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Changing Skills and Jobs

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EXECUTIVE SUMMARY

OBJECTIVES

This research study provided insights on the changing skills and jobs from the perspective of employers and businesses and identified the impact on workers. The study measured the extent of such changes and how these changes would develop over the next two years. For workers, the views of such changes from current and future employers can serve as a guide on the direction of job creation.

APPROACH

This study involved a survey of various types of employment-generating organisations in Singapore. The targeted respondents were the Chief Human Resource Officers (CHROs) and HR specialists whose responses represented the manpower issues confronting their organisations. The fieldwork was conducted between February to May 2017.

FINDINGS AND RECOMMENDATIONS

The findings and recommendations are classified under 3 key areas:

1. Training
2. Mismatches
3. Knowledge Work

1. Training

Singapore continues to see significant investment in training at the institutional, organisational and individual levels. This is not a recent development, having been a feature of the skills and manpower framework in Singapore for decades. The natural question that arose was whether any change to the existing approach to training was required.

Key Findings

i. Organisations relied heavily on on-job-training (OJT) as the main form of training and found OJT to be beneficial.

ii. Organisations struggled to find effective ways to meet their training needs; the effectiveness of training in promoting skills development in an organisation's workforce was affected by turnover.

iii. As a result of staff turnover, organisations tended to address their skills gaps through hiring rather than training. This strongly suggested that there may be a lack of options for effective training. This finding was also supported by the close resemblance between the hiring and turnover rate at both organisational and occupational level – implying that organisations preferred to hire to fill the skills gaps.

iv. Having the right set of skills will become increasingly important for workers to be of value in helping organisations confront the challenges of disruption and advancing technology.

Recommendations

i. Individual workers should focus on the acquisition of skills sets relevant to the job market and business needs, and be pro-active to train and utilise all available training resources. This will enhance their employability and value to their organisations.

ii. Organisations should recognise that every worker can acquire new and better skills through customised and curated training, and view training as an investment in building labour capital. It is particularly important for employers to appreciate the importance of building Singapore's labour capital as the demand for highly-skilled manpower becomes more pressing with Singapore's small labour pool.

iii. A concerted tripartite effort can be made to help all organisations view training efforts more strategically as the development of a higher skilled labour pool will benefit Singapore's economy. Employers will collectively gain in terms of talent choices when Singapore's labour pool is highly-skilled even if the trained workers do leave for other employers.

iv. Organisations which have their pulse on the needs of workers must take the lead in promoting acquisition of skills that are in demand and advocate for appropriate and high-quality training. One approach is to prepare workers to move to adjacent higher-skilled roles within the organisation. Organisations can leverage the Labour Movement's analysis of sectors and the in-demand jobs and skills in these sectors.

v. Assistance should be provided for companies who embark on efforts to train workers to take on higher-skilled roles. More support can be provided to SMEs as they face training challenges due to their much smaller workforce.

vi. There should be more systematic tracking and evaluation of training courses offered to ensure quality and relevancy to the current and future job market as well as business needs.

2. Mismatches

To better understand the state and development of mismatches, this study compared recent past and the near future on hiring, turnover, skills adequacy, training and job requirements. The opinions gathered showed that the type of mismatches coincided with the ones already identified by the Labour Movement as well as government agencies.

These are namely a mismatch of placement, a mismatch of skills, and a mismatch of expectations on areas such as remuneration and job requirement. Of these, the mismatch of expectations between employer and worker is the most common occurrence.

Key Findings

i. The mismatches can take different forms – the relation between the types of mismatches differed between Manufacturing sector and Services sector.

ii. In the Manufacturing sector, the mismatch of jobs and mismatch of skills were distinct, and this distinction remained consistent over time.

iii. In contrast, the Services sector was less clear – there was a distinction between the jobs and expectations for the recent past but less clear for the near future.

iv. More than one type of mismatch could affect an individual worker simultaneously. Hence, for an individual worker, one type of mismatch could be made up of, for example, 2/3 skills mismatch and 1/3 expectations mismatch. It could also shift into another type of mismatch over time.

Recommendations

i. As the types of mismatches differed between Manufacturing and Services, policy intervention must be tailored to the needs of the sectors. Additionally, policies need to be dynamic to address the changing and evolving types of mismatches.

ii. It is imperative to identify which form of mismatch a job-seeker is affected by and address it early lest it develops into another type of mismatch over time. In severe cases, such a job-seeker could add to the ranks of the long-term unemployed[1]. Hence, placement agencies should have processes for early identification of the mismatches and more customised intervention.

iii. Even though it may be necessary to apply a broad policy framework to address mismatches and challenges, agencies should recognise that the challenges and differences between organisations will dilute the effectiveness of such broad policies. Hence, more targeted approaches, factoring in the different and evolving mismatches, will be more beneficial and relevant to organisations.

[1]For example, if a job-seeker has been experiencing a mismatch in skills for a prolonged period, this could develop into another form of mismatch such as a mismatch in expectations and lead to the job-seeker leaving the labour force as a "discouraged worker".

3. Knowledge Work

Knowledge work involves a decision-making process about how to improve the performance of the task at hand with technology.

Key Findings

i. Organisations faced a mounting challenge especially with the increasing reliance on almost all their workers to perform some sort of knowledge work. PMETs were the first group to be hit by this heightened requirement as they were the ones expected to perform the "knowledge work" in the current labour force. The PMETs who are unable to adapt to such demands would be most at risk.

ii. There was growing emphasis on knowledge work for future jobs and this growth will continue to strengthen. Unfortunately, organisations revealed that this was also where Singapore workers are least prepared. The challenges posed by the growth in "knowledge work" affected both workers and supervisors. Supervising the performance of knowledge work would be difficult for those who are struggling with knowledge work requirements themselves.

iii. Knowledge work was no longer an exclusive domain of white-collared or top management.

Recommendations

i. Workers in all occupational groups should take responsibility for their own learning and improve their long-term labour market value by acquiring knowledge-based skills to enhance their job performance.

ii. Employers should view knowledge capabilities from the perspective of individual workers and recognise that every worker is a knowledge worker. Hence, training opportunities in knowledge work should be applied across all the occupational groups with a framework put in place to manage knowledge workers and encourage curated training in knowledge work for different group of workers.

iii. As knowledge work will be required for all ranks of workers and future jobs, employers should leverage available programmes and resources such as the national-level SkillsFuture for the Digital Workplace programme.

RESEARCH REPORT

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Section 1. Introduction

Recent years have seen rising concerns about mismatch between workforce skills and labour market needs in Singapore. Although technological disruptions are often considered to be at the root of this growing concern, the precise causes have not been comprehensively investigated in the local context.

"Skills" – defined as competencies and abilities[2] - are the outcome of the individual choices of education, training and work experience. In a dynamic and globalised world, it is becoming increasing evident that skills are of critical importance as assets not just to the individuals who possess them and the businesses which harness them, but also to societies which seek the right conditions to nurture them.

Labour market mismatches[3] can be observed in various forms. Commonly recognised forms may include qualification/education mismatch, over/under-skilling, and gaps in technical skills. In recent years, the frequency of reports of mismatches has been rising in many countries[4,5]. Currently, there is a lack of clarity about the forms or types of mismatches (if any) and the gravity of the situation locally.

"Technological disruption" – a term used to describe the impact of emerging technology in altering the business and social landscape, and disrupting the status quo – changes the way people interact and hence, how they conduct business. What we observe could be just the beginning of a prolonged period of disruption.

Although all advanced economies are being confronted by disruptive changes, Singapore's size and location make its situation particularly unique. As a small city-state, we are also exposed to such changes from external sources when they occur in the region and the world. To complicate matters, the current economic slowdown, a relatively short-term phenomenon, has to be distinguished from the longer-term structural challenges, including those stemming from technological disruptions. Hence, we have to re-position our economy for this next phase. To begin, Singapore's workforce should be prepared for the impact of these changes on the jobs of the future.

[2]World Economic Forum (2014). Matching Skills and Labour Market Needs: Building Social Partnerships for Better Skills and Better Jobs. Davos-Klosters, Switzerland.

[3]Cedefop (2010). The Skill Matching Challenge: Analysing Skill Mismatch and Policy Implications. Luxembourg: Publications Office of the European Union. Also, see Organisation for Economic Co-operation and Development (OECD) (2011). Right for the job: Overqualified or Underskilled? OECD Employment Outlook. Paris: OECD Publishing: 191-233.

[4]Channelnewsasia (2017). "Workers wanted - French jobs unfilled despite high unemployment". Media report dated 30 May 2017.

[5]Yle News (2017). "100,000 jobs with no takers – Government planning new subsidies to tackle labour shortage". Media report dated 2 April 2017. https://yle.fi/uutiset.

This study involves carrying out a survey of various types of employment-generating organisations in Singapore. The targeted respondents are the Chief Human Resource Officers (CHROs) and HR specialists whose responses would represent the manpower situation confronting their organisations. The main objectives are to shed some light on changing skills and jobs seen from the angle of the employer and business and to identify the impact on workers. We measure the extent of such changes and ask for projections about how these changes will develop over the next two years. For workers, the views of their potential current and future employers about such changes can serve as a guide to the direction of job creation.

In addition, this study has several secondary objectives. It is intended to contribute to an understanding of the changes in skillset requirements, and the gaps in meeting these requirements. In doing so, we distinguish different types of mismatches. Finally, we also assess the willingness of employers to hire workers on flexible work arrangements.

The remaining parts of this report are organised as follows. In Section 2, we begin the reporting of our findings with an overview of the responses about the overall workforce in each organisation. On the key manpower issues such as hiring, turnover and training, in addition to asking about an organisation's workforce, we also request specific information about each occupational group or job role that is present within that workforce. The analysis and modelling of those responses are covered in Sections 3 to 5. Section 3 presents evidence from the bivariate analyses of the survey questions that were designed to distinguish differing types of mismatches at the occupational level. Section 4 discusses the potential implications of these findings for dealing with mismatches. Section 5 presents a multivariate analysis of the same questions discussed in Section 3. It discusses the results of a general structural equation model whose objective is to examine if the differing types of mismatches described in Section 3 are simultaneously determined. Section 6 discusses the increasing importance of knowledge work in the future. Section 7 presents concluding remarks.

Section 2. Changing Skills and Jobs in Singapore

This section discusses the responses about conditions at organisation level. In order to provide the background to assessing the condition of the overall workforce for each responding organisation, we asked about the health of the particular markets they operate within. After that, we turned to the state of hiring and turnover, before further probes into the state of workforce skills and training. Following that, we proceeded to manpower challenges, covering workplace developments and the effects of disruptive technology.

Responses on Business Outlook

Unstructured comments by the respondents to various open-ended questions often suggest that they are pre-occupied with the current manpower and economic situation. As a result, they are not completely focused on addressing future challenges and needs. Such pre-occupations are partly reflected in their responses to the structured questions on markets and outlook.

More than half (54%) of organisations expect the markets[6] they operate within to remain the same in the next 2 years while 14.3% of them expect a different market situation. About a third are uncertain. At the same time, about 44% expect no change in business outlook over the next 2 years while 43% expect at least some improvement. For the remaining 13%, they expect the business outlook to be worse. The net outlook could therefore be regarded as positive.

Although overall economic performance in 2016 exceeded expectations, uncertainty lingers over whether this can be sustained in the face of changing external conditions and the depth of our ongoing domestic restructuring. The Economic Survey of Singapore of 2017, First Quarter[7], has posted a year-on-year growth of a strong 2.7 per cent but the quarter-on-quarter figures showed a contraction of 1.3 per cent.

This mottled picture is seen in other parts of the economy. Although the economy has evaded a general recession since 2010, there have been signs of weakness at the sectoral level. Immediately after Manufacturing sector recovered from five consecutive quarters of contraction from end-2014 to end-2015, the all-important Services sector suffered its own localised recession in the first half of 2016. When that ended, the combined non-Services sectors shrank again. Casting continuing doubts onto the strength of its recovery, the Manufacturing sector's rebound remains less than uniform, with its Transport Engineering and General Manufacturing clusters contracting in the first quarter of 2017. Meanwhile, in Services, the Accommodation & Food Services sector also contracted.

[6]By market, we are referring to the specific sector of the local/global economy within which the company/organisation operates, does business and receives demand for its output from.

[7]Ministry of Trade and Industry (2017). Economic Survey of Singapore, First Quarter 2017. Refer to p.8. The cited growth figure is given as a seasonally adjusted annualised rate.

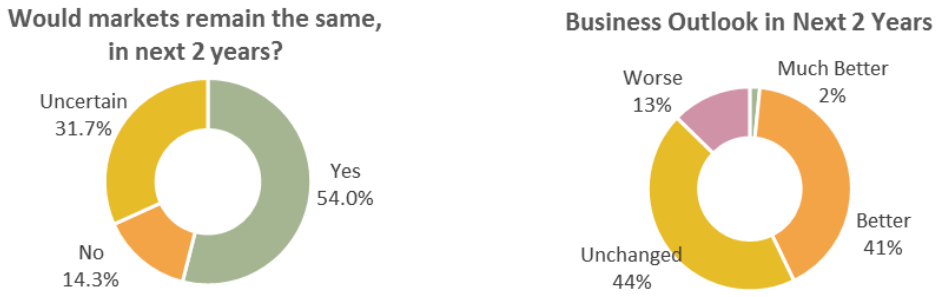


Figure 2.1. Business outlook in next 2 years

In the sample, the business outlook differs with the size of the organisation. Larger organisations tend to have a better business outlook (Kendall's τ_b = 0.2193, p-value of 4.2%; Somers' d = 0.192, p-value = 4%)[8]. There is reason to believe that this is a reflection of what holds for organisations in the population. Larger organisations are often outward-oriented. As the MTI noted in the Economic Survey of Singapore of First Quarter 2017, there was an acceleration in external demand growth. In contrast, domestic demand grew at a much slower pace[9]. There are important exceptions, of course, such as some financial institutions, as well as the Offshore and Marine sector.

