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# WORKERS IN TRANSITION

Second topic in the conference proceedings: Workers in Transition.

Research partnership between Ong Teng Cheong Labour Leadership Institute (OTCi), Singapore University of Social Sciences (SUSS) and Public Service Division (PSD).

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# EXECUTIVE SUMMARY

## Brief Introduction

International comparisons continue to find that sizeable proportions of the workforce are affected by changes brought on by technological disruption, with the impact on advanced economies greater because of their more intensive use of technology. It will therefore come as no surprise that workers in all sectors of Singapore's advanced economy are feeling the effects of this exposure, with the impact set to increase over time. The largest employer in Singapore – its Public Service – will be at the forefront of this challenge. A study of transition risk among Public Service officers will be a significant step towards addressing this challenge. The lessons learned will also be beneficial for understanding if the same problems and solutions are open to workers in the private sector.

## Approach

Our objective is to analyse the impact of transition risk on the labour market outcomes of individual Public Service officers. In this study, transition risk is defined as the probability of being able to adjust to a new job role should the need arise as a result of technological disruption. The higher the probability of a successful transition, the lower the transition risk.

Using statistical classification techniques, three segments of the Public Service workforce with different degrees of transition risk are derived using indicators of levels of skills use, training achievements and job requirements measured for individual officers.

## Key Findings

1. These risk segments are ordered according to how the individuals falling within them are predicted to react to jobs disruption, and are referred to as:
    - Low-risk segment
    - Medium-risk segment
    - High-risk segment

    The medium-risk segment can be further sub-divided into a low-medium-risk segment, and a high-medium-risk segment.

    Looking at variables which were not used in deriving the risk, it is immediately obvious even from a cursory inspection that risk is characterised by age group, level of earnings, and difficulties encountered with training.

Other important characteristics which differ significantly across risk segments are

- Educational attainment
- Work experience
- Supervisory responsibilities
- Proportion of time spent collaborating with colleagues, and the change in this proportion over time

Age group

2. Age accounts for some, but not all of the source of the difference in transition risk. Age is not the primary factor that determines the degree of transition risk. Rather than age, it is the deterioration in skills (decay in skills) over time that contributes to transition risk. The tipping point occurs for those in their forties, with the appearance of higher proportions of respondents over the age of forty in the high-medium-risk and high-risk segments.

Educational attainment

3. All educational levels are represented across risk segments. Possession of higher qualifications does not necessarily inoculate an officer against transition risk. Regardless of the level of education, the skills acquired will be subject to the natural process of obsolescence. In times of rapid technological change, this process occurs at an accelerated pace. Nonetheless, since a higher proportion of non-degree holders are found in the high-risk segment, having a degree is better than not having one.

4. Professional qualifications and skills acquired from work experience were reported to have a longer shelf-life (i.e. remain relevant longer) compared to formal educational qualifications.

   However, econometric analysis shows that an additional year of formal educational attainment has better impact on labour market outcomes compared to an additional year of professional qualification attainment or an additional year of work experience.

Work experience

5. Lengthier durations of work experience do not always lead to improved human capital unless the time is spent repairing the natural process of skills obsolescence. In particular, the proportion of respondents with more work experience is higher in the high-risk segment compared to low-risk segment. This suggests that if there is a failure to take advantage of work experience to strengthen skills, longer durations of work experience can actually result in a widening skills gap and thence, higher transition risk.

Supervisory responsibilities

6. Respondents with supervisory roles were represented in all risk segments. Officers with supervisory responsibilities are also exposed to transition risk and might have implications on their subordinates. The most serious concerns would be if there were knock-on effects which impeded the development of officers in the reporting chain.

Proportion of time spent collaboration with colleagues

7. For the changes in person-to-person interactions at work over the preceding 24-month period, there is a significant difference between respondents in different risk segments in their experience with persons they serve, those they collaborate with and those they supervise.

   Those in the high-risk segment report less change than their lower-risk counterparts across several domains dealing with such people-to-people interactions at work, with sharp contrast between the two extreme risk segments. Since this is true regardless of whether the interactions involve job roles as a service provider, a co-worker or a supervisor, the overall connection to risk is clear.

   - In terms of interacting with others as a service provider, this difference is reported for non-face-to-face interactions, both with members of the public as well as with officers from other Public Service agencies.
   - In terms of interacting with colleagues, this difference is reported for the proportion of time spent in collaboration with colleagues and the change in this proportion over the preceding 24-month period.
   - In terms of interacting with others in a supervisory capacity, this difference is reported for the number of persons supervised and the change in this number over the preceding 24-month period.

Transferable skills

8. Those in the high-risk segment have a significantly weaker capacity to identify specific skills. This weakness is evident from questions about skills that they were able or unable to transfer from a last job (if any) as well as questions about skills that were or were not transferable from their current job.

   A similar difference can also be seen with identifying training courses that have been found useful in the past or that the respondent aims to achieve going forward, with those in the high-risk segment displaying a weaker capacity.

   The above findings represent evidence that the respondents in the high-risk segment could be affected by a lack of information and awareness about the range of skills required at work and the range of training they can possibly access.

This could severely limit the types of skills they plan to acquire or the types of training interventions they understand to be effective. This would be unhelpful for individual job performance and could lead to a decline in service standards.

Training

9. The extent and type of training challenges differ significantly across risk segments. Those in the high-risk segment are more likely to indicate that the training they would like to undertake is unavailable, and less likely to indicate that they have no problems with availability of the training as compared to the officers in the low-risk segment.

   On the other hand, those in the low-risk segment are more likely to report that training they would like to undertake has limited places.

Profile of risk segments

10. In general, our study finds that older, lower-wage public officers with less in-depth training achievements are more vulnerable to disruption. This group will also be less prepared for a smooth transition to another job, should that be necessary.

11. However, the high-risk segment is not confined to the group of older, lower-wage public officers with less in-depth training achievements. Instead, the high-risk profile cuts across age groups, salary levels and training achievement grades.

    The key distinguishing feature is the existence of skills gaps not adequately addressed by existing forms of training. In contrast to the high-risk segment, the low-risk segment is characterised by younger as well as higher-wage public officers.

Based on the analysis of the differences between the high-risk and low-risk segments, we propose the following forms of general intervention be considered, as well as specific recommendations for training.

## Suggested Recommendations on General Intervention

Individual skills assessment

1. It would be useful for reporting officers to conduct skills assessments for individual officers under their supervision periodically. This would address the issue faced by those who are unclear or unaware of the skills they have and hence the ones they lack for their current job.

The weakness in recognising skills deficits is clearly seen in several aspects of the responses with the high-risk segment. In this regard, it would also be useful to consider requesting that officers provide some form of regular skills assessments of their organisations. This would serve to inspire individual officers to see themselves as contributors to their organisational skills pool. It should also encourage them to see themselves as sharing responsibility for their organisation's strengths while at the same time motivating them to see themselves as a starting point in overcoming any perceived organisational weaknesses. Reporting officers can use this as a basis for proposing ways for the officers under their supervision to be reskilled or upskilled.

Inter-division workgroups

2. To actively promote increased and closer collaboration among colleagues within each agency as well as across agencies by increasing opportunities for inter-division workgroups to help foster cross functional collaboration among divisions and officers, of different ranks, to work on various projects collectively. Putting together diverse teams has the potential to create opportunities for workers to step outside of their respective comfort zones, exposing them to new ideas and new ways of doing things where learning takes place.

Cross-agency postings

3. To increase exposure, cross-agency postings should be made available even for officers that are

   - in non-supervisory role,
   - at the lower end of the salary scales, and
   - have lower educational qualifications.

   Our recommendation is to consider grouping Public Service agencies along functional lines, such as those based on the degree of inter-dependency of their officers' job scope, and hence facilitate cross-agency postings within each group. For example, an officer from a ministry's human resource team could be posted to the human resource team in another ministry. This concept is similar to those employed by multinational organisations to train promising employees through international postings. The difference in this case is that the focus should be on the officers who are in need of this exposure in order to overcome their tendency to be in the high-risk segment when it comes to transition. In other words, this should be considered for officers that are at the lower end of the salary or educational spectrums. Ultimately, of course, such cross-postings could be extended to whole of government.

## Suggested Recommendations Specific to Training

### Accessibility of training

4. There is some urgency on the need to improve accessibility of training. In particular, timeliness, continuity and depth of intervention are important. From our analysis, workers who are older, with lower levels of educational qualifications and at the lower end of the salary spectrum would require most immediate and urgent interventions.

### Better curation of training courses with the involvement of stakeholders

5. There is a need to better curate useful and relevant training courses as the quality of training may be affected as the demand for training rises. This is an area which all stakeholders, including Public Service Leaders and the Labour Movement (LM), can contribute to and work hand-in-hand. Given the familiarity of union leaders with the needs and preferences of their members / workers, LM and the unions could play a role in the process of curating relevant courses that meet increasingly complex needs of workers, within and outside of Public Service. Better curation of useful and relevant training courses will also help to address the issues faced by those in high-risk segments such as the lack of awareness or visibility of the range and depth of skills that an organisation offers and needs, and the skills they need to acquire.

### Timeliness of intervention

6. Early intervention matters. For a typical officer, training intervention not only becomes costlier the longer it is delayed, delayed intervention is also diminished in effectiveness. Therefore, it is crucial to put in place structured intervention which recognises that the older a worker is, the shorter the runway for intervention such a worker would have. This could include preparing workers to transit or reskill from as early as the age of 40.

### Application of training

7. Training should not be conflated with individual job performance, and should not be defined as a Key Performance Indicator (KPI). Ability and opportunity to apply training at work should be regularly discussed before and monitored after training through evaluation process in
    - Pre-training
    - During training
    - Post-training

Innovate forms of training

8. The way training is designed, delivered and implemented can greatly influence the effectiveness of the training. There is a need to move away from traditional forms of training and to put in place innovative ways in training for officers at all grades to balance the pressures from conventional sources of training.

# RESEARCH REPORT


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# SECTION 1. INTRODUCTION

There is widespread agreement that technological disruption will result in the destruction of certain jobs, and the creation of new ones. The demand that employers have for transferable skills under normal circumstances can be expected to increase in response to the uncertainties brought about by disruption (Bennett, 2002).[1] Figures 1.1 and 1.2 are based on data from the present study and show the proportions of different types of responses that each individual respondent can provide about whether he/she has transferable skills.

Less than half of the respondents had skills which could be transferable to a new job role within the Public Service, while the remaining either did not know or said no (Fig. 1.1). And of those who did, nine in ten said the skills which could be transferred to the private sector were the same (Fig. 1.2). These show the need to find out more about the state of skills and the level of preparedness for disruption in the Public Service.

Figure 1.1: Proportion of respondents who believe they have transferable skills

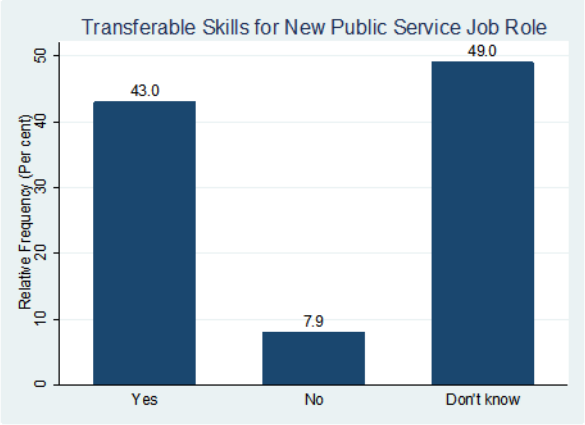
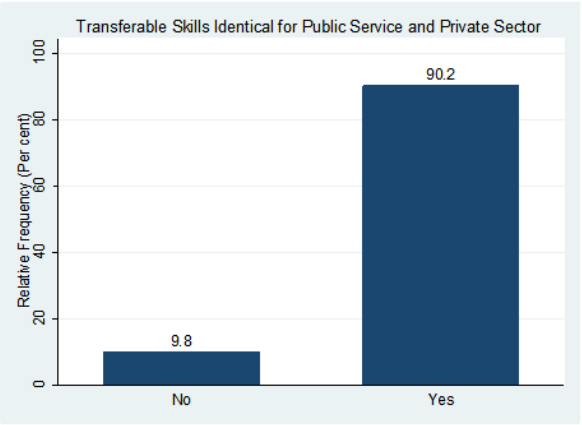



Figure 1.2: Proportion who believe their transferable skills are the same for both Public Service and private sector jobs




Note: Percentages for each category may not add up to 100% due to rounding.

