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SEPTEMBER 2019 | THE MALAYSIA DEVELOPMENT EXPERIENCE SERIES

Monitoring Occupational Shortages

Lessons from Malaysia's Critical Occupations List

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Introduction

Many emerging economies have skills shortages but fail to effectively deploy students and job seekers towards filling those shortages. In emerging economies, new technologies, digitization, automation, and other trends like Industry 4.0 result in a constantly changing demand for sophisticated skills. In this environment, there are often students and job seekers who could potentially fill skills gaps but face significant challenges in identifying job opportunities and the skills needed to obtain them. The schools, training centers, and public service providers that are responsible for preparing the workforce to fill skills gaps often face similar challenges in terms of deploying attention and resources towards filling those gaps.

In Malaysia, the Critical Skills Monitoring Committee (CSC) is charged with producing a Critical Occupations List to serve as a platform for coordinating human capital development policies. The CSC is a specialized interagency body that was established as part of the Eleventh Malaysia Plan to monitor skills imbalances in Malaysia. To do so, the CSC created an annual Critical Occupations List (COL) of occupations that are middle- or high-skilled, sought-after, and strategic. The COL has evolved during the last several years to become a best-practice tool for monitoring skills. The COL is updated regularly and improved continually, is based on rigorous evidence, and is widely circulated. The production of the list is undertaken by the CSC and incorporates a wide range of input from both the public and private sector.

This is a case study of the origins, development, and lessons of the Critical Occupations List. The case study has four parts. Part I describes the problem that the COL aims to solve, namely policymakers' lack of a tool to monitor labor market shortages. Part II discusses the COL's origins, methodology, and use. Part III compiles lessons learned from the COL, and provides key takeaways for policymakers in other countries considering the development of a skills monitoring tool. Part IV concludes.

PART I

The Problem

Malaysia's labor market has evolved significantly in recent decades. An economy that was once driven by agriculture and manufacturing is increasingly shifting to growth based on productivity, innovation, and knowledge creation. The transformation has had significant consequences for the labor market. As Malaysia urbanized and the economy grew, jobs shifted first to the manufacturing sector and then to the services sector, which now accounts for more than half of Malaysia's GDP and around 60 percent of employment.

Malaysia's shift to an economy based on high productivity and knowledge creation has resulted in shortages in the labor market. Labor market or skills shortages arise when the supply of workers with particular skills is insufficient to meet demand (Veneri 1999). Put simply, labor market shortages are jobs that employers want to fill but have difficulty filling. The condition occurs when wages or labor supply do not adjust to demand, or when information problems prevent job searchers and employers from finding each other.

These shortages are not unique to Malaysia but they are particularly acute there, for several reasons. First, Malaysia has a small working-age population compared to regional competitors like China, Indonesia, Thailand, and Vietnam, which limits its labor supply. Second, Malaysia's strong economic growth in recent years has resulted in a generally tight labor market: The unemployment rate has been below 4 percent for the last two decades, further limiting the number of workers available for employers to hire. Finally, labor market shortages can be particularly problematic in emerging economies like Malaysia's, where new technologies, digitization, automation, and other trends like Industry 4.0 result in a constantly changing demand for particular skills. In that environment, the students and jobseekers who could fill skills gaps—and the schools, training centers, and public service providers responsible for preparing them to fill those gaps—face a significant challenge in trying to identify where job opportunities are and what skills are needed to obtain them.

Filling labor market shortages is strategically important for an economy whose growth strategy is based on knowledge production and innovation. Labor market shortages can disrupt economic growth. Such shortages reduce output and productivity in the short run when high-potential firms cannot hire the talent needed to grow. If such shortages persist, there is a risk of long-run losses in competitiveness and businesses' ability to innovate. Identifying labor market shortages as they arise and developing strategies to fill them is therefore important to maintain productivity and competitiveness.

The government of Malaysia created the Critical Occupations List as a tool to identify labor market shortages. Despite investing substantial public resources in human capital development, the government of Malaysia did not have an effective mechanism to monitor labor market shortages. Three problems hindered the government's ability to monitor those shortages effectively. First, the workforce development system was supply-side driven with few channels for information to flow from employers to decision makers, education and training providers, or individuals eager to invest in human capital. Second, formal responsibility for identifying the skills needed to propel the economy was dispersed among a number of government ministries, government agencies, and state-owned enterprises that did not coordinate well with each other. Third, efforts to identify skill needs followed an outdated "manpower planning" approach based on predicting quantities of workers that was not well-suited to keep pace with a dynamic, globally integrated, market-led economy.

PART II

The Solution

In 2014, the government of Malaysia established a Critical Skills Monitoring Committee (CSC) with the mandate to monitor skills imbalances. In its five-year national planning strategy, the Eleventh Malaysia Plan, the government called for the creation of a committee to identify critical skills gaps in strategic sectors to enhance human capital planning. The result was the CSC, which is jointly chaired by Talent Corporation (TalentCorp) and the Institute of Labour Market Information and Analysis (ILMIA), both agencies in the Ministry of Human Resources (MOHR).

The CSC's primary objective is to manage and update the COL to identify labor market shortages. The COL is a platform for the coordination of human capital development policies that is adapted from international best practices in skills monitoring. More practically, the COL is a list of occupations for which there is strong evidence of a labor shortage that may be alleviated through government action. Occupations on the COL are middle- or high-skilled, sought-after, and strategic. The COL seeks to identify and draw stakeholder attention to occupations that are critical to the continued growth and development of the Malaysian economy but that are currently difficult to fill.

What is the Critical Occupations List?

Occupational shortage lists identify and monitor critical skills and needed occupations. Occupational shortage lists are an approach to skills monitoring that is designed to help align workforce development policies with employers' needs. They do this by monitoring the industries, occupations, and skills that are in demand; by monitoring the skills of the current labor force and current students; and by assessing how well the supply of workers meets the demands of employers. The result is a list of occupations, and sometimes the qualifications and skills associated with them, for policymakers who are involved in making decisions about human capital development policy.

Shortage lists are common in the OECD. Sixteen OECD countries employ shortage lists. The application of the lists varies, but policymakers generally use the lists to identify short- and medium-term occupational and skills gaps, frequently seeking to fill those gaps through immigration but also by directing resources to training programs and job seekers. The United Kingdom and Australia are prominent examples of countries that use shortage lists, and experts from both countries advised the CSC regarding the creation of the COL (**Box 1**). In both countries, the methodologies draw on quantitative and qualitative data sources to make determinations about labor market shortages.