[8]We use two common measures of association in our report, namely Kendall's τ_b , and Somers' d. As the former is symmetric, we supplement it with the latter to provide information about directional association. These measures allow us to understand how two ordinal variates may be connected, and assess them for further analysis. The usual measure of association, Pearson's correlation coefficient, is unsuitable in this case because the responses are either ordinal or nominal. Both Kendall's τ_b and Somers' d take possible values in the range -1 to 1. For each realised value of these statistics, we assess the strength of the association using p-values computed using the software SPSS.

[9]Ministry of Trade and Industry (2017). Economic Survey of Singapore, First Quarter 2017. Refer to p.7.

Manpower Situation in 2016

The overall manpower situation in the economy has followed the mottled picture described above for economic output. In a corresponding development, the Construction and Manufacturing workforces have also been contracting, led by the decline in numbers in their foreign components.

In our analysis of responses, we looked at how closely each responding organisation's experience corresponded to the general picture above. Turnover[10] and hiring are the core concerns of HR managers, and are natural starting points to enquire into the state of an organisation's workforce.

Turnover

97% of the organisations experienced turnover in 2016. Of these, 32.8% had a turnover of at least 100 workers.

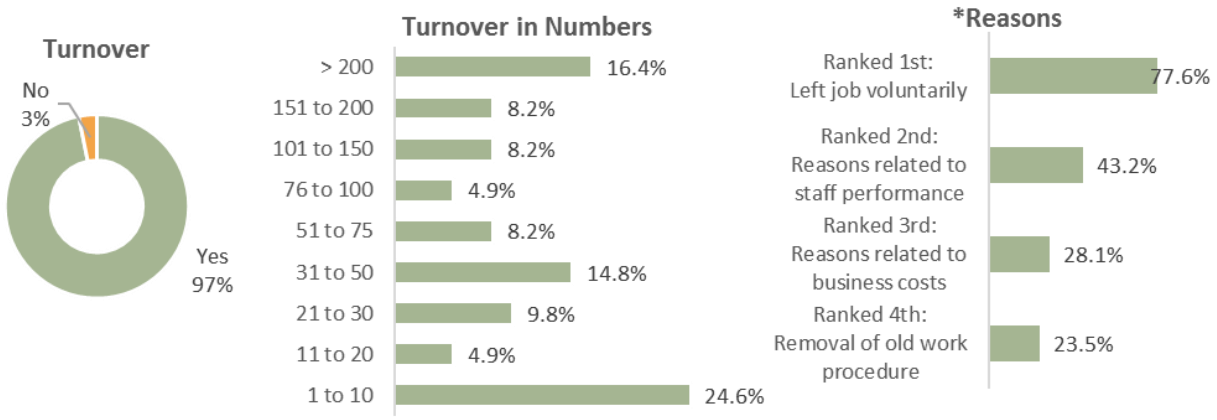


Figure 2.2. Turnover in 2016

(*Values in graphs with asterisked titles do not add up to 100% as respondents are allowed to select multiple options.)

The main reasons for turnover were staff-related. Among business-related reasons for turnover, business costs and removal of old work procedures were indicated.

Hiring

In our questionnaire, we ask about the hiring activity of organisations in two forms. Total hiring activity comprises successful and unsuccessful attempts at hiring. We refer to these as hiring rates and hiring difficulties respectively and capture them in separate questions. The former shows how much hiring is taking place, while the latter shows how much hiring is prevented from taking place despite the demand for manpower. The two are distinct.

[10]In the questionnaire, we included the following definition - the rate of people leaving your organisation is called the turnover rate. People may leave under either voluntary or involuntary circumstances. Unlike with hiring, we decided not to make any distinction as the rate of involuntary turnover may be a sensitive issue.

97% of the organisations hired workers. Of these, 32.8% hired more than 100 workers. The close resemblance between hiring and turnover is a salient feature in our sample and is noticeable from the responses of individual organisations. As we will see in later sections, it is also present in the rates of hiring and turnover at the occupational group level.

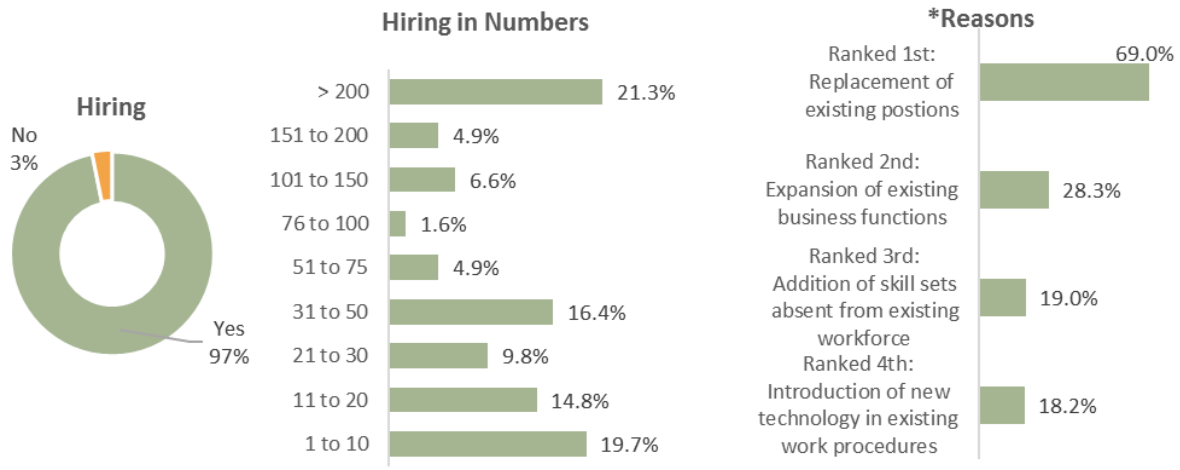


Figure 2.3. Hiring in 2016

The main reason for hiring is replacement of existing positions. This is consistent with the fact that the number of organisations which had some hiring or turnover are related at the organisation level, to a very high level of statistical significance. The strong statistical relation is also seen between hiring rates and turnover rates. For number of organisations, this is suggested by the first graphs in both Figures 2.2 and 2.3 (Kendall's τ_b = 0.4836, p-value of 0.02%). For rates of hiring and turnover, this is suggested by the second graphs of both Figures 2.2 and 2.3 (Kendall's τ_b= 0.7152, p-value of 0.00%)[11].

As a measure of the manpower situation of an organisation, volume of hiring is limited in what it can tell us. Low hiring volumes could be due to either a lack of job creation or a lack of suitable candidates. These are completely different and opposite things altogether.

[11]In Section 3, a close relationship between hiring and turnover is also observed at the occupational group level and is the basis for our working definition of a mismatch of jobs. There is an important difference between what we observe here at the organisation workforce level and that seen in Section 3 at the occupational level. Here, a large part of the extremely high value of Kendall's τ_b can be attributed to a spurious relation. This spurious relation can be traced to organisation workforce size. After accounting for organisation workforce size, the relation between hiring and turnover rates is weaker, but still statistically significant. In Section 3, the relation between the hiring rate and the turnover rate at the occupational level is not affected by organisation workforce size because the indicators were designed to measure changes in rates (relative to 2016).

In order to overcome this ambiguity, we included an indicator of hiring difficulty. As a measure of unsuccessful hiring effort, when used as a supplement to hiring rate information, this can reveal information about the tightness of the labour supply which an organisation is drawing from.

Respondents were also asked about the reasons behind the hiring difficulties. The options refer to problems they faced when assessing applicants, and were designed to focus on a mismatch of between what job-seekers asked for and what employers required. From the perspective of the hirer, these options are equivalent to a mismatch of expectations.

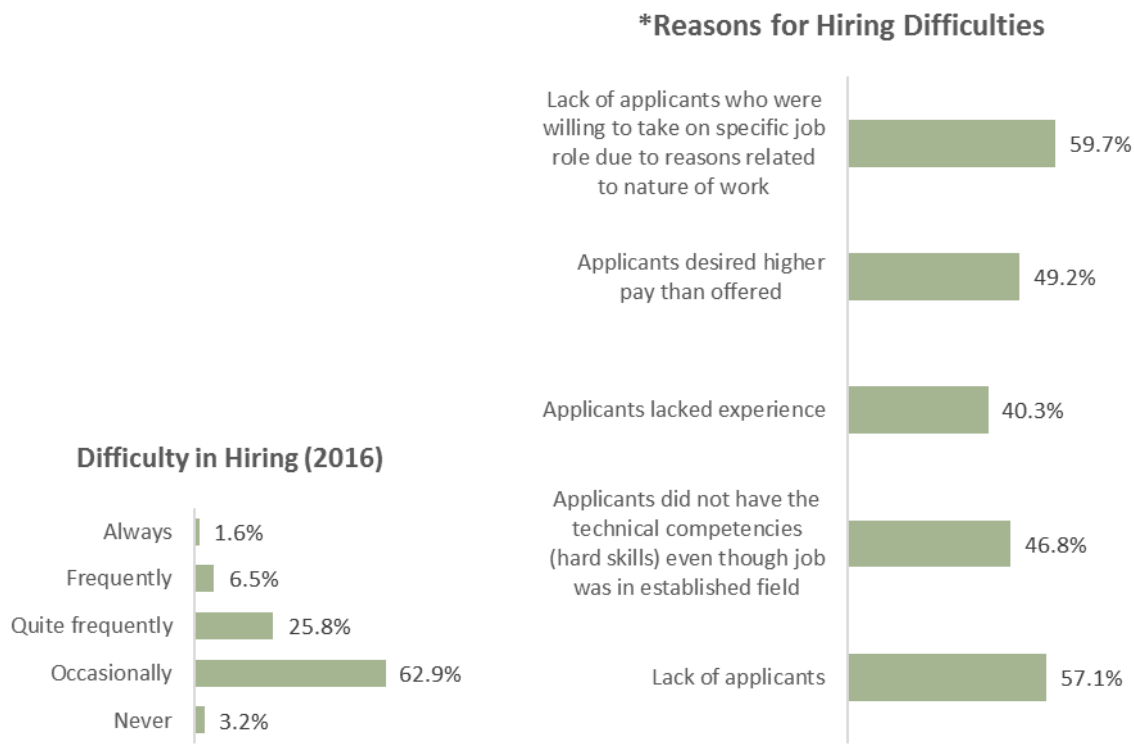


Figure 2.4: Hiring Difficulties

Compared to hiring rates, hiring difficulty is not as widespread. Almost all organisations experience some sort of hiring difficulty, but only a third report doing so more than occasionally.

Our findings show that hiring difficulty has consequences for business performance. As Figure 2.5 shows, at least two-thirds of organisations report negative impact on operations, and a similar proportion do so for growth.

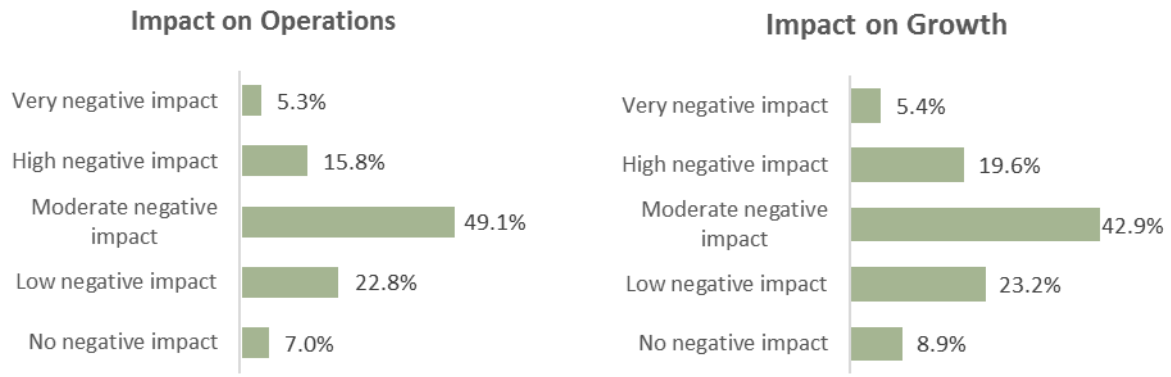


Figure 2.5. Impact of Hiring Difficulties on Business

This is not unexpected. In a moment, we will see when we bring in the impact of technological disruption that hiring difficulty is related in an unusual manner.

Changing Skill Set Requirements

Technological Change

A result that deserves closer attention is the fact that a small number of respondents actually do not believe that their organisations will be impacted by technological disruption. An examination of their profiles revealed that they tended to be large organisations and also reported hiring difficulties. In general, the uncertainty surrounding organisations with large workforces experiencing hiring difficulties is with the impact on the overall manpower situation. Clearly, a large workforce implies more slack and less pressure even if there is a temporary shortage. But whether the outlook should still be sanguine when there is persistent hiring difficulty is not so clear. For a rapidly advancing economy, the potential downside risks could be much more insidious. If an organisation is experiencing persistent shortage of a certain type of manpower, it would be expected to have to make long-term adjustments, such as re-tooling its processes in order to remove the impact on the shortage. Otherwise, the persistence of the problem could develop into a drag on the remaining parts of the workforce. Such an organisation would be expected to report this as a form of disruption.

The sample we have is too small to permit further inferences to be drawn, but this is an area which deserves further study.

One of the primary objectives of this study is to understand whether change is positive. In terms of technological change, when an organisation responds that it is impacted, we followed up by asking about the creation of new jobs[12]. A majority of respondents do not believe that technological change will lead to the creation of new jobs in their organisations[13] (Figure 2.6, first graph). This is an interesting result, and resonates with recognised fears about how technology could negatively affect job creation.

