicators, trends and insights;

- Making it easier to download data, especially regional data;

- Create a tutorial that explains the intent of the website, describes content available, and provides a tutorial on how to navigate and consume key content;

- Enhance the quality of email notifications by better summarising key content releases and linking directly to context pages/reports (NSC, 2020).

Stakeholders

Cooperation and engagement

The NSC cooperates and engages with the national statistical agency, the [Australian Bureau of Statistics](#) (ABS) and the federal [Department of the Treasury](#) in the sourcing and production of LMI and data.

As part of developing a 'joined up approach' between the demand and supply of skills, the NSC's Pricing and Performance unit draws upon research from other units of the NSC in providing research and analysis on prices for VET courses, employment, income and further study outcomes from VET courses, public and private return on investment on government investment in VET courses, the performance of Australia's system, and

opportunities to improve access, skills development and choice for regional, rural and remote Australia in relation to VET.

The NSC and NCI engage with Australian industry stakeholders, including with the [Australian Industry Skills Committee](#) (AISC), who gives industry a formal, expanded role in policy direction and decision-making for the vocational education and training (VET) sector. The ASIC draws on advice from [Industry Reference Committees](#) (IRCs). They are the formal channel for considering industry skills requirements in the development and review of training packages, where the IRCs advise the AISC about the skill needs of their industry sector. In turn, the IRCs are supported by independent [Skills Service Organisations](#) (SSOs), who review and develop VET training products and curriculum (including training packages).

The NSC also cooperates with a range of international stakeholders who are also involved in producing LMI including analysts from the United States, Canada and New Zealand.

Another stakeholder in the Australian LMIS is the NCVER, the national professional body responsible for collecting, managing, analysing and communicating research and statistics on the Australian VET sector. The NCVER website includes a dashboard with data builder for statistics on VET courses, including government-funded VET courses, apprenticeships in schools, and student outcomes.[40]

The NSC and the NCI cooperate to produce and disseminate LMI. They also liaise with the state government departments response for education, skills and employment. Both the NSC and the NCI liaise with industry, education and training providers, in addition to having industry and careers development professionals represented their respective advisory boards.

The main engagement the NSC has is with departments of the federal government, such as DESE, Home Affairs (immigration), the ABS and Treasury. Other key stakeholders include state and territory departments responsible for education, skills, vocational training, workforce development and regional economic development. For example, the [Skills NSW](#), [The NSW Skills Board, the Victorian Skills Authority](#), Office of the Victorian Skills Commissioner ([Skills Insights](#)), the [Queensland Department of Employment Small Business and Training](#) (DESBT), [South Australian Skills Commission](#), [Western Australian](#)

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[40] NCVER has licensed access to [Australian internet job postings data](#) collected by Burning Glass Technologies on the number and types of jobs available, as well as the required and desirable skills requested by employers. NCVER has designed four products to demonstrate the utility of these data and the possibilities they offer for further research and analysis: Internet job postings: preliminary skills analysis – technical paper; Internet job postings: employability skills – infographic, Internet job postings: trending and emerging skills – infographic, which focuses on the skills being requested more often across occupations and industries and has case studies on the ICT and telecommunications sector and Electricians; and Internet job postings: personal care and support skills – infographic, which focuses on the skills being requested for jobs involving personal care and support.

[Department of Training and Workforce Development](#), [Jobs and Skills WA](#), and [Skills Tasmania](#).

Feedback and validation

As mentioned earlier, the NSC conducted a survey of users to obtain feedback and validate their LMIS. Of the specific products available on the NSC's LMI platform, the employment projections data was identified as the most useful content, followed by employment by region, industry information, workforce shortages and vacancy reports (NSC, 2020). In addition, data produced by the NSC, in particular the more experimental data from NERO, is checked against other data such as the LFS and similar international data and reports. While insights generated from the IVI vacancy data is validated by checking it against data about recruitment difficulties collected from the REOS of employers.

Dissemination

Every month, the NSC's Labour Market Research and Analysis unit releases a range of data, including:

- Internet Vacancy Index (IVI) of online job advertisements.

- REOS monthly report summarising key trends (the 'Recruitment Insights Report'), together with a companion data file. This report gauges employer recruitment difficulty and sentiment about hiring staff.

- NERO (experimental), which tracks employment by occupations within regions, where dashboard data is updated monthly.

Every quarter, the NSC's Labour Market Research and Analysis unit releases: SALM analysis on unemployment and the unemployment rates; and the Labour Market Quarterly Update. Every year, the NSC develops 5-year employment projections and emerging areas, [41] and updates the Skills Priority List (SPL), the [Skilled Migration Occupation Lists](#) and the [Priority Migration Skilled Occupations List](#) (PMSOL).

In addition, DESE's [Workforce Dashboard](#), published monthly, provides a one-page summary of workforce data on labour market conditions, employment by industry, job active caseload insights, measures of labour demand and supply, and information on in-country visa holders.

In addition to publishing LMI insights on their website, the NSC regularly publishes blogs and opinion pieces on topical issues (with links to related NSC research). Complementing data disseminated via the NSC website, the NCI website hosts the *Your*

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[41] See the NSC's inaugural report, [State of Australia's Skills 2020: now and into the future](#).

Career website, which is targeted at jobseekers, as opposed to career development professionals or policy makers.

Presentation

Primarily, national LMI data are presented on the NSC's website, formerly available via the LMI Portal but it has recently been refreshed and is now presented on the Labour Market Insights website. The NSC website was also recently refreshed to optimise user access and data visualisation. It is the entry point to the data outlined earlier. Data are presented under three main headings: regions, industries and occupations. In addition, the website has data by topic, including for example labour market update, migrants, employers' insights for jobseekers, and recruitment insights.

In the regions section of the LMI portal, labour force regions are the largest geographical areas defined within each State and Territory, where the LMI portal shows information for 87 Labour Force Regions (referred to as Statistical Areas Level 4 – SA4s in the Australian Statistical Geography Standard), which cover the whole of Australia without any gaps or overlaps. Most of the data for Labour Force Regions comes from the ABS LFS, where Labour Force Regions were specifically designed for the reporting of labour market data from the ABS LFS.

Relevantly, Jobactive providers are contracted to provide employment services in Employment Regions, where there are 51 Employment Regions, which do not cover all of Australia. While the Employment Regions are not part of the ASGS structure, the NSC produce data for Employment Regions by finding the best match to one or more ASGS regions.

At the regional level, there is an overview of the region, including a short summary about its geographic location, including main cities, large towns and other urban areas. This is followed by a snapshot of regional labour market data is provided that includes a snapshot of ABS Labour Force data showing the 12-month moving average for employment, unemployment rate, jobactive caseload (officially registered jobseekers receiving government benefits), mature age (e.g., 50 years plus) jobactive caseload and youth (15-24 years) jobactive caseload. Below the key statistics, a chart showing the region's trend lines for employment, unemployment and participation rates (15-year trend data). There is a chart showing the latest ABS monthly regional population by labour force status (employment full-time, employed part-time, unemployed, or not in the labour force). This is followed by a breakdown of the region's share of employment by industry compared to the State and Territory average, where the data are drawn from the latest ABS LFS (detailed) data four-quarter averages. A chart showing expected change in employment level by industry over the next five years are shown, based on the NSC's employment projections.

In addition, LMI data are disseminated via the NCI website, that links education, training and work resources and support, including the NSC's employment projections data on

the [Your Career](#) website. The Your Career website, aimed at jobseekers, contains a quiz where jobseekers can answer a short series of questions to help find study, training or job options; an A to Z searchable list of ANZSCO [occupations](#) with current LMI (such as occupational overview, day-to-day tasks, average salary, links to job vacancies; projected future demand; formal qualification requirements, skill requirements employers are looking for; and links to other similar career options); a search option to explore [industries and their related occupations](#) (industry overview; industry top 5 occupations; search option to explore occupations in the industry with sort function by future demand; median wage or title), ability to refine search by interests and dealbreakers (e.g. irregular hours, requires driving, shift work, etc); and a search option to explore [learning and training options](#) to get a job or extend skills (with links to information about [apprenticeships and traineeships](#), VET qualifications ([MySkills](#)), higher education ([CourseSeeker](#)). The main page of the NCI website also has links to information about free or low-cost courses for jobs in demand like health, aged and disability care, IT and trades ([JobTrainer](#)) and [support for school leavers](#) (links to [school leavers information kit](#), [school leavers information service](#) and [school leavers webinar series](#)).

As mentioned, it is possible to download data in a range of formats, so that users can customise data.

When LMI data are presented, the NSC provides a brief explanation of relevant methodology. When summary or headline results are reported, links to full reports are typically provided so that users can delve deeper into the data. As noted, the NSC conducted a survey of its LMI users, where some users suggested more support in helping with interpretation of the NSC's LMI.

Assessment of Australian LMIS

Skills anticipation outputs from the NSC play a key role in informing government policy in a number of areas, in particular the labour market and employment policy, education and training policy (in particular, VET policy), regional development, and immigration policy.

The NSC's LMIS is used to inform government workforce development and skills policy. For example, LMI produced by the NSC features in DESE's [National Workforce Strategy 2022-2027](#).

The NSC updates and publishes the [Skills Priority List](#) (SPL), which provides a detailed analysis of the intensity of demand with respect to occupation and geography. The SPL is based on evidence including labour market data analysis, employer-employee surveys and consultation with federal and state government agencies and representatives. The SPL is publicly available, most recently having been updated and published in June 2021. The published report identifies occupational fields in national shortage but with high future demand, professions with: moderate future demand but national shortage, other occupational segments that are in national shortage with soft future demand,

occupational fields with national shortage but strong future demand; occupational fields with national shortage but moderate future demand; and occupational fields with national shortage but soft future demand.

Related to the SPL, the NSC also provides LMI data to the Australian government (Department of Home Affairs) on the [Skilled Migration Occupation Lists](#) (short, medium and long-term strategic skills, and regional occupation lists) and the Priority Migration Skilled Occupations List (PMSOL), where Australia's skills related migration visas are underpinned by these lists, where eligible occupations are found in legislative instruments for the relevant visa program (published on the [Department of Home Affairs website](#)).

At the time of undertaking the desk-based research and interviews, a federal election campaign was underway. The election was held on 21 May 2022, resulting in a change of government. It is unclear whether the incoming Labor Government will make changes to the current structure, responsibilities or funding arrangements of the NSC and/or NCI.

A2.2 Canada

Summary

There is a long history of LMIS and career guidance services in Canada. The Canadian LMIS is well established, well-funded and well maintained, and according to the OECD, the system is one of the best in world.

The pan-Canadian LMI landscape is a complex system made up of stakeholders from the public, private and not-for-profit sectors, where some have missions solely focused on LMI, while others position LMI as complementary to their core objectives and activities.

Statistics Canada (STC) is the source of most primary LMI data, while Federal, provincial and territorial (FPT) governments all work to produce LMI that can be used internally and externally. The federal department of Employment and Social Development Canada (ESDC) coordinates and publishes LMI for general public use, developed by a network of economists across Canada, in collaboration with the provincial and territorial governments who also publish some LMI of their own. In addition, ESDC provides guidance on methodology and analysis to all their partners.

The LMIS in Canada is also supported by the efforts of the Labour Market Information Council (LMIC), a non-profit organisation created by the Forum of Labour Market Ministers (FLMM) – an intergovernmental forum that promotes discussion and co-operation between federal, provincial and territorial governments on pan-Canadian and regional labour market issues. The LMIC has a mandate to improve the timeliness, reliability and accessibility of LMI across the country. The organisation acts as a broker

between various orders of government and other Canadian LMI stakeholders, on issues of common interest, including professional development. There has been heavy investment in the LMIS, including efforts to consolidate and coordinate LMI activities, including consolidation of ESDC's LMI into the one location on the Job Bank website.

Canada uses the Canadian Occupational Projection System (COPS) to develop projections of future trends in the numbers of job openings and jobseekers at the occupational and national level. The projections allow for the identification of occupations that may face labour shortage or labour surplus conditions over the medium term (10 years).[42] The department also provides projections on jobs prospects for each occupation at the provincial, territorial, and economic region levels, over a 3-year time horizon.

Canada has invested in several foundational LMI frameworks to streamline data collection and measurement of jobs and competency-based information across the country. The National Occupational Classification (NOC) is the national reference for occupations in Canada. The Skills and Competencies Taxonomy was developed to improve the comparability and application of skills concepts throughout occupations and sectors. Inspired by the US O*NET system, ESDC is developing the Occupational and Skills Information System (OaSIS), a system that will allow users to understand how competency descriptors are used in hundreds of occupational profiles at varying levels of proficiency, frequency, importance, duration and other measurement dimensions, within Canada. OaSIS will be released in late 2022.

The Canadian LMI data are current and continual improvements are made to make the LMIS more accessible and relevant for the various stakeholders and end-users. Technology plays an important role in the LMIS, where data are accessible via dashboards, repositories and mobile phone apps.

Organisation

Legal and institutional framework

The Canadian LMI landscape is a complex system made up of stakeholders from the public, private and not-for-profit sectors, where some have missions solely focused on LMI, while others position LMI as complementary to their core objectives and activities (LMIC, 2022). Statistics Canada is the source of most primary LMI data, while Federal, provincial and territorial governments all work to produce LMI that they can use internally and externally (LMIC website). Sector councils also collect LMI, which feeds into provincial and federal efforts.

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[42] For more information see: https://occupations.esdc.gc.ca/sppc-cops/

Statistics Canada (STC) is the national statistical office where its mandate includes collaborating with government departments and agencies to collect, compile and publish statistical information, including information derived from departmental activities; to promote integration; and to avoid duplication of the information collected. The *Statistics Act* makes provisions for statistical matters including a commitment to making more information available about the use of its authority, including data sharing and data disclosures. The Corporations Returns Act legislates requirements for reporting of financial and other statistics relating to the affairs of corporations in Canada.

In the STC organisational structure, the responsibility for LMI sits in the specialist unit, the Centre for Labour Market Information. It is responsible for the development, collection and analysis of the Canadian LFS, the Job Vacancy and Wage Survey, and the Canadian National Occupational Classification (NOC).

ESDC is a large federal department with primary responsibility for LMI, along with other areas such as the pension plan, student loans, among others. The department produces and provides expertise on data, methods and analysis related to LMI products and frameworks. The department jointly manages and maintains the NOC with Statistics Canada. ESDC also maintains the Skills and Competencies Taxonomy, the Occupational and Skills Information System (OaSIS), and develops LMI products, including employment outlooks and information on prevailing wages for each occupation at the national, provincial, territorial and economic region levels, that are made available on the Government of Canada's Job Bank website. The department uses highly specialized techniques to develop these products and manages their validation alongside a network of Service Canada and provincial and territorial government economists.

Recognising the need to promote collaboration and coherence across Canada's large LMI ecosystem, the Forum of Labour Market Ministers (FLMM) – an intergovernmental forum that promotes discussion and co-operation between federal, provincial and territorial governments on pan-Canadian and regional labour market issues – endorsed the creation of the Labour Market Information Council (LMIC) as a non-profit organisation in 2017. The LMIC 'works collaboratively across governments with stakeholders, public and private, to empower Canadians to make informed decisions by enabling access to quality, relevant, comprehensive data and insights across the pan-Canadian LMI ecosystem (LMIC website).

Management and control

Within STC, the Centre for Labour Market Research is responsible for collecting and analysing labour market data, tools and reports on labour market statistics and LMI.

STC works closely with ESDC to provide a collection of products and services to Canadians, including jobseekers, employers and other providers of training and employment services, various levels of government and private sector through its learning and labour market information activities.

The learning and labour market information activities of ESDC consist of development, collection, production and dissemination of information in various formats. LMI is gathered from multiple sources, including ESDC, STC, sectoral councils, provincial and territorial governments and private job boards.

One of the main areas of research undertaken involves undertaking assessments of labour market conditions at the occupational level. ESDC provides 10-year occupational projections that allows for the identification of potential shortages and surpluses over the medium-term at the national level. In addition, the department also develops 3-year occupational outlooks at the provincial and regional levels. These products are published on their Job Bank portal. Finally, these assessments are complemented and supported by ongoing research to better tune these tools.

The FLMM plays an important role in collaboration and coordination across Canada, as the Forum brings together representatives from federal, provincial and territorial governments work with the aim of ensuring 'Canada has a skilled, adaptable and inclusive workforce that supports a competitive Canadian economy'.

Established by the FLMM, the LMIC is governed by a Board of Directors and three sub-committees of the Board: Executive, Audit and Strategy and Evaluation. The Board of Directors is comprised of 15 senior government officials representing each province and territory, as well as ESDC and STC. In addition to its 16 staff, the LMIC has three sub-committees: the National Stakeholder Advisory Panel, Labour Market Experts Information Panel and Career Development Stakeholder Committee.

Vision and strategy

At the overarching level, the Canadian government priorities include the publication of high-quality job market information, and promotion of employment services and training supports for those struggling to find and maintain employment (ESDC, 2021).

Significant efforts have been made towards improving the coordination of the Canadian LMIS. In 2008, an independent group was established by the Forum of Labour Market Ministers (FLMM), the Advisory Panel on LMI to provide advice on how best to improve Canada's LMIS to make Canadian labour markets function better. The panel consulted with business, labour, Canadian and international experts, and with federal, provincial, and territorial governments. Arising from the study, 'Working Together to Build a Better Labour Market Information System for Canada' (the Drummond Report), the Advisory Panel recommended that FLMM assume a leadership role in managing and coordinating Canada's overall LMIS, and STC Canada be called upon to fill in the main gaps in the national LMIS and work with the provinces and territories to fill gaps that are more specific to their circumstances. In addition, the panel recommended that federal, provincial and territorial governments contribute financially to the improvement of the LMIS, and STC provide national labour market statistics free of charge on its website.

The 2017-2020 FLMM Strategic Plan identified [five areas of strategic priority](#), including a priority around strengthening knowledge and engagement to better respond to Canada's changing labour market needs through engaging partners, knowledge development, and effective use of LMI.

While the LMIC's mandate is 'to improve the timeliness, reliability and accessibility of LMI to facilitate decision-making by employers, workers, jobseekers, academics, policy makers, educators, career practitioners, students, parents and under-represented populations' (LMIC website). The LMIC's vision is for Canadians to 'have the necessary information and insights to succeed in a changing, dynamic world of work' and the mission is 'to empower Canadians to make informed decisions by enabling access to quality, relevant and comprehensive data and insights across the pan-Canadian LMI ecosystem' (LMIC website).

The [LMIC's Strategic Plan 2021-2025](#) sets out the following strategic goals:

- Guide LMIS – ensure that the ecosystem responds to pan-Canadian LMI needs in an efficient manner by fostering an innovative LMIS and collaborating with stakeholders to address LMI priorities.

- Enhance LMI practices – promote benchmarks and guidelines to improve the quality and application of LMI.

- Champion LMI access – enable access and sharing of LMI data, knowledge and best practice.

Resources

Funding

Compared to other OECD countries, the LMIS in Canada is well funded, where funding is received from a variety of sources. Statistics Canada and ESDC are funded from the federal budget, where STC has overarching responsibility for producing statistics. The labour ministries in each province fund provincial and regional activities, including career guidance. The Labour Market Information Council (LMIC) was established by the Forum of Labour Market Ministers. It is an independent non-government organisation, receiving government funding. Sector councils also collect LMI, which feeds into provincial and federal efforts, where funding is provided by various channels including from the federal government's Sectoral Initiatives Program.

In addition to recurrent funding, specific funds have been allocated to development and enhancement of the LMIS. In terms of an indicative historical overview, in the 2012 Budget, CAD$21 million over two years was committed to enhancing the content and timeliness of the job and LMI for jobseekers, in the 2013 Budget, CAD$19 million over two years was committed to activities including informing young people about fields of

study that are relevant to existing and forecasted demand for labour in particular occupations; in the 2014 Budget CAD$11.8 million over two years and CAD$3.3 million ongoing was committed to enhance Job Matching to jobseekers and employers; in the 2015 Budget, confirmed new investments in enhanced learning and labour market information, with reallocation of CAD$4 million over two years to support the launch of a new one-stop national LMI portal, the launch of a new labour mobility portal and a new Career Tool, and an improved Job Bank.

Data

A wealth of LMI is produced at the national, provincial and regional levels in Canada. A range of data are gathered from different sources including household surveys, labour force surveys, business surveys, job vacancies surveys, and the Bank of Canada surveys, among others.

In addition to conducting a Census every five years, STC has around 350 active surveys on all aspects, including the labour market. The Centre for Labour Market Information (CLMI) in STC brings together data, tools and reports on the labour market in Canada. The CLMI collects data on earnings, wages and non-wage benefits; employment and unemployment, employment insurance and other social benefits, hours of work and working time arrangements and job vacancies, labour mobility and layoffs, among other data related to LMI.

The labour market data and intelligence produced by CLMI can be downloaded from a portal on their website. Data are presented in a range of formats including tables, thematic profiles, thematic maps, public use microdata, and visualised data. Data can be filtered by various criteria, such as provinces and census metropolitan areas. STC conducts its own research as well as works with ESDC and labour market specialists to produce other LMI. For example, STC works with ESDC on maintaining and updating the Canadian National Occupational Classification (NOC).

In terms of projections, every two years, ESDC uses the models of the Canadian Occupational Projection System (COPS) to develop projections on the number of job openings and jobseekers for 293 occupational groupings at the national level, which allows the identification of occupations that may face labour shortage or labour surplus conditions over the medium term. While the current COPS projections were completed in 2019 (e.g., before the Covid-19 pandemic), the focus of the COPS projections in on long-term trends in occupational labour markets, where these long-term trends are not expected to be affected markedly by the short-term impact of the pandemic. ESDC is currently working in updating the projections. The COPS national projections feed into regional associations.

ESDC also produces 3-year Employment Outlooks for the 500 occupations of the NOC, by province, territory, and economic region (data permitting). The 3-year Employment Outlooks are produced on an annual basis, where the objective is to assess whether the

employment outlook for a given occupation within a specific province or economic region is good, fair or limited. The outlooks are published on the Job Bank website. Additionally, a number of other LMI products are disseminated to the public via Job Bank, including Job Market News (a weekly summary of local labour market news), Labour Market Bulletins (monthly, quarterly and annual analysis of Statistics Canada's LFS results for each of the provinces and one for the territories), environmental scans (annual reports providing an analysis of the current labour market condition and trends that are impacting the local economy), sectoral profiles (overviews of recent labour market developments for key industries in various regions), and wage estimates (for specific occupations by region).