The COL is Malaysia's labor market shortage list. The COL is primarily concerned with identifying labor market shortages that are associated with Malaysia's growing knowledge-based economy. To accomplish this, the COL focuses on identifying occupations that are (mid- or high-) skilled, according to the Malaysian Standard Classification of Occupations (MASCO). The COL also determines whether there are mismatches between employers' demand for certain occupations and the supply of skills associated with those occupations. As a result, the COL seeks to identify shortages in occupations that are sought after by employers. Finally, the COL is designed to be a tool to help policymakers make decisions. Thus, after shortages in skilled occupations are identified, an occupation is considered critical only if filling that occupational shortage is consistent with Malaysia's strategic economic development objectives.

BOX 1

Shortage lists in the United Kingdom and Australia

An independent body of economists is responsible for developing the UK's Shortage Occupation List. The UK's Migration Advisory Committee (UK MAC) is an independent body established in 2007 and staffed by economists that provides evidence-based advice on migration to the government. Its work includes advising the government on skills shortages by developing and revising a Shortage Occupation List (SOL). The primary objective of the SOL is to help the government fill labor market shortages with workers from outside the European Economic Area, though the list also informs policymakers' decisions about training and education.

Australia has a research program devoted to identifying labor market shortages, as well as skilled occupation lists that are designed to fill labor market gaps through migration. The Department of Jobs and Small Business, formerly the Department of Employment, has a research program to identify shortages in skilled occupations. The research program informs education, training, employment, and migration policies. The department also produces the Short Term Skilled Occupation List (STSOL) and the Medium and Long Term Strategic Skills List (MLTSSL), which guide decisions about temporary and permanent migration.

Source: Authors

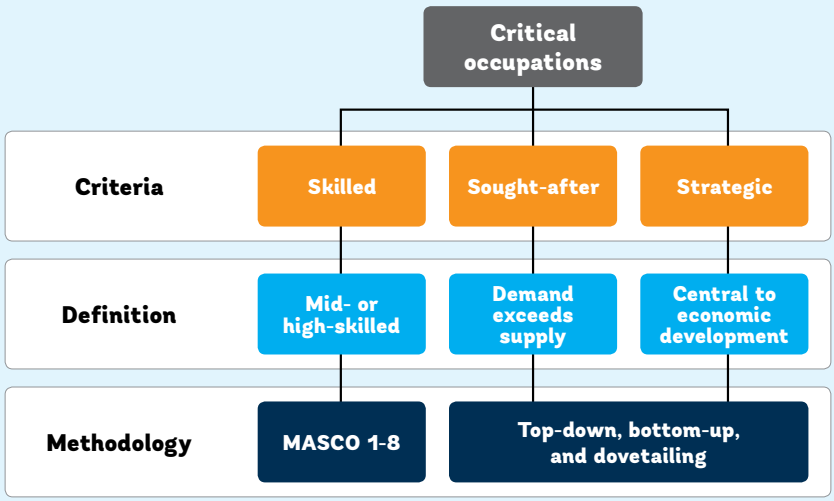
Who creates the Critical Occupations List?

The CSC is an interagency body that creates the COL. The CSC is composed of representatives from TalentCorp and ILMIA, which are both under the Ministry of Human Resources. Each agency brings a unique strength to the CSC. TalentCorp has a mandate to nurture talent in Malaysia through a suite of initiatives for graduates and professionals that build skills, create connections with employers, and seek to make living and working in Malaysia more attractive. Thus, TalentCorp brings to the CSC its partnerships with the private sector and its knowledge of the skills ecosystem in Malaysia. ILMIA analyzes Malaysia's labor market and human capital, and has built a data warehouse of labor market information drawn from a variety of sources. Thus, ILMIA brings to the CSC expertise in labor market analytics and access to and understanding of Malaysia's different sources of labor market information. The CSC has been supported by the World Bank, which provided technical advice and hands-on support during the creation of the COL.

How is the Critical Occupations List created?

The methodology for the COL combines rigorous quantitative methods with stakeholder engagement. The methodology for the COL builds on international best practices and uses a mixed methods approach to define occupations that appear on the list. The criteria for inclusion is three-fold: occupations must be skilled, sought-after, and strategic (**Figure 1**). The process of defining skilled occupations relies on Malaysia's 10-tiered MASCO. The first eight tiers of MASCO, which range from Managers (tier 1) to Plant and Machine Operators (tier 8), are considered to be mid- or high-skilled occupations. The process of defining occupations that employers are in need of (where demand exceeds supply) and that are strategic (central to economic development) requires rigorous analysis of quantitative and qualitative evidence in the "top-down," "bottom-up," and "dovetailing" approaches summarized below (which are described in more detail in **Appendix 2**).

FIGURE 1. Defining critical occupations



Note: MASCO stands for Malaysian Standard Classification of Occupations.
Source: Authors

- **The top-down approach provides the basis for determining whether an occupation is sought-after by identifying shortages.** The top-down approach generates objective evidence of the current labor market that is comparable over time and across occupations. That evidence draws on multiple quantitative data sources such as labor force surveys and administrative data. It relies on multiple indicators of whether an occupation has a shortage and provides initial evidence of whether employers are seeking workers in that occupation. Those indicators can also offer guidance about which occupations are strategic. **Table 1** provides examples of shortage indicators used in the top-down process.