This study focuses on the assessment and analysis of transition risk in the Public Service workforce in Singapore. In this study, transition risk is defined as the probability of being able to adjust to a new job role should the need arise as a result of technological disruption. The higher the probability of a successful transition, the lower the transition risk.

[1] See also World Economic Forum (2018b), the latest update to the report on the Future of Jobs, which reiterates "a continued fall in demand for manual skills and physical abilities" as well as the growing prominence of skills in analytical thinking and innovation, and active learning and learning strategies, as well as "the sharply increased importance of skills such as Technology design and programming" (p.12) as broad trends affecting large parts of the global economy, and hence a significant proportion of employers across industries. Such skills in demand will remain transferable across industries as well as economies for some years to come.

We analyse the impact of disruption and technological changes on Public Service officers and their jobs, and identify vulnerable groups. Data was collected from 1,642 respondents who are current or retired Public Service officers through online survey.

The problem with accepting the absence of transferable skills, whether real or perceived, has to do with whether a respondent has sufficient time to react in order to address any gap in skills. In a time when change is rapidly occurring due to technological disruption, the reaction time – what we refer to as the runway for preparation to deal with the changes - will be truncated. The changes that accompany disruption are also not likely to be discrete, with precipitous changes less likely than gradual shifts.

In this sort of evolutionary shift, there will be an increase in demand for workers equipped with the necessary skills, as organisations scramble to ride the wave of change, and avoid being overwhelmed by the tide.

Hence, despite the difficulty of making long-term predictions about the skills that will be in demand in the economy of the future, there are certain indicators about how workers perform in their jobs today which can serve as a predictor as to how they would deal with the increasing challenges of working in a disrupted environment.

The workers who will remain relevant are those who possess good skills levels, maintain the relevance of their skills by accessing effective training[2], and keep up with changing job requirements without either being confined to dealing only with mundane tasks or being immobilised by insurmountable obstacles at work.

In the current economic climate, workers are confronted with the transition to the future economy. There has not been much research on what those struggling with the transition are grappling with. Instead, studies tended to focus on the extent of the impact on the workforce and the need for reskilling, and are in general agreement that a small but sizeable proportion of the workforce will be affected.[3]

Given that the most obvious impact of technological disruption in the workplace is increased uncertainty, the lack of information could also exacerbate growing concerns about job security and changing job requirements in the future economy.

Hence, employers and workers would benefit from a clearer strategy on managing the transition to the future economy, especially one that is derived from an understanding of where the risks in transition lay.

[2] Training includes structured accredited or no accredited courses/programmes and/or more informal workplace learning process.

[3] The World Economic Forum (2018a) has estimated that 1.4 million jobs in the US alone would be disrupted by 2026, with the outcomes for at-risk workers highly dependent on the adequacy of reskilling. Meanwhile, Mckinsey & Company (2017) has predicted that anywhere from 3 to 14% of the global workforce will be affected by occupational switches by 2030, with the impact on advanced economies – of which Singapore is one – understandably greater.

In order to understand what the overall labour market outcomes resulting from the ultimate impact of such changes are, it is necessary to undertake a deeper investigation of the attributes of individual workers and their resilience in the face of change.

There is a solid body of evidence that formal educational attainment is the main contributor to human capital enhancement. Hence, more years in school can be generally linked to better payoffs later in terms of job remuneration. However, tracking human capital changes alone does not provide enough information about the outcomes from engagement in labour market dynamics. Such outcomes could take the form of lower success in jobs matching and/or skills deficits which are the consequences of transition risk. Observed increases in transition risk will inevitably take the form of interrupted employment and/or degraded job performance. Hence, in order to examine these phenomena, we require an investigative framework based on analysing actual skills usage.

Any connection between employability measures and transition risk can only be implicit: An individual that performs better on employability measures could naturally be regarded as one with lower transition risk. While there has been scant attention paid to transition risk, much more attention has been accorded to the related concept of employability. The focus on what employability means is due to the priority government policies have accorded to tackling employment-related challenges in advanced economies over the last few decades. There is a clear and fairly consistent understanding across different jurisdictions and contexts about what constitutes employability skills, and this serves as an important starting point for our study.[4]

The aspects of employability covered in the contemporary literature are focused mainly on school leavers and new graduates, with the main challenge being to tackle youth unemployment.[5] Although the focus on employability is relevant, in order to explore the issue of transition risk in our study, that framework has to be augmented to take account of the extent to which individuals have been able to acquire skills in their current jobs (if any) and the transferability of their skills across jobs. This would involve an in-depth investigation of the constituents of each individual's total work experience. The assessment of the value of work experience is an intrinsic part of the returns to schooling literature and already contained within the human capital earnings model framework.

An essential component of our analysis is therefore to understand how measurable labour market outcomes are affected by transition risk.

[4] Agreeing the specific items which may be considered employability skills opens the way to making comparisons of these skills for different individuals or groups of individuals, enabling an assessment of which individuals or groups suffer from a deficit of the skills in question.

[5] This consistency enables comparisons across studies, so that the employability of different groups of graduates in the Botswana and Syria can be related in a manner which throws light upon the institutional structures of those countries. See, for e.g., Beatrice et al (2018). An alternative qualitative approach is found in Anderson and Lees (2017).

For this reason, our preferred approach to studying transition risk is to undertake a large-scale survey of the individual members of a workforce, using an instrument that collects self-reported assessments across a range of the domains of skills used at work, training achievements while employed, and job requirements. Three segments of the Public Service workforce with different degrees of transition risk are derived as:

- A low-risk segment
- A medium-risk segment, which can be further sub-divided into low-medium-risk and high-medium-risk segments
- A high-risk segment

Before we proceed to the analysis of the results in the subsequent sectors, it is important to caution against drawing conclusions about the Public Service workforce in general from the findings of this study. The results presented in this report are specific to the sample obtained. In order to be able to determine whether they are representative of the Public Service in general, it would be necessary to obtain further information about the distribution of key characteristics of the target population which is beyond the scope of this current study.[6]

[6] For agencies to interpret the findings based on their own profiles, we would suggest employing a weighting scheme based on the age, education and earnings distributions of their agency workforce.

# SECTION 2. CHARACTERISTICS OF RISK SEGMENTS

In this section, we will look at the characteristics of the risk segments derived in Appendix B – Research Strategy. It should be emphasised that the characteristics that we consider here are ones which were not used in the derivation of the risk classifications (i.e. level of skills, training achievements and job requirements).

The objective is to discern if the properties of the risk segments can lead us to a profile of high-risk officers. Ultimately, we are looking to develop profiles which offer opportunities for the design of effective intervention and remedial measures for reducing the number of officers at risk in the transition process.

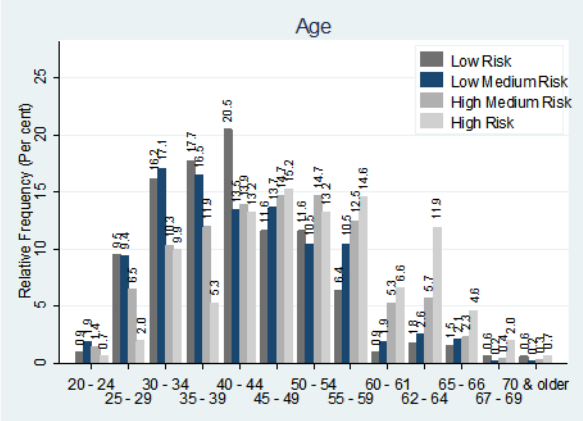
To make the comparisons of the characteristics of the risk segments, we will present several graphs of distributions in this section. All of the graphical comparisons shown are based on responses whose means differ significantly[7] across the four risk segments (i.e. low-risk, low-medium-risk, high-medium-risk and high-risk segment). We begin the analysis on important characteristics such as age and educational qualifications.

## Age across risk segments

Age accounts for some, but not all of the source of the difference in transition risk. Age is not the primary factor that determines the degree of transition risk. Rather than age, it is the deterioration in skills over time that contributes to a heightening of transition risk. Often, age is seen as a causal factor when in fact, it is the complications associated with being an older worker with inadequate skills. For example, skills gaps that open up due to obsolescence are not closed by interventions and the impediments are age-related. Closing skills gaps require investment by both the employer and employee of time, commitment and resources.

In the following graph (Fig. 2.1), the age distribution of the high-risk segment is centred to the right of that for the low-risk distribution. The shift in the weight of the distribution begins in the 40 to 44 age group, as seen from the medium-risk segments.

Figure 2.1: Age distributions of risk segments[8]




[7] Tests are carried out using both univariate and multivariate analyses of variance at 5% levels of significance.

[8] The graphs are histograms for each of the risk segments. For each risk segment, the total height of (also area under) the graphs sum to 100%. However, please note that some of the percentages for each risk segment may not add up to 100% due to rounding. The number of observations differ across different risk segments, so the heights represent relative, not absolute, frequencies for that category.

In Figure 2.1 and all subsequent graphs of the similar type, the vertical axis measures relative frequency, with the total area contained in the bars of all the same colour summing to 100%. The aim is to compare the distributions of the characteristic across different risk segments. We often start out by looking for salient differences in the distributions of the low-risk and high-risk segments, such as whether the modal class and/or medians differ.

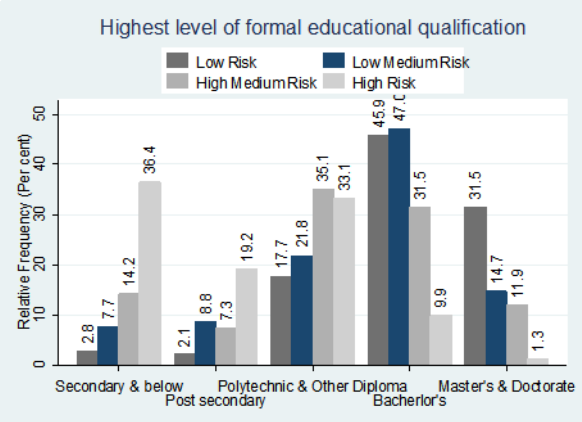
Not all older workers are at high-risk because early intervention (e.g. training, reskilling or even job rotation) matters, and older workers may have a shorter runway for intervention.

The relation between age and transition risk is a major challenge for both employers and employees. Respondents have reported issues with access to training in which age is a complicating factor e.g. eligibility (real or perceived) for certain types of training when re-employment and/or retirement is impending.

## Formal educational qualifications across risk segments

The next important comparison is for formal educational qualifications (Fig. 2.2). Educational levels are represented across all risk segments.[9]

Figure 2.2: Distributions of formal educational qualifications




Possession of higher qualifications does not necessarily inoculate an officer against transition risk. Nonetheless, having a degree is better than not having one. This can be seen from fact that in Fig. 2.2, there are higher proportion of respondents in the low- and low-medium-risk segments in the bachelor's degree category. In contrast, there are higher proportion of respondents in the high-risk segment in the lowest educational level depicted in the Fig 2.2.

[9] Without precise weighting based on the actual distribution of qualifications in the Public Service, it would be difficult to be conclusive about the overall state of transition risk.

Respondents reported professional qualifications (Fig. 2.4) having longer shelf-life (i.e. remain relevant longer) compared to formal educational qualifications (Fig. 2.3). Respondents also report that the skills acquired from work experience (Fig. 2.5) have longer shelf-life (i.e. remain relevant longer), again compared to formal educational qualifications.

However, econometric analysis shows that an additional year of formal educational attainment has better impact on labour market outcomes compared to an additional year of professional qualification attainment or an additional year of work experience.