The LMIC also collects, produces and disseminates a range of data, including data on job trends, early career earnings of trade certificate holders and post-secondary graduates. The LMIC's LMI Resource area provides links to a Labour Market Information Best Practices Guide; WorkWords (an online labour market encyclopaedia), Now of Work (an annotated bibliography of latest findings related to COVID-19), and Future of Work (annotated biography). Additionally, the LMIC has partnered with the Future Skills Centre (FSC) to create the LMIC Data Hub, a central data repository that hosts LMI from several vetted sources across Canada. The hub, currently under development, is a cloud-based repository in Google Cloud Storage (GCP). New skill indicators are being developed, including metrics for emerging skills that will be added to the Hub.

In addition to national-level LMI, some provincial and regional government agencies, as well as sector-specific organisations produce more detailed information at the provincial, regional and local levels. However, this information is not standardised and typically not as up-to-date as the detailed LMI ESDC produces at the regional level. Each of the provinces and territories provides its own guidance services and LMI (Tuomi et al., 2021, p. 96).

One example at the provincial level, is the LMI produced and disseminated by Emploi-Québec the Department of Employment in the province of Québec, who have one of the best provincial systems to consolidate LMI data. While the monthly LFS is the primary source of LMI for Canada, including Québec, the Institut de la statistique du Québec run provincial surveys. Emploi-Québec also has access to administrative data, including data on people registered as unemployed[43] and taxation returns (salary data, family situation, demographics). Some of the data that provinces, such as Québec, use is provided by ESDC, who share their data as well as purchase data that is then shared with all provinces and territories. In addition, Emploi-Québec also buys in additional economic data. Another strength of the LMIS in Québec is the network of local experts (2 to 3 staff based in each city and town) to provide detailed and reliable intelligence on local labour markets, where the reporting of information collected from the local offices to the

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[43] Although this does not include all unemployed people, as it only includes those with enough working hours to claim, and that have made a claim.

provincial head office is timely (approximately 25 to 30 days after local occurrence). The LMI in Québec is used by a range of stakeholders including Higher Education in the Ministry of Education (who use the data to inform decisions about the design of education and training) and the Ministry of Immigration (who use the data to customise the immigration system based on skills needs and shortages in the provinces and regions).

The Emploi-Québec website has links to a range of tools and information, including its Online Employment Service dashboard, which is the main Emploi-Québec website for LMI. The dashboard has information for jobseekers on occupations, labour market trends, skills requirements and training (Tuomi et al., 2021, p.10), including detailed information on Trades and Occupations (job profiles, training information, and other careers related support) as well as links to careers related support services. The dashboard also has information for employers where they can create a profile and post vacancies.

In addition, accessed via the employment area of main website of the Québec Government's central website links are provided to job postings (public and private sector), job and careers fairs, job search tips, career planning and management, recognition of prior studies and experience, and information on retirement planning.

While BuildForce is a good example of a Canadian sector council that produces detailed, sector-specific LMI. Funded, in part, by the federal government's Sectoral Initiatives Program, BuildForce provides sector-specific intelligence to the Federal and provincial departments responsible for LMI. It also conducts its own programme of research and analysis, including producing an annual Construction and Maintenance Looking Forward forecast, which provide a 6-year scenario of workforce supply and demand by trade, province and region. The forecasts are shared with federal and provincial departments to help industry, training providers and government policy makers with matching of skills demand and supply. The BuildForce website has a dedicated member area that provides construction organisations with forecast data on residential and non-residential construction investment activity and labour supply and demand at the national, provincial and regional levels. BuildForce makes some data publicly available, but also enables data to be purchased (data series on key economic indicators, construction investment, and labour market conditions for the years 2006-2031 and the 6-year projection data). It also offers a service where BuildForce will mine the data and produce customised spreadsheets and/or tables and graphs.

Despite there being a vast array of LMI, a lack of good Canadian data on training investment was reported by several experts. While education is a provincial jurisdiction, ESDC funds Canada's Survey of Adult Skills as part of the OECD's Programme for the International Assessment of Adult Competences (PIAAC). While PIAAC remains useful it is only run every 10 years so there is a need for more frequent and better data on occupation/job-specific skill requirements and educational data. There is a lack of good data on training investment.

Methods and expertise

To produce its LMI, the Canadian LMIS draws upon a range of data science methods and techniques, including methods traditional to labour economics, projections using CGE modelling, as well as big data analytics. While a combination of quantitative and qualitative methods is used to consider current, emerging and future skill requirements, most of the data are quantitative.

A range of technological advances are used in producing the data, both methodological (such as web scraping and taxonomies) and presentational (such as the interactive portals and mobile apps). The role of technology is critical to improving dissemination, interpretability and accessibility.

In terms of projections, every two years, ESDC's Canadian Occupational Projection System estimates the number of job openings and jobseekers by occupation at the national level. The projections assist in identification of those occupations that may face labour shortage or surplus conditions over the medium term. ESDC uses the modelling of the COPS and the 2016 National Occupational Classification (NOC) to develop projections on the number of job openings and jobseekers for 293 occupational groupings at the national level, covering the entire Canadian workforce.[44]

Jointly developed by ESDC and Statistics Canada, the National Occupational Classification (NOC) is Canada's national system for describing occupations. The NOC is based on a four-tiered hierarchical structure, where the first level contains 10 broad occupational categories, the second level is made up of 40 major groups, the third level consists of 140 minor groups, and the last group comprises 500 unit groups. It provides a systematic classification structure that categorises occupations in Canada for collecting, analysing and disseminating occupational data for LMI and employment-related program administration, including labour market and career intelligence, skills development, occupational forecasting, labour supply and demand analysis. The NOC matrix provides an overview of the entire NOC structure, illustrating the relationship between broad occupational categories (BOC) and skills levels.

There is a searchable NOC database where details are shown for all classified occupations such as the main duties, educational requirements and other useful information. The NOC database can be searched by job title, occupation or NOC code. ESDC and Statistics Canada released the new version of NOC in September 2021 (NOC 2021) for data collection purposes, where ESDC programs are expected to start implementing NOC 2021 in late 2022 as survey and census data based on the new classification becomes available.

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[44] Additional details about the projections and a glossary are found on the COPS website.

The Career Handbook is the counselling component of the NOC system. The handbook provides global ratings assigned to occupations to define worker characteristics and other indicators related to occupations that are important for career exploration and informed career decision-making (example aptitudes, interests, physical activities, environmental conditions, employment/educational requirements). The third edition of the Career Handbook was released in 2018. It includes 939 occupational profiles. There is a searchable database of the handbook. While the Career Handbook information will remain available, going forward, ESDC will make detailed occupational and competency information available through the new OaSIS platform, described further below.

The ESDC Skills and Competencies Taxonomy aims to improve the comparability and application of skills concepts throughout occupations and sectors. The Taxonomy is comprised on hundreds of occupational descriptors used in the labour market to describe job requirements and/or individuals' personal characteristics. Each descriptor is associated with one of the seven main categories of the Taxonomy (skills, personal abilities and attributes, knowledge, interests, work context, work activities, or tools and technology. A diagram showing the structure of the Taxonomy is set out in Figure 2.

The Taxonomy was developed based on internal products (including the Career Handbook, Skills and Knowledge Checklist, and Essential Skills profiles), the US O*NET system, and a variety of other national and international competency-based frameworks.[45]

The Taxonomy is a tool used by labour market analysts, employment counsellors and employers, as well as jobseekers. Importantly, the Taxonomy was used as the framework for developing the Occupational and Skills Information System (OaSIS), which will capture the measure of most descriptors in the Taxonomy for around 900 occupations.

OaSIS Inspired by the US O*NET system, ESDC is developing the Occupational and Skills Information System (OaSIS), a system that will allow users to understand how competency descriptors are used in hundreds of occupational profiles at varying levels of proficiency, frequency, importance, duration and other measurement dimensions, within Canada. OaSIS was developed according to a set of principles and guiding framework, including ensuring that every occupational profile adheres to the skills taxonomy; developing a new Canadian rating guide to measure and assess skill descriptors and help transpose O*NET data to the Canadian labour market context; and informing and maintaining profiles via a network of stakeholders, including those involved in other national skills-related activities (LMIC, 2022).

To leverage the data via the US O*NET, ESDC and STC worked together to build two distinct but complementary concordances, one for statistical indicators (STC) and one for occupational profiles (ESDC) (LMIC 2022b). There were many more modifications to made to customise O*NET to the Canadian labour market than initially anticipated, as for

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[45] A full of resources used to develop the Taxonomy is available on the ESDC's website.

most occupations, there was no one-to-one mapping from the Canadian NOC to the US SOC used in O*NET was not possible (LMIC, 2020). For example, the STC concordance and mapped the Canadian NOC (4-digit level) to the US SOC (6 digit-level) to develop statistical indicators. While the ESDC concordance mapped the Career Handbook (5-digit NOC) to O*NET-SOC (8-digit level) to create occupational profiles using a skills lens (LMIC, 2020). In some cases, the skills profile of O*NET for one US occupation applies to several Canadian occupations and in others, several O*NET profiles apply to one Canadian occupation.

In order to develop OaSIS, ESDC consulted with a range of Canadian and international experts. While still in the development phase, OaSIS now has around 200 competences for 900 occupations. While the full Canadian NOC has 500 occupations, in OaSIS some occupations are divided to make them more specific. With the new NOC 2022, STC will move to 5-digits and OaSIS codes to 7-digits. Results are validated against O*NET as a comparator.

ESDC is currently working on validating the data, as well as developing tools to present the information on the ESDC website. Some additional examples of methods include:

- Geomatics using GIS tools and other software for data visualisation

- Dashboards created as relational data bases, where you can customise queries

- Data linking/matching – for example, the Education and Labour Market Longitudinal Platform (ELMLP)[46] links three anonymised administrative datasets through time

- Data scraping of online job postings using machine learning technique of natural language processing to extract occupation and work requirements from each job posting. Job posting data are updated monthly.

- In partnership with the Future Skills Centre, the LMIC is working on the first stage of app and tool development using the LMIC Data Hub focussed on supporting career service organisations that develop tools so they can meet the needs of their clients.

Accessibility

Information is widely accessible via various websites and publications by several institutions already mentioned, in particular STC, ESDC and the LMIC.

The majority of Canadian LMI data are open for public use. There is a legal requirement to publish data and Open Access Canada places a legal obligation on Federal, provincial

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[46] ELMLP links the Post-secondary Student Information System (PSIS), the Registered Apprenticeship Information System (RAIS) and the family tax records (T1FF).

and territorial government agencies to lodge their data in a repository annually, where these data are used mainly for research purposes.

Since 2009, the Government of Canada has stressed the importance of providing access to comprehensive, up-to-date and timely learning and labour market information for Canadians. To that end, between 2012 and 2016 the Government made several budget announcements relating to learning and labour market information. For instance, Budget 2012 committed to providing $21 million over two years to enhance the content and timeliness of the job and LMI for Canadians searching for employment. Budget 2013 committed to reallocating $19 million over two years to inform young people about fields of study in demand. This investment was split between the Youth Employment Strategy and the web-based Career Tool (available now on Job Bank website) (ESDC, 2017).

To improve accessibility, the Government of Canada requires plain language to be used in its communications with the public with rules that public agencies must adhere to around the creation of web content based on writing principles and techniques that help make web content clear and adapted to the needs of all people.

Statistics Canada and Job Bank have both developed mobile phone apps to allow individuals to access LMI, as well as to receive notifications.

Stakeholders

Cooperation and engagement

There is a relatively high level of cooperation and engagement with stakeholders in the Canadian LMIS. Statistics Canada, ESDC and the LMIC all cooperate and engage in outreach activities to seek feedback from, and share LMI with, stakeholders.

Considerable efforts have been made to improve coordination between the various stakeholders in the Canadian LMIS. To better understand needs about LMI and help determine data priorities, the STC and the LMIC administered an online questionnaire to gather input from organisations and professionals with an interest in LMI. The questionnaire was available online during late November 2021 and the results will be published online when available ([Statistics Canada website](#)).

The participation of stakeholders in skills anticipation is extensive. The federal and provincial departments with responsibility for the LMIS maintain strong relationships with employer bodies, confederations, trade unions, education and training institutions and employers. These connections generate additional qualitative information on the labour market, which is used to validate and/or supplement the results of quantitative forecasts.

The FLMM plays a role in guiding the development of the LMI in Canada, together with representatives from federal, provincial and territorial governments:

- British Columbia – [Ministry of Advanced Education, Skills and Training](#); [Ministry of Social Development and Poverty Reduction](#)

- Alberta – [Labour and Immigration](#)

- Saskatchewan – [Ministry of Immigration and Career Training](#)

- Manitoba – [Advanced Education Skills and Immigration](#); [Workforce Training and Employment](#); [Economic and Labour Market Intelligence](#)

- Ontario – [Ministry of Labour, Training and Skills Development](#)

- Québec - [Ministère du Travail, de l'Emploi et de la Solidarité sociale](#)

- New-Brunswick – [Post-Secondary Education, Training and Labour](#)

- Nova Scotia – [Department of Labour, Skills and Immigration](#)

- Prince Edward Island – [Workforce and Advanced Learning](#), Department of Economic Growth, Tourism and Culture

- Newfoundland and Labrador – [Immigration, Population Growth and Skills](#)

- Yukon – [Education and Schools](#)

- Northwest Territories – [Education, Culture and Employment](#)

- Nunavut – [Department of Family Services](#)

The federal and provincial government departments responsible for LMI also cooperate and engage with sector councils (over 50 sector councils and associations), not-for-profits, the private sector, education and training institutions, think tanks and career development practitioners and organisations, among others. With some overlap, the LMIC consults with stakeholders via the Board of Directors, as well as via its sub-committees.

Feedback and validation

Feedback and validation of products and tools occurs via both formal regular and informal channels. In compliance with the Canadian Government's [Policy on Results](#)[47], the Evaluation Directorate of the ESDC regularly undertakes [evaluations](#) of its labour market activities, services and products, including an evaluation of dissemination of learning and labour market information using a web-based consolidated approach (ESDC, 2017), the [Job Bank Evaluation](#) to assess the impact of the Job Match function on job search activities; and the [Evaluation of Connecting Canadians with Available Jobs Initiative](#), which included an evaluation of the Job Alert function of Job Bank. While with

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[47] [Policy on Results](#) sets out the fundamental requirements for Canadian federal departmental accountability for performance information and evaluation, while highlighting the importance of results in management and expenditure decision making, as well as public reporting.

COPS, consultations take place with regional analysts, provincial governments and some stakeholders validate their data, projections and assessments of the labour market.

During such evaluations, users are surveyed and/or interviewed. For example, the review of Job Bank included key informant interviews with 41 employers who used Job Bank, 10 provincial and territorial representatives who participated in the co-delivery of Job Bank services, and five Job Bank officials who work at ESDC in various areas related to the delivery of Job Bank (ESDC, 2021).

Dissemination

LMI collected and produced by STC is disseminated through the website. Statistics Canada has also developed My StatCan, a customisable portal that allows individual users to access articles, reports, data tables and indicators, as well as to receive notifications on latest data releases. There is also a facility for users to engage with experts via online discussions.

The ESDC's LMI is mainly disseminated through the Job Bank website. Some LMI is also disseminated via the COPS website, and the Federal Open Data Portal. ESDC's LMI data are also shared with the provinces and territories for their own analysis and development of their own LMI products. Administered as part of the National Employment Service, the ESDC's Job Bank portal and mobile app provide jobseekers access to job opportunities across Canada. There are various job searching tools. Job Bank also provides LMI products that allow jobseekers to explore the Canadian labour market. Job Bank targets a range of users including employers, jobseekers, students and youth, newcomers to Canada, members of underrepresented groups, employment or education service providers and researchers.

The job board area of Job Bank allows jobseekers to search for job postings by position and location. and an area where employers can register their job vacancies. Additionally, the Job Bank website also has dedicated areas with careers information (where you can search by field of study or occupation, complete career quizzes), and a trend analysis area (with salary comparisons, details about job prospects, and current job trends by province). Further improving dissemination, launched in 2018, the Job Bank mobile app was developed by the Government of Canada, as part of its commitment to provide Canadians with digital services that work for them. The mobile app allows users to customise their search from all of the jobs posted on Job Bank from their mobile phone.

The LMIC website is also used to dissemination LMI data, where the LMIC website has three main dashboards:

- Canadian Job Trends Dashboard, an interactive tool, allowing users to explore detailed LMI related to online job postings by occupation, geography, time period and work requirements.

- [Trade certificate holder earnings interactive dashboard](#) allowing users to explore information on early career earnings (annual earnings and earnings growth) of journeypersons (trade certificate holders)

- [Post-secondary graduate earnings interactive dashboard](#) allowing users to explore information about earnings of Canadian post-secondary graduates by credential and field of study (last updated December 2021).

In addition to the LMIC's three interactive dashboards, the website has a [publications area](#) with a search field. The publications area features reports and monthly insight reports and technical papers on a range of topics, each with accompanying audio recordings. The LMIC has a blog, LinkedIn and Twitter Accounts, as well as an option to subscribe to the LMIC newsletter.

LMI data are also disseminated by other stakeholders including the provincial and territorial governments and sector councils.

Customisation

The STC, ESDC and LMIC websites allow users to download data in a range of formats, so that users can customise data. For example, it is possible to download underpinning data and customise tables, as well as save the labour statistics data from the Statistics Canada website. Users can download an entire data table in CSV or XML format from the Statistics Canada website, where these downloads contain both data and metadata files. Statistics Canada has also developed a [Web Data Service](#) that provides access to data and metadata, including time series data. PDF versions of summaries and reports can also be downloaded from the Statistics Canada website. Statistics Canada also offers a variety of customised products and services.

ESDC's Job Bank website allows users to download PDF versions of LMI, including job search information, occupational, regional and sectoral profiles and outlooks.

Interpretation

In terms of interpretability, there are some very specialised data that can only be interpreted by statisticians, but there is also a wide range of data that can be easily understood by the public. However, reports are usually provided to complement data dissemination, which helps users with the interpretation of LMI. While there has been a great deal of progress made in making LMI more accessible, the various Federal and Provincial agencies remain committed to further simplifying data for general use, and in improving the way that data are presented.

Consistent with the aim of making LMI more interpretable for the general public, ESDC has a dedicated team of Geomatics[48] specialists who use Geographic information system (GIS) tools to collect, store, analyse and visualise LMI data on both static and more dynamic maps. The static maps are used to, for example, visualise regional unemployment rates across Canada.

The LMIC plays an important role in disseminating LMI to stakeholders, including career development professionals. Career counselling is a regulated profession in Canada, where counsellor training includes training in both access to, and use of, LMI in guidance. For example, in collaboration with the Canadian Career Development Foundation (CCDF), the LMIC presents seminars and webinars geared toward help career development professionals on understanding the impact of LMI (for example, 'Webinar: Making Informed Career Decisions'). In recognition of the need to provide non-specialist users with training in how to use LMI, the LMIC has collaborated with the Canadian Career Development Foundation (CCDF) to develop four micro-credential courses in LMI. The training is aligned to the CCDF competency framework. At the time of conducting this case study research, it was expected that the courses would go live in the 2022 Canadian fall.

Presentation

STC, ESDC, the LMIC, provincial labour ministries and sector councils are increasingly using dashboards to present their LMI. With such dashboards it is usually possible to search using interactive tools, to customise queries and to download data and other information in a range of formats. For example, ESDC's Job Bank portal consolidates a wide range of LMI with dashboards tailored to jobseekers, employers and other users (ESDC, 2021).

In addition, the LMIC website provides links to three dashboards:

- Canadian Job Trends Dashboard which has an interactive tool to allow users to explore online job postings by occupation, geography, time period and work requirements. The dashboard offers two ways to view the online postings data: by Job Title and by Work Requirement.
- Trade certificate holder earnings dashboard which has an interactive tool to allow users to explore information on early career earnings (annual earnings and earnings growth) of journeypersons (trade certificate holders);
- Post-secondary graduate earnings dashboard which has an interactive tool to allow users to explore information about earnings of Canadian post-secondary graduates by credential and field of study.

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[48] Geomatics is a scientific term for gathering, storing, processing and delivering geographic information. Geomatics includes tools used in land surveying, remote sensing, GPS and related forms of earth mapping.

All material on the respective dashboards is available in both English and French, reports are mostly downloadable and short audio recordings are sometimes available where key findings from publications are read out.

Assessment of Canadian LMIS

The Canadian LMIS is well established, well-funded and well maintained. The data are current and continual improvements are regularly being made to make the LMIS more accessible and relevant for the various stakeholders and end-users. LMI outputs from STC, ESDC, the LMIC, the provinces and territories and sector councils play a key role in informing government policy in a number of areas, in particular labour market and employment policy, education and training policy, and immigration policy.

A2.3 France

Summary

While France has made significant investments in their LMIS, and despite efforts to improve coordination between the stakeholders, the system remains fragmented. Numerous governmental and non-governmental bodies produce and disseminate data at the national, provincial, sectoral, and local levels. While the system itself is relatively robust and there is a high level of engagement, the complexity of skills anticipation and high number of stakeholders means that it is difficult for users to navigate the system.

A range of quantitative and qualitative methodologies are used to produce LMI about current, emerging, and future skills requirements. Such methods include traditional econometric modelling, surveys of both employers and workers, as well as future projections, foresight exercises, skills audits, and sectoral studies.

The relatively recent establishment of France Stratégie as the new Employment and Skills Network (REC) have improved coordination and knowledge sharing across the LMIS, however a vast amount of LMI is produced. Arguably, this has resulted in over-provision of skills anticipation data and analysis. This can make it difficult to end-users to locate resources suitable for their respective needs.

Organisation

Legal and institutional frameworks

There are a number of institutional stakeholders involved in the French LMIS operating at national, regional, sectoral and enterprise levels (Cedefop, 2017a). At the national level, the public sector actors of the Ministerial Statistical Office for Labour and Employment

include the [Organisation de la direction de l'animation de la recherche, des études et des statistiques](.) (DARES) and [France Stratégie](.) which have overall responsibility for anticipating skill needs (Cedefop, 2017a). Other ministries coopering in relation to LMIS at the national level include the [Ministry of National Education, Higher Education and Research](.) (Ministère de l'Education nationale, de l'Enseignement supérieur et de la Recherche), the [Ministry of Labour, Employment and Economic Inclusion](.) (Ministère du Travail, du plein Emploi et de l'Insertion), and the [Ministry of Health and Prevention](.) (Ministère de la Santé et de la prévention). [The National Employment Council](.) (COE), an associate network of France Stratégie, brings together various stakeholders (e.g., social partners and experts) to discuss issues relating to employment and skills needs (Cedefop, 2017a).

While at the regional level the main stakeholders are the Regional Employment and Training Observatories (Observatoires Regionaux de l'Emploi et de la Formation, OREF). The national network of [public employment services](.) (Pôle Emploi) also undertakes skills anticipation activities to support the work of their local offices. At local level, there are also 300 job centres (Maisons de l'Emploi) that assist workers, unemployed people, and employers. Another important actor in the skills anticipation process in France is the network of [Chamber of Trade](.) (Les cadres communautaires d'appui, CCA), the French [Chambers of Commerce and Industry](.) (CCI de France) which publish labour market needs analysis for their members (small- and medium-sized enterprises).