TABLE 1. Sample shortage indicators

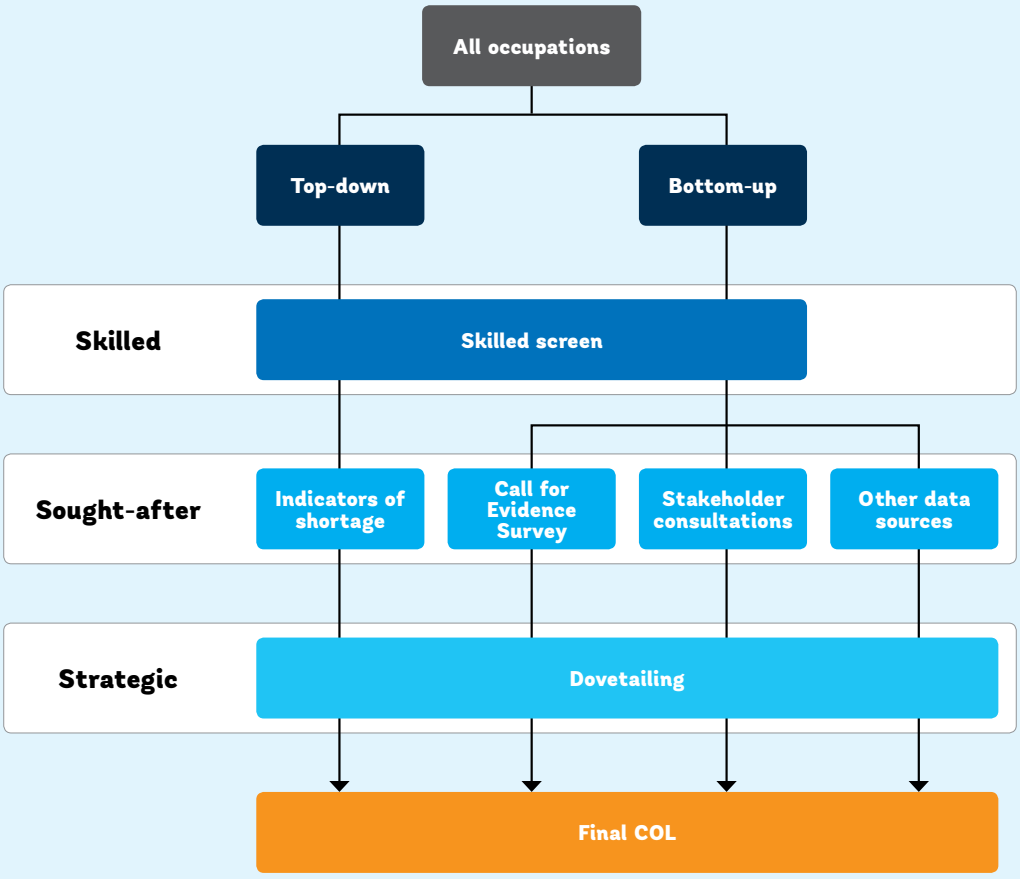
Data source	Indicator	Shortage rationale
Labour Force Survey	3-year employment growth	• An increase in the number of employees in an occupation is a sign of a previous increase in the number of vacancies (or a reduction in firing/quits). Rising employment in an occupation suggests that the relative demand for that occupation is rising.
Survey of Wages and Salaries	3-year median wage growth	• Rising median wages in an occupation relative to other occupations may indicate increased demand for workers in that occupation.
Online job posting data	Vacancy rate	• A large number of vacancies in an occupation is positively associated with rising labor demand.

Source: Authors

- **The bottom-up approach complements the top-down approach to generate additional evidence of sought-after occupations.** The bottom-up approach serves two functions. The first is to build an evidence base directly from stakeholders that, in conjunction with top-down information, allows for a systematic assessment of which occupations merit inclusion on the COL. The second is to build contextual knowledge about occupations and sectors to allow the CSC to continually update its efforts to interpret indicators, communicate decisions, and plan monitoring efforts between COL rounds. The bottom-up approach involves a Call for Evidence (CfE), which is a survey of employers, and consultations with employers and industry associations. The CfE asks a wide range of employers about occupations they believe are in shortage to generate as complete a picture as possible of employers' hiring challenges. Consultations are an opportunity to collect information similar to that gathered by the CfE, but also allow for the collection of additional contextual information that can aid in interpretation of the CfE and of the top-down evidence.

- **A process of "dovetailing" the top-down and bottom-up approaches ensures that the final COL reflects both quantitative evidence and the input of knowledgeable stakeholders.** Dovetailing helps synthesize the evidence from the top-down and bottom-up approaches to develop the final list. When used together, the top-down and bottom-up components combine objective and contextualized indicators of the degree to which a skilled occupation is sought-after. The strategic importance of occupations that meet the skilled and sought-after criteria for inclusion on the COL is also assessed during dovetailing. This assessment is based on a variety of factors, including which industries report shortages in certain occupations, the degree to which employers are actively seeking to fill shortages, the potential impact of shortages on businesses and industries, and the ability to automate particular occupations. The use of both quantitative and qualitative sources of information in creating the COL allows for robust justifications for an occupation's inclusion on the list. **Figure 2** summarizes the process of compiling the COL.

FIGURE 2. The process of compiling the Critical Occupations List



Source: Authors

What is the result of creating the Critical Occupations List?

The COL has been created annually since 2015. The CSC first launched a pilot list for 2015/2016. Lists were also created in 2016/2017, 2017/2018, and 2018/2019. The 2018/2019 COL included 59 occupations, ranging from managing directors and chief executives to mechanical engineers, aircraft pilots, software developers, and heavy truck and lorry drivers. Most of the occupations on the COL are high-skilled occupations at the managerial, professional, and associate professional level but some are mid-skilled occupations. The latest COL represented 12 percent of the 480 non-military 4-digit occupations in MASCO and about 23 percent of total employment in Malaysia in 2017. **Appendix 1** shows the full list of occupations on the COL and the top three skills required for each occupation.

Each iteration of the COL seeks to improve on the previous version. The CSC has learned from the United Kingdom and Australia's experiences with shortage lists as well as its own experience. The methodology for producing the COL has evolved over time. The list has been expanded to include mid- as well as high-skilled occupations. Improvements have been introduced to allow for more holistic consideration of labor market conditions and their potential impact on Malaysian employers. An important improvement that has increased the quality of the COL over time is the growing availability of data sources, in part because of the creation of ILMIA's Labour Market Information Data Warehouse, which has centralized labor market information in a single location. To further enhance the capacity of the COL to be a useful tool for decision making, the most recent COL includes detailed information about each occupation's characteristics and skill requirements.

How are the Critical Occupations List and other shortage lists used?

Governments around the world have implemented shortage lists to improve policymaking for human capital development. Most countries have used shortage lists in two areas. First, countries like Australia and Ireland use them to inform decisions about education and training programs. Because they identify areas where skills are lacking, shortage lists are a useful tool to help guide resources to training programs that can generate those missing skills. Second, countries like New Zealand and the United Kingdom use the lists to inform immigration decisions. Shortage lists are often used to attract high-skilled labor that can fill gaps in the labor market immediately, without the time lag involved in developing and delivering training programs. In some cases, shortage lists have also been used to identify highly skilled individuals who can meet longer-term skills needs. The uses of shortage lists are not mutually exclusive. Occupations with a shortage of workers that can be filled through immigration in the short term can also be targeted by investments in education and training in the medium term.

Many stakeholders use Malaysia's COL as a source of labor market intelligence and to inform immigration policy. Various stakeholders, including policy makers, training institutions, institutions of higher education, job seekers and students use the COL as a source of information. The recent Mid-Term Review of the Eleventh Malaysia Plan accords the COL a prominent place and mentions that "[t]he COL report will

be continuously updated to identify shortages of workers in critical occupations that will have an impact on the economy. The Government will intervene based on the report by reprioritising the field of studies and leveraging the Malaysian diaspora." Institutions of higher education are using the COL in developing courses of study that meet industry demand. As part of the government's efforts to leverage the Malaysian diaspora, TalentCorp is using the COL in very concrete terms in its Returning Expert Programme (REP). TalentCorp's REP seeks to attract qualified Malaysians who are working abroad back to Malaysia. The REP uses a points-based system to assess candidates' qualifications. Points are awarded for education, salary, and work experience. Points are also awarded to candidates in occupations that appear on the COL. Thus, the REP is a strategic tool to fill labor market shortages identified by the COL.