Figure 2.3: Self-assessed shelf-life of formal education

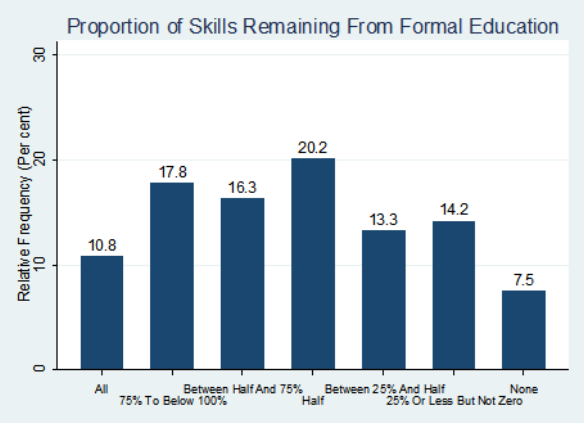



Figure 2.4: Self-assessed shelf-life of professional qualifications

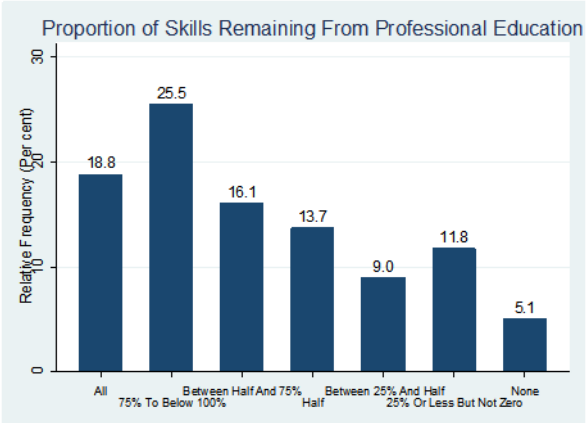
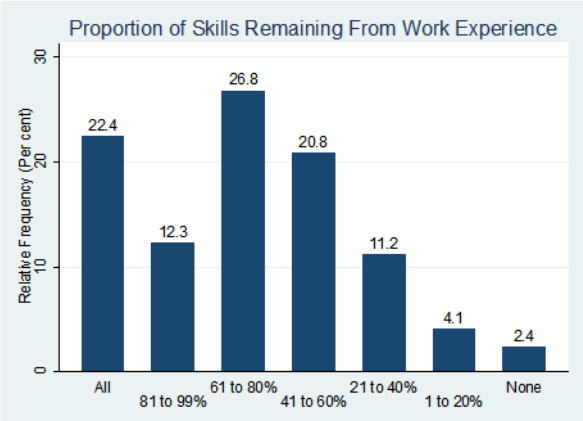


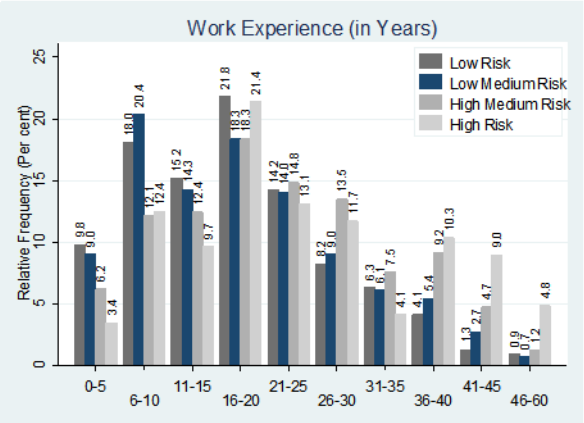

Figure 2.5: Self-assessed shelf-life of work experience




## Work experience across risk segments

Lengthier durations of work experience do not always lead to improved human capital unless the time is spent repairing the natural process of skills obsolescence. In particular, the proportion of respondents with more work experience is higher in the high-risk segment compared to low-risk segment. This suggests that if there is a failure to take advantage of work experience to strengthen skills, longer durations of work experience can actually result in a widening skills gap and thence, higher transition risk (Fig. 2.6).

Figure 2.6: Distributions of total work experience

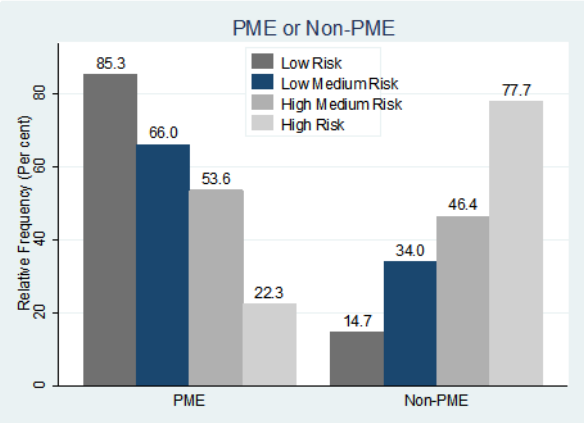



## Non-PMEs across risk segments

The proportion of non-PMEs (Fig. 2.7) in the sample is significant and enables us to examine the impact of job type on transition risk. There is a significant difference in the proportions of non-PMEs across risk segments. This shows that despite the growth in the proportion of PMEs in the local labour force, the situation of non-PMEs remains one of concern because their challenges remain daunting despite their shrinking numbers.

Besides characteristics such as age, educational attainment, salary, total work experience, and job tenure that are highly statistically significant across segments, there are also significant differences in the risk status seen in other qualifications-related aspects.

Figure 2.7: Distributions of non-PMEs




## Qualifications-related aspects across risk segments

In both Figures 2.8 and 2.9, there is an interesting coincidence in the fact that the proportions of low-risk respondents currently pursuing the qualifications are three times those of the high-risk respondents. What these constitute, we believe, is further evidence that the continuing acquisition of fresh skills is key to overcoming skills obsolescence.

Figure 2.8: Distributions of responses on current pursuit of formal education

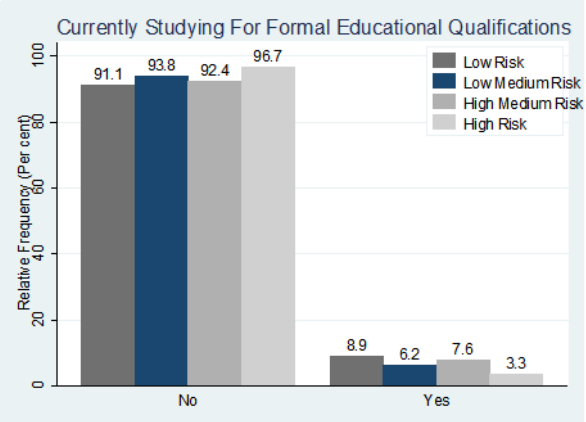
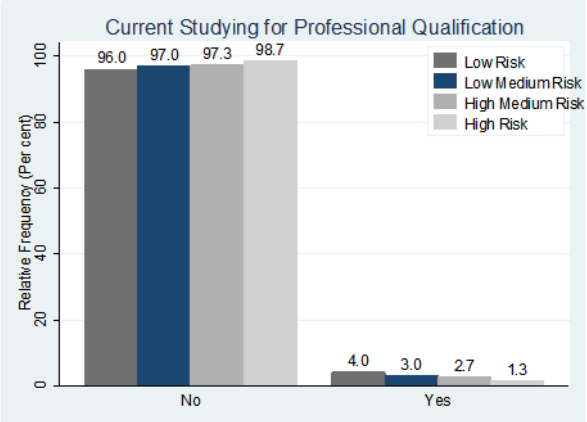



Figure 2.9: Distributions of responses on current pursuit of professional qualifications




## Person-to-person interaction in job across risk segments

Another important set of distinguishing characteristics that are statistically significant include those involving person-to-person interactions. Such interactions occur in serving members of the public (Fig. 2.10) and officers from other Public Service agencies (Fig. 2.11), collaborating with colleagues (Fig. 2.12 and Fig. 2.13), and performing supervisory roles (Fig. 2.14 and Fig. 2.15).

Figure 2.10: Distributions of responses on changing non-face-to-face contact with public

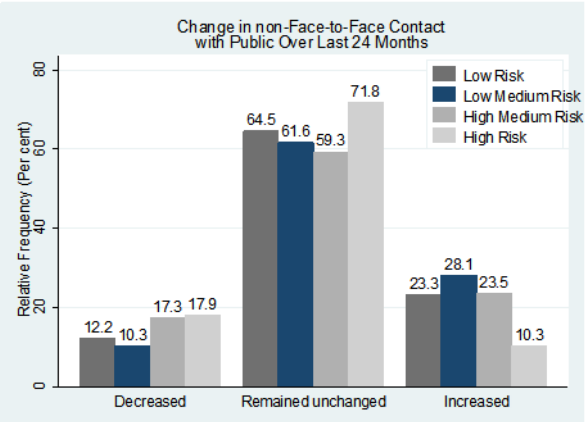



Figure 2.11: Distributions of responses on changing non-face-to-face contact with other agencies' officers

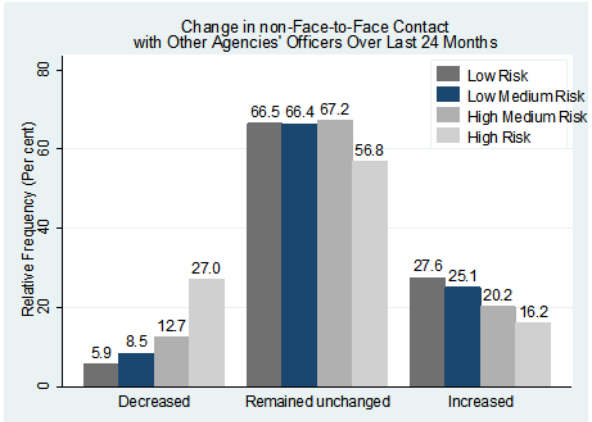



Figure 2.10 shows that respondents in the high-risk segment are less likely to see an increase in non-face-to-face contact with members of the public. Figure 2.11 depicts the same situation involving non-face-to-face with officers from other Public Service agencies. These clearly mirrors the situation of collaborative work with colleagues. There should be heightened concern because they relate to service activity. In particular, the situation in Figure 2.10 raises the issue of whether there is a knock-on effect in the service performance towards members of the public by those in the high-risk segment. This is an issue which should be examined more closely by determining if there is corroboration from records of service performance.

It is also not possible to rule out an alternative explanation, that it could be due to a weaker capacity of those in the high-risk segment to fully recognise changing work requirements.

Figure 2.12: Distributions of responses on time spent collaborating with colleagues

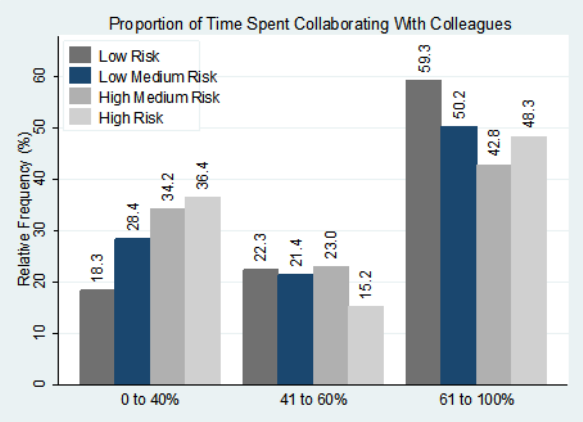
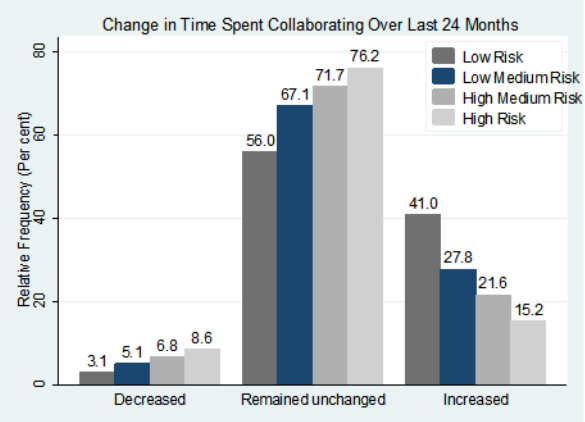



Figure 2.13: Distributions of responses changes in time on collaboration




Figures 2.12 and 2.13 show that those in the high-risk segment spent less time collaborating and were also more likely to report either a decrease or no change in time spent collaborating over last 24 months.