At sectoral level, trade unions and employer associations have their own observatories known as the Observatories of prospects of trades and qualifications (Observatoires Prospectifs des Métiers et des Qualifications, OPMQ). These were created to facilitate better understanding of skills and lifelong learning needs at the sectoral level, to better serve the needs of companies and workers, and to inform discussions between the social partners by providing them with an indication of future skills needs (Cedefop, 2017a). The observatories are a joint technical tool of which uses qualitative and quantitative information to enable professional and sectoral organisations to conduct a review of changes in employment, qualifications and skills.[49] At company level, a legal obligation is placed on companies with more than 300 employees to collaborate with social partners to design three to five-year strategies called [Prospective Management of Jobs and Skills](.) (Gestion Prévisionnelle de l'Emploi et des Compétences, GPEC) (Cedefop, 2017a).

Finally, some anticipation initiatives formally bring together several of these actors. For instance, [Prospective Study Contracts](.) (Contrat d'Études Prospectives, CEPs) are undertaken between the Ministry of Labour, Employment and Economic Inclusion, trade unions, and occupational/employer organisations (e.g. bodies representing different professions) to understand the effects of social and economic changes on the future needs of the labour market over the next five years. These studies are supported

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[49] For example, [OPTL](.) is the observatory for the transport and logistics sector in France.

financially by the state and are normally carried out by private sector organisations (Cedefop, 2017a).

Notwithstanding the complexity of stakeholders involved in the French LMIS, the main institutions responsible for providing LMI are DARES, France Stratégie, L'Institut National de la Statestique et Des Études Économiques (INSEE), Pôle Emploi and Centre d'études des Recherche sur les emploi et qualification (Céreq). The following sections discuss their legal and institutional framework, respectively.

DARES is an independent department which works closely with the Ministry of Labour, Employment and Economic Inclusion. DARES provides data on employment, unemployment, work conditions, job vacancies, jobs for the disabled, extra working hours, working hours per week, and unemployment. It produces publications and reports on the labour market and works closely with other stakeholders to gather and disseminate data. DARES also disseminate data within the European Union and internationally. Data produced by DARES are not all accessible to the public.

France Stratégie is an independent French department created in April 2013 which reports directly to the French Prime Minister. It provides data on the economy, work, employment, skills, society and social policies, sustainable and digital development. France Stratégie took over its role from the General Planning Commission (1946-2006) and the Centre for Strategic Analysis (2006-2013). In order to improve coordination of the fragmented LMIS and to improve skills anticipation, France Stratégie was commissioned to organise and share experience, methods, and tools for carrying out skills anticipation exercises. This included creating a new French Employment and Skills Network (Réseau Emplois Competénces, REC) in 2015, which, in collaboration with stakeholders, produced methodological guidelines for agencies in carrying out anticipation exercises (Cedefop, 2017a). The primary role of France Stratégie in the French LMIS is to provide skills anticipation to support policy making decisions based on how the composition of the labour market is expected to change over time, including skills forecasts (see for example Les Métiers en 2030).

Pôle Emploi is the public employment service in France attached to the Ministry of Labour, Employment and Economic Inclusion, represented by its director general. It is responsible for developing knowledge on the French labour market, informing decisions and improving the effectiveness to support actions for jobseekers and companies. Pôle Emploi has two main functions. First to administer unemployment benefits for jobseekers and to provide services to support their return to work. Second, it supports companies with their recruitment strategies. Pôle Emploi has around 55,000 labour market officers who are charged with anticipating trends and bringing together key stakeholders in the French labour market. The board of directors comprises 20 members from government, trade unions and employer professional organisations as well as representatives from the regions and local authorities. Pôle Emploi also carries out statistical studies on the labour market, including the Labour Needs Survey or Besoins en Mains D'œuvre (BMO).

This survey, sent to 1.9 million establishment, examines labour market requirements and recruitment needs for France by sector of activity and by employment area.

INSEE (The French National Institute of Statistics and Economic Studies) is a Directorate-General of the [Ministry for the Economy, Finance and Industrial and Digital Sovereignty](#) (Ministre de l'Économie, des Finances et de la souveraineté industrielle et numbérique). INSEE's mission is to collect, analyse and disseminate information on the French economy and society across French territories and regions. It provides data that feds into economic analyses of the labour market and economy, and more generally for the analysis of fluctuations in economic activity, at global and sectoral levels. As an independent organisation, INSEE recruit staff with a wide range of skills, including civil servants. It operates with 50 employees in the head office, and 100 employees located across the French regions.

Céreq (Centre for Studies and Research on Qualifications) is a public institution under the responsibility of the Ministry for Education and the Ministry for Labour and Employment. The organisation has responsibility for producing data and insights about training, work, and employment. Established in 1971, Céreq conducts its own surveys, studies and evaluations of public policies. For example, one project undertaken by Céreq included the 'Transversal skills and vocational Training' (2017-2019). This project was part of the Track-Vet project which was a European project funded by the Polish agency of the Erasmus+ program. It brought together a range of education, research and training partners from across Europe in a qualitative study to research those involved in supporting the development and evaluation of transversal skills. More recent and ongoing projects by Céreq comprise 'Skills Building Course for Low-Skilled Adults' commissioned by Cedefop. This project focuses on the translation, in Italy and France, of the European Recommendation (2016) Upskilling pathways: new opportunities for adults. The latter is oriented towards unskilled / low-skilled adults (employees, jobseekers, inactive) and aims to strengthen their basic skills (reading, writing, calculation, digital) and broaden their skills to achieve level 3-4 certification for better professional and social integration. The project uses the analytical framework used in 'Upskilling pathways' and aimed at French and Italian employees and jobseekers to strengthen their basic skills.

[Etalab](#) is a government data repository that publishes data on the labour market. Data are published as part the Open Government ethos with the objective to promote open transparency, citizen participation and collaboration. Relevant to the LMIS, Etalab includes the following:

- Labour market data: data on unemployment and jobseekers, monthly pre-employment declarations of more than one month (the Social Security Contributions and Family Allowance, [URSSAF](#)), monthly series of pre-employment declarations of more than one month throughout France;
- Pension data: number of working people contributing to the CNRACL (the national pension fund for local government agents) which covers the risk of old age and

invalidity of territorial civil servants and hospital civil servants; and number of IRCANTEC (Public supplementary pension) contributors by employer since 2014;

- Job offers and recruitment data: collected as part of the BMO by Pôle Emploi is analysed to anticipate recruitment difficulties, to improve the orientation of jobseekers towards training or professions in line with the needs of the labour market, and to inform jobseekers about the evolution of their labour market and promising professions.

- Job vacancy data: number of vacancies published by Pôle Emploi website includes all the vacancies available to jobseekers;

- Employer data (2019): data on individual employers compiled using the national contribution system (URSSAF)

- Economy activity level data: derived from the INSEE Macro-economic Data Bank which is the main database of series and indices on all economic and social domains.

- Sector data: an inventory of job titles, most common professions, analysis of activities and skills, grouping of jobs are available using the Operational Directory of Trades and Jobs (Répertoire opérationnel des métiers et des emplois, ROME)[50];

- Worker job characteristics data: numbers based on national insurance contributions by payroll and monthly temporary workers;

- Jobseeker data: numbers of jobseekers starting trainers and numbers leaving and returning to work from Pôle Emploi.

Management and control

Those operating in the French LMIS have their own management structures. The main actors whilst operate independently with their own remit there are structures in place to share data. Data from a range of institutions are made available through etalab. INSEE operates independently by law as the official statistical authority of France. It is responsible for maintaining the design, production, and dissemination of official statistical data.

Pôle Emploi staff work for the statistics, studies, and evaluation department. The aim of the department is to administer, mobilise 'big data', carry out studies, evaluations, simulations on the employment markets and ensure the project management of the LMIS of Pôle Emploi.

DARES is managed by department heads with specialisms in, for example, employment, evaluations of employment policies and vocational training, jobs and professional

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[50] ROME was built by Pôle Emploi in collaboration with a large network of partners (companies and professional unions, AFPA (Centre de formations professionnelles qualifiantes pour adultes), etc.).

relations, placements and vocational training, and jobseekers. POEM (politique de l'emploi), as part of DARES, is responsible for producing and maintaining the employment, labour and vocational training policy data dashboards. POEM's editorial, graphic and technical monitoring is provided by the Research, Studies, and Statistics Department of DARES. POEM is also managed by the General Delegation for Employment and Vocational Training (Organisation de la délégation générale à l'emploi et à la formation professionnelle, DGEFP) created by the French Ministry of Labour, Employment and Economic Inclusion. The DGEFP ensures the coordination of services and data.

France Strategy (France Stratégie) is an autonomous government agency reporting to the French Prime Minister. France Stratégie comprise a team of more than 40 permanent experts (economists, lawyers, engineers, sociologists, political scientists, etc.), 15 scientific advisers who work within four sectoral departments, 20 agents in functional support roles such as human resources, finance, internal affairs, and archives. The Orientation Council for Employment (OCE) of France Stratégie is a body of expertise and consultation on all employment issues. Created by a decree in 2005, the OCE is composed of 35 members including social partners, the PES directors general, the labour and employment directors, labour market experts and representatives from local authorities and Parliament.

France Competence (France compétences) is another public institution in the LMIS. Located within the French Ministry for Vocational Training and Apprenticeships, it oversees the finance, regulation, and evaluation of the vocational training systems in France. It works with other government departments and agencies, regions, and social partners, including trade unions.

Vision and strategy

The France LMIS, through a range of skills anticipation activities, aims primarily to support policy making and help companies avoid recruitment difficulties. It is also intended to help people make informed decisions about which courses to study by providing information about sectors and occupations that are likely to grow in the future (Cedefop, 2017a). The main actors support policy making through their own aims:

- Dares aims to decipher the world of work and to inform the public debate;

- INSEE aims to provide quantitative data to understand the French economy and society;

- Pôle Emploi aims to support jobseekers by providing services to match jobseekers with employment opportunities;

- France Stratégie aims to develop tools for medium- to long-term forecasting, inform policy by using local expertise and international comparison data, evaluate public policies and collaborate with and get feedback from stakeholders.

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Resources

Funding for the LMIS and the range of skills anticipation activities is through the Ministry of Labour, Employment and Economic Inclusion and the Ministry of Economy and Finance. DARES, INSEE, Pôle Emploi and POEM have allocated budgets. France Stratégie is funded via the Prime Minister's strategic cabinet's budget. Resourcing of the LMIS was not publicly available.

The French have invested heavily in skills anticipation and have a range of datasets produced or held by various government departments, at the national, provincial, and local levels. Main datasets relevant to the LMIS are described.

INSEE, as the national statistical agency, is responsible for collecting and analysing a range of labour market data, with the LFS being a primary data collection tool. In line with the International Labour Organization (ILO) and Eurostat, LFS is collected annually and comprises measurement of employment and unemployment by region, department, and employment area.[51]

DARES uses the official statistics collected by INSEE. DARES also funds research on adult learning and vocational training to generate new data. DARES also works on national and international surveys, like PIAAC, EU-CVTS, administrative data where the main source is URSSAF (a public administration establishment that is responsible for managing the French social security system). Another source is DSN (Déclaration Sociale Nominative, Nominative Social Declaration) which is an online monthly declaration by employers about their employees' payroll, employment activity such as work terminations, illness, maternity, paternity, end of contract, etc. The information collected from the DNS feeds into other datasets from Pôle Emploi and URSSAF using DSN payroll software.

Data in the LMIS is disaggregated by region and provinces in France. Ad hoc research is also undertaken as part of regional and local research projects. For instance, INSEE conducted research on payroll employment by region in the fourth quarter in 2021 (see for example Localized employment and unemployment rates (by region and department) - fourth quarter 2021).

In 2016, DARES conducted the Employment and Recruitment Survey, which collected data on employers' recruitment difficulties, skills gaps and actual recruitment decisions. It does not appear to have been conducted again since 2016 (Lhommeau & Remy, 2020). However along similar lines, the Labour Needs Survey (or BMO) conducted by Pôle Emploi, is an annual survey sent to employers to understand their recruitment needs by sector. The survey investigates recruitment difficulties and supports the orientation of jobseekers in line with their skills and qualifications. The latest BMO survey was conducted in 2022, receiving data from 2.4 million companies. POEM, as part of DARES,

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[51] Details of the latest LFS conducted in 2022 are available.

produces and hosts a dashboard on employment and vocational training policies. The POEM dashboard hosts data acquired from INSEE, DARES, DSN, URSSAF on employment policy. Examples of data include:

- Data Flow (number of new contracts, number of new beneficiaries, number of training courses ordered, etc.);

- Data stock (number of beneficiaries);

- Other data (number of hours worked, number of organisations, etc.).

The data are updated monthly, and users can customise data into tables, graphs, or raw data.

Pôle Emploi collects and processes labour market data analysed by region/province. Some of the open data produced are the economic situation in regions/provinces, where the focus is strongly represented by data about professions or professions in demand and recruitment data.

In 2017, Pôle Emploi launched its online job portal. Relevantly, job advertisements are regulated by French labour laws, where five criteria are legally required to be included by employers in the content of the online job vacancies: occupation, place of work, description of the job, nature of the labour contract, and required professional experience (Cedefop, 2018). The Pôle Emploi online job portal has links to regional job vacancies, online and other training courses, financial assistance for jobseekers, and support such as tips for preparing CVs. Pôle Emploi also posts jobs on the European portal, EURES.

Commencing in 2019, France Stratégie and DARES produced medium to long-term projections on the demand for professions (metiers). The REC (the Skills and Employment Network) data are used to investigate sectoral and regional skills and qualifications. Cedefop data are also used. This forecasting exercise looks at net job creation, as well as replacement demand, generating the number of projected job openings for each occupation (OECD, 2017). The projections provide insight into which occupations are likely to experience the strongest demand (see France Stratégie & DARES, 2022).

Etalab regularly undertakes a comprehensive stocktake of existing databases and public datasets in the field of employment such as, data on unemployment, pension, BMO, job vacancies advertised by Pôle Emploi.[52] Etalab publishes an inventory of 161 databases with open data.[53] The inventory is open to contributions. Data held in the repository relevant to the French LMIS includes.

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[52] A full list of the employment data are available on the French government data website.
[53] More information on the inventory of employment databases that open are available on the French government data website.

Among other data, Etalab holds: job vacancy data from Pôle Emploi's; URSSAF 2019 data collected from individual employers by trade unions; DARES public lists of Vocational Training; the Pôle Emploi leaving training and returning to work data; ROME Operational Directory of Jobs and Professions; and France Competence's Vocational Training and Apprenticeships.

In addition to data produced by French government statistical and research agencies, Cedefop produces a range of country specific LMI, including quantitative skills projections of future trends of employment, by sector of activity and occupational group. Future trends in the level of education of the population and the labour force are also estimated. Cedefop's forecasts use harmonised international data and a common methodological approach, to allow for cross-country comparisons up to 2030 (Cedefop, 2020c).

Methods and expertise

Skills foresight exercises are generally undertaken at the sectoral and regional levels, where the French State sometimes co-funds such research (Cedefop, 2017a). To produce its labour market data DARES, Céreq, France Stratégie and the PES draw upon a range of data science methods and techniques, including methods traditional to labour economics. A combination of quantitative and qualitative methods is used to consider current, emerging, and future skill requirements. Labour market data are produced using four main methods: employer surveys, surveys of workers and graduates, sector studies and other qualitative methods (Cedefop, 2017a). Skills audits are conducted through surveys and skills assessments (diagnostiques) drawing on context information from both the national and local levels (Cedefop, 2017a).

The data collected by INSEE are processed using statistical tools from sampling to estimation. INSEE uses its data to conduct studies on skills and labour force projections publishing regular analyses of the economy, demography, wages, enterprises and the business sector. Pôle Emploi uses statistical data on labour market obtained mainly collected by INSEE and DARES.

The Job and Skills Network (REC) was established in 2015 by France Stratégie with the objective of creating a space for dialogue and knowledge exchange among stakeholders. The REC brings together representatives of the state ministries responsible for education and higher education, employment and sustainable development together with Pôle Emploi, a Joint Fund for Securing Professional Paths (FPSPP) and the social partners. The REC has five main working groups for sectoral and regional employment projections; transversal and transferable skills; supply methods for the professions; knowledge of seasonal jobs; and digital jobs in industry (Céreq, 2017).

Skills projections undertaken at the national level are conducted by DARES and France Stratégie, which includes studies on labour market demand by occupation and 10-year quantitative projections using macroeconomic modelling to estimate future demand for skills by occupation (France Stratégie & DARES, 2022). Some regional and sectoral

observatories also undertake their own forecasting by combining qualitative survey data with macroeconomic projections. For instance, in the first quarter of 2021, some regional studies were conducted to assess the impact on the Covid-19 crisis on employment by geographical territories.[54]

Accessibility

In line with France's commitment to open data, all statistical data collected by Pôle Emploi and INSEE is made public after anonymisation. The opening up public was initiated by the State in collaboration with the Etalab, which includes an inventory of database. DARES data are disseminated via the department's publicly available area of the website. However, not all data produced by DARES is open access. So, for example, budget-related data are not shared, but exclusive to the Ministry of Labour, Employment and Economic Inclusion.

While a large amount of labour market data are collected in France, the complexity of skills anticipation and high number of agencies engaged may serve as a barrier to prevent users (including students, workers and unemployed persons) finding the information they require. It has been suggested that this has resulted in an over-production of skills anticipation data and analysis that has presented user groups with difficulties regarding what sources to use (Cedefop, 2017a).

Stakeholders

Cooperation and engagement

There are a large number of stakeholders in the French LMIS with clearly define engagement and cooperation in terms of data collection, sharing and analyses. The various processes result in an opportunity for stakeholders to feed into the French LMIS.

DARES as is the main organisation providing data in the LMIS with direct reporting to the Minister of Labour. DARES cooperates and engages with INSEE the main provider of statistical data the labour market and economy, skills and vocational training. DARES also works closely with Pôle Emploi to obtain data on jobseekers, including the number of registered unemployed people by region. DARES works under the Ministry of Labour, Employment and Economic Inclusion and uses this information to inform public policies.

INSEE conducts surveys, population census, local and regional studies. INSEE also uses administrative data such as income tax by directly engaging the employers and jobseekers registered with Pôle Emploi. Pôle Emploi also conducts research and studies through its network of more than 1,000 agencies. Pôle Emploi deploys a range of local services, adapted to the needs of its partners, in a logic of complementarity aimed at

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[54] See for example Géographie de la crise. Premier trimestre 2021 : quelles dynamiques territoriales en matière d'emploi et de chômage? (2021).

better coordinating actions in favour of jobseekers at territorial level. For example, Pôle Emploi conducts the annual BMO survey which is considered essential for acquiring information from employers to understand their skills and recruitment needs and for the orientation of jobseekers towards training and support in their job search and their professional development.

France Stratégie has a corporate social responsibility (CSR) Platform that is a space for dialogue, consultation, and construction of proposals with various stakeholders (France Stratégie, 2021). Chaired by the permanent secretaries of the platform, it brings together a wide range of stakeholders: businesses, social partners, civil society organizations, networks of actors, researchers, and public institutions to involve them in the development, assessment forecasts and suggestions of public policies.

Feedback and validation

All the organisations and institutions in the French LMIS has feedback, validation and quality processes in place. A key player in the LMIS feedback process is the National Employment Council (COE), which is a permanent forum for debate between key stakeholders in the labour market. Its objective is to establish shared diagnoses and to formulate proposals for reform.

DARES analyses go through several commissions represented by employers and trade unions to verify the validity and accuracy of information before publication. INSEE follows the European Statistical Code of Practice to ensure the quality of its official statistical services before dissemination to the public. This includes statistical authority of the European Union (Eurostat), national statistical institutes and other national authorities responsible for the development, production, and dissemination of European statistics, undertake to comply with the Code of Good Practice. An independent advisory board, the European Statistical Governance Advisory Board (ESGAB) provides an overview of the European Statistical System with regard to the implementation of the Code of Practice. ESGAB analyses annually the implementation of the Code of Practice by Eurostat and by the European Statistical System as a whole. It provides advice on the measures to be taken to facilitate the implementation of the Code of Practice, on its dissemination to users and data providers as well as on its possible updates.

Pôle Emploi engages and cooperates with the scientific council, set up in 2013, which has largely contributed to developing of Pôle Emploi links with academia. It comprises nine representatives from several academic disciplines (economics, sociology, law, psychology, management sciences, political science). The scientific council assists Pôle Emploi in its partnerships with academia and guides their research and evaluation studies.

France Stratégie hosts the CSR Platform which brings together a wide range of stakeholders from the public, private and third sectors. It also engages with eight bodies public bodies (the Economic Analysis Council; Centre for Prospective Studies and

International Information (CEPII); the Employment Orientation Council; the Pensions Orientation Council; High Council for the Future of Health Insurance (HCAAM); the High Council for Climate (HCC); the High Council for the Family, Childhood and Age (HCFEA); and the High Council for the Financing of Social Protection).

Dissemination

The various websites and portals containing labour market data use a range of data visualisation tools to present data. The main institutions publishing LMI and intelligence reports are France Stratégie, DARES and Céreq. France Stratégie reporting to the French prime minister publishes monthly reports and analysis notes on various topics such as skills and jobs, sustainability, economic and demographic studies including the annual skills projections. Typically, an option to download publications and labour market analyses is available. Some of the portals and websites featuring labour market data provide the ability to customise data by generating queries and choosing indicators, such as date and geography, which then gives the option to create graphs and/or tables that can be saved and updated. There are a number of websites and portals in the French LMIS aimed at the range of stakeholders.

Some examples of how data are disseminated by the various organisations are included, but most are organised thematically. For instance, DARES produces long-term statistical series through the publication of thematic reports. The data can be accessed and filtered by theme, year, location, and frequency of publications (monthly, quarterly, and annually). INSEE enables access to their data through their portal, which is presented thematically and variously available as an electronic publication, or in a visual format such as a chart or table. Data are also available to download as datasets.

With a different target audience, Pôle Emploi has developed a number of mobile application tools for their users which include data on the French labour market.[55] Four tools have been developed to be used on smartphones for online job searches:

- The *My Offers* app allows jobseekers to regularly check available job offers, save job searches, get notification of jobs, upload and edit their CV, cover letters and business cards directly from the application and to manage their online prolife;

- The *My Space app* allows those registered with Pôle Emploi to update their profiles, follow-up on work compensation payments and declare a change in work situation (such as absence, retirement, start of an internship, illness, maternity, reactivation), and upload supporting documents (such as medical certificates, pay slips);

- The *My Training* app supports jobseekers access training to support return to work, rate the training, and see opinions of former trainees;

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[55] Four mobile applications are available by Pôle Emploi.