The COL has the potential to help adapt workforce development policies in Malaysia to economic needs in the context of Industry 4.0. The Malaysian economy and the global economy are changing rapidly as new advances disrupt labor markets. Those changes will require Malaysia's workforce development policies to be responsive and flexible as new occupations emerge and employers demand new skills. The COL has the potential to enhance that flexibility in three areas: First, the COL can further improve the responsiveness of upskilling and reskilling programs to industry needs. Second, the COL can further improve the efficiency of the job-matching process for displaced and retrenched workers. Third, the COL can further improve the responsiveness of immigration admissions decisions to economic needs (See **Table 2**).

TABLE 2. Potential future applications of the Critical Occupations List

Policy area	Application
Upskilling and reskilling	• Inform development of TVET and higher education programming • Inform development of occupational standards and accreditation • Target funding for TVET and higher education programming • Target incentives to businesses for apprentices
Employment services	• Inform career counsellors about occupations in shortage • Target upskilling and reskilling for jobseekers
Immigration	• Target admissions to workers in occupations on the COL

Source: Authors

PART III

Lessons Learned

Learning from the strengths of the Critical Occupations List

Lessons from the CSC's experience with the COL suggest several key principles for implementing a shortage list that is accurate, accepted, and relevant. Those key principles can help guide the creation and use of shortage lists in other countries.

Shortage lists should be updated regularly and improved continually

Shortage lists should be updated regularly and improved continually. The COL is updated each year to ensure that it remains relevant to current labor market needs. Improvements to successive iterations of the COL have expanded the number of data sources reviewed, expanded and improved the calculation of shortage indicators, and expanded the number of stakeholders consulted in the bottom-up process. The first COL was a pilot that included just two shortage indicators from two datasets and involved limited consultations with stakeholders and no survey. The depth and breadth of evidence considered by the COL was expanded over time as the CSC became more experienced. By the 2018/2019 iteration of the COL, 14 shortage indicators were included based on review of 14 different datasets. They were supplemented with evidence from 23 consultations and nearly 4,000 surveys of stakeholders about critical occupations. The process of expansion involved regular consideration of what was working and what was not, and regular communication with government and private sector stakeholders to ensure that those in a position to provide relevant data were motivated to do so.

Shortage lists should be based on rigorous evidence

The methodology for creating the shortage lists should be evidence-based. The process of developing the COL begins with a consideration of all available data sources that potentially have information relevant to the labor market. Rather than rely on a single measure of labor market shortages, multiple measures that are both quantitative and qualitative in nature are preferred (Veneri 1999; Shah and Burke 2005; Richardson 2007; Infometrics 2006). That helps ensure that diverse sources of labor market information are considered. Information about employment and unemployment rates, vacancy and hard-to-fill vacancy rates, and changes in wages; employer surveys; and the opinions of employers, regulators, educational institutions, and other labor market stakeholders are all important to understand the future skills of the workforce, future demand by employers, and future shortages. A complete set of information is almost never available, so careful consideration of which available indicators are best suited to the labor market is key. Those indicators should be evaluated rigorously for how well they capture shortages. The COL methodology considers each indicator on its own against shortage benchmarks; then it considers indicators in combination; finally, it considers different combinations of indicators. Qualitative information from surveys and consultations is incorporated to supplement and provide context for quantitative data.

Real-time labor market information can enhance shortage lists by providing a proxy for vacancies and detailed occupational information. Real-time labor market information takes advantage of the proliferation of online job search by "scraping" or "spidering" the Web for job postings, resumes, and other employment-related information (**Box 2**). This scraping results in raw data that can be assembled and

structured into information on occupations, vacancies, salaries, skills, and career pathways. Real-time labor market information can be collected constantly, resulting in monthly or even daily data on labor market trends. Real-time data is particularly useful when vacancy data is limited or unavailable. Additionally, real-time labor market information techniques can generate detailed data about job openings and worker skills. The COL incorporates real-time labor market information in two ways. First, online job posting data is used as a proxy for job openings to create indicators of labor market shortages because information on vacancies is not available from other sources. Second, online job posting data provide detailed information on the skills and experience requirements of occupations in high demand.

Shortage lists should be transparent

The methodology for creating shortage lists should be transparent. Making shortage lists and their methodologies publicly available increases trust that they accurately reflect labor market needs. Each iteration of the COL is accompanied by a report. That report is both a methodological manual that makes the process of producing the COL transparent (including any shortcomings and recommendations for improving it) and a guide to how the COL can be useful to policymakers. Helping stakeholders understand the tool, its purpose, and its benefits is essential to motivate policymakers, training institutions, employers, and others to use the shortage list and to contribute to its improvement by providing their own evidence of shortages.

Shortage lists should be produced by a specialized agency

The body responsible for creating shortage lists should be specialized and make use of relevant expertise. The staff of the CSC devotes a significant portion of time to creating the COL. That allows them to develop occupational and sectoral expertise and deep knowledge of the COL's methodology. A significant advantage of the CSC's structure is the partnership between TalentCorp and ILMIA. The institutional structure allows the CSC to draw on ILMIA's labor market information sources, including its Labour Market Information Data Warehouse, and on TalentCorp's ties with stakeholders in the private sector.

Shortage lists should involve private and public sector stakeholders in their production

The production of shortage lists should involve many different labor market stakeholders. Soliciting input from stakeholders such as employers, industry associations, unions, and others not only contributes valuable evidence to the shortage lists, but also raises the profile of the lists and generates buy-in from potential users. The CSC has devoted significant effort to developing relationships with private sector stakeholders. The number of responses to the annual survey about critical occupations grew from fewer than 200 to nearly 4,000 in just four years. During the same period, the number of consultations grew from 9 to 23. Those sources provide vital intelligence from the employers that know the most about current demands in the labor market. Relationships with data providers are also essential because data is the lifeblood of the quantitative evidence included in shortage lists. Relationships should be cultivated with data providers and they should be kept informed about how their data are used.