## Supervisory role across risk segments

Those with supervisory roles were represented in all risk segments (Fig. 2.14). The reality is that officers with supervisory responsibilities are also exposed to transition risk. This might have implications on their subordinates. The most serious concerns would be if there were knock-on effects which impeded the development of officers in the reporting chain.

Figure 2.14: Distributions of responses on whether one has a supervisory role

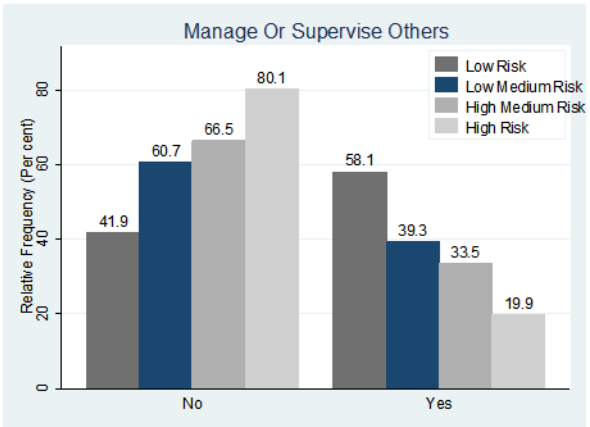
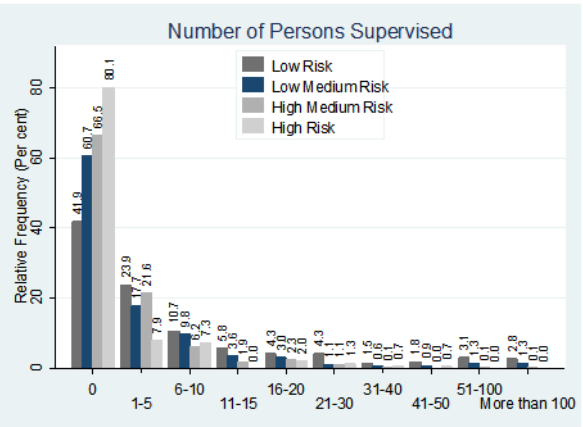



Figure 2.15: Distributions of responses on number of persons supervised




The proportion of respondents in the low-risk segment who had supervisory roles average was three times that in the high-risk segment. Hence, an officer in the high-risk segment is much less likely to hold supervisory responsibilities.

The number of persons supervised by respondents in the low-risk segment was also significantly higher than those in the high-risk segment, with the difference estimated to be at least 30% higher (Fig. 2.15). Figure 2.16 shows that the change in number supervised is significantly different across risk segments.

Figure 2.16: Distributions of responses on change in numbers supervised

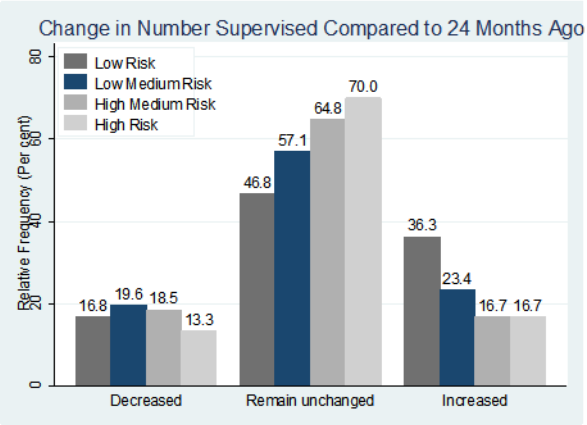
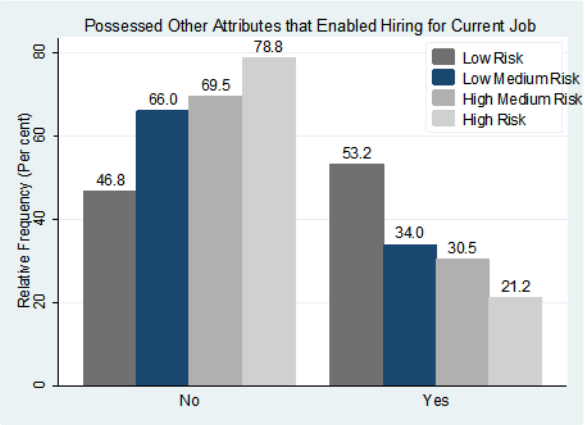



Figure 2.17: Distributions of responses on attributes during hiring




Finally, there are a set of characteristics which differ across risk segments that relate to the way officers think of their capacity and value as workers. It is important to reiterate that these ones which we will discuss in the remainder of this section are not included in the assessment criteria used in the construction of the risk indicators.

Among these, the first question is what attributes he/she had in order to have been successfully hired (Fig. 2.17). More than three-quarters in the high-risk segment did not think they had any. This brings us again to the issue mentioned above about the importance of being able to recognise requirements at work as a pre-condition for reducing transition risk. To examine this further, we posed a series of questions asking for detailed recollection of the specific skills.

## Transferable skills across risk segments

For those who had a last job, we asked about skills transferred (Fig. 2.18), and skills that could not be transferred from a previous job to the current job (Fig. 2.19).

Figure 2.18: Distributions of responses on skills transferred

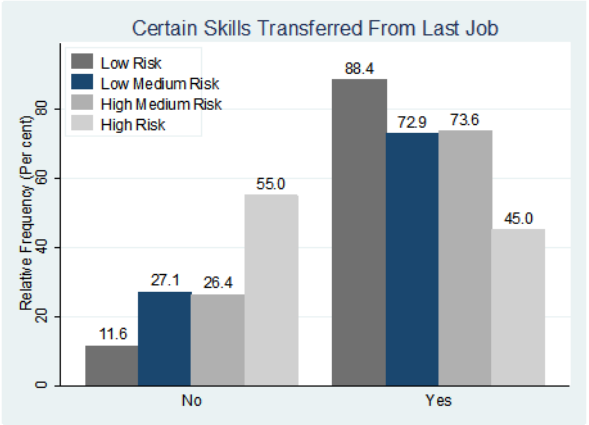
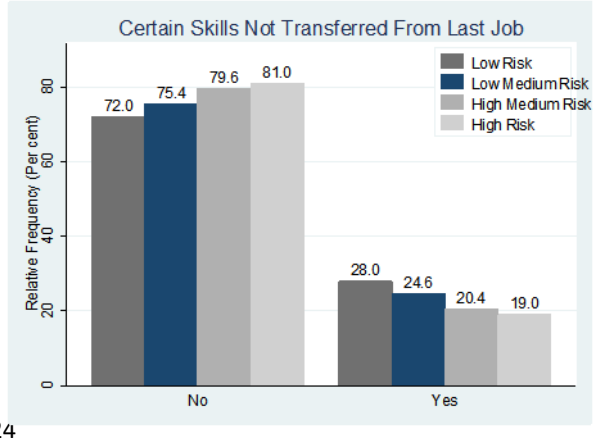



Figure 2.19: Distributions of responses on skills not transferred



In examining the specific responses, we found that management skills appeared to be more easily identifiable for most respondents than specific technical skills.

Soft skills that were featured highly were time management, communications skills, and attributes such as diligence often identified as transferable skill. Technical skills were also identified but not as much as they should be.

Except for those in the high-risk segment, the majority of respondents with a last job believed they were able to transfer skills. A respondent in the high-risk segment is less likely to believe he/she had skills which had been transferred to their current, and also less likely to believe that he/she had skills which had not been transferred. The implication is that such respondents are less able to address gaps because of a lack of recognition about where these lay.

As in all the other responses discussed in this section, these differences are statistically significant across risk segments. This suggests that recognition of skills is a critical difference across the risk segments. Further corroborating evidence for this conjecture arises with other questions on skills below.

In listing the specific skills that could not be transferred, the responses showed that there was some overlap with transferable skills, suggesting that there are a set of skills which are critical across jobs and sectors, especially management skills. Technical skills feature more often than for skills that could be transferred, especially specific skills from niche industry sectors, such as specific types of software or hardware.

Comparison of skills also suggest that the definitions of specific skills sets are a challenge for many respondents.

Enumerating skills is an important precursor to a respondent successfully identifying such skills. In Section 1, we noted that more than half of the entire sample either did not know or said they had no skills which were transferable to roles within the Public Service. The breakdown by risk segments is even more telling. While 65% or close to two-thirds of the low-risk segment indicated that they had transferable skills, only 19% or under a fifth of the high-risk segment indicated that they had transferable skills (Fig. 2.20). Indeed, the proportion of those in the high-risk group which indicated that they did not have transferable skills, was four times that in the low-risk group. That is, 14.9% or about one out of every seven respondents in the high-risk segment said they had no skills which could be transferable to another Public Service job role (Fig. 2.20).

Figure 2.20: Distributions of responses on transferable skills within Public Service

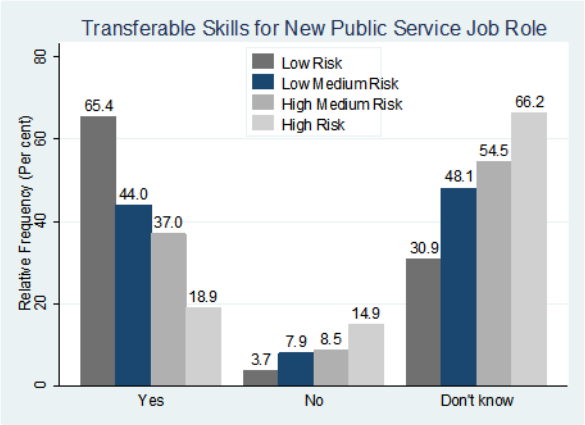
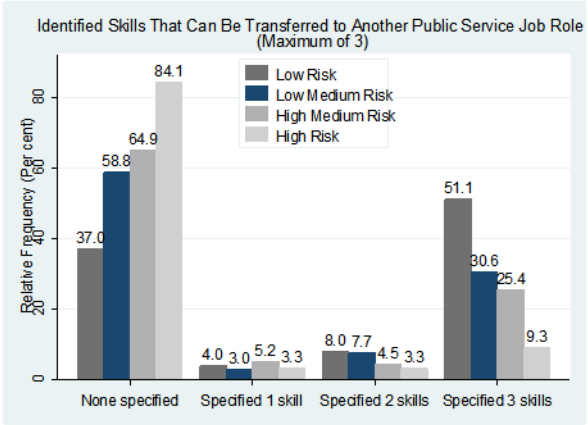



Figure 2.21: Distributions of responses on listing skills within Public Service




When asked to list the actual skills they could transfer within the Public Service, the disparity observed above is borne out in the numbers. A respondent in the low-risk segment could list 1.7 skills on average while one in the high-risk segment could only list 0.4 skills.