- The *My Events* app is a calendar where jobseekers can search for job-related events managed by Pôle Emploi in their region or province.

Assessment of French LMIS

The French LMIS is traditional in terms of the methodologies and approaches to collecting labour market data and intelligence and in anticipating skills. A key strength of the French LMIS is range of data available and the efforts to disseminate and share that data. Data are produced by several governmental and non-governmental bodies at the national, provincial, sectoral, and local levels. In practice, data are available at disaggregated levels which help inform local policy and delivery of services. However, the system is complex and fragmented with little robust coordination and collaboration. Recent investments are aimed at improving this, including the establishment of France Stratégie as the new Employment and Skills Network (REC) to support knowledge sharing across the LMIS. In addition, the development of a range of applications aimed at end-users in the LMIS are improving dissemination.

A2.4 Finland

Summary

Finland has a population of 5.5 million people most of which are concentrated in the south of the country with the result that population density varies from 0.2 per km^2 in the north of the country, to 3,000 per km^2 in Helsinki. As a geographically large country with a relatively small population this poses a number of challenges to skills anticipation not least that of capturing reliable data for the more sparsely populated areas. Finland also has an ageing population. 2021 marked the sixth year in a row when deaths exceed births. Statistics Finland's projections indicate that immigration will sustain current population levels to 2034 after which it is expected to decline.[56] The ageing population has implications for the labour market with increasing concerns about the impact on labour shortages, especially so in key sectors such as health and social care. Arguably this has focused increased attention on the role of skills anticipation and the capacity of the education and training system to develop the key skills the country will need in the future. The workforce in Finland is one characterised by relatively high levels of educational attainment and participation in lifelong learning. The challenge facing the skills anticipation system is that of being able to signal the short- and longer-term skill needs of the economy so that it is well placed to address the twin digital and green transitions. As will be explained, the skills anticipation system is used to provide information to determine the number of enrolments in courses of various kinds and their associated funding, as well as signalling emerging skill needs relevant to individuals,

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[56] See Statistics Finland, https://www.stat.fi/til/vaenn/2021/vaenn_2021_2021-09-30_tie_001_en.html

employers, training providers, guidance counsellors, etc. The worry is that labour and skill shortages will hamper competitiveness (which is relatively high by international comparison). Export and investment led growth has been supported by wage moderation. Labour and skill shortages are a potentially disruptive factor here. They may also have an adverse impact on the extensive provision of welfare services which characterises the country's way of life. In particular, there are major concerns about meeting the labour and skill needs of the social and health care sectors even if these become less labour intensive in the future. This tends to raise the stakes with respect to how available labour is best utilised so that the supply of skills more effectively and efficiently meets demand.

Skills anticipation in Finland has a long tradition of combining quantitative and qualitative techniques, including the use of forecasts and expert panels, to determine national and local skill needs. There is also a strong tradition of stakeholder engagement in the process of skills anticipation reflecting the role of social partnership in the country. More recently the process of skills anticipation has been experiencing a period of reform as more emphasis is given to identifying specific skill requirements rather than just looking at the number of people who will need to be employed in a given sector or occupation or obtain a particular qualification. The country is not unusual in this respect as it is something which has been observed across many countries. The main change over the relatively recent past has been the shift towards supplying more information about specific skill requirements into the existing structures used to determine future skill needs and how to respond to them. This concerns both the processes in place for determining the skills young people in the education and training system will need to acquire to assist them to make the transition into employment, and the skills the existing workforce will need to obtain in the face of the manifold changes which affect the way in which goods and services are produced (cf. the debate about the need to reskill and upskill the adult workforce).

Organisation

It is useful to make a distinction between skills anticipation where the focus is mainly on: (a) people in the formal education and training system who are yet to make the transition into the labour market; and (b) economically active adults including unemployed jobseekers and those in employment who need to update their skills and / or wish to change jobs. The former tends to be concerned more with planning education provision especially in, respectively, the vocational education and training and higher education systems. Whereas the latter tends to be focused more on identifying the skills people will need to get back into work or avoid skills obsolescence in the current job. To some extent the distinction is an artificial one since the skill needs may well be similar, but it is often an important one for policy making and service delivery. Skills anticipation in Finland is the responsibility of two ministries:

- [Ministry of Education and Culture](#) (opetus- ja kulttuuriministeriö, OKM); and

- [Ministry of Economic Affairs and Employment](#) (työ- ja elinkeinoministeriö, MEAE).

In summary, the MEAE is responsible for assisting adults to find work, whereas the OKM is responsible for ensuring that the education system at all levels is producing the skills, knowledge, and competence Finland requires (Cedefop, 2017b).

The vision for skills anticipation policy in Finland is to provide detailed evidence on skill needs which takes into account sectoral, occupational, and geographical differences. To this end, quantitative data provides:

- Economic forecasts of economic growth and labour demand;

- An indication of short- and long-term labour demand (rather than skill demand);

- An indication of shifts in the occupational structure of employment;

- An estimate the educational needs of the workforce;

- An estimate of the national and regional provision of education places for young people (including access to vocational and higher education courses).

The purpose of quantitative skills anticipation exercises is to provide an evidence base on which more qualitative assessments can be developed. In doing so, the aim is to provide a comprehensive system of skills anticipation. The 2017 establishment of the Skills Anticipation Forum is an important step towards this goal.

Ministry of Education and Culture (OKM)

The OKM is responsible for education, science, culture, sport and youth policies, and for international cooperation in these fields. It is, amongst other things, responsible for estimating enrolments and funding in vocational education and higher education. It undertakes forecasting via its MITENNA model which translates projections of future labour demand into estimates of education provision which are then analysed by a range of stakeholders responsible for education provision. As will be explained in more detail below there are developments taking place which will reformulate the means used to determine skill needs and the associated educational provision this gives rise to. Within the OKM, [the National Agency for Education (EDUFI)](#) is the agency responsible for the development of education at all levels. It is also involved in the anticipating future education and skill needs and is currently engaged in the development of a system which will identify specific competences which are in demand in the economy.

Ministry of Economic Affairs and Employment (MEAE)

The MEAE is responsible, amongst other things for,

- Industrial policy;

- Innovation and technology policy;

- Employment and unemployment matters including the public employment services (PES);

- Work-environment issues, non-discrimination in working life, collective agreements and arbitration of industrial disputes;

- Regional development and co-operation areas of the regional councils;

- Integration of immigrants and labour migration.

MEAE's employment and enterprise policies are directed at the reconciliation of supply and demand in the labour market including provision of training designed to meet the needs of companies and the workforce. Its skill anticipation responsibilities rest mainly in its forecasting of employment demand and matching jobseekers to jobs. It is also the ministry responsible for higher education. Its direct skills anticipation activities include:

- Employment forecasting including Short-term forecasting of labour demand (currently to 2024) and long-term forecasting of labour demand;

- Coordinating the regional foresight work and for incorporating it into national foresight work. Foresight activities focus on anticipating trends in education, competence and structural change undertaken by the regional councils and [Centres for Economic Development, Transport and the Environment](#) (ELY Centres);

- The occupational barometer (a twice-yearly assessment of local / regional skill needs in conjunction with the ELY Centres).

Joint activities

An audit undertaken in 2011 indicated that the system of skills anticipation that focused separately, respectively, education and the labour market, appeared to work well in practice (Cedefop, 2017b). There was recognition that at the regional / local level, where forecasting was much less well established there was scope for joint enterprise (via the ELY Centres). This is something which has been taken up in practice. It is also apparent that the skills anticipation process – for both education and the labour market – is directly tied to policy making. The information generated is used to decide upon enrolment levels in certain courses and programmes, funding for education, and the provision of adult training.

Resources

Developing the skills anticipation system for the education sector

The standard model has consisted of providing long-term data on:

- Changes in the external environment (technological change, demographic change, etc.);

- Changes in labour demand;

- Natural wastage of labour (e.g., the number of replacement workers required in different parts of the economy as people exit jobs for one reason or another but mainly retirement);

- The demand for skilled labour;

- Education and training needs;

- Skills needs related to generic competences (Ministry of Education and Culture (2019).

The process for carrying out the above has involved the collation of information from various sources at a national level, including forecasts of future labour demand and the conversion of this into an assessment of future training needs, linked to a deliberative process involved a wide range of stakeholders. The information is then further modified by institutions at the regional / local level, so it more directly meets their needs vis-à-vis planning of education and training provision. More recently the skills anticipation system has been modified by the OKM. The modified approach is designed to identify emerging skill needs which can then be used by a range of stakeholders involved in, for instance, course and curriculum design or, say, careers guidance. It draws information from a range of sources (qualitative and quantitative) to provide detailed sectoral insights.

Anticipating skills and training needs is a statutory task of the Finnish National Agency for Education. In particular, the Agency anticipates long-term labour and education needs (quantitative anticipation), and skills needs (qualitative anticipation) (Ministry for Education and Cultural Affairs, 2019). The Ministry of Education and Culture appointed the National Forum for Skills Anticipation to produce national long-term foresight and anticipatory views National Skills Anticipation Forum consists of nine sectoral groups comprising a range of stakeholders from the sector: employer representatives, entrepreneurs, trade unions, sector experts / academics, training / education providers, etc. (see Figure 13). In essence the National Forum for Skills Anticipation is engaged in a foresight type activity where experts assess impact of megatrends, drivers of change, analysis of and weak signals to give assessments of changes in the size of the workforce and skills requirements in different occupational groups. To date, the Forum has assessed the change in the skills needs of the nine industries to 2035. The detailed results can be found in Leveälahti et al. (2019) which provides a detailed assessment of the skills needed but also draws attention to the issues which will need to be addressed in producing competences (e.g., the attractiveness of the sector / occupation to new entrants, training supply, etc.).

The process which is now in place involved assessing the skill needs of more detailed sub-sectors so that detailed sectoral information on skills is provided for 33 industries in total. Each of the networks depicted in Figure 15 are free to develop their own network of experts.

Figure 15 Sectoral basis to skills anticipation in Finland

Each network is encouraged, amongst other things, to:

- Pay attention to the competences, skills and educational needs of the current and emerging workforce;

- Make use of quantitative and qualitative data sources;

- Report regularly on their deliberations at different stages of the skills anticipation exercise;

- Engage in experimental thinking;

- Use the inputs of the MITENNA model and the results from the VOSE projects.

Each network works through a five-stage process as outlined in Figure 16:

1. Identification of trends likely to affect future workforce composition including megatrends, including the development of scenarios via a Delphi-like exercise;

2. Analysis of specific drivers, signals, trends which will influence the future demand for skills via a workshop;

3. Surveys of various business segments to identify workforce developments;

4. Survey of skill needs which reveals the skills the workforce of the future will require by occupation, qualification, and task;

5. Identification of the measures which will need to be introduced to develop the skills identified.

Figure 16 Basic skills anticipation process in Finland
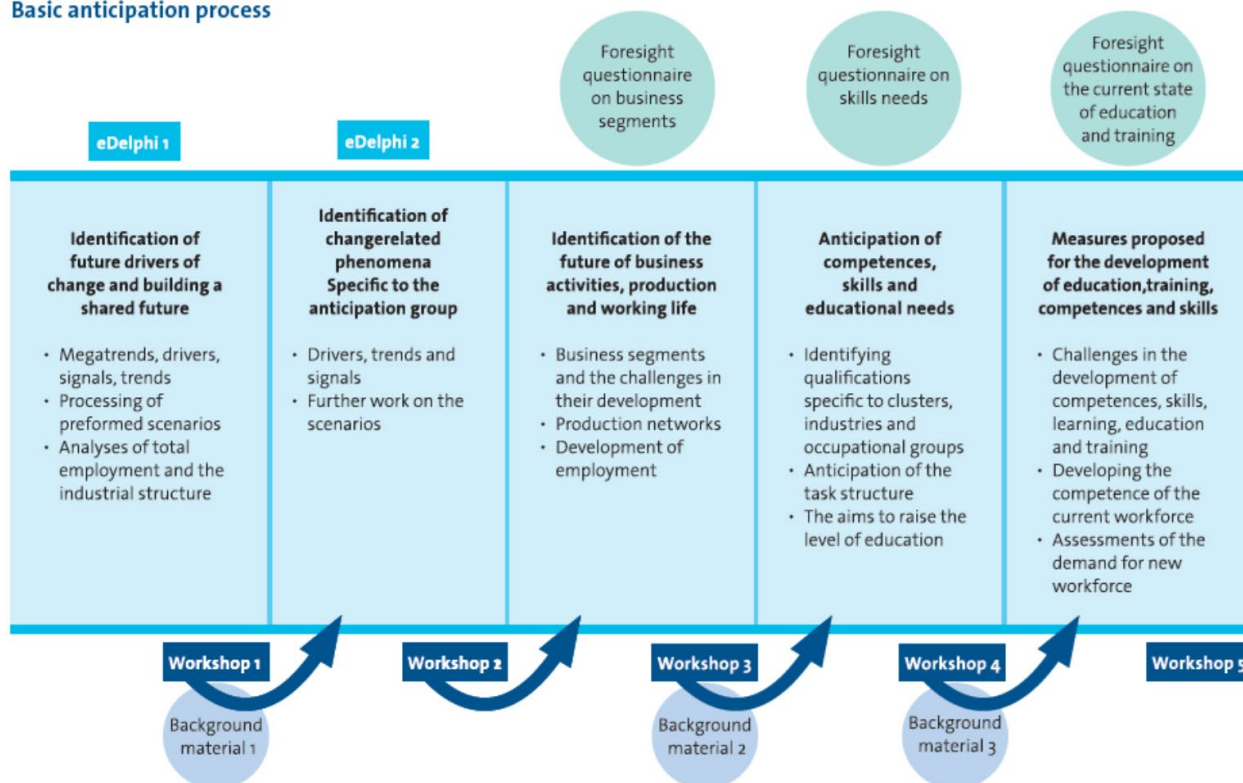
The process gives rise to identifying specific skill sets which are increasingly in demand. A skills classification has been developed through the process which draws upon ESCO and O*NET which identifies generic skills, specific working life skills; occupational skills (for 79 occupations); and digital skills.

The dissemination process provides information which produces infographics such as the one illustrated in Figure 17.

Figure 17 Example of sector-based information on future skills demand in Finland

As noted above, the process of skills anticipation is expected to make use of the MITENNA model and VOSE. The MITENNA model anticipates long-term educational needs (approximately 15 years ahead) based on labour market needs by calculating changes in labour demand, the number of people exiting the labour market, and the demand for new labour market entrants, while taking skills supply into consideration from all levels of the education system (Hanhijoki et al., 2012). The anticipation results are updated as new industry forecasts are released, which allows for the development of continuous anticipation data.

The Finnish National Agency for Education coordinated a project on future competences and skills, known as VOSE between 2008 and 2012. VOSE developed a model or process to anticipate vocational competence and skills needs for the future. The knowledge produced through the model serves different levels of education, including vocational, university of applied sciences, and university education. It provides a means of identifying specific skill needs and is now embedded in the qualitative anticipation process. The VOSE model provides the basis for the current system of skills anticipation drawing on a number of quantitative and qualitative approaches to skills anticipation. Pilot projects were undertaken in several sectors, including that providing services to elderly people (see Taipale-Lehto & Bergman, 2015).

The quantitative assessment – with some input from the expert assessments – is able to provide an indication of the number of people required each year, by field of education, over a given time period to enter:

- Vocational education;

- Universities of applied science (something similar to the pre-1992 polytechnics in England); and

- Universities.

This information is then used for educational planning and budgeting.

There is also a regional / local dimension to the anticipation process. The EDUFI Regions produce their own forecasts on educational needs in their area based on nationwide forecasts and their own estimates for regional development. The regional forecasts aim to develop a robust evidence base for strategic development in regions, municipalities and communities. This information is used by the regions in their strategic planning and by the Ministry of Education and Culture when planning education provision. The information is also used in performance negotiations between the Ministry of Education and Culture, the universities and the polytechnics when agreeing on the scope of their educational provision.

Developing the skills anticipation system for the labour market

As noted above, the MEAE produces forecasts of future employment / unemployment demand on a national basis with its short-term forecasting model. If this represents the top-down approach, then there is also the bottom-up aspect to consider as well. The occupation barometer is important here. The occupation barometer is the view of the PES local offices about the developments in key occupations over the short-term. The occupational barometer is carried out twice a year. It aims to increase the balance between jobseekers and vacancies and promote occupational and regional mobility. At the regional level, the occupation barometer provides information which the 15 ELY Centres – see below - use to develop a short-term estimate of the outlook for key occupations and workforce availability. The [Occupation Barometers](#) (Employment Outlook by Occupation, Ammattibarometri) estimate the demand of approximately 200 occupations, and the balance between supply and demand for next six months, based on interviews with employers and employees, visits to the employers, data from the barometers, etc (see Figure 7). The Occupation Barometer is published twice yearly providing skills anticipation data to public employment offices, career guidance, and information services at schools, the planning of VET provision, and labour market forecasts. The aim is to improve the match between vacancies and jobseekers, and to promote occupational and regional mobility.

The [latest occupational barometer](#), from April 2022, gives an indication of the type of information provided. It provides a list of the top five shortage and surplus occupations ((and in doing so highlights the shortages of health and social care workers which appears to be a reoccurring theme in the issues that the education and training system needs to address.).

Top five shortage occupations

- Practical nurses

- Registered and public health nurses

- Social work and counselling professionals

- Senior physician professionals

- Generalist medical practitioners

Top five surplus occupations

- General secretaries

- Travel agency employees

- Tailors, dressmakers, furriers, etc.

- Journalists

- Administrative and executive secretaries

Along with an indication of the extent to which the supply of, and demand for, are in balance at the sectoral and local levels. There is also [online access to the database](#) which bespoke information requests to be produced.

As noted above, regional anticipation is carried out in regional councils and ELY Centres. The aim of the ELY Centres, which are supervised by the MEAE, is to ensure that adult education supports the participation of ordinary citizens in civic activities and working life. ELY Centres help to strengthen regional co-operation and networking in adult education between providers of education, companies and other stakeholders and, in doing so, ensure that local skills supply is better matched to skills demand. In this role they also providers of adult education with grants to ensure that supply meets demand at the local / regional level and ensure that the needs of certain groups are met (e.g., small to medium-sized enterprises).

There are plans, in the relatively early stages of development, which will provide detailed information on skill requirements similar to that being developed by the OKM but in relation to the jobs market rather than the education and training system. This will include big data analysis of vacancy websites.

The MEAE also produces short- and long-term forecasts. Long-term forecasts for employment have historically been undertaken using the VATT general equilibrium model (Ahokas et al., 2015). The basis of the model was the continuity of existing trends. More recently, a new forecasting consortium has been established by a consortium of ministries, including those pertaining to employment and education respectively, to develop, a model which will provide a forecast to 2040 and explore long-term changes in the economic structure encompassing scenarios (Toumi et al., 2021). This potentially

brings together the wide range of foresight projects undertaken about what working life will look like (or should look like) and quantitative forecasting.

Short-term forecasting is based on, amongst other things, time series of analysis of Labour Force Survey data, national accounts statistics, population statistics, and the Ministry of Finance's economic forecast. It also includes expert judgments and qualitative assessments of the policy impacts. The current forecast provides information for the period 2022 to 2024 (Mähönen et al., 2022). It provides a forecast of:

- Working age population 15-74 and 15-64 respectively;

- Labour force;

- Number of people in employment;

- Labour force and employment rates;

- Unemployment rates;

- Number of unemployed people – all, under 25 years, and long-term unemployed.

On the supply-side there are forecasts of population change by age and the migration.

Separate, but integrated approaches

An audit undertaken in 2011 indicated that the system of skills anticipation that focused separately, respectively, education and the labour market, appeared to work well in practice. There was recognition that at the regional / local level, where forecasting was much less well established there was scope for joint enterprise. This is something which has been taken up in practice. It is also apparent that the skills anticipation process – for both education and the labour market – is directly tied to policy making. The information generated is used to decide upon enrolment levels in certain courses and programmes, funding for education, and the provision of adult training.

Other data sources

The information provided above outlines the information sources produced within the two ministries, there are other data sources which are potentially in scope of the skills anticipation process, including:

- A variety of forecasts produced by the Ministry of Finance, the Bank of Finland, and those produced by international organisations such as the European Commission, the OECD, and Cedefop;

- Research and analyses undertaken by a range of research centres in Finland;

- Surveys undertaken by various bodies including Chambers of Commerce;

- Foresight activities commissioned by the Finnish government.

In practice, a plurality of information relevant to skills anticipation can be drawn upon.

Stakeholders

As the commentary above indicates there is a high degree of stakeholder participation in the skills anticipation process. This is consistent with the role social partnership plays in policy making in Finland. Stakeholders, many if not all of which will be the users of the information produced, are involved in the deliberation process. This is seen in the way in which the sector committees determine emerging skill needs but also in the regional deliberations. This is designed to ensure that there is a wide range of perspectives included in the anticipation process which facilitates consensus building.

In summary, at the national level, the main stakeholders involved in the skills anticipation process includes:

- The Ministry of Economic Affairs and Employment;
- The Ministry of Education and Culture;
- Public Employer Services;
- Education Regional Councils;
- ELY Centres; and
- Municipal authorities.

These organisations, in turn, include other stakeholders in their deliberations, including:

- Employer representatives;
- Trade unions;
- Pes counsellors / guidance counsellors;
- Education institutions (including schools, vocational providers, and higher education institutions);
- Academics / researchers.

The intended users of the outputs of the anticipation system are the same as those which are involved in carrying it out, please learners looking for information about courses which will meet their skill needs.

Assessment of Finnish LMIS

Finland as an established LMIS in which collaboration at local, regional and national level are well-development and maintained. The current system of skills anticipation was shaped in part by the VOSE project – undertaken via funding from the European Social Fund – which sought to develop forecasts of future economic demand (via the VATTAGE model, Ahokas et al., 2010) which then fed into the MINTENNA model to provide an indication of skill / education needs. This was then supplemented by qualitative insights

derived from foresight type activity. As explained, this has developed apace over recent years with an emphasis on both short- and long-term forecasting allied to providing detailed insights into the specific competences which will be in demand in the future. There are a wide range of providers in the private and third sectors delivering forecasts, foresight, and apps designed to assist people identify their capabilities and the skills they will need to acquire if they want to further their careers. The inclusion of stakeholders in the skills anticipation system provides a valuable feedback mechanism in which the system is continually improving.