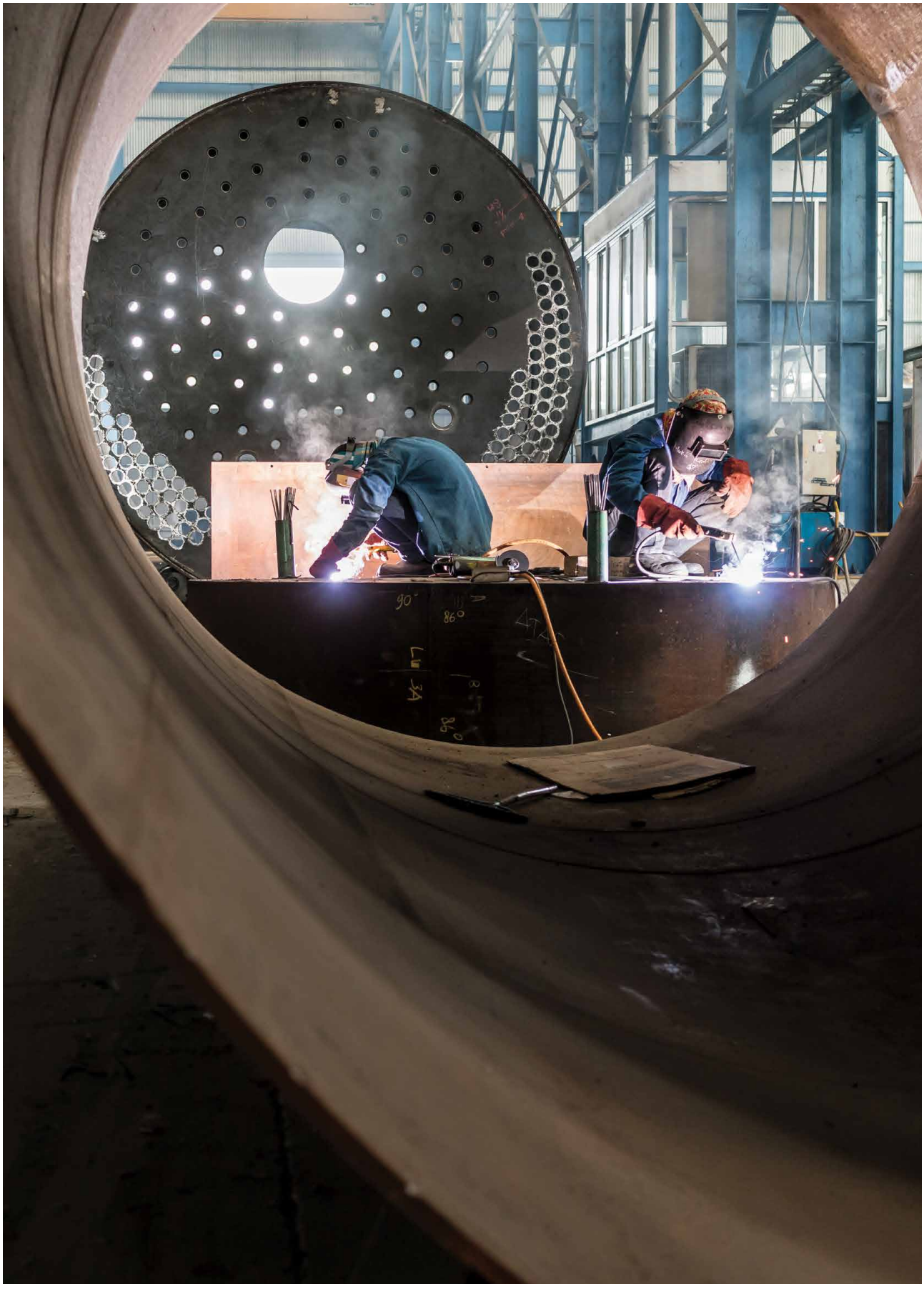
BOX 2

Using real-time labor market information to improve policymaking

The benefits of real-time labor market information are its timeliness and granularity. Real-time information is generated constantly and can be useful almost immediately. Different from traditional surveys of the labor market that take weeks or months to be completed and published, real-time data can provide users with an up-to-date portrait of the labor market, assuaging concerns that information is outdated. Real-time information on the labor market provides a very granular picture of occupations, skills, salaries, industries, education levels, and other characteristics, allowing users of the information to enhance their knowledge of the labor market and improve policy interventions.

Labor market information systems and workforce development policies around the world incorporate real-time labor market information. Job search websites are increasingly being used by academics to study labor market dynamics, job search, the relationship between skills and wages, and labor market concentration (Marinescu 2017; Deming and Kahn 2018; Azar et al. 2018). Policy applications are also proliferating. The European Centre for the Development of Vocational Training is using online job ads to establish a pan-EU tool for collecting data on skills demand. Local governments in the United States, including economic development agencies, educational institutions, and workforce development agencies, are using real-time labor market information to inform career counsellors about occupations in demand and the qualifications that can help lead to careers in those occupations; to inform sector strategies; and to target education and training investments (Alstadt 2011; Maher & Maher 2015). The City University of New York uses real-time labor market information to create "career maps" for medical assistants, home health aides, and cooks (Maher and Maher 2015). The Consortium for Workforce and Economic Development of the New Jersey Council of County Colleges uses data from online job posts to help community colleges direct training opportunities to occupations that are in demand.

Source: Authors



Learning from challenges faced by the Critical Occupations List

The Critical Occupations List, like all shortage lists, faces challenges that the CSC continues to work on. The CSC continues to face challenges as it works to increase the effectiveness of the COL. However, those challenges are not unique to the COL. They, and the CSC's responses to them, have important lessons for other countries considering shortage lists.

Shortage lists should weigh the pros and cons of regional disaggregation

As in many countries, labor markets in Malaysia vary between regions. In Malaysia, geographic labor market differences are most clearly reflected in different employment rates, labor force participation rates, and sectors of employment. For instance, the unemployment rate in Peninsular Malaysia was 3 percent in 2017, compared to 5 percent in East Malaysia on the island of Borneo. Seven percent of employment was in agriculture in Peninsular Malaysia, compared to 28 percent in East Malaysia. The variation suggests that labor market shortages likely vary across geographies as well. While the current version of the COL does not directly consider such variations, its most recent version included a pilot of a subnational COL that divided Malaysia into Peninsular Malaysia and East Malaysia. Although the two geographic areas are quite large and labor markets may vary within them, the approach demonstrated the potential benefits and challenges of creating a subnational COL. Still, developing full subnational shortage lists requires significant additional resources because surveys are not always representative at subnational levels and consultations must be undertaken for different regions, which multiplies the number of meetings required.

Shortage lists should invest in standardized occupational data

Obtaining data with standardized occupational classifications is not always possible. Obtaining datasets with standardized occupations is essential since occupations are the backbone of the COL and similar shortage lists. However, occupational information is not always classified in a standardized format. While survey data in Malaysia is frequently provided in the standardized MASCO scheme, administrative and qualitative data—and some survey data—is not. The CSC has worked with data providers to classify occupations in MASCO. The CSC has also employed machine-learning techniques that can classify unstructured text, such as job titles or job descriptions, into MASCO. Nonetheless, standardized occupational data continues to be a challenge to obtain and will require significant investment by practitioners developing their own shortage lists.