Figure 2.22: Distributions of responses on skills transferable to the private sector

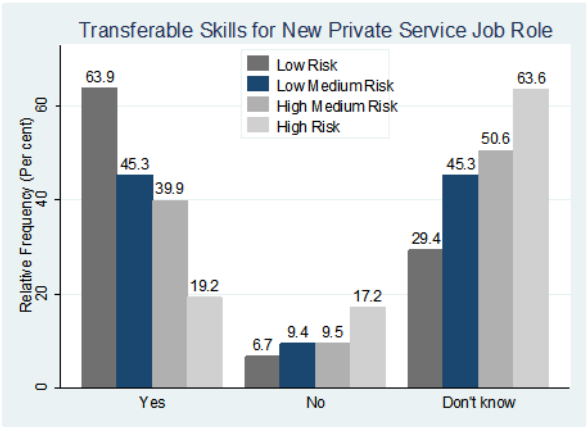
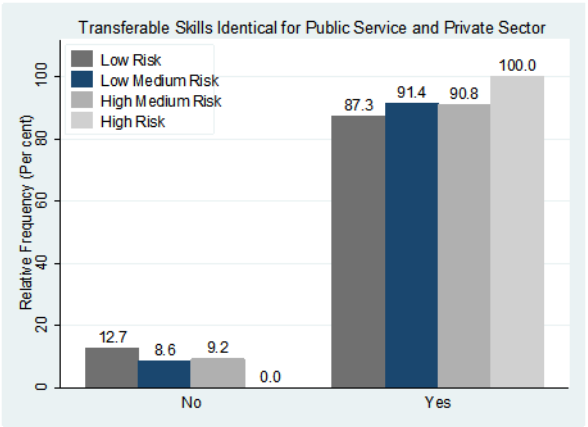


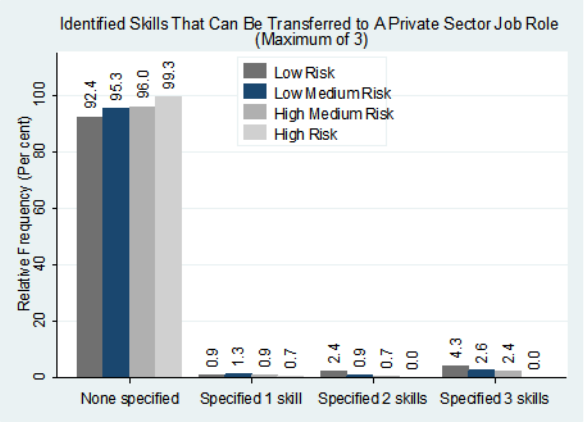

Figure 2.23: Distributions of responses on comparing transferable skills




As expected, the corresponding figures relating to skills that could be transferred to a new private sector role are poorer, but the pattern remains.

The issue of cognition (i.e. lack of capacity/ability to recognise personal skills gaps) which was mentioned earlier, is a familiar theme from business school psychology research. There is strong agreement in the literature that an important starting point for effective individual career development is the personal recognition of skills and strengths (Linley et al, 2007). This theme will arise again below with the identification of training courses, to be discussed below. Taken together, therefore, this difference between the risk segments is taken up again when we make our recommendations in Section 4.

Figure 2.24: Distributions of responses on listing skills to the private sector




## Training

Respondents were asked to list courses they had taken and found to be useful, as well as courses desired (Fig. 2.25 and Fig. 2.26 respectively). On the former, the high-risk segment listed an average of 1.6 courses per respondent, significantly less than the average of 2.3 courses of the low-risk segment.

When asked to list courses that they would like to undergo training in going forward (Fig. 2.26), the high-risk segment listed an average of 1.5 courses per respondent, again much lower than the average of 2.0 courses of the low-risk segment. In both cases, there was also a clear decline in the average number of courses listed as the risk level increased. This suggests that those in the high-risk segment were not aware of the training courses that had been useful or relevant to their job roles.

In terms of actual courses named, there are obvious similarities between the two sets of responses about training courses. A large number of these relate to training for clearly defined skills sets or training standards which are in demand in the workplace. Many of these come with widely-recognised certification awards, rendering them portable across jobs. There is strong demand for training in soft skills, such as time management and change management but demand for training in software techniques, especially those related to data science are also evident.

Figure 2.25: Distributions of responses on listing training found to have been useful

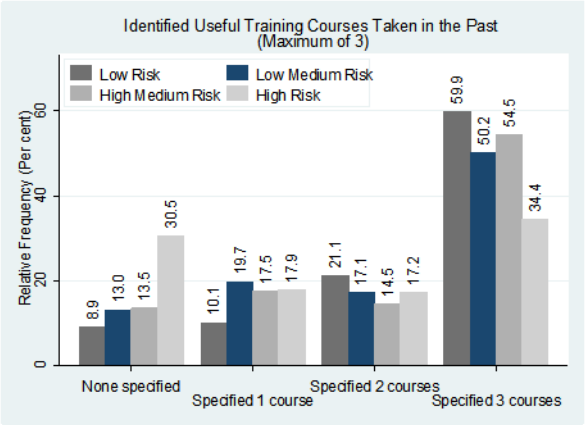
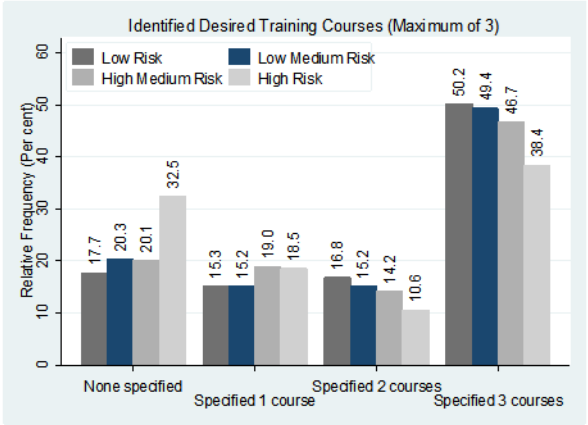
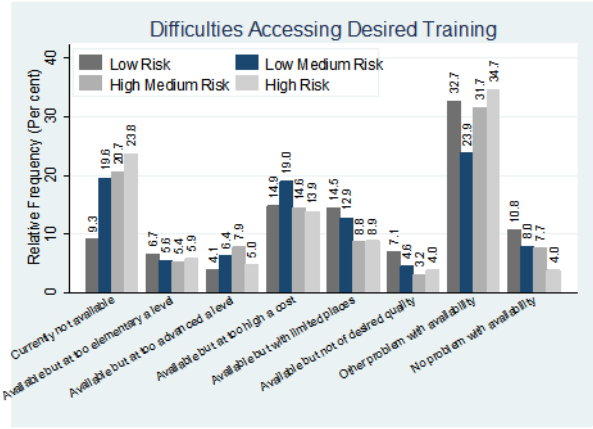



Figure 2.26: Distributions of responses on listing desired training




Finally, for training, it is important to also identify training challenges faced by workers in the high-risk segment. They report more frequent problems (Fig. 2.27) with access to training. The problems reported are about whether training is of the form, depth, and design that meets individual needs. This leads us to consider refining the distinction of training needs, such as the ones which constitute upgrading (pre-emptive or anticipatory in nature), versus those meant to plug already existing gaps (repair shortfalls).

Figure 2.27: Distributions of responses on difficulties with accessing training




## Changes in qualifications required

The discussion in this section raises the question of how much changes there have been in jobs. One way to approach this is to ask if there are changing skills requirements. This is the perspective taken by the above analysis of transferability of skills use. Another approach is to ask about whether qualifications required for a job have changed over time.

Figure 2.28: Changes in educational requirements for current job since hiring

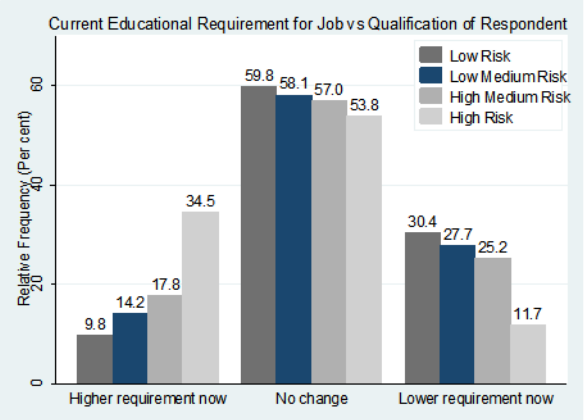



Figure 2.28 shows the differences in qualifications required at the point of interview compared to the qualifications the respondents possessed at the point of hiring. The difference across risk segments is statistically significant,[10] and shows that high-risk respondents are much more likely to say their job requirements have risen in terms of qualifications needed for the job. In our opinion, this is the clearest indication that transition risk is a problem with a gap that ultimately relates to the level of preparation for the job.

To recapitulate this section, we looked at a range of characteristics which were not part of the survey items used to derive the three sub-indicators of risk and found them all to be significantly different across risk segments. In the case of each characteristic, the difference between the distributions of the characteristic for the high-risk and low-risk segments conformed to commonly-held notions of opposing labour market status. These differences would be useful as part of a strategy designed to intervene decisively to overcome transition risk at the workforce level, but not suitable for assessing individual officers.

[10] The test result remains significant even after accounting for the confounding effects of higher education, age, and job responsibilities. For this purpose, the weight of a respondent's job responsibilities is proxied by his/her gross monthly salary. This is not the best proxy but should be adequate for the purpose of eliminating the confounding effect due to differences in job responsibilities. That is, even after removing the effects due to the fact that those with lower educational qualifications, heavier job responsibilities or older age are more likely to see an increase in the qualification requirement for a job, the difference remains statistically significant. The test, an analysis of covariance, gave a calculated value for the F-statistic of 4.00 (for which corresponds to a probability value of just 0.75%), while all covariates were highly significant.

# SECTION 3. CHARACTERISTICS WHICH DID NOT DIFFER SIGNIFICANTLY ACROSS RISK SEGMENTS

Not all characteristics differ across segments. There are several interesting exceptions, namely,

- Participation in part-time work
- Experience of unemployment

Most of the above-mentioned factors would have been expected to have an impact on skills acquisition, obsolescence and maintenance, but are not significant in this study.

Figure 3.1: Distributions of responses on having worked part-time

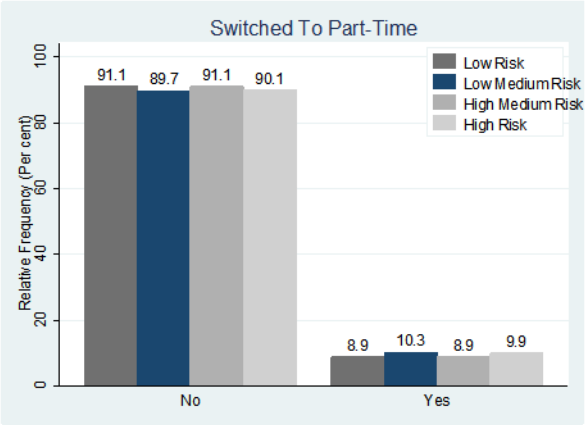
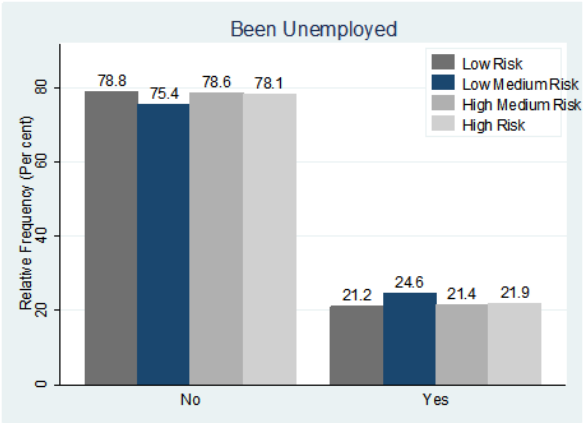



Figure 3.2: Distributions of responses on past unemployment




The proportion of respondents who had switched to part-time work was very similar across risk segments (Fig. 3.1). This is interesting because it is often not clear if part-time workers have access to the same conditions of work, such as eligibility as well as equality of access to training. The test for a difference across risk segments is insignificant.[11] We would conjecture that while this is not surprising for the Public Service, it remains to be seen if the same reassuring result would hold for the private sector.

Index of training achievement (also separately, skills and job requirements indices) did not differ significantly for those who had worked part-time previously.

Under a quarter of respondents had experience of unemployment (Fig. 3.2). This is close to what we would expect based on national unemployment rate. Again, there is very little difference in the proportion across segments of those who had unemployment stints in the past.

[11] This does match some anecdotal evidence we have received from respondents during fieldwork.

# SECTION 4. PROFILES OF RISK SEGMENTS AND RECOMMENDATIONS

We summarise the profiles of the risk segments, as seen in the characteristics that were found to be significantly different in Section 2. Based on the profile differences, we make some suggestions for intervention. Our suggestions are derived from the comparisons of the risk segments in the preceding section. Hence, they are limited to addressing the needs of those in the high-risk and possibly, high-medium-risk segments.

## Low-risk Segment

The respondents in this group include those with deepest and broadest skills sets, as well as deepest and broadest training achievements.

They are more likely to be PMEs than their high-risk counterparts. More of them in supervisory roles, they report more time spent in collaboration with colleagues, with such time increasing over the last 24 months.