A2.5 Germany

Summary

Information about current and future skills demand and supply in Germany is provided as shortage analysis (Engpassanalyse) by the Federal Employment Agency, and as projections for skills demand and supply in medium term (up to five years) and longer term (up to 20 years). The projections are undertaken as part of the QuBe project focusing on qualifications (Qu) and occupations (Be) in the future.[57] While the long-term projections have been conducted since 2007 (first published in 2010), the medium-term projections were launched in 2018 (published in 2021), closing the gap between the present shortage analysis and the long-term projections (BMAS, 2021). Collectively these projections are referred to as skilled labour monitoring and form the basis of the skilled labour strategy of the federal government. This report focuses on the medium to long term forecasting, providing some information about shortage analysis focusing on the present situation in the annex.

In addition, the report touches on the National Skills Strategy (Nationale Weiterbildungsstrategie, NWS), launched in 2019, which aims to develop forecasting and analytical tools to support continuing education and training in Germany.

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[57] In addition, there is the skilled labour monitor by the chamber of industry and commerce (IHK) for 11 out of the 16 States providing forecasting by occupations until 2035, down to the local chamber of industry and commerce level. They are commissioned by the chamber of industry and commerce, use a different methodology and have not been included here. However, as part of the NWS the skilled labour monitor Brandenburg (Fachkräftemonitor Brandenburg) will explore the presentation of regional labour demand and supply projections until 2030 using an online portal. (BMAS & BMBF, 2021b).

Organisation

Legal and institutional framework

At national level there are a number of actors who play an important role in assessing skills demand and forecasting skills supply and demands.

The [German Institute for Employment Research](#) (Institut für Arbeitsmarkt- und Berufsforschung, IAB), which is part of the [Federal Employment Agency](#) (Bundesagentur für Arbeit, BA), 'has a statutory mandate to conduct labour market and occupational research to observe, evaluate and report developments and changes in the German labour market. The IAB especially advises the BA and [the Federal Ministry for Labour and Social Affairs](#) (Bundesminiterium für Arbiet und Soziales, BMAS) based on research evidence.' (Müller & Wolter, 2021, p. 313-314).

Founded in 1970 the remit of the [Federal Institute for Vocational Education and Training](#) (Bundesinstitut für Berufsbildung, BiBB) is laid down in the Vocational Training Act (*Berufsbildungsgesetz,* BBiG), which has been modified in January 2020. BiBB's role is to conduct scientific research on vocational education and training as part of the education policy of the federal government. Being financed through government funding its annual research programme needs to be approved by the [Federal Ministry of Education and Research](#) (Bumdesministerium für Bildung und Forshung, BMBF). BiBB has thus core funding for permanent tasks yet also opportunities to pursue contract research, including through research funded by the BMBF and other federal ministries and opportunities to develop its own research ideas following discussions with its stakeholders. BiBB liaises with stakeholders in vocational education and training as part of its responsibility for the regulation of dual education and is therefore seen as a platform for communication among science, policy and practice.

The forecasting work evolved through a collaboration between the IAB, BIBB, two leading research institutes with key expertise in relevant areas, and the [Institute of Economic Structures Research](#) (GWS), a private organisation, around 15 years ago, with long-term projections having been updated every two years and since the pandemic on an annual basis at it brought about significant short-term labour market changes.

There is, thus, an established long-term collaboration building on supplementary expertise each party brings to the table, with work being undertaken by largely publicly funded research institutes (IAB and BiBB) who have working relationships with key ministries, the BMAS and BMBF respectively, with BiBB also having established working relationships with other key stakeholders as part of their remit.

'The BA, is a corporation under public law directly under federal government control with self-governance' (Section 367, paragraph 1 Social Code (*Sozialgesetzbuch – SGB*) III, 'subject to legal supervision by the Federal Ministry of Labour and Social Affairs (Bundesministerium für Arbeit und Soziales)' (Section 393 Paragraph 1 Social Code

III).'[58] Largely funded though contributions of employees and employers to unemployment insurance, its responsibilities include administering unemployment benefits, job placement, LMI and careers guidance. The BA also provides a free of charge employer service (*Arbeitgeberservice*) offering advice on staffing matters, support for job placements, an online job board for all vacancies advertised via the BA, and labour market expertise to individual employers. Its administrative committees bring together representatives of employers, employees and public bodies (federal government, state government and local authorities), each taking a third of the seats (Bundeszentrale fur politische Bildung).

Management and control

QuBe is a long-term projections project evidence-based trends into the future to assess structural changes. In addition, scenario projections have been commissioned by the government e.g., on the digitisation of work to help it assess worst-case scenarios or to explore the likely impact of policy changes (decarbonisation or hydrogen strategy) on the labour market to assess whether the policy can by delivered with the existing workforce.

In 2019 Germany launched the National Skills Strategy (NWS) to advance continuing education and training (CET), with the key aim to help address structural changes in the labour market, such as the digitisation and decarbonisation, impacting skill needs. It evolved from a longer-term collaboration across several federal ministries, and it is based on a partnership approach involving key stakeholders with responsibilities for CET. As part of the NSS the stakeholders agreed a ten-point plan with outcomes having been reviewed in 2021. One of the goals was to strengthen strategic forecasting and to optimise statistics on CET, with further work having been undertaken as part of an innovation lab (one of four) on strategic foresight and analysis tools (BMAS & BMBF, 2021a).

Vision and strategy

The QuBE project draws on existing large-scale data sets for its medium- and long-term projections and will continue to be undertaken this way.

The vision for NWS is to bring together ongoing pieces of innovative research to feed into national skills intelligence providing more detailed data on skills supply and demand over a two-to-three-year development period with funding being provided by the Federal government during this time. The analysis will have a focus on three levels providing high level to company-specific data: macro level (e.g., skilled labour monitoring), meso (e.g., online job vacancies analysis) and micro level (e.g., strategic workforce planning at company level) (BMAS & BMBF, 2021b). Moving forward, the report recommended 'continued, more intensive use of innovative methods (artificial intelligence, data mining and big data) in the development of analytical tools (BMAS & BMBF, 2021a, p. 55). A key

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[58] See https://www.iab-forum.de/en/glossar/federal-employment-agency/

element of the vision is to work towards a one-stop shop website and the provision of target group specific information for various stakeholders.

Examples of such innovative projects are two pilots using online job vacancies data to analyse changes in competence requirements within occupations over time as there is a recognition that in addition to qualifications and occupations competence requirements play an important role in labour recruitment. As part of the initiative vocational education 4.0 (Berufsbildung 4.0), led by BMAS and BMBF, one project tested indicators for a new monitoring and forecasting system, using job vacancy data to extract competence requirements in two selected occupations[59] to assess how this can be used to analyse the impact of the digitisation of work (Köhne-Finster, 2020). The second pilot, the feasibility study competence compass (*Machbarkeitsstudie Komptenz Kompass*), aims to capture soft and hard skills from online job vacancies posted on the Federal Employment website, focusing on three diverse examples.[60] This method it is argued will enable the government to better monitor skills demand and help inform labour market policies more rapidly (Stops et al., 2021).[61] Both pilot projects have achieved good results and point to the need for further methodological development.

Resources

Funding

QuBE: The base model of the QuBE project is financed through IAB's and BiBB's core funding with government funding the scenario planning and other special reports it commissions. The IAB funds the demand side of the QuBe projections (equivalent to around 1.5 full-time equivalent (FTE)) and BIBB the supply side projections (equivalent to around 1.5 FTE), with IAB and BIBB sharing the costs for the services provided by GWS mbh. In addition to the basic model the QuBe project has a digitised world of work projection based on QuBe's economy 4.0 scenario[62] with an update being funded by BMBF as part of its project polarisation 4.0 (BMAS, 2020).

Special thematic reports may be conducted on behalf of a federal ministry, e.g., a study exploring the impact of the hydrogen economy on the labour market and education (see Stegg et al., 2022).

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[59] Industry merchant/industrial clerk (Industriekaufmann) and mechanic for plastic and latex technology (Verfahrensmechaniker für Kunststoff und Kautschuktechnologie)

[60] Mechanical engineering, information services, and human health and social work activities.

[61] Concurrently, a project involving the German Federal Statistics Agency, investigates the use of online vacancies for real time labour market information using data from five portals provided by Cedefop, including data from the Federal Employment Agency. It does however have a narrower scope than the NWS funded studies (De Lazzer & Rengers, 2021).

[62] For more details on the methodology see BMAS (2019).

The federal state funded the development phase of the NWS for 2-3 years, including the data collection/procurement, data analysis and the linking of data, with details about funding past this period yet to emerge.

Data

QuBe: The forecasting model exclusively uses existing large-scale data sets, including e.g. data from the annual micro census (*Mikrozensus*), a 1% representative survey of the population and households or the IAB establishment panel (IAB Betriebspanel), a representative annual survey of 15,5000 employers for the supply model. Time is being spent to harmonise the dataset so that data are consistent, considered to be a unique selling point as it facilitates the projections.

The supply model factors in data about the occupational flexibility of employees (berufliche Flexibilitätsmatrix)[63] as not everybody who has trained for a certain occupation will continue to work in this occupation over the course of their working lives. This has been made possible by coding the text data from the micro-census, provided by the German Statistical Agency on request, into the classification of occupations. This is considered to be a unique selling point as such data may have to be modelled in the absence of data. The supply model also differentiates between the number of people supplying labour and the number of desired hours of work, as these data are useful for the interpretation of mismatches, e.g., if there is a shortage in number of people, the situation may be less acute if people working part-time want to increase their working hours than if that would not be the case. Adjusted search duration (*adjustierte Suchdauer*) based on data from the IAB panel on the average time it has taken to recruit to vacancies has been used as a new indicator to identify skilled labour shortages.

Demand and supply data are being linked using Germany's classification of occupations (*Klassifikation der Berufe 2010[64]*). It contains 1-to-5-digit codes, with 5-digit codes also providing information about the skill level (low-skilled, skilled, specialist or expert).

The basic model projecting evidence-based trends and behavioural patterns into the future, is being produced every two years. QuBe includes indicators for identifying occupations with potential mismatches (focus occupations) (BMAS, 2021)

NWS: Demand and supply data will be linked via the EU's European Skills, Competences, Qualifications and Occupations (ESCO) classification which has been developed to support job mobility across Europe. Following the launch in 2017 an updated version was published in 2021, with both versions being accessible electronically. ESCO consists of around 3,000 occupations, 13,890 skills which are linked

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[63] Data are available at https://www.bibb.de/de/12229.php as an excel file.
[64] It superseded two separate classifications used by the BA and the German Statistics Agency and was revised in 2020. For details see Bundesagentur für Arbeit (2021).

to these occupations and eight qualification levels reflecting the National Qualifications Frameworks, allowing for a granular analysis of the data.

Methods and expertise

QuBE's long-term forecasts are led by three partners. The partnership between IAB and BiBB and two leading research institutes. This partnership was based on the recognition that each could bring specific strengths to the activity, and this has led to a clear division of labour. The IAB has responsibility for demand side data, BIBB for supply side data and GWS for bringing the data together in an econometric model. At the time when labour market forecasts were first provided a university chair had already developed a macroeconomic input/output model that could be used for forecasting supply and demand, but it needed to factor in the labour market expertise of the IAB in a newly developed model referred to as the IAB/INFORGE (inter-industry forecasting Germany) model (Zirka & Schnur, 2009). These modelling services have since been offered as part of the newly launched Institute of Economic Structures Research (GWS), a private, independent economic research, business and policy consultancy organisation.

QuBe uses existing large scale data sets collected by various organisations, including the German Statistical Agency and the IAB. Data are matched using Germany's occupational classification ([Klassifikation der Berufe 2010](#)).

NWS: A range of projects are being undertaken as part of the innovation laboratory, also exploring taxonomies, including competences.

Accessibility

QuBE: Detailed forecasting data are published on the [QuBE data portal](#) separately for qualification levels and occupational groups, with data available for labour demand and supply, headcount and hours worked, years, regions and type of scenario, with full details provided in Table 6. In addition, detailed projections for 34 local labour market regions, based on travel to work areas and degree of self-sufficiency, were first being presented in the form of a report (BMAS, 2020). Based on the digitised working world scenario, the report allowed for a breakdown by 37 2-digit occupational groups and 37 industry sectors, yet also had some limitations as set out by the authors (BMAS, 2020).

Table 6 Data provided for long-term projections until 2040 by qualification levels and occupations via the QuBe portal, Germany

	Qualification levels	Occupations
Categorisation	4 levels[65]	37 two-digit occupational main groups (regions) and 3-digit occupational groups (Germany) (based on the national classification of occupations)
Demand, supply	Labour demand Labour supply Labour supply without persons in school or training	
Persons, hours	Persons (desired) work volume	Persons (desired) work volume Adjusted search duration[66]
Years	Individual years for 2015 to 2040 5-year intervals	
Regions	Germany 16 states States constituting former West Germany and states constituting former East Germany	
Scenario	Basis projection Digitised working world scenario	

Source: Adapted from The QuBE data portal, BiBB – Germany

Stakeholders

Cooperation and engagement

QuBe: This study involves three long-standing partners with a clear division of labour, based on their respective expertise: IAB, BiBB and GWS. They use data from publicly

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[65] Qualification levels: (1) unskilled/semiskilled tasks or no completed vocational training, (2) Skilled tasks or completed vocational training, (3) Specialist tasks or advanced vocational training / bachelor's degree, (4) Highly complex tasks or master's degree; (5) Other training, (6) Overall (qualifications or requirement levels).

[66] The adjusted search duration provides information about the skilled labour situation in the occupation by showing the effort required by a company to successfully fill a vacancy in days. The longer the average adjusted search duration in an occupation, the more difficult it is to fill a position. See https://www.bibb.de/en/qube_datenportal.php#

available large-scale datasets to create a harmonised dataset for the projections and work together to disseminate the projections.

NWS: As noted earlier, the NWS has deliberately adopted a partnership approach involving federal government, state government representatives, the Federal Employment Agency, trade unions and employer associations as they all share CET responsibilities. At federal government level this involves collaboration across three ministries: the Federal Ministry of Labour and Social Affairs (BMAS), the Federal Ministry of Education and Research (BMBF), and the [Federal Ministry for Economic Affairs and Climate Action](link) (Bundesministerium für Wirtschaft und Klmiaschutz, BMWK). At state level this involves the three Standing Conferences of Ministers (Fachministerkonferenzen) with responsibilities for CET: the Standing Conference or Ministers of Education and Cultural Affairs (Kultusministerkonferenz, KMK); the Standing Conference of the Ministers of Economic Affairs (Wirtschaftsministerkonferenz, WKK); and the Standing Conference of the Ministers of Labour and Social Affairs (Arbeits- und Sozialministerkonferenz, ASK).

The innovation labs work with additional contributors, such as leading research centres or other ministries. More specifically, they involve all of the above as partners (except BMWi), led by BMAS, with the Institute for Employment Research (IAB), the Federal Institute for Vocational Education and Training (BiBB), and the Federal Ministry for Economic Affairs and Energy being involved on a permanent basis and others being involved selectively: the Federal Ministry of Health, the Organisation of Economic and Development (OECD) and the Science Centre Berlin (Wissenschaftszentrum Berlin, WZB).

Feedback and validation

QuBe: Internal validation of data occurs within the team. Scenario bases assumptions are discussed with an interdisciplinary expert team. The project uses data from existing large scale data sets. Scenario projections have been commissioned by BMAS to explore the impact of the digitisation of work and policy changes. Steering group meetings involving a range of stakeholders are held on a regular basis with comments made being reflected upon and taken into consideration, where feasible.

NWS: Stakeholder feedback has been provided during the development process as part of the innovation lab discussions. The aim of the NWS is to provide valid and evidence-based data.

Dissemination

QuBE: Data are aimed at governments (national and regional level) and also of interest to social partners who may use the data to support their work. There has been some interest from states enquiring about a more detailed analysis and potential courses of

action. State level data are indeed provided at the QuBe website yet at a more aggregated level than for Germany (e.g., 2-digit level for occupations instead of 3-digit level for occupations), potentially with scope to provide more detailed analysis for larger states. A short state level report is also available from the website (see Hummel et al., 2021).

Based on the wave 6 QuBe basic projection, reports for 36 occupational groups (2-digit level) have been published for the first time on the [QuBe website](#), providing among others information on competence profiles, regional distribution and occupational flexibility. These have not been widely disseminated to career guidance professionals, in part because the longer-term projections are considered less relevant for their practice. To date there was not perceived to be much interest generally among careers guidance professionals employed at the BA. There was also a view that it may be useful to provide some commentary to help with the interpretation of data published on the QuBe website.

Data are disseminated via the project website with data being interpreted by the data user. The research organisation(s) may receive queries from organisations asking for support in the interpretation of data. While figures provide information it is also important for stakeholders to consider implications for suitable courses for actions, it was argued by one of the interviewees. While occupational have been produced they have not been widely disseminated careers guidance professionals.

NWS: Specific information and useability of information by target groups is being considered in the NWS, including what data are needed by particular target groups requires and how to present information for further education providers can work with (BMAS & BMBF, 2021b). Projects being developed further as part of the NWS are mindful of the particular target groups for whom the data will be relevant, and it was reported that exemplary formats or products targeting specific groups had been developed (BMAS & BMBF, 2021b).

Bearing in mind that the project is still in the development phase, three levels of target groups are currently being envisaged: (a) researchers meeting website registration criteria to enable quality assurance of data, (b) stakeholders with responsibilities for vocational education, including career counsellors, and (c) the European Union (EU) in the sense of enabling the EU to incorporate the data available on Germany's platform into its data intelligence. Furthermore, there is the vision that individuals can access tailored continuing education and training provision through intelligent algorithms (Bundesministerium für Bildung und Forschung, 2022).

A key aim is to present target-group specific information in a way that is easy to understand by potentially involving communication specialists in the process. While projections provide useful data about likely developments, based on scenario assumptions or projecting trends into the future, the key question remains as to what strategies may best be employed to help alleviate any mismatches between skills

demand and supply. This may in part depend on required entry qualifications and occupational mobility as one interviewee explained. Where entry qualifications are regulated, require long periods of training, and where occupational mobility is low, e.g., people continue to work in the occupation they originally trained in, international recruitment may need to be considered part of the solution (e.g., in the health care industry). In other scenarios, where people at some stage in their career may be more likely to move on to other occupations (e.g., in research), measures to help them retain them in this area for longer may be part of a strategy.

Assessment of German LMIS

The skills demand and supply projections are key data in the LMIS and part of the federal governments' skilled labour strategy. These data are also used to inform the NWS. More recently, a scenario exploring the impact of the digitisation has been added providing indication of a worst-case scenario. Separately commissioned projects are exploring the impact of decarbonisation strategies on the labour market to assess whether sufficient skilled labour is available to implement the policies.

In terms of stability of the German LMIS, there is stability in terms of collaboration, with IAB, BiBB and GWS having jointly produced both the medium- and longer-term projections throughout the years. The QuBe long-term projections on skills supply and demand are well-established., they have first been published in 2010 and are being updated every two years, with the most recent round, the sixth wave, providing data until 2040. Since 2018, more detailed medium term skilled labour projections (up to five years) have been produced alongside the longer-term projections covering up to 20 years, alongside a scenario exploring the impact of the digitisation of work on skills supply and demand has been added. In the 6th wave, adjusted search duration has been added to assess the skilled labour situation (BiBB, 2020).

New territory is currently being explored as part of the NWS with its focus on continuing education through the innovation lab forecasting.

A2.6 Scotland

Summary

The Scottish LMIS is well-established and stable with a range of agencies and institutions collecting, collating and disseminating data and intelligence to key partners and stakeholders. These agencies have defined roles and responsibilities in the LMIS with minimal duplication. The system is underpinned by a developed digital infrastructure enabling data to be presented and accessed. Across the Scottish LMIS, a range of actors and stakeholders are translating LMI into intelligence for their own purposes. A key actor

in terms of LMI dissemination is Skills Development Scotland (SDS). SDS produces a range of intelligence on learners, the workforce, sectors and economy by Scottish region, city deal, growth deal and local authority areas. Scotland has adopted a multi-methods approach where a combination of quantitative and qualitative methods are used to consider current, emerging and future skill requirements. Whilst most data are quantitative, qualitative data are playing an important role in contextualising and validating data.

A key strength of the Scottish LMIS is arguably the established collaborative partnerships that support the collection and dissemination of data, but that also play a role in validating and contextualising data. This process ensures that the resultant intelligence is useful in, for example, local education and labour market development and planning. However, this is needed in order to address the main challenge with the Scottish LMIS which is the lack of granular and timely data. This is particularly important in an economically diverse country with rural areas and distinct local economies. A range of data and intelligence on the Scottish labour market and economy are available and accessible in different formats to support the needs of different users. This is seen to be part of an effective part of the system as users are able to access the data themselves with little support.

Organisation

Scotland is a devolved nation in the United Kingdom (UK). The UK Government is responsible for the constitution, foreign policy, defence and immigration. The Scottish Government (Riaghaltas na h-Alba) has devolved responsibility for the economy, education, health, justice, rural affairs, housing, environment, equal opportunities, consumer advocacy and advice, transport and taxation. The law-making body is the Scottish Parliament, which comprises elected members. Policies, actions and legislation are set out in the annual Programme for Government (Scottish Government, 2021a) following the National Performance Framework. The National Strategy for Economic Transformation details the priorities for the economy, actions and opportunities for the next 10 years, including 'stimulating entrepreneurship; opening new markets; increasing productivity; developing the skills we need for the decade ahead; and ensuring fairer and more equal economic opportunities' (Scottish Government, 2022a).

The Scottish Government is structured into eight directors and over 30 directorates. Of relevance to the Scottish LMIS is the:

- Director General Economy responsible for the Economic Development Directorate, and the Fair Work, Employability and Skills Directorate; and the

- Director-General Education and Justice responsible for the Advanced Learning and Science Directorate and the Learning Directorate.

The Directorates have a range of responsibilities in terms of delivering policies on the education and training sector, and the labour market.

- The *Economic Development Directorate* contributes to the delivery of sustainable and inclusive economic growth through progressing the Government's economic strategy. This involves: supporting key sectors in the country (namely manufacturing, construction, space, financial services, life sciences and digital economy): increasing productivity, competitiveness, sustainable employment, and workforce engagement and development; developing the regional economies through the City Region deals and Regional Growth deals.

- The *Fair Work, Employability and Skills Directorate* develops policies that maximise employment opportunities and produce a skills workforce. The aim is to 'improve productivity, reduce inequality and ensure that work improves people's lives'.

- The *Advanced Learning and Science Directorate* supports the delivery of further and higher education in Scotland. It has responsibility for: developing the young workforce and tackling youth unemployment; maintaining access to higher education; and creating an education workforce to help sustainable economic growth.

- The *Learning Directorate* aims 'to improve the lives of children and young people in Scotland through education'. It has responsibility for developing the teaching workforce and leadership in schools and communities.