PART IV

Conclusion

The Government of Malaysia established the CSC to monitors skills imbalances. One of the CSC's primary objectives is to develop a COL annually to serve as a platform for the coordination of human capital development policies. The CSC is jointly chaired by TalentCorp and the Institute of Labour Market Information and Analysis, which are agencies in the Ministry of Human Resources. This institutional structure allows the CSC to draw on ILMIA's labor market information sources, including its Labour Market Information Data Warehouse, and on TalentCorp's ties with stakeholders in the private sector.

The CSC has published an annual Critical Occupations List (COL) since 2015. The COL is a list of occupations for which there is strong evidence that there is significant labor market shortage that may be alleviated through government action. Occupations on the COL meet the criteria of being mid- or high-skilled, sought-after, and strategic. The COL seeks to identify and draw stakeholder attention to this set of occupations that are critical to the continued growth and development of the Malaysian economy but that are currently difficult to fill.

The experience of Malaysia with the COL has several lessons for other countries exploring tools to monitor skills shortages.

1. Shortage lists are a useful tool for monitoring labor market shortages, and they are particularly critical now as new technologies disrupt labor markets.
2. Shortage lists should be updated regularly and improved continually, should be based on rigorous evidence, and should be transparent. Governments can take advantage of new data sources, such as online job postings, to create lists that are up-to-date and include detailed information about skills requirements.
3. Shortage lists should be developed by a specialized agency but should incorporate evidence from public and private sector stakeholders.

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Appendix

Appendix 1: The 2018/2019 Critical Occupations List and top associated skills

MASCO title	Top skill	Second skill	Third skill
Managing Directors and Chief Executives	Communication Skills	English	Planning
Finance Managers	Accounting	Finance	Budgeting
Human Resource Managers	Communication Skills	English	Planning
Policy and Planning Managers	Planning	Communication Skills	English
Business Services Managers	-	-	-
Business Services and Administration Managers Not Elsewhere Classified	Communication Skills	Project Management	English
Sales and Marketing Managers	Sales	Communication Skills	English
Advertising and Public Relations Managers	Communication Skills	English	Social Media
Research and Development Managers	Communication Skills	Research	English
Manufacturing Managers	Communication Skills	Planning	English
Construction Managers	Chinese	Construction Management	English
Information and Communications Technology Managers	Communication Skills	English	Project Management
Chemists	Chemistry	English	Quality Assurance and Control
Geologists and Geophysicists	Geotechnical Engineering	Civil Engineering	Communication Skills
Mathematicians, Actuaries and Statisticians	Microsoft Excel	Communication Skills	English
Industrial and Production Engineers	Quality Assurance and Control	Communication Skills	English
Civil Engineers	Civil Engineering	Communication Skills	English
Mechanical Engineers	Mechanical Engineering	Communication Skills	English
Chemical Engineers	Process Engineering	Communication Skills	Troubleshooting
Mining Engineers, Metallurgists and Related Professionals	English	Communication Skills	Teamwork / Collaboration
Engineering Professionals (Excluding Electrotechnology) Not Elsewhere Classified	Communication Skills	English	Chinese

MASCO title	Top skill	Second skill	Third skill
Electrical Engineers	Electrical Engineering	Communication Skills	Troubleshooting
Electronic Engineers	Troubleshooting	Communication Skills	English
Graphic and Multimedia Designers	Graphic Design	Creativity	Adobe Photoshop
Aircraft Pilots and Related Professionals	English	Communication Skills	Chinese
Manufacturing Professionals	Welding	English	Chinese
Environmental and Occupational Health and Hygiene Professionals	Occupational Health and Safety	English	Communication Skills
University and Higher Education Professional Teachers	Lecturer	English	Research
Early Childhood Educators	Teaching	Chinese	English
Accountant and Auditor	Accounting	Communication Skills	English
Financial and Investment Advisers	Sales	English	Planning
Financial Analysts	Accounting	Communication Skills	Finance
Advertising and Marketing Professionals	Marketing	English	Social Media
Systems Analysts	Communication Skills	English	SAP
Software Developers	Software Engineering	Software Development	SQL
Applications Programmers	SQL	English	.NET
Software and Applications Developers and Analysts Not Elsewhere Classified	Quality Assurance and Control	English	Communication Skills
Systems Administrators	Troubleshooting	Communication Skills	English
Computer Network Professionals	Troubleshooting	Communication Skills	Teamwork / Collaboration
Database and Network Professionals Not Elsewhere Classified	Communication Skills	Information Security	English
Civil Engineering Technicians	Troubleshooting	English	Communication Skills
Electrical Engineering Technicians	Troubleshooting	Preventive Maintenance	English
Mechanical Engineering Technicians	Troubleshooting	Preventive Maintenance	English
Physical and Engineering Science Technicians Not Elsewhere Classified	Troubleshooting	Quality Assurance and Control	English
Manufacturing Supervisors	-	-	-

MASCO title	Top skill	Second skill	Third skill
Other Supervisor Not Elsewhere Classified	English	Communication Skills	Chinese
Commercial Sales Agents	Sales	Chinese	English
Chefs	Cooking	English	Food Preparation
Receptionists	Administrative Support	English	Communication Skills
Welders and Flame Cutters	-	-	-
Agricultural and Industrial Machinery Mechanics and Repairers	-	-	-
Electrical Mechanics and Fitters	-	-	-
Bakers, Pastry, Pasta and Confectionery Makers	-	-	-
Tailors, Dressmakers, Furriers and Hatters	-	-	-
Rubber Products Machine Operators	-	-	-
Steam Engine and Boiler Operators	-	-	-
Stationary Plant and Machine Operators Not Elsewhere Classified	-	-	-
Heavy Truck and Lorry Drivers	-	-	-
Mobile Farm and Forestry Plant Operators	-	-	-

Note: "-" indicates not available.
Source: CSC 2019.

Appendix 2: The methodology for the Critical Occupations List

The methodology for creating the COL combines rigorous quantitative methods with stakeholder engagement. The criteria for inclusion on the list is threefold: occupations must be skilled, sought-after, and strategic. Occupations are determined to be skilled based on the MASCO occupational classification scheme. This process is relatively mechanical based on classifications of occupations established by MASCO. The first eight tiers of MASCO are considered mid- or high- skilled occupations. Sought-after occupations are identified using quantitative indicators of shortage and qualitative evidence from employers and other stakeholders. Strategic means that an occupation is central to Malaysia's economic development objectives. The process of defining occupations that are sought-after and that are strategic requires rigorous analysis of quantitative evidence through a top-down approach, rigorous analysis of qualitative evidence through a bottom-up approach, and a thorough process of dovetailing evidence resulting from both approaches. This appendix describes the top-down, bottom-up, and dovetailing processes that identify sought-after and strategic occupations for inclusion on the COL.