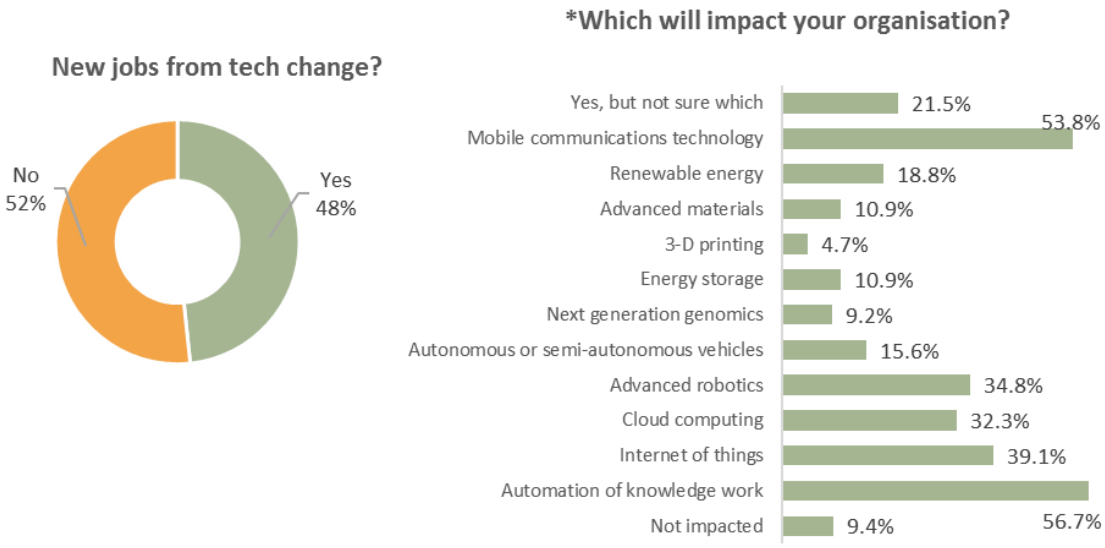


Figure 2.6. Technological Change

Those that indicated job creation as the potential outcome of the technology change provided views of what the new jobs will entail. These include work involving robotics, artificial intelligence (AI), and analytics and/or data scientific work. The skills required by such work are technically demanding but clearly also rewarding. However, not everyone who works in such roles or facing such skill requirements necessarily should be trained to the same depth. This consideration is especially relevant since deep training in such areas would incur heavy costs. Hence, appropriate levels of training become an important supervisory decision. We will discuss more of this in Section 6, in relation to the idea surrounding the proliferation of knowledge work.

[12]The questionnaire used the term "new jobs" rather than "more jobs" in order to emphasise that it is the outcome of change that is in question, rather than say, the normal cyclical demands for manpower. This could, admittedly, be a very fine distinction. Hence, for further evidence, this point is taken up at the occupational level in a slightly different way, through relating specific types of change to reported changes in hiring and turnover.

[13]This result differs from the interim report. There, a slight majority had said no. The change is attributable to sampling variation.

Skills for Performing Jobs

A majority of the respondents indicated that workers need to keep pace with changes, with 53% stating that the frequency of the need arose more than occasionally. However, it is also worth noting that just under half of respondents believe that their workers need to keep pace with change only occasionally, and there are even a few who believe that their workers do not need to keep pace with change.

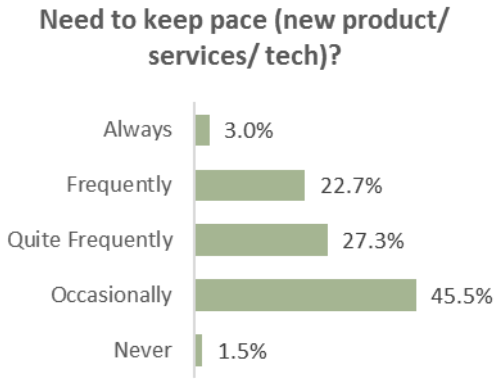


Figure 2.7. Keeping pace with change

We find that larger organisations in terms of 2016 revenue are more likely to require specific training and that the statistical relationship is significant (Kendall's τ_b = 0.2146, p-value = 6%, Somers' d = 0.107, p-value = 9.8%). We also found that belief in job creation is correlated with the need for specific training when placing workers (Kendall's τ_b = -0.2153, p-value = 9.05%, Somers' d = -0.192, p-value = 7%).

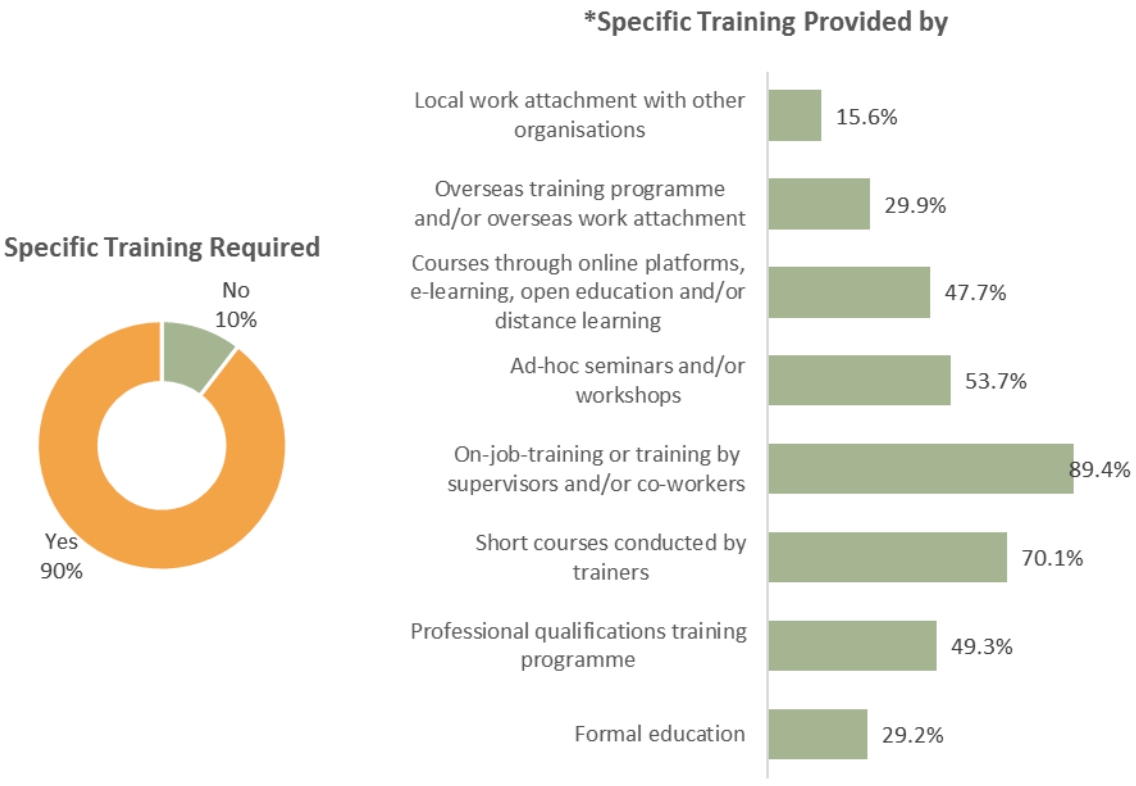


Figure 2.8. Specific training required

More than 50% report very good outcomes from training. This is important because of the amount of resources devoted to training. Unfortunately, related to outcomes from training, we are unable to find any factors which contribute to better outcomes.

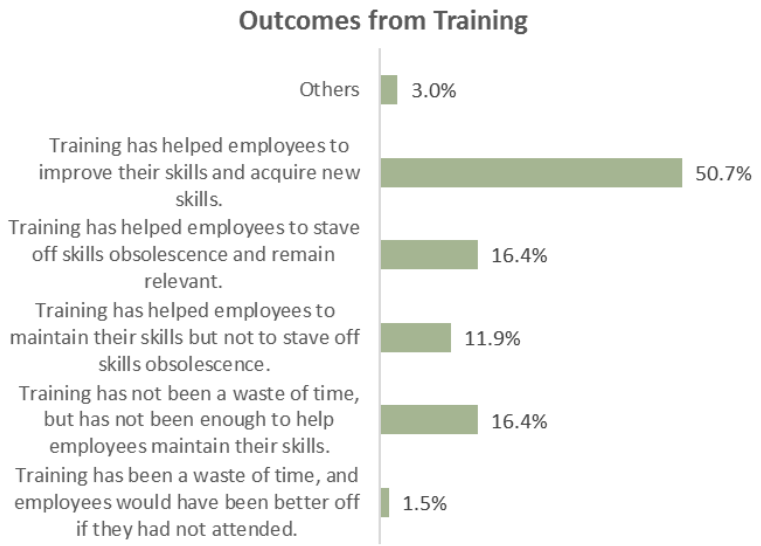


Figure 2.9. Feedback on Training

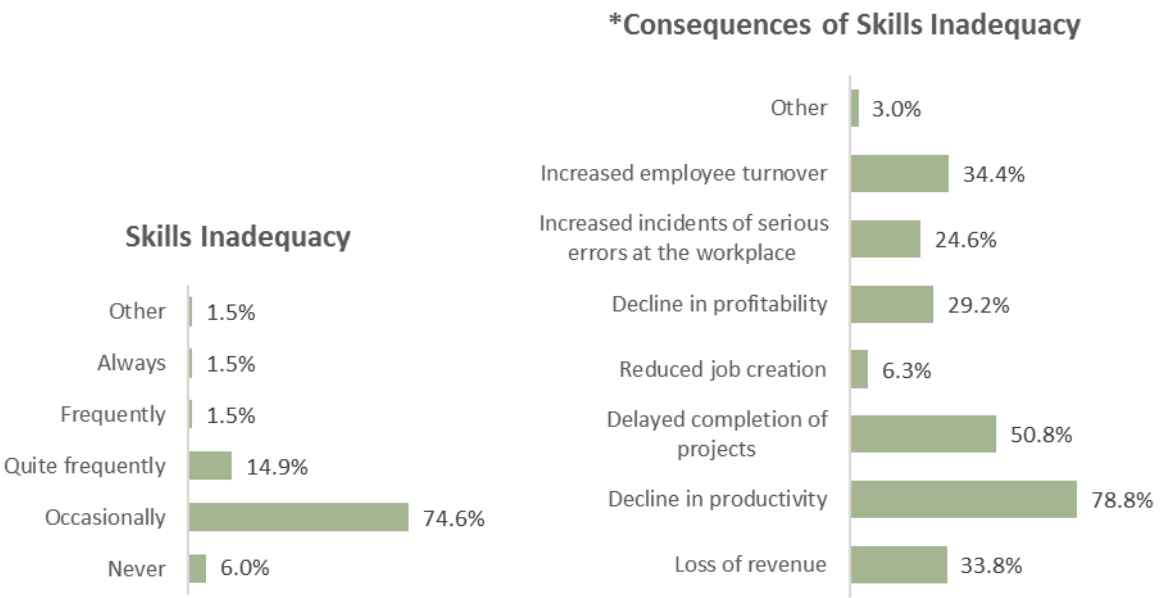


Figure 2.10. Skills Inadequacy

Organisations with better outlook for 2017-2018 are slightly more likely to report inadequate skills in their workforce (Kendall's τ_b = -0.1886, p-value = 11.4%, Somers' d = -0.239, p-value = 9%). Organisations reporting hiring difficulties are also more likely to report inadequate skills (Kendall's τ_b = 0.2533, p-value = 3.6%, Somers'd = 0.304, p-value = 2.8%).

Skills Gaps

Skills inadequacy leads to skills gaps. What are some explanations for the skills gaps that lead to workers being exposed to increased risk from disruption? It is common to hear of the appearance of requirements for new skill sets in a various fields of work and professions. However, there is often a lack of supporting empirical evidence on the extent of the gaps arising from the inability of workers to meet such requirements.

Data on changing skill set requirements are difficult to obtain for obvious practical reasons. The assessment of skill sets is a difficult challenge, and workers who possess strong skill sets may not necessarily always perform well. Similarly, weak skill sets are not necessarily correlated in an observable way with poor performance. Other factors – such as motivation – also play a part. Analysing changing skill sets involves going beyond assessment to measurement of the extent of change. The reason is that in advanced economies such as Singapore, the new challenges are posed not merely by change. They also come from an unexpectedly rapid pace of change and a lack of evenness in this pace.

For evidence on this, we analysed our survey data on reasons for hiring, the experience of, impact from, and reasons for, any hiring difficulties, as well as the impact of technological changes.

Skills inadequacy is one of the types of mismatches that we are interested in analysing in this study. In section 3, we will discuss the possible types of mismatches in greater detail.

Our survey included a question which explicitly asked about solutions to the problem of mismatch. The opinions gathered show that the problem of mismatch takes forms which coincide with the ones already been identified by the leadership of the Labour Movement as well as government agencies. These are a mismatch of jobs (or less ambiguously, a mismatch in placement), a mismatch of skills, and a mismatch of expectations (or a mismatch in expectations about remuneration and/or job requirement). Of these, the respondents selected the last - a mismatch of expectations between employer and worker - as the most common source of disagreement, and proposed solutions to address it[14].

However, the broader evidence gleaned from the responses to this question as well as those about hiring difficulties and skills inadequacy suggest that the problem may have to do with the small size of the labour pool from which employers can draw. The size is relatively small for the state and stage of development of the Singapore economy. To be clearer on this, the increase in the depth and sophistication of the economy over the last decade and a half may also have contributed these elevated needs for more highly-skilled manpower.

To serve as a comparison, other dynamic advanced economies – most notably Hong Kong, Luxembourg and Switzerland – have seen their regional operating environment expand over the same period of time, i.e. since the millennial change. Hong Kong has enjoyed the benefits – as well as the challenges – of an expansion of its hinterland, while Luxembourg and Switzerland benefited from the EU, even though the latter is not a member.

[14]The relevant responses are summarised in Figure 4.1, which is presented in Section 4 in this paper.

In comparison, Singapore's labour market has not achieved a similarly sustainable expansion of the labour pool which could enrich the fount of skills it can readily access and which it naturally demands as an advanced economy.

Our findings show that the changing skills requirements confronting workers in Singapore are not substantially different from those seen in other economies. These are the need to keep up with new technologies such as information and communications technology (ICT), artificial intelligence (AI), robotics in industrial and service applications while having improved communications and team work (soft skills).

The challenge is heightened for Singapore workers because we are a small economy with limited resources competing against advanced economies at the frontiers of technology. As a result, the impact for certain organisations and their workers are amplified. The consequences of being unprepared for change are also, more severe.

From the changes identified above, the key inference we draw is that there is a growing emphasis on knowledge work, and this growth will continue to strengthen. Unfortunately, organisations seem to think that this is also where Singapore workers are least prepared.

Good Hiring Prospects in Next Two Years

Overall, 43% of the organisations reported recent increases in the size of their workforce. A similarly substantial minority anticipate continuing growth in manpower needs, with 41% expecting their workforce to increase in the next 2 years.