As in the UK, there is little statutory governance in the Scottish LMIS. The Scottish LMIS is governed by the Scottish Government, with responsibility shared between the ministers and the directorates, working alongside a number of key public and non-departmental public bodies. The Post-16 Education (Scotland) Act 2013 governs what data should be shared with Skills Development Scotland (SDS). Data includes that on young people's involvement in education and training in order to monitor progress.

A Concordat is in place which sets out an agreed framework for co-operation between the UK Government (including the UK Statistics Authority and the Office for National Statistics (ONS)) and devolved administrations (England, Scotland, Wales and Northern Ireland). The framework outlines how the devolved administrations cooperate in the production of statistics and share statistical standards.

Management and control

There are a number of public bodies, non-departmental public bodies and agencies that are key players in Scotland's LMIS that manage the collection, collation and dissemination of LMI.

The main data provider is Statistics Scotland, which is managed by the Scottish Government. It provides access to a range of official statistics (over 250 datasets) about Scotland from a variety of data producers (including the Scottish Government, National Records of Scotland, NHS Information Services Division and Transport Scotland). It provides public access to official statistics enabling users to explore, visualise and download data by theme, organisation, or geography. An API is also available to enable access to the data. It is the main source of LMI data in Scotland. The Scottish LMIS

includes data from the Office for National Statistics (ONS), which is the UK's independent producer of official statistics.

Skills Development Scotland (SDS) is the Scottish national skills body. It works across Scotland supporting employers, and further and higher education institutions with skills advice and workforce development funding. It is the main provider of an all-age career guidance service in Scotland. SDS works with education and training providers and employers to help industry needs to be met particularly at a regional level. The LMI and intelligence collated by SDS informs planning and investment in future skills provision (see Figure 18).

Figure 18 Skills Development Scotland skills planning model
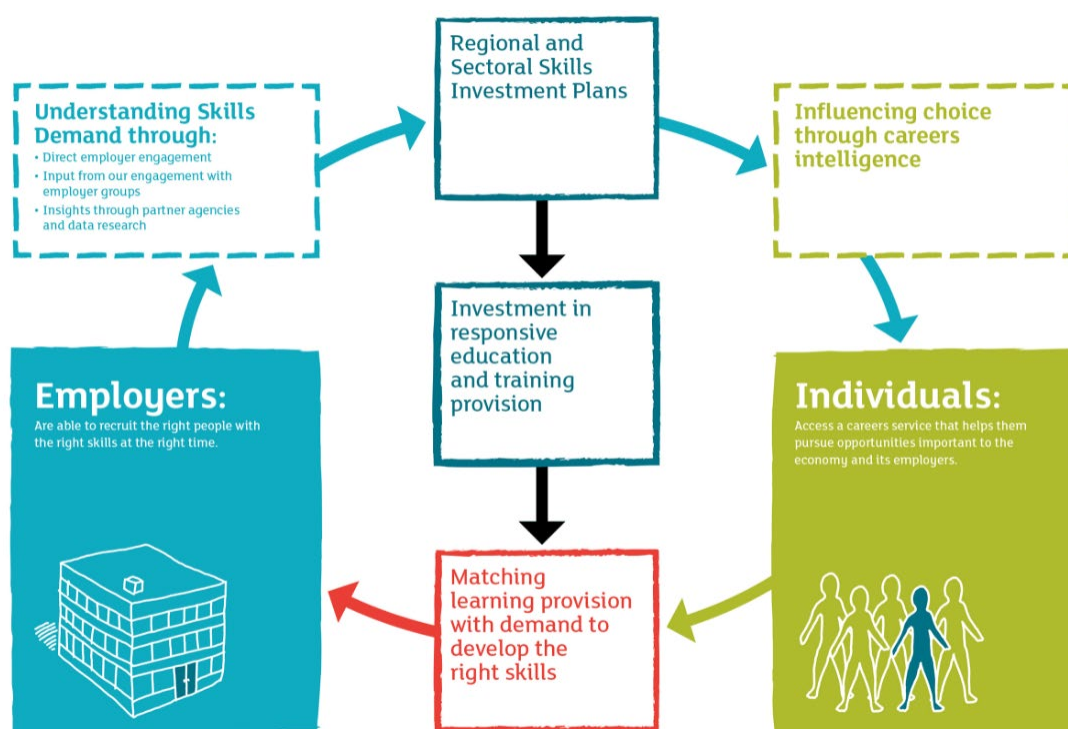
Source: Skills Development Scotland – Scotland

Scotland's enterprise and skills agencies (non-departmental public bodies), namely Scottish Enterprise, Highlands and Islands Enterprise (HIE) and South of Scotland Enterprise, work together to support productivity growth and equality, wellbeing and sustainability (Scottish Government, 2018). Scottish Enterprise is the national economic development agency for Scotland supporting the Scottish Government Economic strategy by working with businesses to secure inward investment, grow overseas markets and build growth in emergent sectors. South of Scotland Enterprise is the economic and community development agency for Dumfries and Galloway and Scottish Borders. HIE is the economic and community development agency for the north and west of Scotland. All variously produce LMI and intelligence for their area as well as undertake research with local businesses. Data are presented for demographics, employment and employment rates, and labour market economic and productivity data.

At a local level, the Scottish Local Authorities Economic Development (SLAED) Group represents 32 councils in Scotland who work together to support local economic development and share learning to improve delivery of local services, such as business support, and skills and employment. They collate and publish local level LMI and intelligence to support local authorities in Scotland.

The Scottish Funding Council (SFC) and Scottish Qualifications Authority (SQA) deliver the education priorities of the Government and responsible for collating and publishing data for the education sector. The SFC funds further education colleges and universities in Scotland and regularly produces national statistics covering the sector. The data supports colleges and universities to measure and improve performance. These also use data produced by Universities and Colleges Admissions Service (UCAS, an independent charity that manages the higher education admissions service) and Higher Education Statistics Agency (HESA, a statistical agency that collects and publishes data on the UK higher education sector). HESA has a statutory function to share data with the Scottish Government amongst others.

Vision and strategy

Scotland's *National Strategy for Economic Transformation* sets out its long-term priorities and further investment for the economy to deliver the Government's vision of 'a wellbeing economy' (Scottish Government, 2022a). It sets out plans to: stimulate entrepreneurship; open new markets; increase productivity; develop skills for the future; and ensure fairer and more equal economic opportunities. This was founded upon the Government's strategy, *A Fairer, Greener Scotland* (Scottish Government, 2021a). Its fourth long-term priority was on 'an economy that works for all of Scotland's people and places'. LMI and intelligence are seen to have an important role in understanding and monitoring performance against priorities and evidencing outcomes. Action set out in the national strategy is to make better use of data and cloud-based services by Government, the public sector, and businesses, plus use data to ensure effective targeting of skills support (Scottish Government, 2022a, pp. 35-41). Data and intelligence are part of strengthening accountability and transparency.

Scotland's Labour Market Strategy provides a framework for Scotland's approach to labour market growth and prosperity and is seen to be part of the Scottish economic strategy (Scottish Government, 2016, 2022a). The enterprise and skills agencies (Skills Development Scotland, Scottish Enterprise, Highlands and Islands Enterprise, and the South of Scotland Enterprise) work together guided by the Scottish Government's vision to deliver economic growth (Scottish Government, 2022a). The Scottish LMIS feeds in data and intelligence from a range of sources including the Scottish Government, ONS, Statistics Scotland, Skills Development Scotland and the country's economic development agencies. Performance is tracked and monitored in the National Performance Framework.

The Scottish Government's [National Performance Framework](#) tracks progress towards National Outcomes (including the economy, education, fair work and business), which are measured by 81 national indicators. Data are produced and assessed by the Scottish Government, regularly updated and made available online (see Figure 19).

Figure 19 Scotland's National Performance Framework – Economy
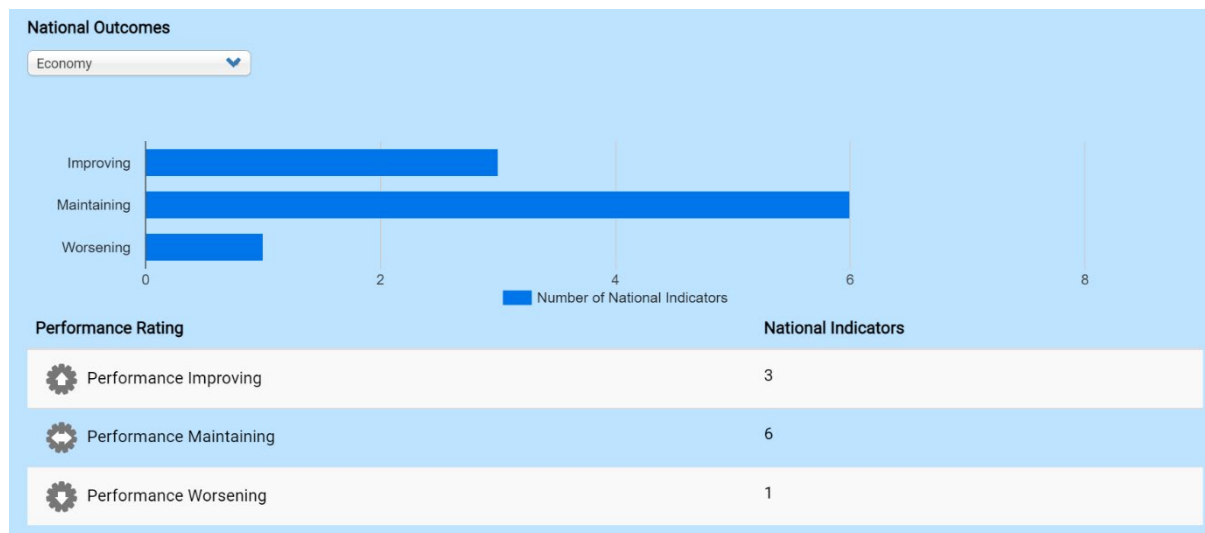
Scotland reports 'a strong, dynamic and productive economy which creates wealth and employment across Scotland'. It is the Government's vision to create an inclusive economy where access to the labour market and jobs, economic growth and opportunities are shared. The Scottish Government aims to improve its ranking of OECD countries in terms of the economic indicators; it has been ranked 16th out of 38 countries since 2008.

Resources

Funding

The Scottish Government is funded by a block grant from the UK Government and taxes raised in Scotland. In 2020/21, there was an allocated budget if £49.3 billion of which £12.2 billion went to 'communities and local government', £6.3 billion to 'finance, economy and fair work' and £3.6 billion to 'education and skills' (Scottish Government, 2022b). SDS received approximately £224 million, research, analysis and other services £71 million, and the enterprise agencies approximately £86 million. It is not possible to disaggregate spending dedicated to developing and maintaining the Scottish LMIS, forecasting and skills anticipation programmes.

At a regional and local level, agencies and local authorities manage their own budgets. Each have programmes of activities around the collation, analyses and dissemination of LMI and intelligence.

Data

The Scottish LMIS is well established, and a range of data are collected, collated and disseminated to a range of actors and stakeholders.

The Scottish Government produces official statistics about public life. These data are used to support policy development and implementation as well as used to measure the success of government policies and services. Various public and non-departmental bodies also collate and share data and intelligence. Data are collected on the population, workforce, economy, education attainment, labour market, businesses, and investments. Data are variously disaggregated to local level for different groups of the population. The Scottish Government publishes national level data on their analytic work as well as detail on the economy and society (see Statistics and research pages on the Scottish Government website). These include official statistics and experimental statistics (e.g., Scottish VAT assignment, No One Left Behind). Data are available as part of the Open Government Licence and published on the Statistics Scotland website.

Internally, the research and statistics teams in Scottish Government produces LMI and intelligence to support policy planning and assess progress against economic and wellbeing indicators. Regional analysis is often undertaken based on City Region Deals (of which there are 6) and Regional Growth Deals (of which there are 6). Official data from the Scottish LMIS is variously used with ONS and OECD data. Whilst sub-national data are increasingly becoming available, the granularity and currency of data are often an issue.

Major population surveys are also undertaken by the Scottish Government to inform policy and evidenced based decision making. UK surveys undertaken by the ONS include a Scottish dimension, which add to the evidence base and provide comparative data with the other devolved nations. The Annual Population Survey (APS) undertaken by the ONS is the main source of data on local labour markets in Scotland. The APS provides headline estimates on employment, unemployment and economic inactivity (see for example Annual population survey: results for year to 31 December 2019).

Other data collected by the Scottish Government includes: the Scottish Household Survey incorporating the Scottish House Condition Survey, and the Scottish Surveys Core Questions (SSCQ) are undertaken annually by the Scottish Government. The Scottish Household Survey covers demographics, housing, and economic activity of households, plus a number of other topics to provide evidence on private households and individuals (see for example Scotland's People Annual Report, 2019). Other Scottish surveys undertaken regularly include: the Scottish Health Survey; the Scottish Crime and Justice Survey; and the Scottish Health and Care Experience Survey. Growing up in

Scotland (GUS) is a longitudinal study that has been running since 2005. It tracks around 14,000 children and their families from birth onwards to support the Scottish Government and others develop policies and services to support them. Analyses are undertaken on a regular basis and reports available on particular cohorts (see for example Scottish Government, 2022c).

Statistics Scotland is the main provider of data in the Scottish LMIS. There are nearly 300 linked datasets available from Statistics Scotland which can be accessed in different formats and by using an API. Some datasets relevant to the LMIS are for the: economy (GDP and labour productivity); business demography (births, deaths, survival, ownership); education, skills and training (pupil attendance, school leavers destinations, qualification of working age adults); and population (birth, death, healthy life expectancy, census). Data are variable by country, council area and industry. Some examples of the key national statistics and analysis regularly produced includes:

- Scottish Annual Business Survey – annual survey collects financial and employment data by broad industry (Production (including manufacturing), construction and service sectors) by year (2008-2019) and council area.

- Scottish Annual Business Statistics (SABS) – an annual report which includes data on employees, turnover, gross value added, labour costs and other financial data disaggregated by industry, sector and local authority area (see for example Scottish Annual Business Statistics 2019);

- Business Enterprise Research and Development – an annual report on business R&D expenditure and employment disaggregated by industry, source of funding and ownership (see for example Business enterprise research and development: 2020);

- Graduate Outcomes (LEO) (data provided by UK Department for Education) – annual data on graduate earnings outcomes for UK domiciled graduate for higher education institutions in Scotland by subject and provider (see for example Graduate Outcomes (LEO) – subject by provider: 2018-2019);

- Attainment and initial leaver destinations – annual data and reporting on educational attainment and initial destinations of school leavers from publicly funded schools in Scotland (see for example Summary Statistics for Attainment and Initial Leaver Destinations, No. 4: 2022);

- Labour market trends – annual reporting on key labour market indicators from Scotland's labour force survey, including: employment, unemployment and economic inactivity, claimant count and earnings (see for example Labour Market Trends: June 2022);

- Population statistics – an overview of Scotland's population, including statistics on births, deaths, life expectancy, migration, marriage and civil partnership, adoption, households and housing (mid-year population estimates by council area and NHS

Board areas by age and sex are also available)(see for example [Scotland's Labour Market: People, Places and Regions - Statistics from the Annual Population Survey 2020/21](#), Scottish Government 2021b).

Statistics Scotland and the UK ONS are also developing experimental datasets with the aim of providing more current data on the labour market, which is needed to monitor the impact of the pandemic and the end of the EU transition period. The Business Insights and Conditions Survey (BICS) is a voluntary fortnightly business survey. Business across the UK provide data on turnover, workforce, prices, trade and business resilience have been affected by current conditions. Scotland estimates are weighted and published fortnightly (for an example on the data published see the [BICS weighted Scotland estimates: data to wave 58](#), published on 24 June 2022). Experimental statistics are also published on Scotland's Gross Domestic Product (GDP) estimates. It is a monthly measure of output of the economy in Scotland (see for example [GDP Monthly Estimate: March 2022](#)). It estimates GDP volume growth from output, income, and expenditure approaches.

The Scottish LMIS is also supported by [National Records of Scotland](#) (NRS) which provides data and research on the Scottish population by [households](#), [life expectancy](#), [population](#), [migration](#), [vital events](#) (births, deaths and marriages) and [electoral statistics](#). Users are able to access these data by council area and area profiles which include data visualisations and downloadable data tables (see for example [Aberdeen City Council Area Profile](#)). The NRS is responsible for Scotland's Census which is the official count of individual and households in the country. It also analyses detailed UK Migration Statistics to provide data on migration in Scotland by sex, age, and local area (such as Middle Layer Super Output Area (MSOA) Boundaries/Intermediate Zone, Ward and local authority level). The NRS also undertakes the [Scottish Longitudinal Study](#) (SLS) which is a large-scale study linking data from administrative and statistical sources. This contains linked census, vital events, education and NHS data for a 5% sample of the population resident in Scotland.

In terms of education data for the LMIS, the [Scottish Funding Council](#) (SFC) collates and publishes regular statistics on: the college sector (full and part-time provision, subject area, links to industry and demographics); college staffing (headcount and FTE for teaching and non-teaching staff, plus demographics); performance indicators; student eligibility for funding; higher education students and qualifiers at Scottish institutions (student characteristics, access, demographics and cross-border flows); college leaver destinations; and student satisfaction and engagement. Some examples of annual reports produced by the SFC, include:

- College Leaver Destinations (see for example [College Leaver Destinations 2019-20](#), SFC 2021a) – data are available for Scottish Credit and Qualification Framework (SCQF) level, subject, and destination. This is part of Scotland's

developed young person tracking system, which feeds into education, training and skills planning.

- Higher education student and qualifiers at Scottish institutions (see for example [HE Students and Qualifiers at Scottish Institutions 2019-20](), SFC 2021b) – data are available for student demographics, level of study, mode of study, Scottish institution. It reports on higher education provision and attainment in higher education institutions and colleges in Scotland.

In the Scottish LMIS, a range of data are collated and produced at the regional and local level. [Scottish Enterprise]() – the national economic development agency for Scotland is supporting the Scottish Government Economic strategy by working with businesses to secure inward investment, grow overseas market and build growth in emergent sectors. It produces monthly updates on economic trends and performance for Scotland, the UK and globally. Data and indicators are drawn from the Scottish Government, ONS, and the Royal Bank of Scotland. The updates include data on the economic performance of the market, business, workforce (staff shortages and recruitment challenges), workplaces, real estate, finances, energy, sectors, plus forecasts for the Scottish economy. Monthly reports are available to [download]() by topic.

At the local level, the SLAED Indicators Framework is published in report format annually and include LMI for the 32 local authorities in Scotland (see for example Young, 2022). The report is a series of local level performance measures relating to the economy, businesses and business activity, workforce, population demographics and earnings. Data are collected from local councils and partners. The aim is to provide a consistent evidence base on local contributions to the Scottish economy.

Methods and expertise

The Scottish LMIS draws upon a range of data science methods and techniques, including traditional methods of data collection through surveys (business and individual) and labour economics to produce LMI and skills intelligence. Forecast data are provided by Oxford economics and presented in a number of SDS products. Scotland has adopted a multi-methods approach where a combination of quantitative and qualitative methods are used to consider current, emerging and future skill requirements. Whilst most data are quantitative, qualitative data are playing an important role in contextualising and validating data.

The role of technology has been critical to developing the digital infrastructure to support the delivery of data and intelligence, and services. An underlying data infrastructure is yet to be developed to take advantage of new data infrastructures which would enable greater linking of data. However, a range of digital tools and platforms are being effectively used in the LMIS to present and enable access to data (such as the interactive portals and mobile apps).

Accessibility

Information and intelligence are widely accessible via various websites across Scotland. There is no data infrastructure that combines the range of datasets on Scotland's population, education, economy and labour market. However, the various insitutions and agencies have, for the most part, clear roles in terms of the data they collect and disseminate.

Electronic publications are widely accessible from the range of actors and stakheolders involved in the Scottish LMIS. The open government licence ensures that official data can be accessed freely and in different formats. An API is available from Statistics Scotland to encourage the reuse of data. Datasets and data tables can be downloaded from the Scottish Government, Statistics Scotland, National Records of Scotland, Scottish Funding Council, SDS and Scottish Enterprise websites.

SDS also provides access to LMI and intelligence through its digital services. It works with key stakeholders to enable data and inteligence to be visualised and presented in publications and dashboards that enable the user to customise the presented data.

Stakeholders

Across Scotland, stakeholder participation in the LMIS is evident at a regional and local level. They are also involved in translating information and data into intelligence for other stakeholders and end-users in the LMIS. At the national level, the main actors and stakeholders involved in the Scottish LMIS include:

- Scottish Government and Ministers (including the Economic Development Directorate; the Fair Work, Employability and Skills Directorate; Advanced Learning and Science Directorate; the Learning Directorate);

- Statistics Scotland;

- UK Statistics Authority (in collaboration with the UK ONS);

- National Records of Scotland;

- Skills Development Scotland;

- Enterprise agencies (Scottish Enterprise, Highlands and Islands Enterprise (HIE) and South of Scotland Enterprise);

- Local authorities (including SLAED);

- Scottish Funding Council (SFC) and Scottish Qualifications Authority (in collaboration with the UK's UCAS and HESA);

- Wellbeing Alliance; and

- Regional Economic Partnerships.

These organisations variously work with regional and local authorities, education and training providers, trade unions, employers and sectoral/professional associations.

Collaboration and engagement

Across Scotland, there are a number of stakeholders that use LMI and intelligence provided by the Scottish LMIS, with some also collating and publishing data that feed into the LMIS. There are well established partnerships and collaborations in place to support the functioning of the LMIS, particularly at the local level. Engagement is considered meaningful by those interviewed. Regional economic partnerships operate across Scotland. They work together to provide and share data and intelligence on the local labour market to develop and implement plans for economic growth. Figure 20 illustrates one example of the range of partners that are collaborating at regional and local level to enhance the Scottish LMIS.

Figure 20 Example of Ayrshire Regional Economic Partnership

Source: SDS Ayrshire Regional Skills Investment Plan 2022-2025 – Scotland

SDS collaborates with organisations and employers at a national and local level to ensure their web services have up-to-date information on jobs and provide a detailed picture of the skills in demand and the skills. Supporting the Local Employability Partners across Scotland's 32 local authorities, SDS provides local LMI and intelligence to support the design and delivery of bespoke local employability services, including:

- [16+ Data HUB](#) – a shared dataset of information on young people aged 16-24 years (part of Post-16 Education (Scotland) Act 2013);

- NTP Equality data – annual equality data for apprenticeships and the employability fund;

- [Annual Participation Measure](#) – all participation data for 16–19-year-olds in Scotland (monthly and annually);

- [Regional Skills Assessments](#) (RSAs) – annual regional intelligence using existing datasets and forecasts;

- [RSA Data Matrix](#) – SDS interactive data tool collating information on skills supply, demand and mismatch;

- [Covid-19 Labour Market Insights](#) – monthly evidence on the impact of COVID-19 on Scotland's economy, businesses and population;

- PACE Client Experience Survey – a biennial report on the experiences of those receiving redundancy support;

- [Sector Skills Assessments](#) – annual report on current and future skills demand in key sectors across Scotland focusing on the economy, employment, vacancies, job openings, and current and future demand.