They usually – but not necessarily – are younger and higher salaried and with better educational qualifications. They are also more likely than their high-risk counterparts to be engaged in current pursuit of additional formal educational or professional qualifications.

## Medium-risk Segment

The respondents in this group make up the majority of sample. This segment does not have as clearly defined attributes as the other two segments and are more aptly describes as 'in-between' segment. They represent a very broad group in terms of the range of characteristics.

Unlike members in the low-risk and high-risk segments who are unlikely to see any change in their risk status, the main concern with the members of the medium-risk segment is that they could potentially move into the extreme segments (i.e. low-risk and high-risk) they are nearest to. To facilitate identification of those who should be prioritised for intervention when resources are limited, the medium-risk segment can be further sub-divided into two smaller groups, depending on potential of becoming more or less at risk over time.

The main challenge then would be to ensure that those in the high-medium-risk segment do not slip into the high-risk segment. The members of the medium-risk segment have skills sets weaker than they could be, compared to those in the low-risk segment. For this sample, it turns out that the main discriminating index lies with that of skills. In comparison, the index of training achievements has less capacity to discriminate in this sample, resulting in a situation where the high-risk segment boundary is only slightly below that of the low-risk segment.[12]

[12] This is seen by comparing Fig. C1 and Fig. C3 of Appendix C.

## High-risk Segment

The high-risk segment comprises respondents with the shallowest and narrowest skills sets. They also have negligible training achievements. Based on further in-depth interviews, respondents are less likely to have completed follow-on training in a way which builds on earlier training accomplishments, if any.

Compared to their low-risk counterparts, they have seen significantly less change in critical areas of person-to-person interactions over the last 24 months.

They have also seen very little increase in non-face-to-face interactions with persons they serve, either in terms of members of the public or in the form of officers from other agencies. They are usually non-PMEs. Hence, they are also usually, but not exclusively, those in non-supervisory roles. They spent less time in collaboration with colleagues, with such time decreasing over the 24 months prior to the survey.

They are usually – but not necessarily – older and lower salaried. They have poorer educational qualifications and are also less likely than their low-risk counterparts to be engaged in current pursuit of additional qualifications.

In terms of the areas considered during the skills assessment, they are less likely to have specific technical or technological skills. Finally, there is strong and recurring evidence that those at high-risk have weaker capacity to identify certain important aspects of their job requirements.

## Suggested Recommendations on General Intervention

Based on the analysis in Section 2, we propose the following forms of intervention be considered.

<u>Individual skills assessment</u>

1. It would be useful to conduct skills assessments for individual officers in the organisation. This would address the issue faced by those who are unclear or unaware of the skills they have and hence the ones they lack for their current job. The weakness in recognising skills deficits is clearly seen in several aspects of the responses with the high-risk segment. In this regard, it would also be useful to consider requesting that officers provide some form of regular skills assessments of their organisations. This would serve to inspire individual officers to see themselves as contributors to their organisational skills pool. It should also encourage them to see themselves as sharing responsibility for their organisation's strengths while at the same time motivating them to see themselves as a starting point in overcoming any perceived organisational weaknesses. Reporting officers can use this as a basis for proposing ways for the officers under their supervision to be reskilled or upskilled.

Inter-division workgroups

2. To actively promote the notion that increased and closer collaboration among colleagues within each agency as well as across agencies as a means of addressing the challenges of disruption. For instance, increasing opportunities for inter-division workgroups to foster cross functional collaboration among divisions and officers, of different ranks, to work on various projects collectively. Putting together diverse teams has the potential to create opportunities for workers to step outside of their respective comfort zones, exposing them to new ideas and new ways of doing things where learning takes place.

   The danger of employees retreating into their own world is not one unique to the Public Service. All organisations face this risk, with size being clearly a determining factor. The Public Service is in many ways primed for this challenge, and the findings on the difference in collaboration times across risk segments would not have come as a surprise.

Cross-agency postings

3. To increase exposure, cross-agency postings should be made available even for officers that are

   - in non-supervisory role,
   - at the lower end of the salary scale, and
   - have lower educational qualifications.

   Usually, postings are offered to those with the potential to excel, as a means of exposure and to 'stretch' their abilities. The reason for this suggestion is no different, but the focus is on ensuring that transition risk of the workforce as a whole is managed in the face of accelerating threats of disruption.

   We found that those in the high-risk segment tended to report less person-to-person interactions over the 24 months prior to the survey. To address this, the Public Service should turn its size to its advantage. For a start, our recommendation is to consider grouping Public Service agencies along functional lines, such as those based on the degree of inter-dependency of their officers' job scope, and hence facilitate cross-agency posting within each group. For example, an officer from a ministry's human resource team could be posted to the human resource team in another ministry. This concept is similar to those employed by multinational organisations to train promising employees through international postings. The difference in this case is that the focus should be on the officers who are in need of this exposure in order to overcome their tendency to be in the high -risk segment when it comes to transition. In other words, this should be considered for officers that are at the lower end of the salary or educational spectrums. Ultimately, of course, such cross-agency postings could be extended to whole of government.

Officers in the high-risk segment generally have a poorer awareness or visibility of the range and depth of skills that an organisation needs, and which individuals can acquire. Hence, the exposure they need – though not necessarily one they may welcome – should be thought of as a literal out-of-the-box experiential learning intervention.

## Suggested Recommendations on Training

There is evidence that the Public Service already prioritises training to take into account an individual officer's long-term needs in addition to organisational needs. It also has systems in place to take into account changes in training requirements over time. The priority is to strengthen and continue this individual officer-centric approach.

Beyond that, the objectives, needs and structure of training must be based on the individual's changing perspective and the evolving challenges facing the organisation. The circumstantial evidence suggests the Public Service would be in a stronger position than the private sector to address such training challenges.

### Accessibility of training

4. There is some urgency on the need to improve accessibility of training. In particular, timeliness, continuity and depth of intervention are important. Just as with all forms of assistance, the aim should be to prioritise the allocation of resources to those who have the most urgent needs. From our analysis, workers who are simultaneously characterised by being older, with lower levels of educational qualifications and also at the lower end of the salary spectrum would require most immediate and urgent interventions. These could take the form not just of training support but also reskilling and job rotations, among other things.

### Better curation of training courses with the involvement of stakeholders

5. There is a need to better curate useful and relevant training courses as the quality of training may be affected when the demand for training rises. This is an area which all stakeholders, including Public Service Leaders and Labour Movement (LM), can contribute to and work hand-in-hand. Given the familiarity of union leaders with the needs and preferences of their members / workers, LM and the unions could play a role in the process of curating relevant courses that meet increasingly complex needs of workers, within and outside of Public Service. Better curation of useful and relevant training courses will also help to address the issues faced by those in high-risk segment such as the lack of awareness or visibility of the range and depth of skills that an organisation offers and needs, and the skills they need to acquire.

   There should be a sustainable approach which balances the needs of older, lower-ranking officers while paying heed to resource constraints. This is because resources are limited, and allocation for one need will always require that some other need be compromised.

Timeliness of intervention

6. Early intervention matters. For a typical officer, training intervention not only becomes costlier the longer it is delayed, delayed intervention is also diminished in effectiveness. Therefore, it is crucial to put in place structured intervention for older workers as they may have a shorter runway for intervention. Some potential ways include more frequent skills assessment for older workers compared to younger workers. In addition, the preparation for workers to transit or reskill should start as early as at the age of 40.

Application of training

7. Training should not be conflated with individual job performance, and should not be defined as a Key Performance Indicator (KPI). Ability and opportunity to apply training at work should be discussed before training and regularly monitored after training through evaluation process in

   - Pre-training
   - During training
   - Post-training

   In doing so, there is a need to be able to distinguish between individual performance and quality of training provision.

Innovate forms of training

8. Finally, the way training is designed, delivered and implemented can greatly influence the effectiveness of the training. There is a need to move away from traditional forms of training and for the Public Service to push ahead with innovation in training for officers at all grades to balance the pressures from conventional sources of training.

# SECTION 5. CONCLUSION

In conclusion, we recapitulate some useful distinctions that have been uncovered by our analysis. In terms of addressing the consequences of skills deficit, the main causal factor of the lack of effective intervention to close gaps which arise and widen as a result the natural process of obsolescence. In doing so, age is as much of a risk factor as an asset. Hence, it would be important to continue with progressive efforts already made within the local employment framework to distinguish age from useful work experience.

There is clear evidence that education, both formal and professional, provides a strong foundation for promoting human capital enhancement and reducing transition risk. The Public Service already recognises professional qualifications, and that is at least one important factor in keeping transition risk under control.

Finally, although the recommendations are heavily focused on training, this is not necessarily about increasing hours of, budgets for, or actual expenditures on training. The study finds strong evidence that in terms of all these measures, the Public Service is also doing a lot to help workers in transition.

# APPENDIX A – REFERENCES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# APPENDIX B – RESEARCH STRATEGY AND QUESTIONNAIRE DESIGN

## Research Strategy

We seek an assessment of the risk faced by a respondent in a situation where there are observed risk classifications of the respondent group. In that sense, the assessments are predictive in nature.

The respondent group comprises the Public Service workforce of Singapore. With a size in excess of 140,000 spread across sixteen ministries, five departments of organs of state, and more than sixty statutory boards, the diversity of skills and job functions clearly present a challenge when it comes to classifying the workforce into groups with profiles that are as distinct from one another as possible.

Despite the absence of known classification of risk of the respondent group, there are generally accepted correlates of risk, such as age and type of work done. However, the inclusion of all such indicators of risk would be arbitrary because many of these characteristics (e.g. age) could be the result rather than the cause of heightened risk in transition.

Rather than using all possible indicators, we confine our assessment of risk to as parsimonious a set as possible. By limiting the number of variates used to assess risk, this would allow us to validate the predicted risk assessments with other commonly observed characteristics seen in workers considered to be at higher risk.

The statistical technique that we employ for dividing the sample into various levels of risk in this situation where the true risk classification is unknown is latent class analysis (McCutcheon, 1987; Hagenaars & McCutcheon, 2002 ).[13]

The OECD's PIAAC conducts the Survey of Adult Skills (OECD, 2016). In order to assess the level of skills used at work by respondents in our study, we developed a questionnaire which adapts the questions from the PIAAC survey's background questionnaire on skills use at work. The specific areas covered are described in Appendices B and C.[14]

The sample of Public Service officers is classified into segments according to their predicted level of transition risk. The segments are derived using Latent Class Analysis

[13] The identification of skills sets, and measurement of skills levels require an extremely detailed and complex approach which may entail conducting individual assessments. This is the approach taken by studies targeting employers. Examples of this abound, ranging from the UK Employer Skills Survey (Winterbotham et al, 2018), to The European Centre for the Development of Vocational Training (Cedefop, 2010). Another approach is to survey individuals, such as that done in the Survey of Adult Skills (OECD, 2016).

[14] This survey involves the administration of a background questionnaire as well as structured assessments in three specific areas of skills, namely literacy, numeracy and problem-solving in a technology-rich environment. Its background questionnaire contains questions on skills used in everyday life and at work. Studies suggest that there is a close coherence between the responses on specific areas of skills use related to literacy skills and the administered assessments in the literacy. In other words, respondents to the PIAAC survey who do well on the literacy assessment also respond to the background questionnaire's questions on literacy skills use in a way which demonstrates a high frequency of usage as well as a high level of competency. This coherence extends to the other two areas of skills covered the PIAAC study, i.e. numeracy and problem-solving in technology-rich environment.

(LCA) to identify risk factors based on skills used at work, achievement in training, and job requirements.

This is a novel approach for assessing overall workforce skills. It yields a composite indicator of the degree of transition risk that can be used for comparisons across agencies at a point in time or for tracking an agency's transition risk over time. However, as the assessment is based on macroeconomic profiling, this approach is only suitable for the identification of segments of the workforce which may be at risk, and does not allow for individual workers to be reliably assessed.

Tests of hypotheses

To test the results of the predicted classifications from LCA, we make use of a model formulation derived from the Mincer's human capital earnings function (Mincer, 1958, 1974). Specifically, such a model is based on estimating the relationship between earnings, educational attainment and work experience.