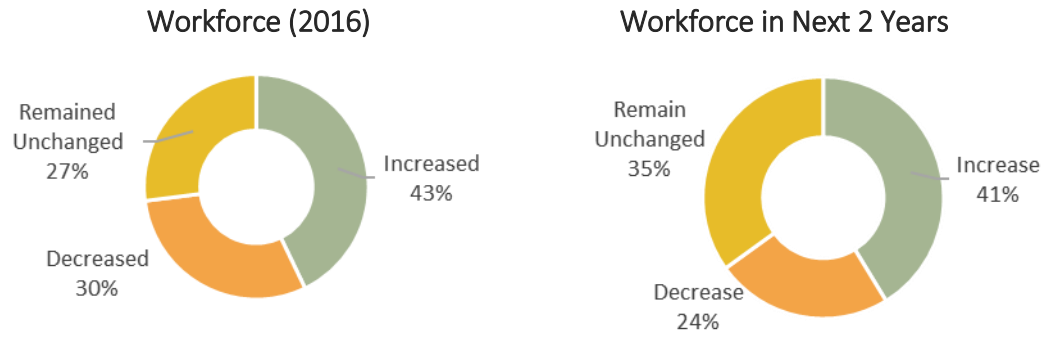


Figure 2.11. Workforce now and next 2 years

In order to identify growth industries with bright hiring prospects, we look at those industries which indicate they expect to hire up to 2018 and who believe that their business outlook will improve through that horizon. In addition, we also consider the organisation's top reason for hiring. Most organisations[15,16] identify replacement of existing positions as the top reason, but a minority identified future needs, such as business expansion and new skill requirements.

Even with the slack in the labour market, we find growth areas in about a quarter of organisations who responded, indicating robust prospects coupled with strong hiring needs in the next two years. Among these, the largest employers are in public transport and advanced manufacturing and the skills in demand are technical and engineering in nature. Apart from that, organisations with smaller workforces but in need of skilled manpower are those in Cloud Software Services, and the Creative industry. This is more evidence that technological needs are driving a strong demand for technical and high-level professional skills in these areas.

Another area in which respondents project manpower hiring to be strong in the coming two years is Cleaning Services. However, the positions that respondents report continued hiring needs for, such as cleaning staff, have seen shortages of manpower because of weak prospects and hence, a lack of interest among resident job-seekers. Given that low-paying low-skilled jobs are likely to see the most significant transformation, this is unlikely to be an area of positive development in the long term for workers who are unprepared for change.

[15]The results in this report have not been adjusted for deviations from the population profile. Consequently, sample descriptive should not be used as estimates of actual population parameters. In this case, this means that the actual reasons for hiring for all organisations in Singapore may not be due to the same reason as discovered in the sample. Refer to Appendix C for a cautionary note about interpretation.

[16]Despite not being weighted, our checks for robustness suggest strongly that the sample is broadly representative of the actual population of companies. The first type of checks is re-estimation after random exclusions of observations. This has shown that the results remain stable with small but not substantial change. An example of a case where a change did occur was noted in Footnote 13. The second type of check involved a comparison with estimates derived using trial weights to correct for the over-sampling of manufacturing companies. The results remained virtually unchanged. More detailed weights cannot be reliably derived because of the small sample sizes in each sub-sector. Although the sample count of respondents is small, the total number of workers their responses cover is very significant. Hence, instead of relying on what would amount to subjective weighting, our analysis and modelling rely on company and occupational group level covariates. Appendix D compares the estimates of selected key statistics from the unweighted sample with those derived from a weighted sample using trial weights. The trial weights used in Table D2 are umber of taxable companies in Services and non-Services categories, obtained from the Singapore Yearbook of Statistics 2016, (published by the Singapore Department of Statistics).

The conundrum facing such sectors is that in order to prepare themselves to make the switch to more efficient less labour-intensive operations, the process of change is exceedingly complex. The decisions and reconfiguration of processes needed take time. Meanwhile, such organisations face significant daily operational issues with insufficient manpower. On the other hand, the longer the heavy reliance on manual labour continues, the more delay there will be in implementing technological improvements that are necessary to meet the long-term needs for cleaning. To-date, the conventional profile of the workforce in this area – older as well as low-skilled – suggests that preparing and training for technological improvements would require heavier investment than the short-term returns could justify. Nonetheless, the Progressive Wage Model that was initiated by the Labour Movement in 2012 should already have begun to provide a much-needed price signal to workers in this area about what the changing skills requirements entail.

Challenging Hiring Prospects: Next Two Years

The main sectors in which jobs are already facing disruption are Financial Services, Real Estate Services and organisations in the OPEC cluster. In Financial Services, for instance, there are new jobs being created but they are very different from those which are being rendered obsolete. New positions require much higher levels of technical skills and technological competency and are essentially different from the ones being replaced. The intensity of the change has been exacerbated by economic conditions.

Next, sectors such as Accommodation and Food Services (i.e. Hotels, F&B), the Cleaning Services industry, and Security Services industry expect to see greater impact from use of technology introduced to deal with the manpower crunch and address the manual nature of these jobs. The problem in these industries is that they still demand large number of workers even as the change is occurring, and training for this workforce to work in the transforming workplace is not an easy challenge, because it depends on mind-set of the workers and organisations. It would also be reasonable to expect some lag between completion of training and the reaping of the full benefits from that training.

Ironically, the very technology that is introduced to remove the manual aspect of some of these jobs may pose a technological challenge to the very workers they are seen as being introduced to help. Workers who cannot fit into the reconfigured process face displacement. It is managing such complexities of technological change that is part of the disruption.

Finally, sectors such as Childcare and Healthcare will require workers with more advanced skill sets and better training. This is because more technology is gradually being introduced at the same time that elevated standards of training and professionalism are being implemented to meet the higher standards of care needed when working with vulnerable clients.

In summary, there are few sectors which are not at risk of disruption. And in a sign of the heightening risk due to a lack of preparedness, some responses suggest that it is not possible for organisations struggling with the heavy demands of their daily operational workload to take time to understand and implement long term plans to adjust to the impending changes.

This could be an area where empathy and support from an informed tripartite leadership will make a difference.

One important result we found is that *respondents from larger organisations are more inclined to believe they would create new jobs following the introduction of new technologies*. The result is statistically significant. Although the sample of organisations is limited, this result is not surprising and echoes a popular view that larger companies, such as MNCs, usually fare better than SMEs.

This result is highly relevant to policy formulation. It supports the view that SMEs deserve to be targeted for special attention in the ongoing restructuring. For example, in recent years, several government policies – such as financial subsidies for promoting productivity improvements - have been adjusted in favour of smaller organisations.

Flexible Work Arrangements

In general, employers are willing to try out flexible work arrangements (FWAs) but they do not display any initiative in developing innovations to facilitate the take-up of such arrangements. Those who do not offer FWAs cite work processes. This suggests a lack of forward planning initiative in catering to the needs of a future workforce.

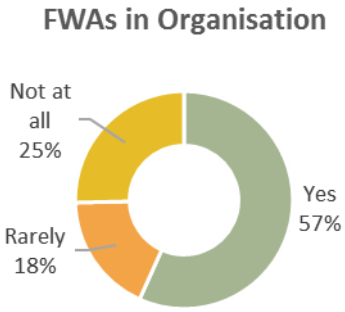


Figure 2.12. FWAs

Although the majority of respondents indicate their organisations offer FWAs, the most popular form – part-time work – is understood to involve a reduction in pay, and may not be attractive to workers.

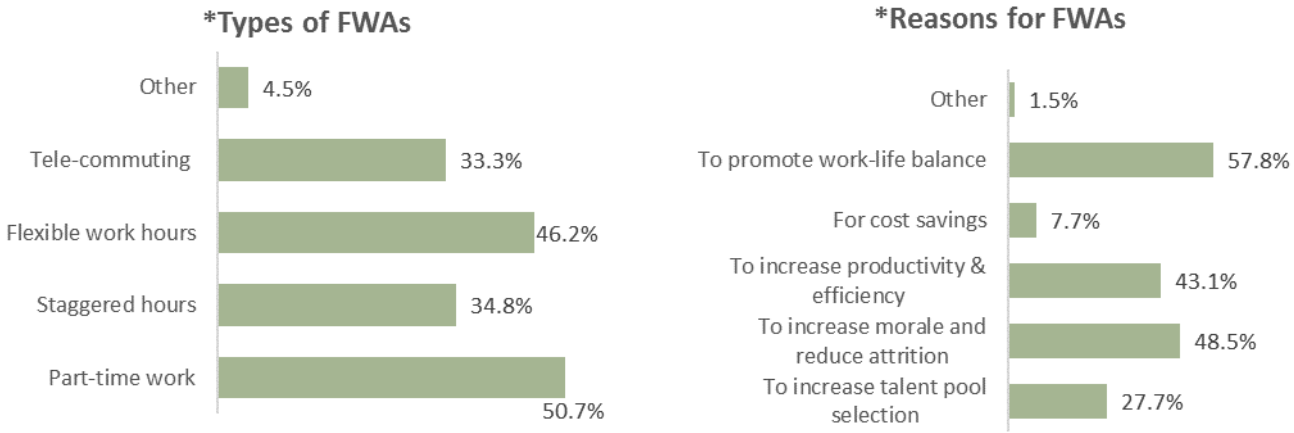


Figure 2.13. Types of flexible work arrangements

In general, the existing FWAs appear to be guided very much by government initiative. There are no responses which suggest a strong employer-driven momentum to effect change in the workplace beyond the alternatives promoted by government policy and persuasion.

For organisations not currently offering FWAs, only a minority are keen to consider adoption in the near future.

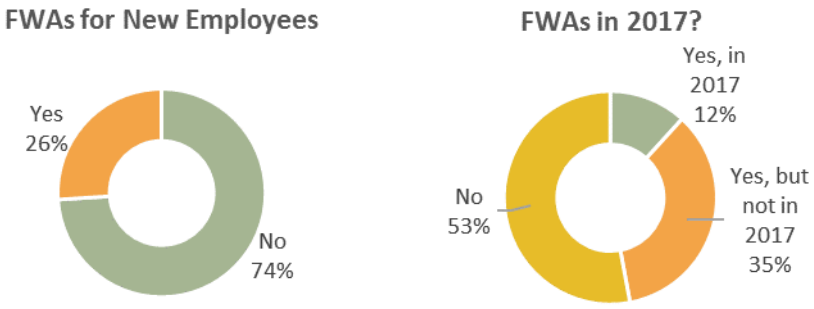


Figure 2.14. Introduce flexible work arrangements?

While Figure 2.13 shows the flexible work arrangements (FWAs) offered by organisations, we also received responses on the actual use of FWAs at occupational group level. Flexible work hours is the top most popular type of FWA used. This is followed by part-time work (second), tele-commuting and staggered work hours. For PMEs, tele-commuting is second most common after flexible work hours. Tele-commuting is also used by Associate Professionals, Sales Personnel and Service Personnel but to a much smaller extent as compared to PMEs.

These responses suggest that it is the nature of work, rather than the occupational levels themselves, which affect FWAs. In Section 6, we will discuss knowledge work in more detail. One of the characteristics of knowledge work is that it can be designed in such a way as to be less tied to physical location, and more adaptable to tele-commuting. As more and more jobs require knowledge work – something which we explain in Section 6 that we expect to occur – more attention will have to be given to configuring work processes to ensure workers perform such work effectively. This includes enabling better-designed FWAs which can contribute to improved work performance.

Section 3. Mismatches

The discussion in the last section was confined to responses at the organisational level. In this section, we looked into the responses provided by each respondent at the occupational level. A respondent may provide responses for more than one occupational group.

Despite the progress made in the study of unemployment, the question of how multiple factors contribute to a mismatch is still an open question. The available literature has examined matching efficiency as well the mechanics of successful matching, but there is very little evidence on the anatomy of matching, or the possible types of mismatches[17].

Compared to the general concept of labour market mismatch, the idea that there are differing and specific types of mismatches is relatively less well-defined.

More recently, in a development which appears to be driven – as well as facilitated - by the increased focus on vocational education and training there has been growing emphasis on studying mismatch through the direct measurement of skills[18]. There are important advantages to this approach, not least of which is that it could allow for the effects of education to be distinguished.

As the targeted respondents are responding on behalf of their organisations, their answers will be based on the overview of the manpower situation obtained from the perspective of HR operations. Such operations relate mainly to hiring, turnover and training.

Unlike the OECD's survey of adult skills which targets workers, the European Centre for the Development of Vocational Training (Cedefop) carries out surveys of which target employers. Cedefop's aim is to analyse skill demand, supply and skill mismatch. Our approach takes reference from Cedefop's.

[17]The convention usually adopted in published evidence on mismatches is to compare active job-seekers, proxied by the unemployed pool of workers, to job vacancies. This is the approach taken in the analysis of Beveridge curves (refer to Valletta, R. G. (2005), "Why Has The U.S. Beveridge Curve Shifted Back? New Evidence Using Regional Data." Working Paper Series 2005-25, Federal Reserve Bank of San Francisco).

While the Beveridge curve can provide information about changes in the efficiency of job matching, it cannot really reveal much else in the absence of further information. If successful matches are also observable, it is possible to go further and examine the so-called matching function. Nonetheless, as some have noted, such an approach essentially still leaves the underlying reason for the lack of a match unresolved (refer to Mortensen, D.T., Pissarides, C.A. (1999). "Job reallocation, employment fluctuations and unemployment" in: Taylor, J.B., Woodford, M. (Eds.), Handbook of Macroeconomics, vol. 1B, North Holland, Amsterdam, for more details).

[18]Refer to Desjardins, R. and K. Rubenson (2011), "An Analysis of Skill Mismatch Using Direct Measures of Skills", OECD Education Working Papers, No. 63, OECD Publishing. http://dx.doi.org/10.1787/5kg3nh9h52g5-en.

In many countries, especially advanced economies, the increase in structural unemployment is occurring together with growing reports of difficulties faced by employers in finding suitable workers to fill certain positions. This is often interpreted as evidence that the problem of skills deficits is worsening. The efforts put into skills measurement pave the way for producing forecasts of the future demand and supply of skills.