Also at the local level, SLAED represents an established collaboration between Scottish local authorities. They work together to provide regular and consistent intelligence on their area, share learning and support planning for their local areas.

SDS partners with [Digital World](#) and the [Centre for Work-based Learning](#) who provide input into the Scottish LMIS. Digital World, developed by SDS and the Digital Economy Skills Group, focuses on data and intelligence on industries and jobs associated with digital careers. Skills and qualifications information is provided to those interested in digital careers, teachers and industry. The Centre for Work-based Learning works with SDS to promote work-based learning in Scotland with the aim of bridging the gap between education and industry with a focus on skills development to reduce skills shortage. Its work aligns with the [Scottish Apprenticeship Advisory Board](#). Skills intelligence supports this work.

Within the education sector, the [Scottish Qualifications Authority](#) (SQA) and the [Scottish Credit and Qualifications Framework](#) (SCQF) collaborate and share educational data they collect as part of the Scottish LMIS. The SQA uses data to guide the development of their products and services in skills, training and education. The SCQF is the national accreditation and awarding body for Scotland, so uses the data to support the development of qualifications (see the SCQF [Interactive Framework](#) for more information on the Scottish qualification system).

One key stakeholder in the Scottish LMIS are those providing careers education and guidance services. Services are delivered by a number of providers, including SDS,

further and higher education institutions, the Department for Work and Pensions (DWP), local authorities, trade unions, and charities. Formal partnerships are in place to support the work supplemented by some informal arrangements (Scottish Government, 2020). The Integrated Employment and Skills (IES) Partnership between SDS and the DWP ensures that individuals are referred to the appropriate organisation depending on their needs. Those involved in the provision of careers and related services include the Scottish Government, Education Scotland, SCQF, Scotland Quality Assurance Agency (QAA) and DWP. SDS works with these organisations and with colleges and higher education institutions across Scottish to deliver careers information and services, including skills workshops and seminars, transition skills development.

Feedback and validation

Overall, the Scottish LMIS is considered to have strong feedback and validation mechanisms through collaborations and forums. Key actors in the LMIS place great emphasis on local knowledge and expertise considering it important to be able to capture that knowledge to inform LMI and policy development. It is seen as strengthening the evidence base.

SDS outputs (reports and online products) are informed and validated by partners and stakeholders, including, for example, joint steering groups, Scottish Apprenticeship Advisory Board, employers, industry groups, plus regional and sectoral partners. Regional and local forum involving all key stakeholders provide local knowledge and expertise to not only validate quantitative data but contextualise so relevant to regional and local contexts. This is considered key to supporting Scotland's diverse local economies. Outputs are used by internal SDS teams and key partners and stakeholders (e.g., Scottish Government, SFC, local authorities and regional and sectoral partners) to inform strategic skills investment planning, careers information advice and guidance, growth and inward investment and work-based learning initiatives.

Statistics Scotland and the Scottish Government are producing experimental statistics and datasets to enhance the Scottish LMIS with more up-to-date data. Whilst these are available, they are in the process of being assessed in terms of suitability and quality by users and stakeholders. If methodologies and processes are validated and considered useful, they will become embedded within the LMIS.

Integration and stakeholder need

As the national skills agency in Scotland, SDS report working with stakeholders to ensure needs are met, particularly in terms of LMI and intelligence. One example is their recent review of the Scotland's career services to ensure they are fit for purpose and future proofed to meet the demands of a changing world of work. The review made 10 recommendations designed to deliver the ambition of Scotland's Careers Strategy (Scottish Government, 2020). These recommendations are based on evidence and were co-designed with over young people in Scotland. The infrastructure of digital and

information services in Scotland provides access to and dissemination of LMI and intelligence from the Scottish LMIS.

The careers review is also informing policy in terms of a national model of services that utilises available data around the labour market and skills gaps. It aims to ensure that all organisations with a role in facilitating education-employer partnerships and experiences have access to and can make use of LMI and intelligence. The aim is to help to identify and engage with employers in growth sectors and those with labour shortages locally and nationally. Whilst it was evident across Scotland that intelligence and data are shared, the review noted that shared intelligence and data, and peer learning will support trend analysis and the identification of needs to better target support and services.

Dissemination

Whilst the Scottish Government and various agencies and institutions involved in collecting and collating LMI within the Scottish LMIS disseminate data and intelligence through a range of reports, SDS is arguably a key player in translating LMI into intelligence for the range of stakeholders in the LMIS as well as end-users in the LMIS. This is demonstrated by the range of products and digital services dissemination and making using of the LMI and intelligence.

SDS provide a range of LMI and intelligence to inform skills planning and investment in Scotland. These data are underpinned by an evidence base validated by other stakeholders in the Scottish LMIS ensuring it is robust. Feedback from these stakeholders is used to develop and improve products and outputs to meeting changing stakeholder needs. The Covid-19 monthly insights in one example of how SDS responded to stakeholder needs for more current and timely data on the changing labour market during the pandemic to inform policy (see for example Covid-19 Labour Market Insight, June 2022). Figure 21 represents the range of LMI products used to disseminate LMI and intelligence by SDS.

Figure 21 SDS labour market insight suite
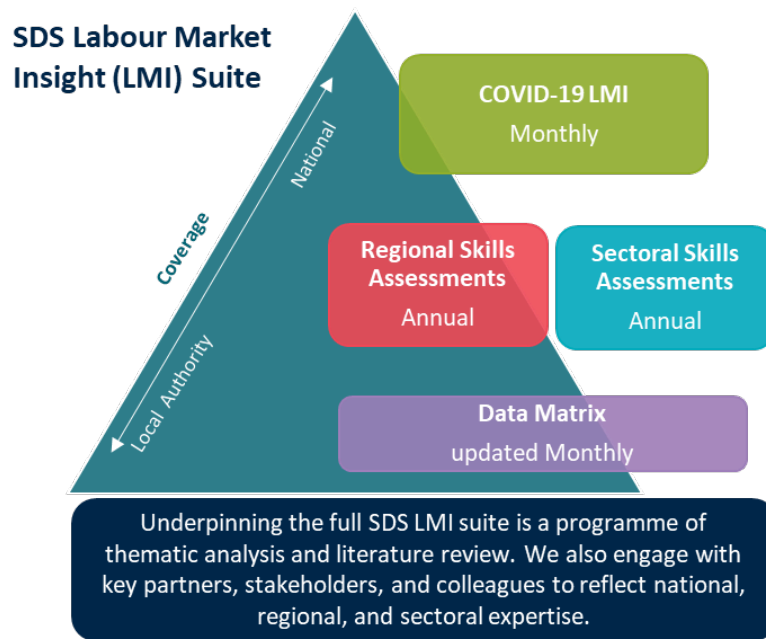
These SDS LMI and intelligence products include data on: job postings; forecasts (future demand to 2031); linked administrative data; qualitative insights; and research from think tanks/ economic commentators. The illustration in Figure 22 was provided by SDS as an example of some of the evidence underpinning their products.

Figure 22 Illustration of evidence underpinning SDS LMI and intelligence
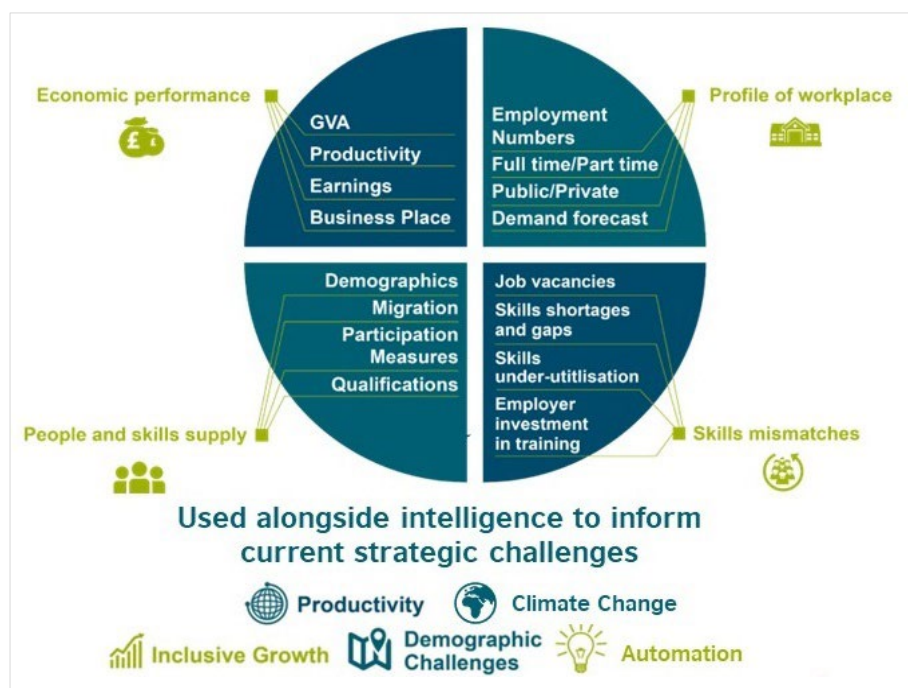
A key dissemination tool is the SDS Regional Skills Assessment (RSA) Data Matrix. It is an interactive tool enabling users to customise by area, theme (skills supply, skills demand and skills mismatch), and topic (such as employment data by industry and occupation, businesses, economic output, etc.). It includes over 80 indicators from sources such as the Annual Population Survey, the Employer Skills Survey and Oxford Economics Forecast Data. These data and indicators are made accessible and visualised through the matrix (see for example Figure 23).

Figure 23 Skills Demand – total requirement by industry for Fife and Scotland

Source: Regional Skills Assessments, SDS – Scotland

Users of the RSA Data Matrix can access help using the Guidance Document, Video tutorial, or Glossary. SDS also offer ad hoc, bespoke training on the RSA data matrix.
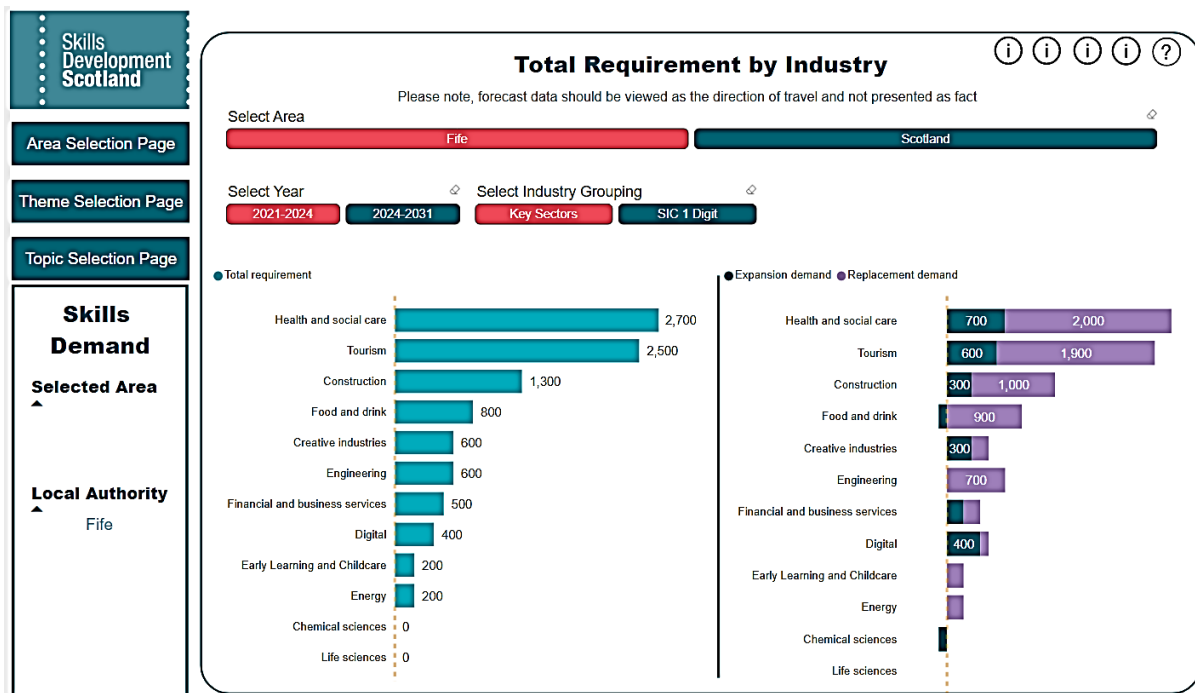
To support the Scottish career system, a review was undertaken to examine services, user perceptions and the performance of the current system (Hooley, Percy & Alexander, 2021). The review identified international best practice and set out a what a future careers ecosystem could look like. It was reported that investment in the infrastructure for effective services had resulted in high quality LMI and digital services in Scotland. For end-users in the Scottish LMIS, there are several platforms where data are embedded within broader tools to support career exploration and learning.

- My World of Work (My WoW) which is the foundation of the SDS careers service and aimed at people at any stage of their career at any age. It provides advice on next steps, personality and skills tools, a personal profile tool to record activities and achievements, and support with option choices. LMI and intelligence on careers, jobs, courses and apprenticeships can be accessed in My WoW to

support decisions. Data are from the SDS Sector Skills Assessments, the UK national Careers Service with forecast data provided by Oxford Economics. MyKids Career sits alongside My WoW and provides advice to parents and careers who are supporting young people in their care with career conversations, understanding options and career pathways. Data are available on jobs in demands.

- [Apprenticeships.Scot](#) provides support and advice for young people who would like to become apprentices and employers who are interesting in recruiting an apprentice. The platform includes apprenticeship vacancies and data on the apprenticeships including entry requirements, duration, and career pathway.

- [Our Skillsforce](#) is aimed at employers to support workforce development and planning. A range of intelligence is provided alongside skills planning advice and support to engage with education.

Assessment of Scottish LMIS

Overall, the Scottish LMIS is well-established and stable with a range of agencies and institutions collecting, collating and disseminating data and intelligence to key partners and stakeholders. There are a number of strengths in the Scottish LMIS. First, established actors in the LMIS have clearly roles and responsibilities in terms of data collection and dissemination, but data sharing is standard. This system enables a range of data and indicators on the population, learners, workforce, labour market, and economy to be collated at national, regional and local level (to an extent) and made available. The longitudinal study of the Scottish population provides a unique dataset using linked administrative data in which to support the development of services. A further strength is the established digital infrastructure and open data policy which provides a foundation in which data and intelligence are present and made accessible. Finally, collaboration and cooperation between the range of partners provides mechanisms for stakeholders to feed in data and analyses, but to also validate and contextualise data. The Scottish LMIS provides a good example of how a multi-methods approach can support a country with diverse and rural local economies.

A2.7 Sweden

Summary

The strengths of the LMIS in Sweden is that it benefits from a long history of skills assessment and forecasting, and access to registered data are quite unique. The overall infrastructure is strong, and the public sector is efficient and well trusted. The amount of data collected is extensive and to a large extent representative. In Sweden, compliance in handing over obligatory data is high, with most surveys receiving good response rates

and updates are frequent. The labour market is highly organised through collective agreements. Sweden is forward looking in its approach and strategies, especially in their efforts to create a digital infrastructure and reform their education system, which creates many opportunities in the future, such as developing new types of analyses and forecasts.

Sweden has also adopted various approaches and different methods in collecting data, such as registered data, surveys and other means of data collection. By combining different methods and exercises it is more likely to be able to produce realistic forecasts and predictions. Although none of the publications provide a holistic analysis of skills anticipation, they complement each other well. Combined, they provide a comprehensive estimate of the current and future demand and supply of skills. The population in Sweden generally has good digital skills which Sweden benefits from in their digitalisation of society in general. Generally speaking, individuals are therefore more capable of using LMIS is finding their place within the labour force, as well as public officials within institutions. Also, LMIS is used to assist people transition from one job to another prior to becoming unemployed.

Sweden is currently changing their approaches in collecting LMIS towards a more data driven model, which can risk information getting lost as there is less human interaction involved, which might impact the analytical process.

Although there is a lot of national and regional collaboration and Sweden has created its regional platforms, there is a general notion that the regions need further support in strengthening their analytical and statistical capabilities and make better use of LMIS, in order to assess and anticipate local skills needs. Coordination between local and national actors could be improved, as well as collaboration between various different public bodies. In addition, there seems to be a consensus that sectoral analysis should be strengthened.

Organisation

Legal and institutional framework

In Sweden, LMIS is based on a network of institutions, which produce, store, analyse and disseminate information related to the labour market. These institutions do not solely focus on LMIS but have other roles as well. The Swedish labour legislation creates a fixed framework for the labour market. The government has a passive role as a legislator and does not actively take part in negotiations among parties. Among actors in the labour market are employers and employees who negotiate through collective agreements on pay and working conditions among other things.

The [Ministry of Employment](#) (Arbetsmarknadsdepartementet) is responsible for issues and matters concerning the labour market, labour law and the work environment among

other. The Ministry is accountable for various institutions which partake in producing and analysing LMI.

The Ministry has two divisions responsible for labour market affairs, which are led by non-politically appointed officials. The Labour Market Policy Division is responsible for matters concerning employment services, labour market policy programmes, the entry of new immigrants into the labour market, unemployment insurance, activity support, vocational rehabilitation, policy issues regarding people with reduced work capacity, development allowance, introduction benefits, the European Social Fund within the EU's Structural Funds and the European Globalisation Adjustment Fund.

The Swedish ESF Council (Svenska ESF-rådet) administers the programme of the European Social Fund in Sweden. The European Social Fund is the EU's most important tool for promoting employment and better jobs. The Swedish ESF Council is also responsible for the programme of the European Integration Fund.

One of the key institution for the labour market is the Swedish Public Employment Service (PES) (Arbetsförmedlingen), which assists people to find work and gives guidance in regards of support and benefits. It also produces various statistics and analysis, forecasts and reports, including a labour market forecast twice a year alongside Jobtech. The Swedish PES provides jobseekers with guidance mostly through their website. Some of the services are only available to those registered with the service.

The Institute for Evaluation of Labour Market and Education Policy (Intitutet för Arbetsmarknads- och Utbildningspolitisk Utvärdering, IFAU) is a research institute which evaluates the effects of labour market policies, studies of the functioning of the labour market and evaluations of the labour market effects of measures within the educational system. The Division for Labour Law and Work Environment is responsible for issues and matters concerning labour law, work environment and working hours, wage formation, labour immigration, the state wage guarantee in the event of bankruptcy, and developments in the employment field, along various other responsibilities and institutions.

Statistics Sweden (Statistikmyndigheten, SCB) operates under the Ministry of Finance (Finansdepartementet) and is responsible for official statistics and supplying users and customers with statistics for decision making, debate and research. They develop, produce and disseminate statistics as well as coordinate the official statistics system in Sweden. Statistics Sweden has a number of councils, boards and working groups. One working group is focused on labour market issues, an expert group for labour market issues (EFAM), which oversees the produced statistics on the labour market reflect it in a good way.

At the regional level, there is a coordinated approach to anticipating skill needs. The Swedish Agency for Economic and Regional Growth (Tillväxtverket) is responsible for supporting regional platforms related to skills, which are based on regional partnerships

that include industry, public sector, and education providers, normally chaired by regional governments. The platforms match regional vocational education provision to skills demand.

The main features of the vocational education and training are that it is decentralised, and education providers are fully responsible for their programmes. High number of immigrants participate in these programmes. Overall, lifelong learning programmes have a high participation rate, although the general goal is for more people take part in vocational education and training.

The educational and vocational guidance system is linked to the national education and employment systems and is overseen by the Ministry of Education and Research and Ministry of Employment (Cedefop, 2020d). The guidance system is grounded in coordination and collaboration among various bodies and organisations and mainly provided by public actors. Offering guidance services to schools, higher education institutions and PES is regulated by law. In general, guidance is part of the broader education and employment initiatives.

The Swedish National Agency for Education (Skolverket) is the administrative authority for the public school system that functions independently but must operate according to the guidelines from the Ministry of Education and Research. The local municipalities are responsible for providing guidance services throughout the educational system in accordance with set national goals and general guidelines on career education and guidance provided by the Swedish National Agency for Education.

The Swedish Schools Inspectorate (Skolinspektionen) conduct regular supervision of all municipal and independent schools. It is their role to monitor and advise schools on the basis of regulations, which includes career guidance and counselling services.

Higher education institutions have independent decision-making authority within the framework of the regulations and parameters laid down by the government. The Swedish Council for Higher Education (Universitets- och högskolerådet) promotes interest and widening participation and internationalisation, as well as manages admission to higher education. Career guidance counsellors are therefore a target group for this institution. The Swedish Higher Education Authority (Universitetskanslersämbetet) reviews the quality of higher education and monitors its efficiency.

Currently, lifelong learning guidance is provided through various public websites. PES has conducted a study on creating a digital platform for career guidance services operated jointly with several national agencies. Within PES, Jobtech is working on building a common digital infrastructure for the labour market with a focus on skills matching and lifelong learning. Jobtech also works with organisations which do proactive work assisting people transit from one job to another to avoid unemployment.

The [National Institute of Economic Research](#) (Konjunkturinstitutets, NIER) is a government agency under the Ministry of Finance. Its aim is to create a good basis for financial decisions, primarily for the government but also for other institutions and private companies. LMI is used by the NIER to inform decision making. NIER also conducts socio-economic analyses and forecasts which feed into economic policies.

The Swedish government will propose a change in legislation in the summer of 2022 which would take effect in the year 2025. It is proposed that the National Agency of Education provides information to education providers on which education programmes are most demanded by the labour market. This is in response to concerns that educational institutions have a tendency to offer the most popular programmes rather than those needed by the labour market, caused by a fierce competition between public and private schools. This tendency amplifies the mismatch between skill supply and demand, which can be seen in forecasts on VET and upper secondary level. Forecasts suggest a huge shortage in some industries. If the new legislation passes the authorities will have an informative role on which programmes should be offered, but as education providers are independent the real impact is unknown.

Management and control

The LMIS is governed by various public bodies, including several ministries, with key stakeholders from both the public and private sector. It is based on a network of different parties and actors, with different roles and responsibilities.

Sweden is fairly unique in international comparison in having a high degree of organisation in the labour market. There is a high rate of workers belonging to a trade union and employers are also organised. Most of the Swedish labour market is therefore bound by collective agreements. Collective agreements do not only entail agreements on wages but also social security.