Top-down approach

The "top-down" approach provides the basis for determining whether an occupation is sought-after by identifying shortages. Developing shortage indicators is challenging because labor market indicators can mean different things in different contexts. For example, salaries might fluctuate before reaching equilibrium, or a large number of vacancies can be caused by high turnover, undermining the effectiveness of those measures as shortage indicators (MAC 2017). The top-down methodology takes such issues into consideration by looking at a range of data sources to define both quantity indicators (for example, employment levels and vacancies) and price indicators (for example, earnings and wage premiums). The methodology also uses indicator-specific thresholds to define when each indicator is likely to provide evidence of shortage, and employs a "traffic light" approach so that evidence of a shortage in a certain percentage of indicators is the final gauge of a shortage, rather than evidence of a shortage in a single indicator.

The top-down approach is a process of identifying data sources, shortage indicators, and shortage occupations. The first step in the top-down approach is to identify data sources with information about shortages. Next, a set of shortage indicators is calculated with those data sources and a number of different indicators are tested singly and in combination. A final preferred combination of indicators for the top-down methodology emerges from this process.

- **Identify data sources.** The first step in compiling the top-down list of shortage occupations is to compile all of the available datasets that can be used to construct quantitative indicators of labor market shortage. This step seeks to be over-inclusive: at this stage the relevance of datasets is evaluated rather than the practicality of constructing indicators from them. Datasets to consider include both surveys and administrative data. The 2018/2019 COL considered the Labour Force Survey, the Survey of Wages and Salaries, job vacancies registered with the public employment agency JobsMalaysia, databases of vocational and university student graduates, immigration databases, and data collected from online job-search websites. Those datasets are then evaluated on two criteria: 1) the availability of data in the most recent year and in previous years; and 2) the feasibility of calculating indicators using occupation as the unit of analysis.

- **Calculate shortage indicators.** The identification of data sources with potential shortage indicators that have occupational information permits the compilation of an initial list of shortage indicators. The initial list includes all indicators that have an economic rationale for using them as evidence of an occupational shortage and that have sufficient data based on occupation. In the 2018/2019 COL, there were 19 initial indicators from five datasets. This initial list is refined through a process that ensures that each indicator adds unique shortage information to the top-down methodology. This involves looking at the correlation between indicators. This also involves evaluating which occupations are found to be in shortage using each indicator. This second step requires defining thresholds for each indicator using a benchmark period defined as a period of high economic and employment growth. At this stage, multiple thresholds are used to test more and less restrictive scenarios. The result is a set of intermediate shortage indicators that provide unique shortage information. Two indicators were pared from the initial list for the 2018/2019 COL, leaving 17 intermediate indicators from five datasets.
- **Select final specification.** The final step in the top-down approach is to combine the intermediate shortage indicators to create lists of occupational shortages. Thus far, each indicator has been considered individually. In order to make final decisions about which shortage indicators to include, however, different combinations of indicators must also be considered to ensure that when they are combined they all add pertinent information about labor market shortages. Creating those lists of occupational shortages requires setting a rule for how to combine the evidence from the different shortage indicators. Following the UK Migration Advisory Committee, the COL considers occupations

TABLE 3. Final indicators included in the top-down approach in the 2018/2019 COL

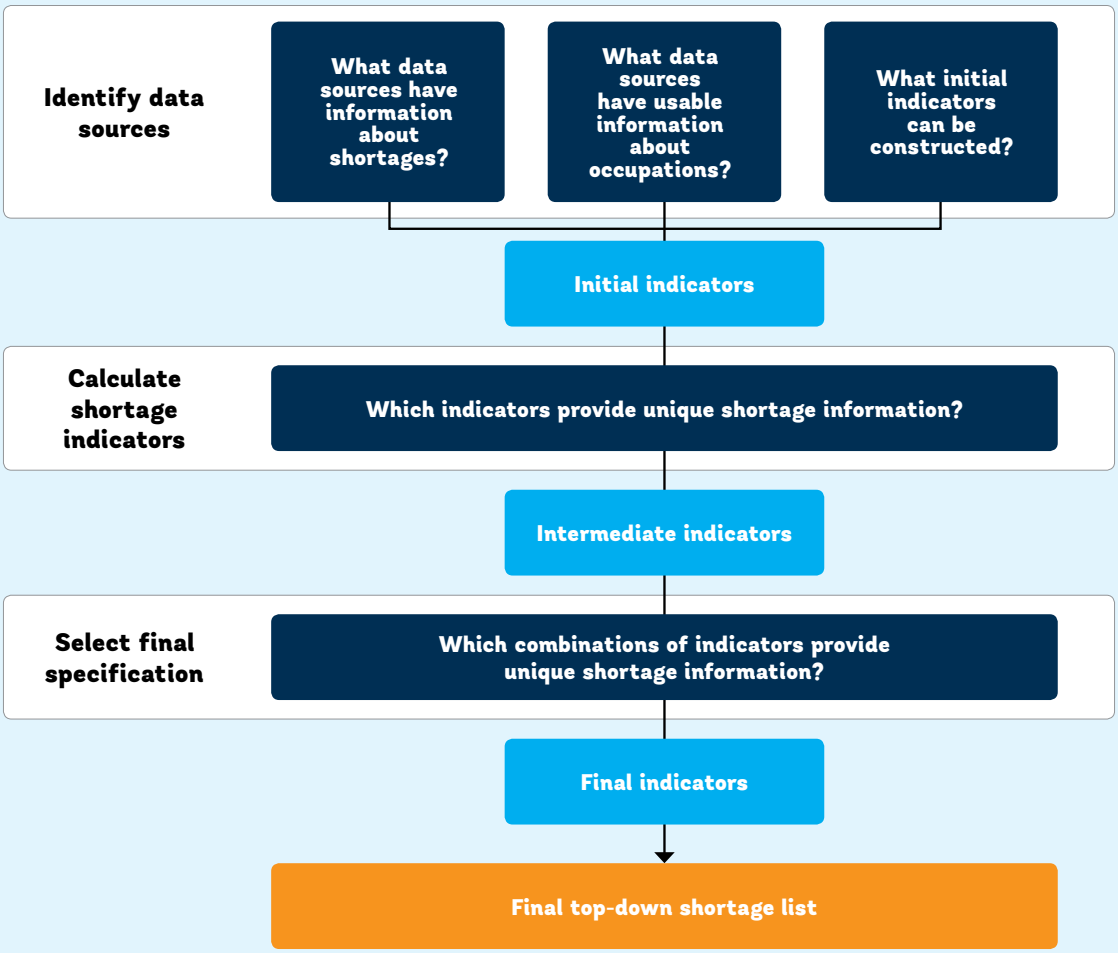
Data source	Indicator
Labour force survey	1) 1-year employment growth 2) 3-year employment growth
	3) 1-year working hours growth 4) 3-year working hours growth
	5) 1-year education level decrease 6) 3-year education level decrease
Survey of Wages and Salaries	7) 1-year wage premium growth 8) 3-year wage premium growth
Resident Pass-Talent database	9) 1-year RP-T applications growth 10) 3-year RP-T applications growth
Online job posting data	11) # of vacancies
	12) Vacancy rate (% of employment)
	13) 1- year education level decrease 14) 1-year experience level decrease

Note: The Resident Pass-Talent (RP-T) is a program run by TalentCorp to encourage talented expatriates who are currently working in Malaysia to remain in Malaysia for work.
Source: Authors

in shortage to be those with values exceeding the shortage threshold for more than half of the available indicators. Potential lists of shortage occupations are created by testing different combinations of indicators. Those tests are evaluated on a number of criteria. One of the most important is the number of occupations found to have a shortage. Longer lists are preferred because they permit further scrutiny during dovetailing (see below). In the 2018/2019 COL, the selected specification included 14 indicators from 4 datasets (**Table 3**).