In order to be able to derive evidence about the state and development of mismatches, questions were designed to make comparisons about the past (going back to 2015) and the near future (extending to 2018) on hiring, turnover, skills adequacy, training and job requirements.

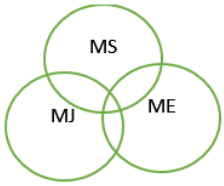
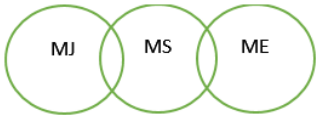
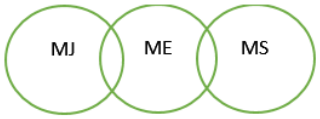
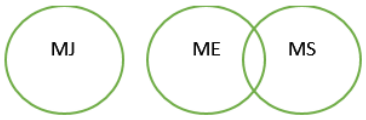
As explained in Section 2, we distinguish two aspects about the hiring activity of organisations. The hiring rate is inversely related to mismatch of jobs while hiring difficulty is directly related to mismatch of expectations. As explained in the following paragraph, the different types of mismatches could be expected to overlap, if only because our characterisation of each type is a working definition. As it turns out, in our results, hiring rates and hiring difficulties are found to be unrelated. This is true for the current situation as well as for the expected situation in the near future. This is a minor but noteworthy empirical result. It implies that the design of these two questions have been successful in separating the two forms of activity. This will enable us to distinguish differences in the types of mismatches, something which the results later in this section demonstrate.

It is important to reiterate at the outset that the approach we take is heuristic. In particular, there is nothing in the literature that prescribes a limit to the number of possible types. Further, what we refer to as a mismatch of jobs may well be interpreted as a mismatch of expectations. Nonetheless, our questions have been structured with three aims in mind. First, taken together, they cover what we considered to be a sufficiently wide range of possible types of mismatches. Second, by juxtaposing observed phenomena from those that are expected but not yet observed, we can compare consistency of interpretation. Finally, the questions do not contain explicit references to mismatches. This means that whether the respondents identify mismatches at all is not pre-specified. These caveats should be kept in mind when interpreting the results. The technical analysis of mismatches using the survey questions can be found in Appendix A, Part 1. The Appendix explains the empirical basis upon which the different types of mismatches are identified from responses to selected survey questions.

Based on a working definition of three possible different types of mismatches as seen from the perspective of hirers, our results show that the profile of mismatches differ both between Services and Manufacturing, as well as between the recent past and the near future. The complete resulting topology of mismatches is presented in Table 3.1.

Table 3.1 depicts graphically the situations in which the different types of mismatches occur at the same time in organisations in the sample or a sub-sample. It also depicts whether – from the perspective of the organisations – the relationship among the different types of mismatches is expected to change.

Table 3.1. A typology of mismatches

Case	Graphical Representation	Interpretation	Applicable sectors and timeframe	Matrix of pairwise relations
1		Each type is related to every other type.	Whole sample for expected future mismatches Services sector for expected future mismatches	Table A5[19] Table A9
2a		None is completely independent	Whole sample for past mismatches. Services sector sample for past mismatches	Table A4 Table A8
2b			Manufacturing sector sample for past mismatches	Table A6
3		One type is completely independent of the rest.	Manufacturing sector sample for expected future mismatches	Table A7
4		All types of mismatches are independent of one another.	Not observed	Not applicable

Notes:
MJ denotes mismatch of jobs
MS denotes mismatch of skills
ME denotes mismatch of expectations

Case 1 represents the situation when there is no distinction at all among the types of mismatches. At the other extreme, case 4 represents the situation when all the possible types of mismatches are distinct. The outcome shown in case 4 is not observed.

Cases 2a and 2b are not regarded as distinct. With case 2a, when addressing the management of workers by occupational groups, respondents experience the current challenges of expectations and jobs mismatches as distinct issues which do not overlap. Case 1 is a situation that is expected for the future. Hence, it depicts the fact that for the samples in question, the distinction between the two types of mismatches tends to blur when respondents talk about the near future up to 2018.

[19]Refer to Appendix A, Part 1 for Tables A4 – A9

The differences in the way mismatches are seen for Manufacturing and Services sectors can also be depicted as follows:

	Past experience	Expected
Services	Case 2a	Case 1
Manufacturing	Case 2b	Case 3

There are clear advantages to being able to verify that differing forms of mismatches that arise in the labour market. From a policy perspective, the identification of possible differences between types of mismatches provides an insight into the structure of how mismatches in the labour market develop. A better understanding could open the way to potential solutions to the labour market challenges which arise from mismatches, such as structural unemployment. From unionists, an understanding of mismatches could facilitate the targeting of strategies customised to the type that a worker is affected by.

On the other hand, it may turn out that even if mismatches do vary by type, they could have a complex typology, in the sense that more than one type of mismatch could affect an individual worker simultaneously. If this is so, it would still be useful to learn about it as it would contribute a better appreciation of why the problem appears so intractable.

Our results are of the latter form. It shows that there are different types of mismatches that can be identified from the responses of hiring managers about the past. When respondents are asked about their expectations for the near future, i.e. up to end-2018, there is a divergence between sectors. For Services, the different types of mismatches tend to overlap more and therefore, may not be distinctly identifiable, when referring to the future. For Manufacturing, however, the opposite appears to be true, i.e. more clarity rather than less develops when talking about future expectations.

In summary, our results support the view that mismatches can take different forms. We find that the relations between the types of mismatches differ between Manufacturing and Services. We also find that the relations between the types of mismatches vary depending on the timeframe of reference.

What we cannot be certain about is whether the distinctions between the different types of mismatches are fixed or whether they shift.

Section 4. Dealing with Mismatches

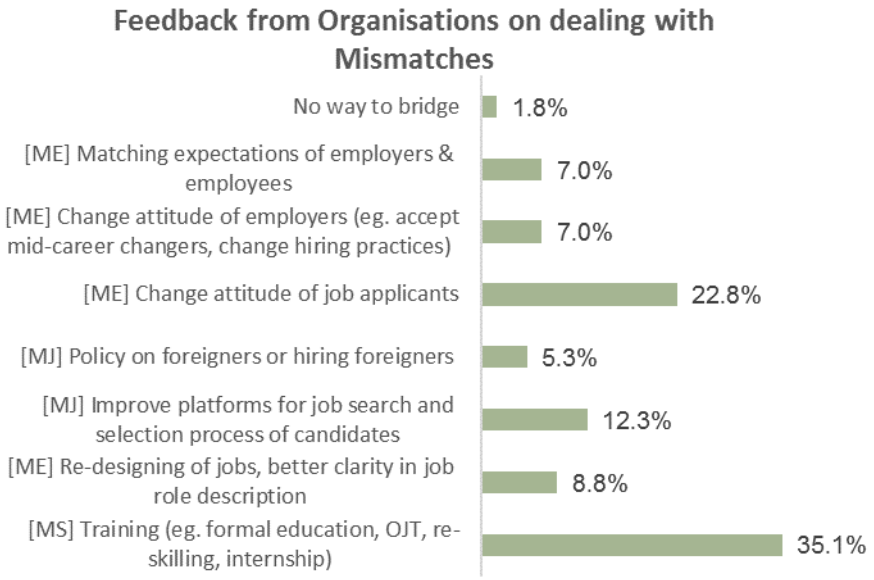


Figure 4.1. Feedback on mismatches

85.1% organisations provided feedback on how to tackle job mismatches. Of these 35.1% felt training is important, while another 36.8% felt that attitudes of either the employer or employees have to change to improve the situation. 1.8% of the respondent felt it is impossible to tackle as the extent of mismatch has exceeded that which training can help to bridge.

The ultimate objective of developing a typology such as that shown in Table 3.1 is to explore the potential for solutions to the problem of mismatches. In this sense, the main result that is of greatest potential applicability is the difference in the pattern of mismatches between Manufacturing and Services.

The Manufacturing sample shows that mismatch of jobs and mismatch of skills (as represented by responses to the designated questions) are distinct. The distinction also remains consistent over time. In order to be certain that this distinction can be employed in policy intervention, it would be necessary to obtain further confirmation through studies of job-seekers. Such a distinction could imply, for instance, that the two different types of mismatches may be tackled through intervening in skills training and placement efforts separately.

In contrast, the case of Services is much less clear. It is not even certain if there are different types of mismatches occurring in the Services sector. This is a major challenge for policy makers, in view of the large proportion of the workforce in this sector.

The results suggest two principles that should be kept in mind in addressing mismatches. First, as policy solutions are forward-looking, when addressing future issues, policies dealing with mismatches should avoid typifying the phenomenon at the macroeconomic level. Doing so would narrow the perspective too much because the ability to discern the different types of mismatches when looking into the future is limited.

Second, when addressing problems of individual mismatch at any point in time, it may be possible and useful to identify which form of mismatch a particular job-seeker is affected by.

Although the two recommendations could appear to be in conflict, they are quite different in terms of the level and timeframe they are targeted at.

Section 5. Skills Gaps, Hiring and the Effectiveness of Training

We find that larger organisations tend to prefer formal qualifications as the foundation of their hiring approach. At the same time, we also find that organisations depend heavily on on-job-training (OJT) as the main form of training, and have found it to be beneficial. Finally, we find that organisations tend to regard their skills challenge as a hiring issue, in the sense that they expect to hire in order to fill skills gaps.

Although seemingly contradictory, taken together, they could be explained by concerns about the adequacy of training provision that is currently available as well as by the range of training arrangements they can access without compromising operating needs.

If organisations rely on OJT for training, they could be hiring candidates on the basis of formal qualifications simply because they are using educational attainment as a predictor of likely performance in OJT.

OJT is clearly important, and by itself does not indicate if an organisation lacks forward thinking about future jobs. However, the fact that OJT and short courses receive much more attention than other sources of specific training, taken together with the result which shows organisations treating skills inadequacy as a hiring – rather than a training – challenge, suggests strongly that there may be a lack of recognition and/or a lack of reliance on effective training.

If this is allowed to persist, it could put preparation for future jobs severely at risk. Clearly, when talking about preparing for future jobs, it should not just be the quantity of training but the quality and depth that count. The problem with an over-reliance on a static approach rather than a strategic range of options is that it could expose organisations to training gaps in future.

In fact, some evidence of that is already observable. Anecdotal evidence suggests that organisations have been affected by their workers leaving after having received in-depth training.

From the organisation's point of view, OJT does not merely incur an implicit cost, it may affect ongoing operations if the frequency has to be increased in order to deal with turnover. In response, organisations may tighten their hiring criteria to require some form of "loyalty". Familiar but often criticised terms for such purposes include a bond period.

On the other hand, workers may interpret such hiring preferences in negative terms, such as discrimination (e.g. older workers and receptivity to training). As this is a problem which could impede workforce development, intervention from government and unions is needed in order to prevent a vicious cycle from emerging.

Singapore's Unique Circumstances

The problem with the small pool manifests itself in several ways. In training, for instance, some comments have noted that a basic class size is needed without which training would not be cost-effective. Again, this would particularly hurt smaller organisations if they train only one or two new hirings.

If the issue is not addressed, it will lead to greater preference for short-term opportunism from both businesses and workers. Employers will become even more reluctant to invest in deep training while workers will become sceptical of investing long-term effort on behalf of their employers. At an extreme, this would in turn exacerbate even worse mismatch in future.

A trust in the effectiveness of relevant training should be a shared investment from both workers and employers. Smaller organisations need special assistance to address the training challenges due to their much smaller workforce size.

The relationship between expected development of skills inadequacy over the next two years and benefits from specific training for the individual occupational groups is examined further using a Structural Equation Model. The details can be found in Appendix A, Part 2.

Section 6. Profiling Workers At Risk

The results of the preceding sections are used to develop a profile of workers who are at risk from disruption due changes in demand for skills and jobs. The exposure of workers to risks is assessed in terms of their skill sets, training needs and work motivation from the perspective of the respondents.

Our findings show that the workers most at risk are those who are unable to adapt to demands for knowledge when these are introduced or increased.

The Future of Work Revisited

A comparison of our findings with those from the widely cited 2016 World Economic Forum (WEF) report on the "Future of Jobs" throws up interesting parallels and differences. Among technological drivers of change, the WEF report identified "mobile internet and cloud technology" as the leading ones.

Our findings agree with this, but also identified "automation of knowledge work" as being an equally important source of change.

Knowledge Work

What is 'knowledge work', how is it relevant to the rank and file, and why does it pose such a challenge to organisations as well as workers? To paraphrase Peter Drucker[20], whose 1959 book is widely recognised for coining the term "knowledge worker", knowledge work is achieved by exerting mind rather than muscle.

In terms of this definition, it can be seen that in an advanced economy like Singapore's, the entire spectrum of work has been undergoing change. There remain few niches within our labour force where a worker can satisfactorily perform by labouring through physical effort.

To take an example, in modern workplaces, efficiency means that even heavy lifting requires the individual worker to acquire technical competency to interact effectively with lifting equipment, and deploy them safely within densely populated and tightly built-up settings. By virtue of the decision-making process involved in deploying such machinery, in modern heavy lifting, muscle power is gradually receding and giving way to the idea that at least a small amount of knowledge work is involved.

This is not an isolated example. In Singapore, for instance, the deployment of intelligent ordering and cashless payment systems at food and beverage outlets is another. Knowledge work is – ultimately – a decision-making process about how to improve the performance of the task at hand with technology and is no longer the exclusive domain of creative workers, the white-collared or top management.

[20]The Landmarks of Tomorrow (published New York: Harper and Row)

But the myriad situations in which workers have to make the leap presents both training and mind-set challenges that have yet to be completely overcome.

Our findings show that while organisations are not averse to making the change, what could be impeding them is the fact that they are confronting a challenging operating environment and may not have the expertise to properly evaluate the cost-benefit trade-off in making the strategy shift with their workforce.

This may possibly also explain why they prefer taking bite-sized training, rather than commit their workers to deeper and more extended forms of training. If the future is apparently so uncertain, what is there to guarantee that the solution will not be fraught with the same uncertainty?

But knowledge workers are not immune from disruption. Indeed, depending on the type of work they perform, unless they upgrade to more complex forms of knowledge work, they may be more exposed.