In this study, the purpose of adopting the human capital earnings formulation is to provide a framework within which a test of the hypothesis about the consequences of a respondent's risk classification for his/her human capital accumulation rate. More precisely, under the null hypothesis that the risk classification of a respondent does not affect his/her human capital formation, the rate at which total work experience contributes to earnings growth will be equal across all risk segments.

A rejection of the null hypothesis will allow for the fact that an individual's human capital will see a relative decline over time through higher transition risk. The main causes of such a reduction are skills obsolescence and depreciation in human capital due to the accompanying heightening of risk.[15]

To provide a more concrete illustration of the impact on labour market outcomes that skills obsolescence would have, consider the concept of what we refer to as "shelf life" of human capital assets.

Shelf-life of education and qualifications

The most important asset in this case is formal educational attainment. We define its shelf-life as the proportion of skills remaining relevant from the respondent's qualification or experience. Hence, the shelf-life of a person's formal education is the proportion of skills acquired from formal education that still remain relevant. As the graph (Fig. 2.3) shows, most respondents are aware of the decline in the value of this asset over time. The same holds for other human capital assets (see Fig. 2.4 for professional qualifications), and in general, the skills they enable a respondent to deploy in a job.

[15] Appendix C describes certain technical considerations relating to the appropriate econometric treatment of identification and estimation issues of the single-equation earnings equation arising from the endogeneity of one of its key explanatory variables.

Skills are acquired, augmented and then undergo decline.[16] In this study, the usual foundations for skills formation are considered to be formal education, the acquisition of professional qualifications and accumulation of work experience. The skills acquired on these foundations do not last forever and have a limited shelf-life.

As the responses are self-reported, they may be subjected to social desirability bias where respondents have tendency to over-report or under-report their responses. For that reason, they cannot be assessed in isolation and should instead be interpreted through comparisons with those from other avenues of skills acquisition.

## Target Population

The target respondents are current and retired officers of the Singapore Public Service. The research team reached out through various channels to encourage participation. The main channel of contact was through e-mail inviting registration from Public Service officers. The e-mail outreach received significant support from the Public Service Division and from the Labour Movement through various Unions with Public Service officers in their membership body. The commencement of fieldwork was initiated by an e-mail message sent to the work e-mail contacts of all serving Public Service officers.

## Data Collection

Data is gathered mainly through an online survey with a structured questionnaire. The questionnaire was deployed using the commercial online platform Limesurvey Professional, running version 3.0.

Information on the respondents are collected in a de-identified and non-intimidating manner with only a very small number of core team members involved in actual interaction with respondents. Fieldwork commenced on June 5, 2018 and closed on December 10, 2018. Subsequent follow-up took place with both e-mail reminders as well as the handing out of flyers in public spaces at locations such Toa Payoh Hub and the Central Business District. There was only a single online version of the questionnaire in English. To reach out potential respondents who either had difficulty accessing the online version or preferred not to, printed hardcopies of the questionnaires were also available for distribution in English as well as in Malay, Chinese and Tamil. The non-English translations of the questionnaires were produced by paid professional translators sourced locally, and the translated drafts were sent to volunteer faculty for review. Where necessary, corrections were sought from the translators. This rigour of this process was imposed in order to prevent biases from being introduced by unintended mis-translations. The number of completed submissions through printed hardcopy questionnaires was about 80, while the total number of non-English hardcopy questionnaires submitted was less than 10.

[16] Arthur and Day (2013) provides a psychological treatment while Sayala et al (2010) undertakes a skills measurement approach.

## Structure of the Questionnaire

The questionnaire comprised 140 questions, organised in 7 sections. The actual number of questions is less, with the later questions depending on the route a respondent takes as a result of his/her responses or choices in preceding questions. The final section of the questionnaire is very brief with only three questions and requests voluntary contact information for the purposes of follow-up by the research team. No other personal information such as postal addresses, marriage status or family details are collected at any point.

The main part of the questionnaire proper comprises two parts. The first comprises four sections as follows:

- Section 1 on respondent's basic background information (age, gender, nationality, union membership status);
- Section 2 on educational and professional qualifications;
- Section 3 on details about department and status of the current (or most recent, for retired respondents) job in the Public Service;
- Section 4 on details about the past work experience including last job as well as any stints of unemployment.

The second part comprises three sections as follows:

- Section 1 on skills used at work;
- Section 2 on training achievements, aspirations and experiences; and
- Section 3 on job requirements.

# APPENDIX C – FORMULATION OF THE INDICES OF RISK

In this appendix, we describe the construction of the three constituent indices which are used to enable comparisons of levels of skills use, training achievements and job requirements.

The design and computation of each of the three indices are similar.

Each index is derived from the responses that are obtained from individual officers to specific questions. Although this will lead to the availability of index measurements at the individual, comparisons can only be made using aggregated measures, because individual level responses lack statistical precision.

It is important to state the caveat that the resulting measures is new and un-calibrated, and require validation.

## Skills Index - Design and Computation

The index is computed from combining indicators of skills use, comprising frequency of use and level of ability across several areas of skills applications. The aim is to assess skills levels and from there, identify skills gaps. Hence, we only need to establish breadth and depth of skills sets at the individual level.

Instead of providing a complete list of generic skills and competencies, we use only two suggestive lists. Listed areas of skills applications are generic skills and competencies. Areas of skills applications which fall outside of the listed ones may be specified by each respondent. In this way, a respondent can define and rate additional skills sets.

Importance of a skills set, as defined by its frequency of use, is used to weight the skill in combining an omnibus measure of overall levels of skills use.

The full list of pre-defined skills and competencies comprise five in general management/administrative areas, and another twelve in specific technical/ technological areas.

The first set of five in general management/administrative are as follows:

(1) Managing the workload of subordinates

(2) Supervising the achievement of key performance indicators

(3) Managing the allocation of resources

(4) Managing the deployment and use of new technology

(5) General people management (e.g. career development of subordinates)

The second set of twelve in specific technical/technological areas are as follows:

(1) Interpretation and assessment of basic reports and submissions

(2) Drafting of basic reports and submissions

(3) Interpretation and assessment of reports and submissions containing complex analyses

(4) Drafting of complex reports and submissions containing complex analyses

(5) Performing moderately difficult calculation

(6) Performing complex calculation

(7) Straightforward use of computer (e.g. basic word-processing and spreadsheets)

(8) Moderately complex use of computer (e.g. manipulating specialised software)

(9) Advanced use of computer (e.g. programming with code)

(10) Use of basic ICT (e.g. accessing materials online, using e-mail)

(11) Use of intermediate ICT (e.g. using skype or video-conferencing software,

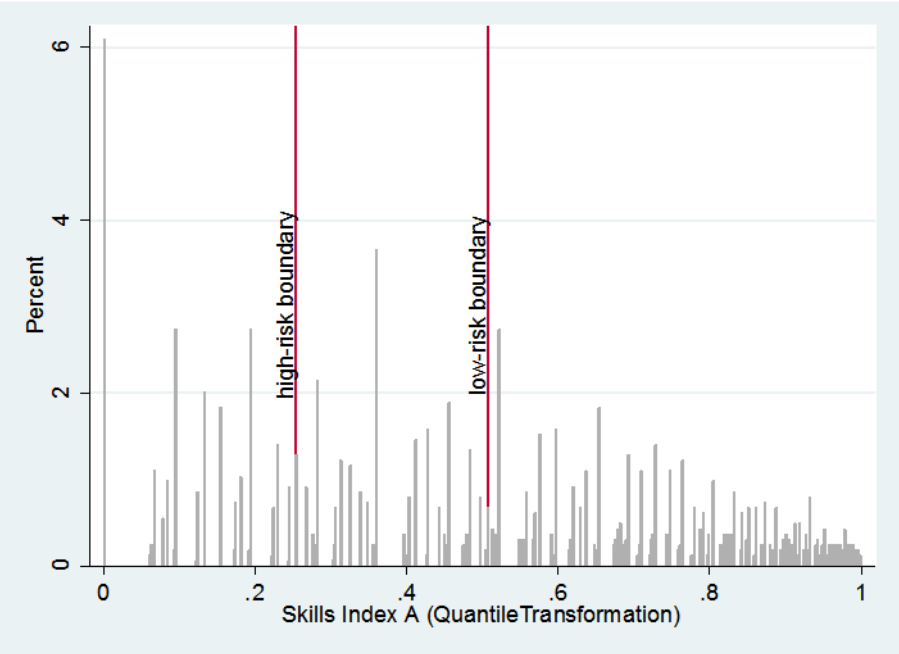
deploying mobile apps for projects)

(12) Use of advanced ICT (e.g. programming apps, troubleshooting ICT issues)

The distribution of the resulting skills is shown below (Fig. C1). This distribution shows the proportion of the sample at each skills index level. The skills index shown here is a transformed quantity that lies between 0 and 1, with a higher value representing a better level of skills use. The height of each bar shows the proportion of the sample at the corresponding value of the skills index.

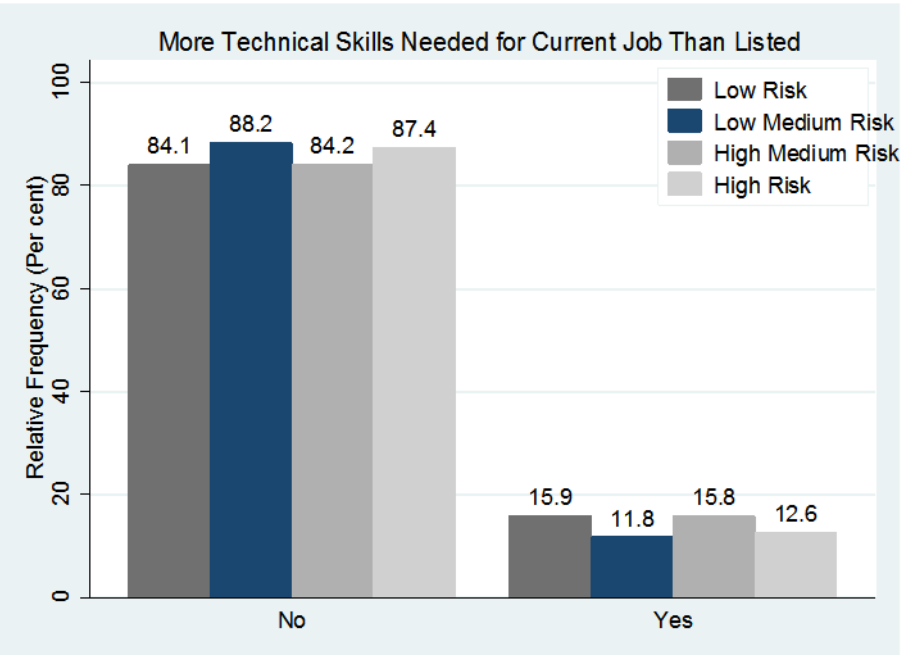
The graph shows the bounds at which the extreme risk segments are identified. We should caution that these bounds cannot be used base on the Skills Index alone. Instead, they are developed on the basis of all three indices devised in this project. The same applies to the bounds in the graphs shown later of the distributions of the Training Index (Fig. C3) and the Job Requirements Index (Fig. C10).

Figure C1: Histogram of index of skills use




There is a concern, of course, about whether the list of skills was complete. In order to address this, respondents were given opportunities to specify skills that they believed should apply to them. The general conclusions from this mirror those discussed in Section 2 on transferred and transferable skills. A comparison of the respondents by risk segments who responded about this is given in the following graph (Fig. C2). A test for differences by segments produced an insignificant result.

Figure C2: Distributions of responses on whether technical skills beyond the listed ones are required



## Training Index

This is an index of training achievements. Its aim is to measure the level of training achievements of a respondent. It is computed from combining indicators of training, comprising frequency of training and extent of application to current work. The list covers forms of training, rather than areas. As with the skills index, forms of training outside of the listed ones may be specified by each respondent

A distinction is made between on-job-training (OJT) and other modes of training. OJT occurs within the workplace setting and within the immediate supervision of experienced co-workers. Non-OJT training usually occurs outside of the workplace setting.