The top-down approach results in a top-down shortage list. The process of identifying data sources, calculating shortage indicators, and selecting a final combination of indicators results in an initial top-down list of shortage occupations (**Figure 3**). In the 2018/2019 COL, 53 such occupations were identified. The list provides evidence that the occupations are sought-after, but additional evidence is also collected through surveys of and consultations with labor market stakeholders in the bottom-up approach.

FIGURE 3. Summarizing the top-down approach



Source: Authors

Bottom-up approach

The bottom-up approach builds an evidence base that occupations are sought-after by directly asking stakeholders for information. Like the top-down approach, the bottom-up approach draws on several sources of data. They include a broad survey of employers, in-depth consultations with employers and industry associations, and sector-based "environmental" scans.

- **Call for Evidence Survey.** The primary purpose of the Call for Evidence (CfE) survey is to allow employers to nominate occupations for inclusion on the COL. Employers are provided with a brief description of the COL's skilled, sought-after, and strategic criteria and are asked to nominate occupations meeting those criteria. The CfE then asks the same series of questions for each occupation. The questions solicit information about each nominated occupation's key responsibilities, number of employees, experience level, strategies to fill vacancies, average time taken to fill vacancies, and reasons why the occupation is hard to fill. Employers to fill out the survey are drawn from several government databases with company contact information that is available publicly or compiled by the CSC. A survey research firm assists the CSC in identifying respondents, building the questionnaire, monitoring responses, and cleaning the final data. The CfE is not meant to be representative, but to gather information for the CSC.
- **Stakeholder consultations.** Like the CfE, the primary goal of the stakeholder consultations is to generate a list of occupations that participants nominate for inclusion on the COL. During the consultations, the CSC team first seeks to compile a complete list of occupations that could potentially be nominated. The team subsequently gathers information from participants to support the contention that the occupation meets the skilled, sought-after, and strategic criteria. This discussion is only semi-structured; it aims to allow for discussion of different types of information in greater breadth than is possible with the CfE. That discussion includes the business impact of shortages. It also covers whether a shortage is limited to one job type or is present in an entire occupation. The consultations should make participants feel that their input is valued, inform them of key milestones in producing the COL, and motivate them to fill out the CfE if they have not yet done so. The consultations also increase knowledge within the CSC about economic sectors, their needs, and their trends.
- **Sector-based environmental scans.** Environmental scans have been undertaken by different Malaysian agencies in several sectors: machinery equipment and advanced engineering; food and beverage; medical devices; pharmaceutical manufacturing; chemical and petrochemical; and electrical and electronics. The scans profile current industry trends, including the current workforce and occupations in the sector; project how workforce supply and demand will evolve; and identify potential skill gaps. The scans also seek to identify in-demand occupations. The CSC considers the information when assessing occupations on the list of nominated occupations.

The CfE and the stakeholder consultations result in a list of occupations that employers and industry associations nominate for the COL. Evidence from the environmental scans is considered when compiling the list of nominated occupations and during the next stage of the process, dovetailing (see below). Additionally, both the CfE and the consultations generate information about recent hiring experiences, companies' reported reasons for hiring difficulties, desired educational profiles, strategies used to address hiring difficulties, and the impact those hiring difficulties have on operations. Consultations also provide employers with an opportunity to contribute other information to support their nominations. To make the bottom-up approach compatible with the top-down approach, occupations are classified using the MASCO occupational classification scheme.

Dovetailing

Dovetailing is the process of consolidating evidence from the top-down and bottom-up approaches to determine whether the evidence shows that an occupation is sought-after and should be included on the COL. While the dovetailing process involves a set of rules to guide decisions, the process does not involve mechanically applying a strict set of weights for different indicators or fixed thresholds for determining if an occupation should be included. Rather, the coherence of top-down and bottom-up evidence and the plausibility of the case that emerges from this evidence are the primary drivers of the decision for inclusion.

In the dovetailing process, the CSC is seeking credible evidence for an occupation's inclusion on the COL. The absence of such evidence results in an occupation not being included on the list. Potential uses of the COL include targeting government resources or providing preferential treatment for an occupation on the list. The usefulness of the list depends on its highlighting only occupations where a strong case for such treatment exists. Accordingly, the COL, like similar lists in other countries, seeks to be relatively selective. The default status of an occupation is that it is not included on the COL. The CSC seeks sufficient evidence to override that default, meaning that the absence of sufficient evidence has the same result as credible evidence that an occupation should not be included. Thus, the process is set up in a way that limits the occurrence of false positives.

There are two rounds of dovetailing analysis and a process of validation. In the first round of dovetailing, occupations are prioritized for inclusion on the COL by the strength of the evidence that employers are seeking them. Most of the time is spent evaluating occupations with weak evidence for inclusion on the COL. The decision about each occupation is documented in reports that capture both the top-down and bottom-up evidence, as well as the team's rationale for recommending an occupation's inclusion or exclusion. Marginal cases are marked for additional data gathering during a validation process. The preliminary COL resulting from the first round of dovetailing is validated with employers, government agencies, industry associations, and other stakeholders. A second round of dovetailing is conducted for those occupations for which additional information is received during the validation process. The process is the same as in the first round of dovetailing, but also makes use of the information gathered in the validation process.

The strategic importance of occupations that meet the criteria for being skilled and sought-after is assessed during the second round of dovetailing. This assessment is based on a variety of factors, including which industries report shortages in certain occupations, the degree to which employers are actively seeking to fill shortages, the potential impact of shortages on the health of businesses and industries, and whether occupations can be automated.

The second dovetailing stage results in the final COL. The second dovetailing stage is the final stage of identifying critical occupations. At this stage, a final list of critical occupations has been identified. The use of both quantitative and qualitative sources of information in creating the COL allows for the creation of occupation reports, which are robust justifications for an occupation's inclusion on the list.

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