The reason is obvious, and has already been touched on by the literature on jobs polarisation[21]. There are different types of knowledge work, which differing degrees of sophistication. The most routine forms, such as information retrieval and basic processing, are also the most readily automated with modern information technologies.

PMETs As Knowledge Workers

One characteristic of knowledge work is the need to make decisions, to use information and data to contribute to such decisions ("interpretation"), and to have some technical skills in gathering and assembling such data and information.

The challenges posed by the growth in "knowledge work" extend beyond the workers themselves, and is also a challenge for supervision. Supervising the performance of knowledge work is difficult for those who are struggling with knowledge work requirements themselves.

Seen in this light, it becomes apparent why Financial Services is at the frontline of jobs disruption. The fundamental knowledge work that underlies Fintech such as blockchains is data science (by which we mean database programming and analytics). Blockchains rely on dynamic databases which can be efficiently maintained and accessed using techniques of data science.

[21]See, e,g., Autor, 2010, "The Polarization of Job Opportunities in the U.S. Labor Market: Implications for Employment and Earnings", Center for American Progress, www.americanprogress.org

Beyond Financial Services, the growing demand for knowledge workers also clarifies the reasons for the greater visibility of the impact on PMETs in general. In Singapore, they now account for the majority of the workforce. Another reason is that PMETs, unlike other occupational groups, are expected to perform "knowledge work", having been the original pool from which knowledge workers are drawn. As such work has been growing in importance within a PMET worker's scope of duties, the challenges that technological change caused in such work is more immediately felt by PMET worker.

In other words, while our findings show that organisations are increasingly demanding that all workers have some capability to handle knowledge work, PMETs are at the front line and therefore, hit first by this heightened requirement.

Overcoming risks through training

Our findings show that training has an important bearing on skills mismatch. The natural question that follows is whether any change to the existing approach to training is called for. Singapore sees significant investment in training at the institutional, organisational and individual levels. This is not a recent development, having been a feature of the skills and manpower framework in Singapore for decades. Early important milestones in training provision include the Basic Education for Skills Training (BEST), Worker Improvement through Secondary Education (WISE) programmes and Skills Programme for Upgrading and Resilience (SPUR). A more recent one was the SkillsFuture for Digital Workplace (SFDW). These programmes intervened at critical points of workforce development in Singapore.

SPUR, for instance, was a massive investment which commenced just before the trough of the deepest recession in Singapore's economic history. Its timing was critical. As it turned out, Singapore rebounded in 2010 with a workforce primed for recovery activity. The size, timing and targeted nature of SPUR, including its expeditious withdrawal, triggered a momentum which paved the way for the subsequent half decade of labour market strength. For the average worker, that produced a tightness in the jobs market which accelerated average wage growth until fairly recently. The close connection between skills and manpower issues in our results should be interpreted in the context of such experience. Although training will always be necessary, it is important to inject nimbleness into the management of training resources, and ensure that continued prudence guides the timing and dispensing of such resources.

This observation would be relevant in deciding between depth or breadth of coverage when providing training. Deep training customised to individual needs is administratively more costly but also inherently more flexible. Overly broad-based training designed to address overall workforce needs may lack the penetration required to deliver the edge needed to overcome the technological disruption that confronts organisations competing at the technological frontier. A multi-faceted framework for training designed to meet a variety of special industry needs could be put in place for the next phase of economic development. The connection of training to skills inadequacy, when taken together with the accelerating changes in skills requirements, would therefore suggest that going forward, a broad policy framework without overly uniform application of training need will be required.

Section 7. Conclusion

In general, the results show that respondents are pre-occupied with the prevailing manpower and economic situation. Consequently, they do not display a clear focus on the challenges that longer term skills gaps in their workforce may bring. Their responses suggest a reliance on government policy to address such longer-term problems arising from changes in skills, as well as others arising from changes in jobs, such as the promotion of innovation in workplace re-design.

Following from this, organisations also face challenges in training their workers effectively to keep up with the changing skills. They appear to turn to hiring as a solution, indicating that organisations tend to see their skills challenges as challenges of hiring.

We find that the effectiveness of training in promoting skills development in an organisation's workforce may be confounded by employee turnover. Simply put, organisations are concerned about investing in training for workers who subsequently leave. At the moment, this is already being addressed to some extent through the use of targeted wage support to incentivise job placement in schemes such as the Professional Conversion Programme (PCP) and Career Support Programme (CSP).

The findings also suggest that having the right skills set will become increasing important for workers, in the sense of being of value in helping organisations confront the challenges of disruption and advancing technology. To be of value to their organisations, individual workers should focus on the acquisition of skills sets that are relevant to job market and business needs. The training should also be worker-centric as much as being organisation-centric. In this regard, organisations which have their pulse on the needs of workers, especially unions, could take the lead both in promoting acquisition of skills that are in demand and in advocating for appropriate and high-quality training provision to be made available.

To provide further support, a concerted tripartite effort can be made to help all organisations view the training effort more broadly in terms of the overall economy's gain from better training for all workers, even if such trained workers do leave for other employers.

We also examined mismatches. Based on a working definition of three possible different types of mismatches as seen from the perspective of hirers, our results show that the profile of mismatches differ both between Services and Manufacturing, as well as between the recent past and the near future.

Organisations would need to be prepared to deal with changing and evolving types of mismatches in the labour market. At the macroeconomic level, mismatches are a likely to pose increasingly difficult challenges for labour market policy. For an individual worker, if a problem with one type of mismatch is not addressed, it can easily develop into another type over time. In severe cases, such a worker could add to the ranks of the long-term unemployed. We developed a typology of mismatches and used it to describe how potential guiding principles for policy to dealing with the problem may be designed.

Organisations face a mounting challenge with knowledge work. Organisations are increasing their reliance on almost all of their workers to perform some sort of knowledge work. Organisations are also increasing their hiring of workers trained in knowledge-related fields, and reducing their hiring of those who do not do such work.

Knowledge work could include handling data and information needs, as well as managing the vast accumulation of data organisations gather in the course of their operations. Given the advance pace of knowledge work, there is a need for such workers to keep their skills current. Hence, one of the main concerns of organisations is about skills obsolescence of such knowledge workers.

Knowledge work is no longer just the domain of the select few. All jobs of the future will require some form of knowledge work. Workers in all occupational groups should be encouraged to improve their long-term labour market viability by using opportunities to improve job performance through the application of knowledge-based skills. Employers should also be encouraged to see knowledge capabilities from the perspective of individual workers.

Finally, the responses reveal that while all organisations face changing needs in skills and jobs, each recognises and deals with these changes differently depending on its priorities and the business conditions it faces. The use of averages to describe a typical organisation is not very representative, and it would be more useful to examine a composite of the challenges organisations face.

APPENDICES

APPENDIX A

Part 1: Analysis of Mismatches

For purposes of exposition, we will name and discuss each measured variate in association with a type of mismatch, but this study is unable to state that the naming convention is conclusive, only that more than one type of mismatch can occur.

There are six pairs of questions. In each pair, the first question asks about the current or recent past in an area of manpower-related challenges, while the second asks about expected developments in that area through 2017-2018. The second question in each pair amounts to asking the respondent to make a prediction. The implication in the design is that the respondent would be comparing the recent past with the future in answering the second question of each pair. Details about the six pairs of questions and the correlations between each pair are presented in the following three tables.

The questions in Table A1 are about mismatch of jobs (abbreviated MJ in the question code), with a distinction made between responses about the recent past (denoted by "Past" in the question code) and the near future (denoted by "Fut" in the question code). A similar coding scheme is used to identify questions about mismatch of skills (MS) and mismatch of expectations (ME).

Table A1. Survey questions on mismatch of jobs (MJ)

Question	Response options	Kendall's τ_b	p-value	sample size
(MJ1Past) compare hiring rate of 2015 to that of 2016	1 "No hiring in 2015" 2 "Significantly lower" 3 "Lower" 4 "Similar" 5 "Higher" 6 "Significantly higher".	.129*	0.036	198
(MJ1Fut) compare the expected hiring rate of 2017-2018 to that of 2016	1 "No intention to hire in 2017-2018" 2 "Significantly lower" 3 "Lower" 4 "Similar" 5 "Higher" 6 "Significantly higher".			
(MJ2Past) compare the turnover rate of the period 2015 to that of 2016	1 "No turnover in 2015" 2 "Significantly lower" 3 "Lower" 4 "Similar" 5 "Higher" 6 "Significantly higher".	.280**	0	188
(MJ2Fut) compare the expected turnover rate of 2017 -2018 to that of 2016	1 "No (expected) turnover in 2017-2018" 2 "Significantly lower" 3 "Lower" 4 "Similar" 5 "Higher" 6 "Significantly higher".			

*Note: In this and following two tables, **, * indicate correlation is significant at the 0.01 level (2-tailed), or 0.05 level (2-tailed) respectively.*

In terms of describing mismatches, the six questions have been divided into three groups. The first group of questions relate to the amount of hiring and turnover. When taken together, these can reveal challenges with filling existing positions. The second group of questions relate to the skills situation, in terms of adequacy and training. When taken together, these can reveal challenges with obtaining the required skills from the workforce. The remaining group relate to challenges in meeting standards in hiring (hiring difficulties), and on the job. These tell us something about the extent of disagreement between job-seekers and hirers when there is a lack of fit due to something other than a skills issue. In that sense, we take this group to be a proxy for mismatch of expectations.

Table A2. Survey questions on mismatch of skills (MS)

Question	Response options	Kendall's τ_b	p-value	sample size
(MS1Past) rate the adequacy of training provision currently available	1 "Very poor" 2 "Poor" 3 "Acceptable" 4 "Good" 5 "Very good".	0.119	0.088	193
(MS1Fut) how demand for specific training is expected to change over 2017-2018	1 "Decrease" 2 "Remain unchanged" 3 "Increase".			
(MS2Past) rate severity of the skills inadequacy that currently exists	1 "Mild" 2 "Moderate" 3 "Severe" 4 "Extremely severe".	0.13	0.123	122
(MS2Fut) how the problem of skills inadequacy is expected to develop over 2017-2018	1 "Significantly improve" 2 "Improve" 3 "Remain unchanged" 4 "Worsen" 5 "Significantly worsen".			

Tables A1 to A3 also present the value of Kendall's τ_b for each of the six pairs and the corresponding p-values. These show that the questions designed to indicate mismatch of skills have the weakest relations between responses for the recent past and the near future. The weakest relation is between MS2Past and MS2Fut, which ask about skills inadequacy in the past and how it is expected to develop up to 2018.

In the analysis of mismatch, the approach to measurement is often dictated by the ability to observe gaps between the supply of, and demand for, required skills. For example, Arpaia and Turrini (2014) distinguished mismatch by skill, sector and region in their estimation of the Beveridge curve[22]. However, what they refer to skill mismatch is not clearly distinct from jobs mismatch. This subjectivity is something we should be prepared for when interpreting the responses to our survey questions. Arpaia and Turrini's (2014) example also raises the question of whether mismatches by sector and region correspond to Singapore's context, and if they do, whether they are equivalent to the types that have been mentioned. Although our analysis does not provide complete answers to such questions, our motivation is to explore the use and importance of making such distinctions.

Table A3. Survey questions on mismatch of expectations (ME)

Question	Response options	Kendall's τ_b	p-value	sample size
(ME1Past) severity of the current hiring difficulty	1 "Light" 2 "Moderate" 3 "Severe" 4 "Extremely severe".	.508**	0	107
(ME1Fut) how the difficulty in hiring is expected to change over the next two years	1 "Significantly improve" 2 "Improve" 3 "Remain unchanged" 4 "Worsen" 5 "Significantly worsen".			
(ME2Past) rate the extent of the need to keep up with new technology/ products/ services	1 "Light" 2 "Moderate" 3 "Heavy" 4 "Very Heavy".	.298**	0	206
(ME2Fut) how the need to keep up with new technology/ products/ services is expected to change over 2017-2018	1 "Significantly decrease" 2 "Decrease" 3 "Remain unchanged" 4 "Increase" 5 "Significantly increase".			

In order to examine whether the three types of mismatches targeted in the design of the questions described in Tables A1 to A3 are distinct, and whether the distinctions remain unchanged in the respondent's perception over time, we compute measures of the strength of their pairwise relation. These are presented in the following tabulated matrices.

Table A4 depicts the estimates of Kendall's τ_b between each pair of variates based on responses about the situation in the recent past relating to each form of manpower challenges. The lack of significant relations between the job mismatch indicators (MJ1Past and MJ2Past) and the indicators of expectations mismatch (ME1Past and ME2Past) shows that these two types of mismatches are unrelated when referring to the recent past.

[22]Alfonso Arpaia, Alessandro Turrini (2014). "What drives the EU labour-market mismatch?". Published 07 March 2014. http://voxeu.org/article/what-drives-eu-labour-market-mismatch.

Table A4. Relations between pairs of indicator variates about past mismatches measured by Kendall's τ_b – Whole sample

	(MJ1Past)	(MJ2Past)	(MS1Past)	(MS2Past)	(ME1Past)	(ME2Past)
(MJ1Past)	1	.275**	.245**	-0.179	-0.028	-0.096
(MJ2Past)	.275**	1	-0.022	-0.162	0.01	-0.073
(MS1Past)	.245**	-0.022	1	-0.052	-0.05	0.016
(MS2Past)	-0.179	-0.162	-0.052	1	.392**	.316**
(ME1Past)	-0.028	0.01	-0.05	.392**	1	0.137
(ME2Past)	-0.096	-0.073	0.016	.316**	0.137	1

Note: Highlighted cells are statistically significant. The same holds for the Tables A5 to A9.

Table A5 depicts the corresponding relations for the near future. Compared to the recent past, the situation has now changed in the sense that there is no clear distinction between any of the three types of mismatches. We interpret this as implying that when respondents perceive the different types of mismatches in future, their understanding of what each phenomenon represents overlap.