The full list of pre-defined modes of non-OJT training comprise the following three:

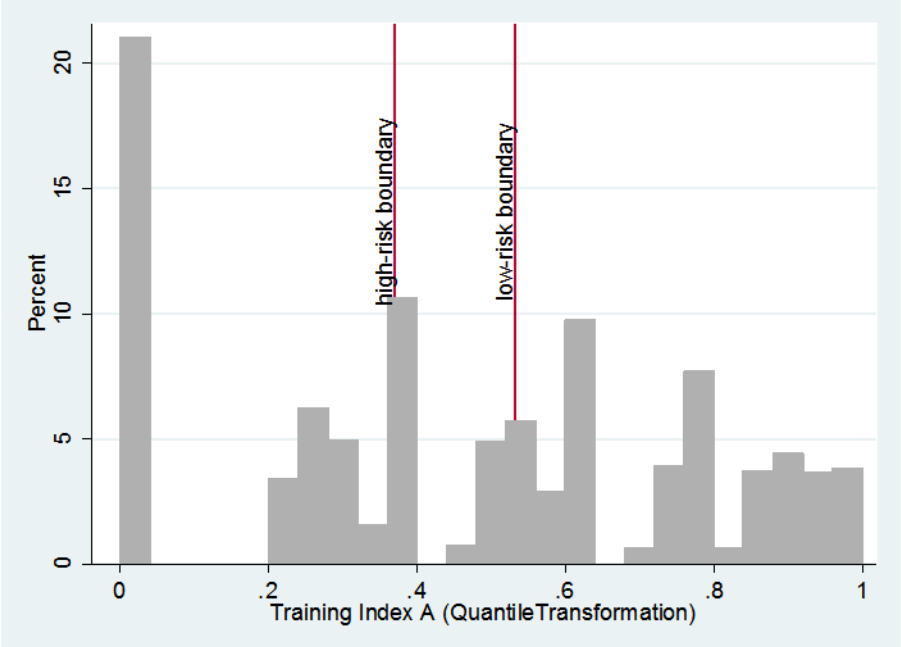
(1) open or online learning

(2) seminars and workshops

(3) any other forms of privately-initiated training

The distribution of the resulting index of training achievements is referred to here as the training index distribution (Fig. C3). This is a probability distribution for an index. The index shown here is a transformed quantity that lies between 0 and 1, with a higher value representing a better level of skills use. The resolution of the horizontal axis is visibly lower than that of the skills index distribution because of the fewer attributes covered by the index.

Figure C3: Histogram of index of training achievements



## Job Requirements Index Distribution

This is categorised into primary and secondary levels of description. Primary levels of job requirements consider whether a job involves face-to-face or non-face-to-face interactions, the extent and form of strenuous exertion regularly involved, and the need to handle problems of varying levels of difficulty. At the secondary levels, each of these are further sub-divided. As the following graphs show, the tests display good discriminatory power in the various job requirement categories.

Figure C4: Distributions of responses on frequency of handling simple problems

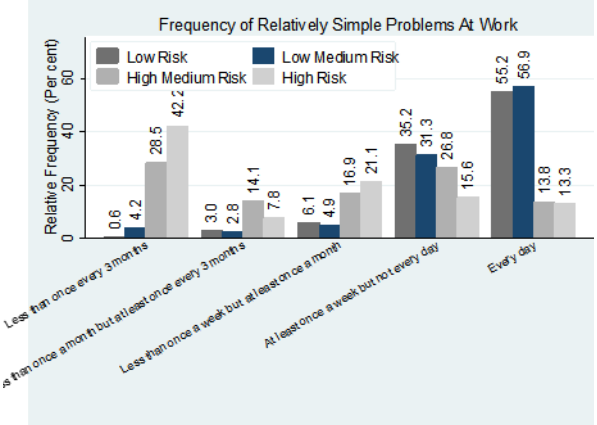
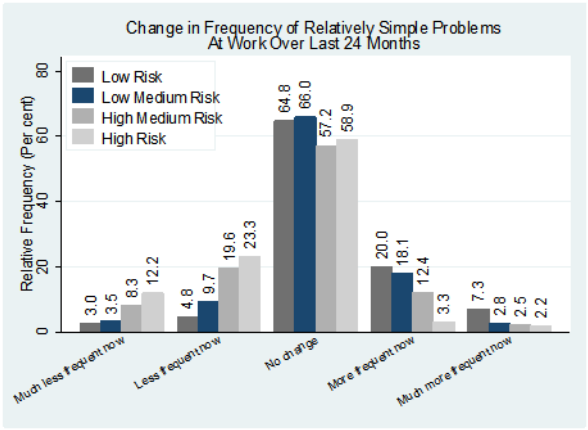



Figure C5: Distributions of responses on change in frequency of handling simple problems




The depiction in the graphs is supported by statistical testing. In all cases shown in Figures C4 to C9, the tests for differences across risk segments are significant. This implies that these responses would be suitable for inclusion as items to be covered in an index of job requirements.

Figure C6: Distributions of responses on frequency of handling more complex problems

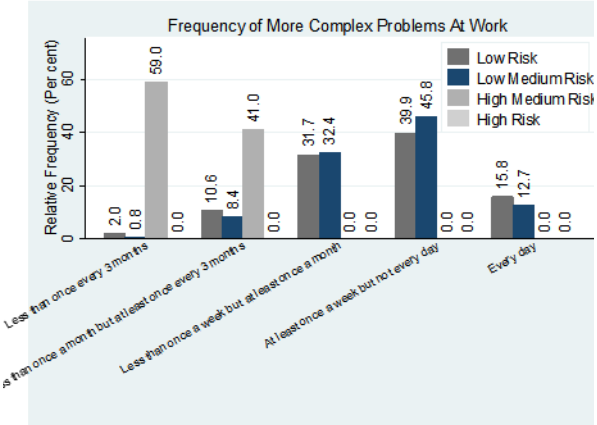



Figure C7: Distributions of responses on change in frequency of handling more complex problems

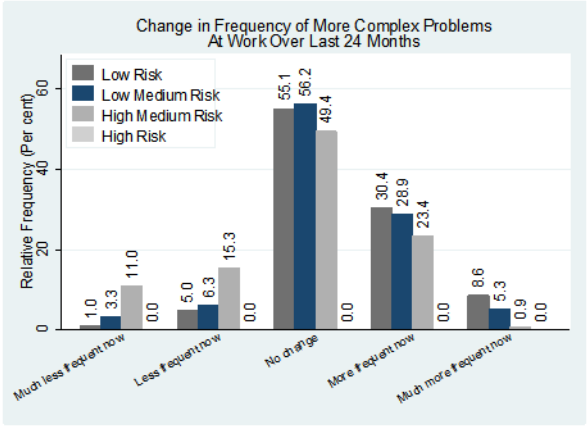


Figure C8: Distributions of responses on frequency of handling extremely challenging problems

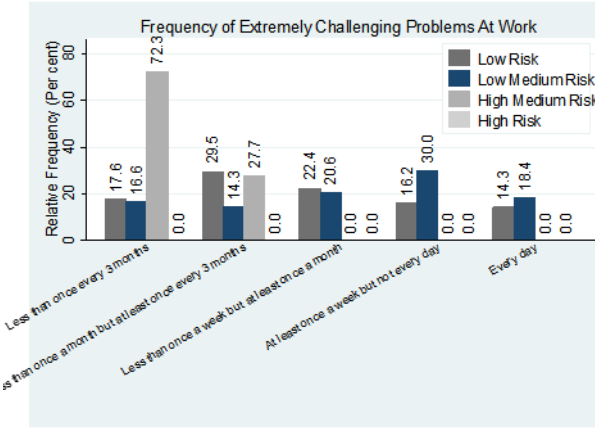
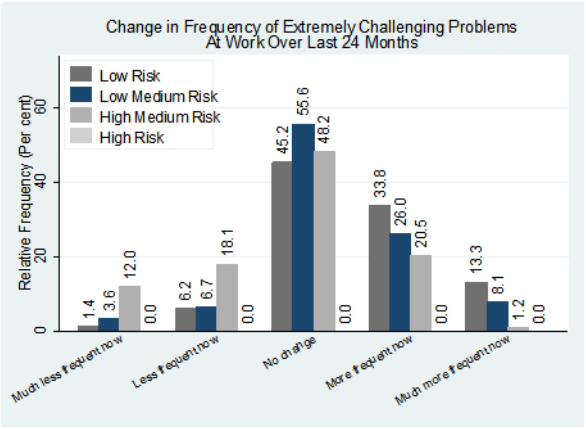


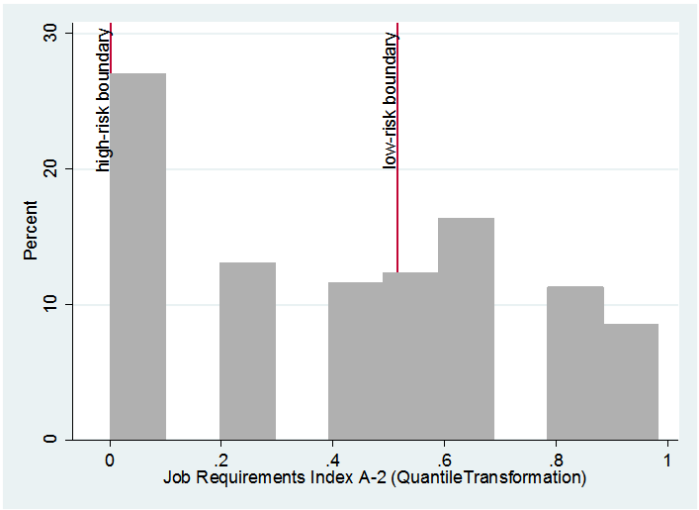

Figure C9: Distributions of responses on change in frequency of handling extremely challenging problems




After some testing, we decide to exclude the details about person-to-person interactions from the index. As discussed in Section 2, the index is able to make a very good distinction between the different segments in terms of person-to-person interactions, thus adhering to the principle of parsimony.

The resulting index distribution is shown below (Fig. C10). It should be interpreted as the probability distribution for an index measuring job requirements. The interpretation of the axes is as in the earlier two cases. The resolution of the horizontal axis is even lower than that of the training index distribution because of the lower number of attributes selected in the construction of the preferred index.

Figure C10: Histogram of index job requirements



Combining index measures of skills, training achievements and job requirements will provide a composite measure of the degree of transition risk (or alternatively, of resilience). The composite measures are discrete, resulting in categorisations of the sample, or segments with differing degrees of transition risk.

The resulting risk segment using this method is distributed as follows:

| Risk rating | Low | Low-medium | High-medium | High | Whole sample |
|---|---|---|---|---|---|
| **Sample size** | 327 | 997 | 158 | 160 | 1642 |
| **Proportion** | 19.91% | 60.72% | 9.62% | 9.74% | 100% |

In Appendix D, LCA is described. The classification from LCA is compared to this, as a means of validating this approach to classifying respondents.

# APPENDIX D – ANALYSIS FROM LATENT CLASS AND ECONOMETRIC MODELS

## Latent class analysis

Latent class analysis (LCA) is an approach to estimating discrete latent variables. Based on finite normal mixture modelling, LCA is implemented using a model-based approach to clustering, classification, and density estimation. This is done using the package mclust available from the R project archive.

The table below shows the close correspondence between the classification from LCA modelling and the classification derived by using the manual cut-offs based on the boundaries shown in the index distributions in Appendix C. The correlation between the two is very high.

The only difference is that the manual classifications can be selected to be non-overlapping. For that reason, we choose the manual classification in our analysis.

| | | Classifications by LCA | | | | | |
|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | | |
| **Classification by cut-offs from indices** | **1** | 165 | 113 | 49 | 0 | 327 | 19.91% |
| | **2** | 245 | 389 | 177 | 186 | 997 | 60.72% |
| | **3** | 17 | 41 | 34 | 66 | 158 | 9.62% |
| | **4** | 4 | 51 | 27 | 78 | 160 | 9.74% |
| | | 431 | 594 | 287 | 330 | 1642 | |
| | | 26.25% | 36.18% | 17.48% | 20.10% | | |

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