The Swedish Agency for Economic and Regional Growth has proposed national guidelines for the regional skills development work. The guidelines include guidance on how and what knowledge base is needed for regional skill supply. In accordance with this aim, the regions have established platforms based on regional conditions. Each platform has a different purpose, focus, function, resources and organisational residence based on regional needs. The variation has complicated the dialogue and the relationship at the national level, causing difficulties in clarifying the role and function of the platforms.

There are regulations at a regional level which include implementing assignments and reporting the results of regional development work by regional development officers. In a joint development project, the regions have developed a set of matching indicators for regional skill needs. Indicators have been developed in two main areas; indicators that describe conditions for matching; and indicators that describe actual matching. According to the national guidelines for the regional skills development work proposed by the Swedish Agency for Economic and Regional Growth, the indicators will be monitored regularly.

Vision and strategy

The Swedish government's vision is a sustainable digitalised Sweden (Regeringskansliet, 2017). The government's role is to create good conditions for digitalisation, where priority is given to combating unemployment, strengthening knowledge results in schools and reducing climate emissions. The vision and aims are that everyone has confidence in the digital society and that digitalisation simplifies everyday life. By having a clear vision and strong leadership, the opportunities entailed in digitalisation can contribute to restructuring the labour market and creating new jobs. Sweden will build on its strengths which are a well-developed infrastructure, generally good technical knowledge and capacity among the population and an efficient and trusted public sector.

Digitalisation has the potential to increase the quality of life through access to community services as well as to media and culture. For that to realise Sweden needs a modern social construction which includes automation, artificial intelligence and Internet of Things. Sweden will create good market conditions and new opportunities in a new digital economy by promoting development and innovation. An important part of the digitalisation will be further technological developments, testing, validation, dissemination and scaling up. The public sector provides necessary services which can be improved and simplified with new technologies which will benefit both citizens and companies. Digitalisation is seen not an end in itself, but rather, using the opportunities that come with digitalisation in a way that benefits society as a whole.

Sweden aims to become a leader in a new digital market economy and has put digitisation policy in place which includes a strategy to achieve its goals. The overall strategy is divided into five subgoals. The government also has a set of goals around efficient, secure and robust electronic communications and world-class broadband which is reflected in its broadband strategy. Furthermore, the digitisation of public administration with emphasis on innovation and collaboration which is legally secure, efficient, of high quality and accessible and contributes to Sweden's development within the EU. The European Commission's strategy for a digital single market is also one of the government's EU priorities. The five strategic subgoals are:

- Digital competence – everyone should be able to develop and use their digital skills;

- Digital security – creating the best conditions for everyone to take part in, take responsibility for and have confidence in the digital society in a safe way;

- Digital innovation – creating the best conditions for digitally driven innovations to be developed, disseminated and used;

- Digital wire – relevant, purposeful and legally secure efficiency and quality development must take place through digitalisation;

- Digital infrastructure – the whole country should have access to infrastructure that allows fast broadband, stable mobile services and which supports digitalisation.

In response to these goals and the drive to digital competence, the education system is being reformed. The government plans to present a national digitisation strategy for the school system to benefit both students and teachers. The strategy will contribute to strengthening the conditions for an education that supports digital skills development. The government will also work towards the content of higher education corresponding to students' and labour market's needs for digital competence. Digitalisation is believed to enable a more diversified range of education as well as the opportunity to reach geographical locations where there are no colleges or universities. The focus will be on quality and validation rather than how the knowledge is acquired.

In an increasingly digitalised economy, the labour market demands new skills of workers in a large number of industries and sectors, and it is important that the needs of businesses and the public sector are met. Artificial intelligence can, for example, lead to higher productivity in the health care sector, but at the same time requires professional and competence development. Mobility and flexibility in the labour market, along with security, and encouraging lifelong learning are a part of the government's vision and a collaboration with all key stakeholders.

The government has also a labour market policy[67] which aims are to ensure that all those who are able to work should have the possibility to take part in working life. Furthermore, it aims to create security and possibilities for transition in the labour market. This policy area includes measures to get young people into work, matching of jobseekers and job vacancies, labour market policy programmes, unemployment insurance and the European Social Fund.

Resources

Funding

There is no specific budget dedicated exclusively to skills anticipation programmes or exercises in Sweden. SCB, PES and NIER are all fully funded by the Swedish Government. The Ministry of Finance allocates each institution a yearly operating budget.

At a regional level, the Swedish Agency for Economic and Regional Growth has allocated funds to regional projects to strengthen the provision of data analysis and to develop a knowledge base on skill needs. The agency also oversees the development and implementation of regional skills platforms, which in 2013-2017 was worth 60 million SEK. All regions have had one or more projects to develop regional skills platforms and

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[67] For the Swedish policy, see: https://www.government.se/government-policy/labour-market/.

will continue their development work. The regions finance the work and prioritise depending on the region's challenges in terms of skills supply.

Data

The Swedish LMIS are of high quality and built largely on registered statistics from various authorities and employers, and partly on interviews and surveys (Wadensjö, 2022). The pervasive data collection at a national level is complimented with qualitative data used to consider current, emerging and future skill requirements. There are also regional agencies and platforms which collect, analyse and disseminate data.

LMI is used for various purposes, such as trend indicators of vacancies and working hours, research on developments in the labour market (seasonal changes and future projections), as well as for the national budget, such as analysis of productivity, distribution of income and wealth (Wadensjö, 2022). The design of the national statistics is, however, in some ways restricted by the EU, as Sweden must produce data comparable with other EU countries, so the same methodologies need to be adopted.

LMI consists mostly of data on the supply and demand of labour, skills assessment, anticipation and matching, remuneration of work, work hours and form of employments. There is also information on entry to and exit from the labour market and labour market organisations, such as trade unions and employer's organisations. Furthermore, by connecting LMIS registered data on demographics it is possible to gain a more detailed picture of the labour market particularly in smaller areas.

Data collection is constantly developing, and Swedish authorities are trying to react to new demands and changes in society. There are a growing number of self-employed people and Sweden aims to collect more data on their circumstances, especially to gain knowledge on their rights for support and pensions. Also, there are always efforts in collecting data on unregistered work, such as domestic work or paid work in the black market. Prior to the pandemic, Sweden had started collecting data on the location of where people work from and will continue to collect information on this.

LMIS combined with other statistics provide an important basis for assessing economic developments at different levels of government. The LMIS provides data on work hours, number of employed people, wages and more, which are used for both short-term economic analysis and a more in-depth structural analysis. These analyses often entail labour costs, productivity, production activities and capital. One challenge is the currency and disaggregation (by sector and geography) of data from the LMIS and how that can be used for GDP indicators and several details and breakdowns on industries and sectors.

There is some development work around a skills and competence taxonomy with Jobtech currently leading this work experimenting with big data techniques and data linking. The structure is called SYK and is connected to ESCO which is used to classify occupations,

skills, competencies and qualifications in a detailed way. There is ongoing work in improving classifications and correcting misclassifications.

Methods and expertise

Skills mismatch and shortages are widespread in Sweden. In 2016 about 34% of workers were employed in a field which was not related to their studies and 39% was mismatched by qualifications. Another 11% was mismatched by skills, that is, being either more or less proficient than required. At the same time around 33% of firms were unable to find suitable workers. In addition, Sweden has faced number of challenges in adopting the skills of migrants to its knowledge-intensive labour market. In an effort to address these challenges Sweden have been developing skills assessment and anticipation exercises.

LMI is mostly disseminated via ministry and agency websites. The PES provide an [Occupational Compass](#) (Yrkeskompassen) (see Figure 24). The website has an interactive interface to be used by anyone interested in advanced labour market data, including jobseekers, in order to match demand and supply of skills. The compass delivers both short-term (1 year) and long-term (5-10 years) skills anticipation for around 200 occupations (80% of the labour market), supported by advisory councils at sector level, alongside a council of vocational experts. These assessments are based on PES forecasting work which is undertaken at a local level. It contains a short summary of the forecast and a map showing regional differences, as well as an overall competition in a profession. The results are then weighted for a regional and national assessment. The compass is explicitly designed to address skills mismatch.

Figure 24 Screenshot from Occupational Barometer, Sweden

Environmental and health protection inspectors

The forecast is an overall assessment of: environmental and health protection inspectors

The profession is included in the professional field science

Environmental and Health Protection Inspectors Summary

There are about 4,000 professional environmental and health protection inspectors in Sweden, of which about 71 percent are women and 29 percent are men.

The Swedish Public Employment Service estimates that there will be very little competition for jobs as environmental and health protection inspectors in the coming year. This means that people who have the necessary education or experience will have very great opportunities for work.

Even in the 5-year term, the Swedish Public Employment Service estimates that the opportunities for work as environmental and health protection inspectors will be very large.

Forecast for environmental and health protection inspectors in 2022
Very large opportunities for work in 2022.

Forecast for environmental and health protection inspectors in 2026
Very large opportunities for work in 2026.

- The number of environmental and health inspectors expected to retire in the next five years is projected to increase

- The number of people who could start working in the profession in the next five years is expected to increase

- The number of environmental and health inspectors in demand over the next five years is expected to increase

Source: Hitta yrkesprognoser – Sweden

The new occupational forecasts undertaken by PES are more data driven. The method of conducting these forecasts is currently being reviewed and updated. The goal is to send digital surveys to every employer that publishes a job vacancy on the PES website and ask them if the post was filled, how many candidates applied for the job, how many had the required skills and if the employer had to lower the requirements to fill the post. The information will be used in order to evaluate the skill demand and address the data gaps in the registered data and published as reports.

PES has developed competency profiles linked to level of education (such as high school or university) which includes type of education and age, and use that in their analysis, for example when looking at individual occupations and the distribution of competence profiles within that occupation. This approach shows what type of education and competence people have within occupations and indicate if competence is more important than education in each instance. This adds to the understanding on what mix of skills and competences are in demand as the impact automation and digitalisation have on the labour market.

The downside to moving towards a more data driven model is less personal feedback from employers and other actors. The Swedish authorities are aware of that and will take that under consideration in future developments.

The regions analyse the needs of different industries' skills needs to create a consensus among stakeholders about short and longer-term needs. Some regions have the capacity to develop and interpret the material while others use subsets of data from the national level. The aim is either to develop new or better methods for augmenting knowledge on skills needs or improving the use of existing data.

Following is a list of various methods used to produce, analyse and disseminate LMIS information.

- Skills assessment
  - [Labour Market Tendency Surveys](#) published by the SCB in annual reports contain short-term skills assessment for selected qualification groups based on questionnaires sent to a sample of Swedish firms.
  - [Where are the Jobs?](#) (Var finnes jobben?) has traditionally been published bi-annually by the PES, which collects regional and national data and augments its short-term assessment with informal data collected by caseworkers through an ongoing dialogue with various stakeholders. In addition, several sectoral councils contribute to the reports, providing information on selected 200 occupational categories. The short-term outlook for each category is reported in the form of a shortage index. The report also includes an analysis of possible shortages and excesses of skills in the labour market for the next five to ten years. Before the results are published, they are reviewed by the SCB forecasting department.
  - Labour Market Outlooks are published bi-annually and examine both national and global labour market trends, developments and forecasts. It analyses different industries and provides an economic outlook for the coming two years. These reports also include estimates of skills shortages and surpluses, although they are not disaggregated to the same extent as in Where are the Jobs?
  - Assessment exercises are also undertaken at a regional level in collaboration with the Swedish Agency for Economic and Regional Growth. Skills forecasts

- o SCB publishes [Trends and Forecasts](#) every three years, which are based on a methodology of cohort analysis and econometric estimations. The future supply of skills is projected using demographic and educational forecasts as well as knowledge of imminent changes in the education system. This model applies both sectoral and occupational forecasts to an econometric model of economic growth. Paired together, skills supply and demand projections provide detailed labour market forecasts for the next 20-25 years. Data are available by occupation, education level and sector. These forecasts are projected on a national level, but the SCB has provided forecasts on a regional level upon request.
  - o The [Swedish Confederation of Professional Associations](#) (Sveriges Akademiker, SACO) and [Confederation of Swedish Enterprises](#) (Svenskt Näringsliv) both undertake and publish regular forecasts and reports on sector specific sectors or occupations.
- Skills foresight
  - o There are no regular foresights activities undertaken in Sweden. The NIER does, however, occasionally publish working papers and research related to skills anticipation and assessment.
- Other skills anticipation activities
  - o The NIER conducts a monthly survey among businesses to develop regular assessments of the Swedish economy, known as the Business Tendency Survey, which feeds into a larger [Economic Tendency Survey](#). In addition, the NIER publishes a more extensive and detailed survey quarterly. The firms involved are questioned on employment strategies, possible labour shortages and more. The purpose of these surveys is to provide policy makers and stakeholders with qualitative indicators of outcomes and expectations, which quantitative data does often not provide.
  - o [Labour market outlets (PES)](#) (published twice a year).

It was note that assessing skills mismatch can be challenging when directly comparing an individual's educational level with that of their occupation. It can result in misleading conclusions as many occupations in practice allow or require a different educational level than stated. Another reason is that many occupations, such as analyst or private instructor, cannot be reduced to one single field of education.

As a result, the SCB has developed a Matching map (Matchningskartan), which consists of around 17,500 combinations of 123 educational and 143 occupational groups, with detailed codes for the level of match for each combination (SCB, 2018). The codes show the match in regard to level of education, field of education and future labour market demand. It enables detailed statistics of skills match in the population. For example, it shows the number of educated working within their subject field, the share of over- and undereducated employees, as well as comparisons between regions and different social groups.

The objective with the Matching map is to provide policy makers, employers, labour market analysts etc. with better statistics on skills match, in relation to a wide range of policy areas. The Matching map provides a detailed and complex analyses of skills match and mismatch in the labour market. As response rates to surveys containing self-assessed skills, the Matching map provides an important complement to existing data.

The Swedish National Agency for Education does occupational and regional forecasts for teachers, which indicate which subjects and forms of education the country needs (Skolverket, 2021).[68] The data and labour market forecasts have shown a large shortage of certified teachers. These data led to new policy to increase the number of certified teachers. Since 2012, the Teachers' Lift 2 programme has been in place aimed at increasing the number of certified teachers in primary and secondary education in subjects they already teach. The programme is funded by the government via the Swedish National Agency for Education, which collaborates with universities providing the courses. Since the beginning of 2012, this project has led to more certified teachers and the agency concluded that the instrument is an important education initiative for teachers who need to attain their credentials and should be a permanent instrument. This is one example of how LMI has influenced policy and programme development.

Accessibility

Information are widely accessible via various websites and publications by several institutions already noted, in particular SCB and PES. For some, PES services users need to register on the PES website. In addition, Jobtech makes PES data and data on vacancies accessible using open source software. Their main focus is building a data infrastructure on skill supply and lifelong learning collaborating closely with educational institutions and agencies. Jobtech's open source code is mostly used by those organisations and services assisting people transitioning in the labour market. There are a number of ongoing pilot projects to test the function and use of the open source data infrastructure so largely this is a new approach in an effort to create greater access and data transparency.

The PES has undertaken research on what products and information are in demand by LMIS users and what information can be helpful to individuals, local governments and national authorities in their planning. The PES have identified two main groups as their target audiences; the first is guidance which consists mostly of those providing career guidance services to the unemployed; second is policy which have an interest in skills shortages and demands. The PES are a key stakeholder in the LMIS identifying shortages and providing educational planners with occupational forecasts to assist in course planning. In addition, the PES provides information to the immigration office in Sweden by tracking the number of immigrants applying for working visas and the

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[68] These forecasts can also be explored online on the Skolverket website.

occupations they enter, which then feeds into their future demand insights for policy. PES has been prolific in targeting different audiences and meeting different users' needs.

Stakeholders

The participation of stakeholders in skills anticipation is extensive. Both SCB and PES maintain a strong relationship with employer's confederation, trade unions, educational institutions and employers. These connections generate additional qualitative information on the labour market, which is used to augment the results of quantitative forecasts. These stakeholder connections have resulted in various collaborations, such as sector councils and panel of experts administered by PES. The main stakeholders include:

- Ministry of Employment;

- Ministry of Finance;

- PES;

- Employer organisations;

- Training providers;

- Trade unions.

There are 21 regions in Sweden which each have regional development actors responsible for the implementation of reginal growth policy. This could be a county council, a joint body or a county administrative board. All regions are responsible for developing a regional development strategy based on an analysis of the conditions of each county.

The Swedish government adopted an initiative in 2010 called [Regional skills platforms](). (Regionala kompetensplattformar) (Tillväverket, 2018). It has two stated goals, matching skills with current and future jobs, which involves improving skills supply and increase collaboration between employers, education providers and authorities. How often analysis is made varies between regions.

Skills assessments in Sweden assess how various drivers of change will affect the future skills demand at national and regional levels. Skills forecasting provides a series of occupational projections. Surveys of employers are also used to get information on both their skill demand and skill shortages.

Three government institutions provide skills anticipation programs. The SCB, PES and NIER. The SCB provides medium and long-term forecasts, while PES produces short term projections. The NIER produces infrequent in-depth research on specific topics. The three institutions work together to some extent, but each produce independent projections and analysis, published in various publications. The most notable of these is

the Job Compass application hosted by PES. The results of skills assessments are utilised by various government agencies and public institutions.

Dissemination

The main bodies disseminating information in the Swedish LMIS include:

- Ministry of Education and Research;

- Public authorities within education system;

- The Swedish Agency for Economic and Regional Growth;

- Regional and county governments and authorities;

- Regional skills and matching platforms;

- Social partners; and

- Sectoral councils.

Their main target groups when disseminating information are education institutions, public authorities, general public, sectoral councils and regional skills and matching councils. LMI are used by: national education authorities to inform education policies and development; educational providers, student counsellors and PES guidance counsellors to working with young people and jobseekers; plus, local education providers in selecting educational and training programs.

Presentation

LMI are mostly available online through the various websites of the organisations and agencies that collect and analyse data. Jobtech provides access to various data through APIs. Presentation of LMI in the broader LMIS varies but it is mostly a mix of quantitative and qualitative data published in reports. Data are also shared internally among analysts and institutions.

Customisation

Some tools and websites are available in the LMIS that enables data to be customised. For examples, the Occupational Compass is a forecasting tool which provides an interactive interface where it is possible to navigate and search for more detailed information. It is often referred to in public discussions and used by regional and local bodies. It has been noted to be a much appreciated tool for various groups and employment agencies in their guidance work. The PES has also developed dashboards for their occupational forecasting data used by the guidance group. There is an app where it is possible to access visualised data, such as sad and happy faces, indicating which occupations are in demand, as well as compare demands among different regions.

PES is concerned with sharing unexplained data which can be interpreted in ways which are not constructive to society.

Assessment of Swedish LMIS

Policy makers normally take notice of the forecasts and assessments when formulating long-term plans for the economy, particularly in regard to the education system, especially when determining which kind of educational and training programmes should be offered or to strengthen existing programs. PES also uses this information in creating programmes for the unemployed. Additionally, local authorities and institutions use these forecasts, notably, local education providers and local branches of PES.

The Regional skills platforms, managed by The Swedish Agency for Economic and Regional Growth, are aimed at policy area in growth and innovation. Their purpose is to improve the national coordination and strengthen local and regional cooperation between public institutions and agencies in charge of skills supply. To aim is to set up platforms to facilitate cooperation in both short and long-term educational planning for each region. A broader goal is to counteract any mismatches in the labour market by supporting the development of structures, processes and methods which can contribute to improved skills supply at the regional level.

In regard to education policy, the decentralised provision of school education grants means that schools have greater flexibility, but it has resulted in less incentives to implement strategic choices for the long-term development of skills required at the national level. Also, the lack of incentives and reputation of VET has resulted in fewer students choosing such training. Guidance and counselling needs strengthening and students to be informed of skills imbalances.

Reforms are underway to modernise the way the PES exploits LMIS information for its skills-matching activities. There is also ongoing work to get employers more involved in the LMIS to improve the job matching process.

The Swedish Education Agency is currently working on a new government assignment of combining information on the LMIS with their statistics of students from different education in different parts of the country. The agency is also tracking graduates and combining various information in their analysis. The aim of the project is to provide planning papers to disseminate information to the education providers so they can make better decisions on how to add dimension to their education so it makes a better match to the demand of competences and skills in the labour market. There is an ongoing discussion in Sweden on how to meet future education and skills demand and if they should primarly be aquired by formal education or during a person's working life, as well as how much education policy should be government by LMIS.

The LMIS is stable and reliable. It is based on a long tradition of data collection on a national level and the public sector is both trusted and efficient in its use of data. The government has set both short and long-term goals for Sweden to become a leader in digitalisation, including matters regarding education and the labour market. There appears to be unity in using LMIS in order to tackle issues such as skills mismatch and skills supply and demand.

PES uses its own forecasting model which has been developed for macro forecasts. This model is well established, has adopted different perspectives, and has been used for a number of years. These forecasts are based on data from the Swedish central bank and other public institutions, such as SCB.

There have been recent changes in PES as a result of a government policy change in 2018, so the PES has been transitioning towards its role of a skills matching body. PES underwent cutbacks and local labour market officers which had collected data by surveying companies and conducting interviews on employment plans, the business cycle, future skills needs, recruitment and skills shortages to inform forecasting were heavily reduced. They also performed matching in order to fill vacancies. The transition towards a more data driven model and basing forecasts increasingly on surveys has made the relationship between authorities and employers arguably less personal. The role of the labour market officers was noted to be appreciated among those working within LMIS. The labour market officers were seen to have a key role providing valuable insights into occupational skills needs, creating data and collaborating with economists within institutions on forecasting.

In light of these changes, the PES has been developing a model to make more disaggregated data available on for example occupations and skills. This is a new project labelled under the term labour market insights. The new model is focused on understanding what types of products needs to be developed for the users. Various registered demographic data from SCB is used to compliment PES forecasts and to gain, for example, insights various business practices and expansions in different areas. The research undertaken to build this model is also the basis for a strategy on the future work.

The Swedish LMIS allows a sound and comprehensive assessment of current needs and the anticipation of skills challenges in the future. Both SBC and PES are actively involved in the dissemination of LMIS through reports and websites, and PES collaborates with the National Agency for Education to build bridges with education providers in the dissemination of LMIS. Although in many ways successful, there is room for improvement in developing further regional and sector analysis.

It has been suggested that it is important to strengthen the link between LMIS, in particular PES and SCB, and the municipalities that provide career and counselling advice to students. Swedish municipalities should, it has been argued, to use existing

network organisations such as the regional co-ordinating bodies or county council platforms to co-ordinate local interests. These mechanisms can foster synergies and reduce competition among local actors and can help align educational provision with labour market needs. Overall, the Swedish LMIS is effective in terms of enabling access to data and data sharing. LMIS are complimented with other sources of information for education planning, unemployment support and migration planning.