Table A5. Relations between pairs of indicator variates about expected future mismatches measured by Kendall's τ_b – Whole sample

	(MJ1Fut)	(MJ2Fut)	(MS1Fut)	(MS2Fut)	(ME1Fut)	(ME2Fut)
(MJ1Fut)	1	.533**	0.114	0.168	0.145	.154*
(MJ2Fut)	.533**	1	-0.088	.280**	0.073	0.101
(MS1Fut)	0.114	-0.088	1	-0.001	0.148	.417**
(MS2Fut)	0.168	.280**	-0.001	1	-0.031	.231*
(ME1Fut)	0.145	0.073	0.148	-0.031	1	.200*
(ME2Fut)	.154*	0.101	.417**	.231*	.200*	1

To gain more insight into what is essentially a question about the typology of mismatches, we examine if the above comparison between the past and the future patterns of relations among the indicators of mismatch changes depending on sectors.

The table below depicts the relations for the recent past when the sample is confined to respondents from the Manufacturing sector.

The pattern of significant estimates shows that jobs mismatch is distinct from skills mismatch. This differs from the case for the entire sample.

Table A6. Relations between pairs of indicator variates about past mismatches measured by Kendall's τ_b – Manufacturing

	(MJ1Past)	(MJ2Past)	(MS1Past)	(MS2Past)	(ME1Past)	(ME2Past)
(MJ1Past)	1	0.024	0.225	-0.191	-0.279	-.370*
(MJ2Past)	0.024	1	0.112	0.092	0.054	-0.094
(MS1Past)	0.225	0.112	1	-0.284	-0.356	-.526**
(MS2Past)	-0.191	0.092	-0.284	1	.490*	0.13
(ME1Past)	-0.279	0.054	-0.356	.490*	1	0.265
(ME2Past)	-.370*	-0.094	-.526**	0.13	0.265	1

Table A7 depicts the corresponding relations for the near future when the sample is confined to respondents from the Manufacturing sector.

Table A7. Relations between pairs of indicator variates about expected future mismatches measured by Kendall's τ_b – Manufacturing

	(MJ1Fut)	(MJ2Fut)	(MS1Fut)	(MS2Fut)	(ME1Fut)	(ME2Fut)
(MJ1Fut)	1	.652**	0.267	-0.031	-0.008	0.065
(MJ2Fut)	.652**	1	-0.011	0.026	-0.122	-0.158
(MS1Fut)	0.267	-0.011	1	-0.244	0.192	.482**
(MS2Fut)	-0.031	0.026	-0.244	1	-0.056	0.155
(ME1Fut)	-0.008	-0.122	0.192	-0.056	1	0.255
(ME2Fut)	0.065	-0.158	.482**	0.155	0.255	1

The pattern of significant estimates shows that jobs mismatch is distinct from both skills mismatch and expectations mismatch. Again, this differs from the pattern seen for the entire sample. For Manufacturing, skills mismatch is distinct both for the recent past and for the near future.

Table A8 depicts the relations for the recent past when the sample is confined to respondents from the Services sector.

Table A8. Relations between pairs of indicator variates about past mismatches measured by Kendall's τ_b – Services

	(MJ1Past)	(MJ2Past)	(MS1Past)	(MS2Past)	(ME1Past)	(ME2Past)
(MJ1Past)	1	.367**	.259**	-0.166	0.039	-0.038
(MJ2Past)	.367**	1	-0.047	-.291*	0.001	-0.076
(MS1Past)	.259**	-0.047	1	-0.118	0.133	0.064
(MS2Past)	-0.166	-.291*	-0.118	1	.533**	.368**
(ME1Past)	0.039	0.001	0.133	.533**	1	0.112
(ME2Past)	-0.038	-0.076	0.064	.368**	0.112	1

This shows that jobs mismatch is distinct from expectations mismatch, but not distinct from skills mismatch. Hence, unlike the Manufacturing sector, skills mismatch tends to overlap with jobs mismatch for the Services, in the sense mentioned above.

Table A9 depicts the relations for the near future when the sample is confined to respondents from the Services sector.

Table A9. Relations between pairs of indicator variates about expected future mismatches measured by Kendall's τ_b – Services

	(MJ1Fut)	(MJ2Fut)	(MS1Fut)	(MS2Fut)	(ME1Fut)	(ME2Fut)
(MJ1Fut)	1	.428**	-0.022	.263*	.268*	.215*
(MJ2Fut)	.428**	1	-0.176	.342**	0.185	.241**
(MS1Fut)	-0.022	-0.176	1	0.09	0.117	.387**
(MS2Fut)	.263*	.342**	0.09	1	0.041	.344**
(ME1Fut)	.268*	0.185	0.117	0.041	1	0.113
(ME2Fut)	.215*	.241**	.387**	.344**	0.113	1

Hence, for the Services, we do not see skills mismatch as a phenomenon that is distinct from jobs mismatch or expectations mismatch.

The last two tables mirror quite closely those for the overall sample. What is clear is that the typology of mismatches differs between Manufacturing and Services. The complete typology is presented in Section 3, Table 3.1.

Part 2: Skills and Training

To further examine the relationship between expected development of skills inadequacy (ExpectedSkillsInadequacy, denoted as MS2Fut above and measured as an ordinal variate) over the next two years and benefits from specific training, we analysed the responses about these items for individual occupational groups using a structural equation model.

Given that ExpectedSkillsInadequacy is a key element of the profile of mismatches derived earlier, the preferred model description should serve as a formal test of that typology. Sections 3 and 4 showed that different types of mismatches can and do occur together. However, this is not a statement about causality. Hence, although that discussion suggests strongly that mismatches are linked, it is still not clear if they affect one another.

From a policy perspective, it would be useful to determine if the different types of mismatches are simultaneously determined, or if a type of mismatch can be treated as being exogenous.

The preferred estimates are presented in Table A10.

In the first structural equation, the estimated coefficients of ExpectedTurnover and TrainingBenefit are significant. There are two alternative ways of interpreting this. The first interpretation is that TrainingBenefit mediates the relationship between ExpectedTurnover and ExpectedSkillsInadequacy. The second interpretation begins from the fact that the relationship between ExpectedSkillsInadequacy and TrainingBenefit is significant. However, the presence of ExpectedTurnover as a significant endogenous regressor in the results suggest that the effectiveness of training in promoting skills development in an organisation's workforce may be confounded by employee turnover. Simply put, organisations are concerned about investing in training for workers who subsequently leave.

Our estimates show that mismatch of skills and mismatch of jobs not only can occur together (as shown in Section 3), they are simultaneously determined. The former type affects the latter, and vice-versa.

Table A10. Estimates of structural equation model with ordinal logit specification for two endogenous variables ExpectedSkillsInadequacy (MS2Fut) and ExpectedTurnover (MJ2Fut)

Variable	Estimate	Std. Err	z	P-value
Dependent variable: ExpectedSkillsInadequacy (MS2Fut)				
ExpectedTurnover (MJ2Fut)	0.940	0.268	3.50	0.000
TrainingBenefit	-1.517	0.578	-2.62	0.009
Dependent variable: ExpectedTurnover (MJ2Fut)				
ExpectedHiringRate (MS1Fut)	1.443	0.197	7.31	0.000
PastHiringRate (MS1Past)	0.638	0.209	3.05	0.002
PastTurnover (MS2Past)	0.657	0.236	2.78	0.005
ExpectedSkillsInadequacy				
/cut1	-1.891	1.129	-1.670	0.094
/cut2	1.673	0.991	1.690	0.091
/cut3	5.152	1.133	4.550	0.000
ExpectedTurnover				
/cut1	4.001	1.070	3.740	0.000
/cut2	7.041	1.173	6.000	0.000
/cut3	9.369	1.316	7.120	0.000
/cut4	13.293	1.463	9.090	0.000

*Notes: (1) Estimates are computed using STATA's gsem command, with **ExpectedSkillsInadequacy** and **ExpectedTurnover** specified to be jointly endogenous of ordinal logistic form. The following are designated as exogenous variates –**PastHiringRate**, **PastTurnover**, and **TrainingBenefit**. The definitions of each variate are as given below. The cuts refer to the estimated boundaries of the corresponding latent continuous variates which delineate the levels of the responses of ordinal endogenous variates. (2) **ExpectedSkillsInadequacy** is the response to the question 'for each affected occupational group, please assess how you expect the problem to develop over the next two years'. **ExpectedTurnover** is the response to the question 'compare the expected turnover rate of Jan 2017 to Dec 2018 (near future) to that of Jan 2016 to Dec 2016 (recent past)'. PastTurnover is the response to the question 'compare the turnover rate of the period Jan 2015 to Dec 2015 (more distant past) to that of Jan 2016 to Dec 2016 (recent past)'. **TrainingBenefit** is the response to the question 'Which of the following occupational group(s) in your organisation's workforce has/have benefited most from training'. **PastHiringRate** is the response to the question 'compare the hiring rate of the period Jan 2015 to Dec 2015 (more distant past) to that of Jan 2016 to Dec 2016 (recent past)'.*

APPENDIX B

Appendix B: Questionnaire Design & Methodology

Target Population

The target respondents were a group of CHROs made possible through the NTUC's contacts. These were human resource specialists with good understanding of the hiring situation of their businesses.

Although the sampling employed was non-representative subset of the larger population, these targeted respondents represented the employers which were an important stakeholder in the labour market equilibrium. Being at a critical position to experience the fluxes of the economy and labour market, they served as a rich source in facilitating the understanding of Singapore's employment landscape.

The primary response units were the human resource management departments of an organisation. Each respondent was a unique representative of the respective HRM department. In addition, each was asked to respond about the occupational groups under that department's manpower purview. These occupational groups constituted secondary response units. The resulting model structure has two levels.

Data Collection

A mixed method approach was used to gather information on the attitudes, opinions and behaviours of the CHROS and the HR specialists on the changes in jobs and skills. Data was gathered by online survey with a structured questionnaire.

Online Questionnaire: The Key Considerations

The first section of the questionnaire assembled information about the organisation such as the type of sector, industry and size of the organisation. This formed a baseline for grouping and making comparison. Similarly, information on the respondent was collected at the last section of the questionnaire to ascertain that the data collected were from a valid respondent that handled the human resource functions of the organisation.

The series of the questions at the main body, not necessarily arranged in order (of the groups) and with overlaps, could be broadly categorised into these groups:

Group 1 sought to discern between the short-term cyclical economic slowdown from the long-term structural ones of the observations reported by the respondents, in particular those resulted from the technological disruptions. This was to clearly draw out the sectors, industries that were affected by these disruptions. Group 1 was also aimed to identify the consequences of the disruptions for instance whether the business and jobs had expanded, created or declined, displaced respectively and uncovering the type of affected workers.

We often heard the difficulties faced by the employers in finding talent. Some assert that the difficulties experienced were due to a lack of technical competencies. Group 2 was to determine the expectations of the qualifications and skills demanded by the employers at the different time points, as at the point of survey, the last preceding and 12 months ahead for the business,

to elicit the changes in skills (including qualifications) and jobs across time. Further, a distinction was purposely made between the qualification and skill sets to understand if there was a gap in the educational system, the skills demanded by employers and the translation of the skills learnt from school to the workforce.

Human resource practices could also underlie recruitment difficulties. Group 3 was used to understand the recruitment policies, practices and strategies applied by the employers. Amount of flexibility in the recruitment practices which could ease the labour mobility were surveyed. It is unrealistic to expect that the skills required for the jobs remain stagnant and increasing there is an expectation of the employer to provide the necessary support for the development of their workforce. The attitudes and behaviours towards these aspects were explored.

The data obtained from these different groups were used jointly to form a picture of the affected workers in terms of their industries, sector, skill sets, training needs and work motivation.

The questionnaire comprised 105 questions. For participants of group engagement sessions held to introduce the study and who agreed to participate, an alternative version of the questionnaire was introduced in which the questions were split into two parts. Part A was administered during the engagement session in either hardcopy or online format, with a question added to invite the respondent to volunteer a contact person from their organisation for follow up on Part B. Apart from the additional question about the contact person at the end of Part A, the combined questions of the two parts in this alternative version are identical to the original single questionnaire.

From the perspective of the respondent, the survey questions may be divided into three categories in increasing order of difficulty or effort required for providing a suitable response. The first are questions seeking opinions or comments about topical issues and the current situation in the topic of investigation. The second are those seeking projections (or what may loosely be regarded as forecasts) into the future about the next two years. The last are the most challenging, and involve the respondent providing measures or statistics for the purposes of profiling their organisation's hiring and turnover.

The questionnaire was deployed using the online platform Limesurvey 2.05. Two versions of the questionnaire were effectively available, allowing respondents to choose whether they would like to describe their workforce in terms of standard occupational groups or by entering their own descriptions of job roles. Only a small minority of respondents, around 10 percent, chose the second option.

APPENDIX C

Appendix C: Sampling quality and fieldwork

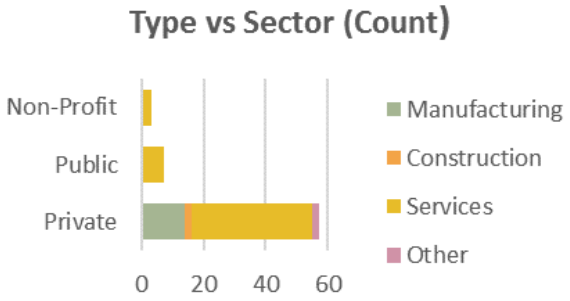
In this appendix, we discuss the characteristics of the sample and highlight potential shortcomings which may weaken the validity of the results. Where relevant, mitigating factors are also identified.

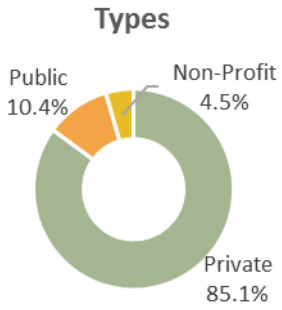
Fieldwork commenced on February 14 and was conducted for three and a half months. By the close of fieldwork, about 200 invitations had been sent out by email, and about 70 submitted responses were obtained, the majority from organisational contacts provided by OTCi. Of these, less than 10 respondents took up the option of completing only Part A of the survey.

Although the number of responding organisations to the survey was rather limited, the statistical significance of the estimates which underlie the key findings are satisfactory. The total number of workers that is represented by the responding organisations is large. More than three quarters of respondents provided their e-mail contacts. This provides some indication of assurance as it enables the project team to carry out follow up checks for validation purposes.

The following give some idea of the overall characteristics of our sample. In terms of type of organisation and sector, we have mainly private organisations with a lower than representative proportion in Construction.

67 organisations responded to the survey. Most are from private organisations. The Services sector makes up the largest group of respondents.





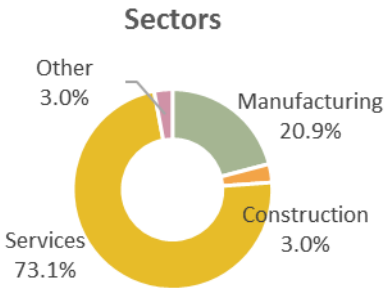


Figure C1. Profile of organisations by type and sector

56% of the organisations are SMEs[23] while the rest are large organisations. 41.3% of them have less than or equal to 250 employees. 31.7% of them have more than 1000 employees.

[23] An enterprise with an annual sales turnover of under S$100 million, as defined by Ministry of Trade and Industry.

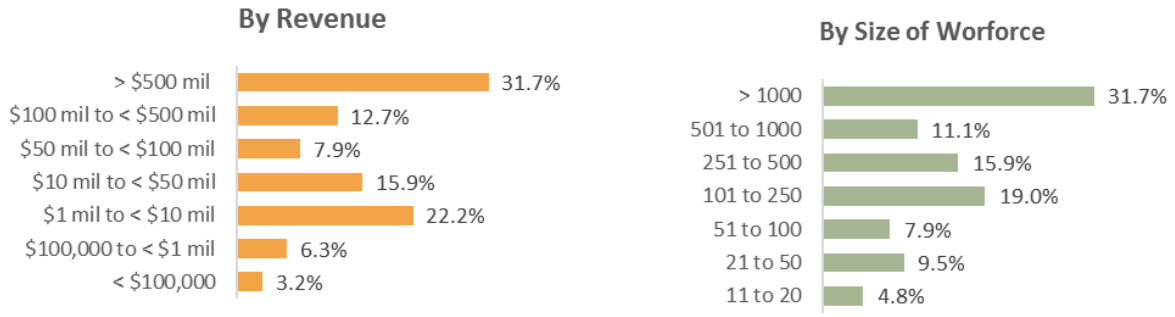
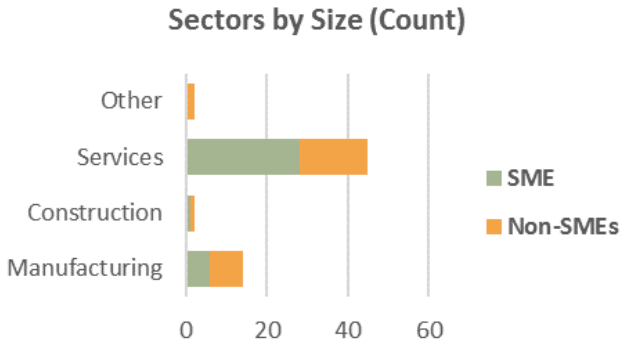
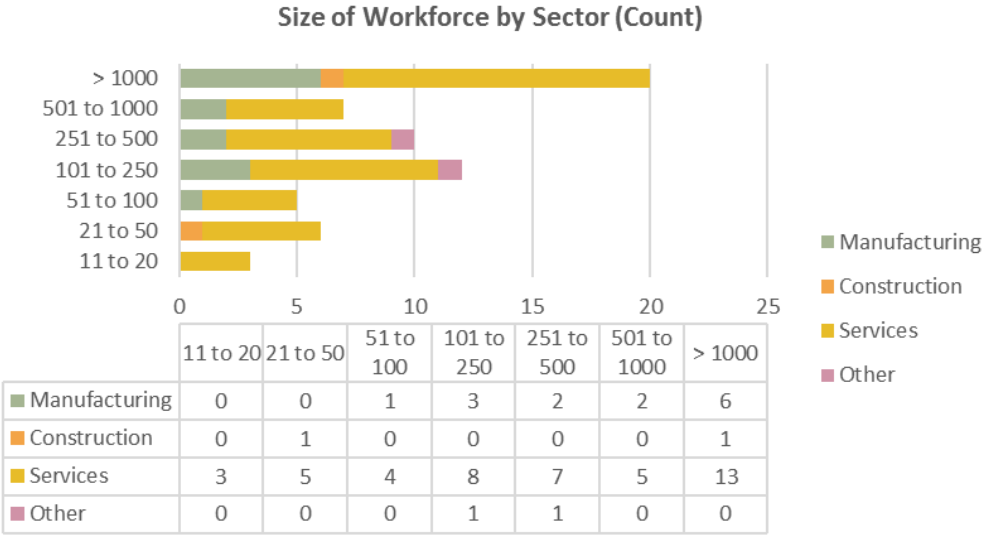


Figure C2. Profile of organisations by revenue and size or workforce



Proportion of SMEs for Manufacturing, Construction and Services sectors are 43%, 50% and 62% respectively. We also have an under-representation of SMEs.

Figure C3. Proportion of SMEs and Non-SMEs



	11 to 20	21 to 50	51 to 100	101 to 250	251 to 500	501 to 1000	> 1000
Manufacturing	0	0	1	3	2	2	6
Construction	0	1	0	0	0	0	1
Services	3	5	4	8	7	5	13
Other	0	0	0	1	1	0	0

Figure C4. Size of Workforce

The lack of conformity of the sample characteristics to the population and the under-representation of SMEs in particular are a problem when assessing the sample descriptive measures. For example, it is unreliable to use the averages from the sample to estimate the population averages. However, structural models, in which the organisational characteristics are used as conditioning variates, do not suffer from such a lack of validity. The conditioning variates – provided they are appropriately selected and essentially complete for the model in question – compensate for the problem due to a lack of representativeness of the sample.

APPENDIX D

Table D1. Kendall's τ_b for Pairs of Variates - Unweighted Sample

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1.000	0.161	.289*	-0.111	0.134	.273*	-.223*	0.009	0.019	0.089	0.081	0.141	-0.030	-0.040	-0.077	0.196	-0.077	0.152
2	0.161	1.000	.408**	-0.154	0.074	-0.146	0.160	-0.145	-0.106	0.170	0.216	-0.033	0.041	0.057	0.221	-0.063	-0.068	-0.095
3	.289*	.408**	1.000	-0.187	0.046	-0.012	-0.084	-0.060	0.083	0.053	0.098	-0.140	-0.051	0.102	0.064	0.062	0.064	-0.018
4	-0.111	-0.154	-0.187	1.000	0.029	.446**	-0.095	0.070	-.263*	-.323**	0.093	0.215	0.106	-0.017	-0.168	.324**	-0.168	.403**
5	0.134	0.074	0.046	0.029	1.000	.219*	-0.154	-0.026	-0.203	0.076	-0.061	0.120	-0.190	-0.029	0.098	.231*	-0.041	.214*
6	.273*	-0.146	-0.012	.446**	.219*	1.000	-.267*	0.029	-.234*	-.233*	0.133	.247*	0.025	0.031	-.251*	.660**	-.251*	.702**
7	-.223*	0.160	-0.084	-0.095	-0.154	-.267*	1.000	0.029	0.011	0.135	-0.048	-0.130	-0.014	-0.028	-0.022	-0.200	-.236*	-.287**
8	0.009	-0.145	-0.060	0.070	-0.026	0.029	0.029	1.000	.272*	-0.046	-0.212	.264*	.255*	-0.148	-0.108	0.205	-0.108	0.178
9	0.019	-0.106	0.083	-.263*	-0.203	-.234*	0.011	.272*	1.000	-0.255	-0.093	-0.059	0.030	-0.086	-0.062	-0.121	-0.062	-0.182
10	0.089	0.170	0.053	-.323**	0.076	-.233*	0.135	-0.046	-0.255	1.000	-0.183	-0.215	-0.146	-0.092	0.171	-0.221	-0.006	-0.186
11	0.081	0.216	0.098	0.093	-0.061	0.133	-0.048	-0.212	-0.093	-0.183	1.000	0.141	0.028	-0.106	0.041	0.118	-0.155	-0.036
12	0.141	-0.033	-0.140	0.215	0.120	.247*	-0.130	.264*	-0.059	-0.215	0.141	1.000	0.082	-0.031	-0.224	.227*	-0.224	0.206
13	-0.030	0.041	-0.051	0.106	-0.190	0.025	-0.014	.255*	0.030	-0.146	0.028	0.082	1.000	-0.120	-0.046	0.008	-0.046	0.056
14	-0.040	0.057	0.102	-0.017	-0.029	0.031	-0.028	-0.148	-0.086	-0.092	-0.106	-0.031	-0.120	1.000	-0.053	0.133	0.151	0.122
15	-0.077	0.221	0.064	-0.168	0.098	-.251*	-0.022	-0.108	-0.062	0.171	0.041	-0.224	-0.046	-0.053	1.000		.484**	-0.149
16	0.196	-0.063	0.062	.324**	.231*	.660**	-0.200	0.205	-0.121	-0.221	0.118	.227*	0.008	0.133		1.000	-0.159	.715**
17	-0.077	-0.068	0.064	-0.168	-0.041	-.251*	-.236*	-0.108	-0.062	-0.006	-0.155	-0.224	-0.046	0.151	.484**	-0.159	1.000	
18	0.152	-0.095	-0.018	.403**	.214*	.702**	-.287**	0.178	-0.182	-0.186	-0.036	0.206	0.056	0.122	-0.149	.715**		1.000

Variate names:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Type of Org	Type of Sector	Target Market (Local, Region-al, Intl, etc.)	Size by revenue 2016	Forecast of business prospects 2017-2018	Work-force Size	Most adopted hiring practice	Frequency of org having hiring problems	Indicate not affected by tech changes	Possibility of new jobs due to tech changes	Rate of staff having to keep up with tech	Demand for job related training	Frequency of lacking skills causing problems	Degree of success in training to overcome skills obsolescence	Successful hirings 2016	Org's view on pro over edu qualifs	Staff leaving, 2016	No. of staff who left

Table D2. Kendall's τ_b for Pairs of Variates - Weighted Sample

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1.000	0.147	.300*	-0.039	0.163	.246*	-0.210	0.054	0.049	0.019	0.063	0.128	-0.013	0.003	-0.070	.237*	-0.070	0.206
2	0.147	1.000	.413**	-0.148	0.078	-0.157	0.174	-0.138	-0.103	0.160	0.211	-0.038	0.044	0.065	0.223	-0.063	-0.064	-0.090
3	.300*	.413**	1.000	-0.194	0.077	-0.010	-0.048	-0.053	0.087	0.045	0.096	-0.146	-0.049	0.116	0.068	0.104	0.068	0.013
4	-0.039	-0.148	-0.194	1.000	0.026	.500**	-0.117	0.046	-.286*	-.301*	0.119	.232*	0.100	-0.044	-0.182	.343**	-0.182	.411**
5	0.163	0.078	0.077	0.026	1.000	.226*	-0.191	-0.032	-0.208	0.087	-0.057	0.124	-0.195	-0.040	0.098	0.214	-0.043	0.198
6	.246*	-0.157	-0.010	.500**	.226*	1.000	-.282**	0.041	-.233*	-.262*	0.124	.245*	0.026	0.051	-.254*	.684**	-.254*	.732**
7	-0.210	0.174	-0.048	-0.117	-0.191	-.282**	1.000	0.019	0.005	0.160	-0.042	-0.127	-0.021	-0.046	-0.026	-.255*	-.247*	-.338**
8	0.054	-0.138	-0.053	0.046	-0.032	0.041	0.019	1.000	.268*	-0.029	-0.206	.272*	.252*	-0.165	-0.113	0.205	-0.113	0.172
9	0.049	-0.103	0.087	-.286*	-0.208	-.233*	0.005	.268*	1.000	-0.258	-0.092	-0.056	0.027	-0.096	-0.064	-0.128	-0.064	-0.191
10	0.019	0.160	0.045	-.301*	0.087	-.262*	0.160	-0.029	-0.258	1.000	-0.200	-0.230	-0.139	-0.073	0.180	-0.220	0.000	-0.176
11	0.063	0.211	0.096	0.119	-0.057	0.124	-0.042	-0.206	-0.092	-0.200	1.000	0.137	0.033	-0.100	0.044	0.127	-0.152	-0.028
12	0.128	-0.038	-0.146	.232*	0.124	.245*	-0.127	.272*	-0.056	-0.230	0.137	1.000	0.085	-0.024	-0.223	.237*	-0.223	0.215
13	-0.013	0.044	-0.049	0.100	-0.195	0.026	-0.021	.252*	0.027	-0.139	0.033	0.085	1.000	-0.128	-0.047	0.005	-0.047	0.054
14	0.003	0.065	0.116	-0.044	-0.040	0.051	-0.046	-0.165	-0.096	-0.073	-0.100	-0.024	-0.128	1.000	-0.056	0.123	0.149	0.108
15	-0.070	0.223	0.068	-0.182	0.098	-.254*	-0.026	-0.113	-0.064	0.180	0.044	-0.223	-0.047	-0.056	1.000		.483**	-0.153
16	.237*	-0.063	0.104	.343**	0.214	.684**	-.255*	0.205	-0.128	-0.220	0.127	.237*	0.005	0.123		1.000	-0.164	.711**
17	-0.070	-0.064	0.068	-0.182	-0.043	-.254*	-.247*	-0.113	-0.064	0.000	-0.152	-0.223	-0.047	0.149	.483**	-0.164	1.000	
18	0.206	-0.090	0.013	.411**	0.198	.732**	-.338**	0.172	-0.191	-0.176	-0.028	0.215	0.054	0.108	-0.153	.711**		1.000

Variate names:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Type of Org	Type of Sector	Target Market (Local, Region-al, Intl, etc.)	Size by revenue 2016	Forecast of business prospects 2017-2018	Work-force Size	Most adopted hiring practice	Frequency of org having hiring problems	Indicate not affected by tech changes	Possibility of new jobs due to tech changes	Rate of staff having to keep up with tech	Demand for job related training	Frequency of lacking skills causing problems	Degree of success in training to overcome skills obsolescence	Successful hirings 2016	Org's view on pro over edu qualifs	Staff leaving, 2016	No. of staff who left

*Note: In both tables, * represents significance at 5% level, ** denotes significance at 1% level, for two-tailed tests computed using SPSS.*

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