



LABOUR RESEARCH CONFERENCE 2018

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POLARISING OF JOB OPPORTUNITIES

CHARTING NEW PATHWAYS AND ADOPTING NEW TECHNOLOGIES

Third topic in the conference proceedings: Polarising of Job Opportunities - Charting New Pathways and Adopting New Technologies.

Research partnership between Ong Teng Cheong Labour Leadership Institute (OTCi) and the Lee Kuan Yew Centre for Innovative Cities (LKYCIC) at the Singapore University of Technology and Design (SUTD).

Report presentation by Poon King Wang, LKYCIC, SUTD.



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Printed in Singapore by Eazi Printing Pte Ltd

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ISBN: 978-981-14-0858-8

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EXECUTIVE SUMMARY

The research collaboration between the Lee Kuan Yew Centre for Innovative Cities (LKYCIC) at the Singapore University of Technology and Design (SUTD) and the Ong Teng Cheong Labour Leadership Institute (OTCi) aimed to answer this question:

Job polarisation¹ has been observed in other countries – what is our way forward?

This report details our research and recommendations on how we can move forward on.

6-5-4-3-2-1. We propose **6 recommendations** to be implemented in the next **5 years** to navigate the **4th Industrial Revolution**. They are designed to tackle **3 polarisation risks** that our research has identified. These recommendations are based on **2 strategies** developed in the LKYCIC and have **1 singular objective** of helping our workers thrive.

1 objective. 2 strategies. In our research into the future of work, workers have told us that to thrive, they need two things. The first is they need clearer skills and career pathways. The second is they need to keep up with new technologies. These needs underpin our 2 strategies.

Our first strategy is to **chart clear task pathways for targeted skills/career paths**. Using task pathways add clarity and precision to existing skills and career pathways (see diagram below). This is because the emerging consensus amongst economists, think tanks, consultancies and technologists is that jobs are not disrupted job by job or even skill by skill, but task by task.

Current Job (LKYCIC Task Database)	Task Pathways: (LKYCIC Task Database)			Direct Transition Options (LKYCIC Task Database)
	Specific to Current	Similar Tasks	Tasks to be Trained	
Bus Driver	•••••	•••••	•••••	Ambulance Driver Locomotive Engineer Loan Counsellor Pilot Driver/Sales Worker
House Keeper	•••••	•••••	•••••	Orderlies Cargo/Freight Agent Pharmacy Aide Packers and Packers Desktop Publishers
Accounts Executive	•••••	•••••	•••••	Statistical Assistants Customer Service Representatives Loan Interviewer Credit Authorisers Gaming and Sports Book Writers
Machinist	•••••	•••••	•••••	Semiconductor Processor Conveyor Technician Medical Equipment Repairer Wind Energy Engineers Moulding and Casting
Cashier	•••••	•••••	•••••	Customer Service Representatives Travel Guides Online Merchants Retail Salesperson Brokerage Clerks
Medical Records and Health Information Technician	•••••	•••••	•••••	Patient Representatives New Account Clerks Medical Transcriptionists Radiologic Technologists Clinical Data Managers

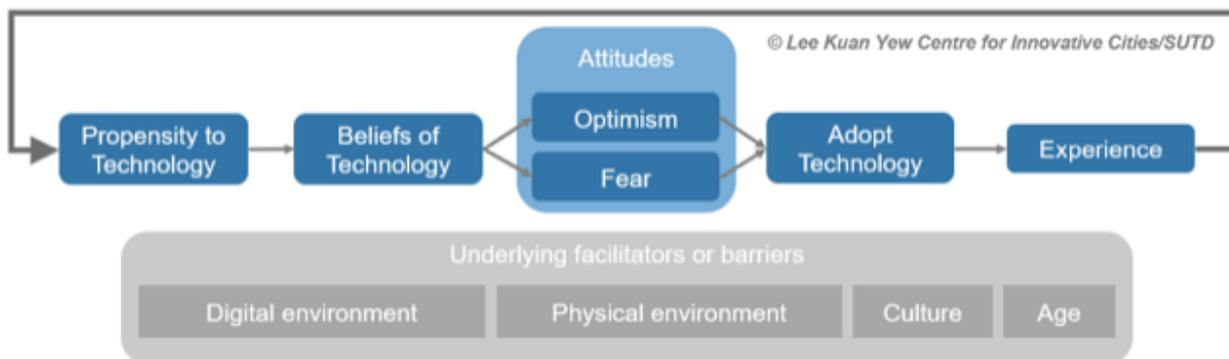
Task Pathways target and expand transition options for our workers

¹ Job polarisation refers to the labour market phenomenon where middle-skilled jobs decline relative to high and low-skill jobs in terms of wages and employment share. Elaboration on job polarisation in Chapter One.

As an analogy, if skills/career pathways are maps, then the LKYCIC’s task pathways provide a “GPS” to those maps. Workers can thus make better transitions in their careers and skills upgrading.

The diagram also shows that task pathways are scalable horizontally (i.e. they can help workers identify job transitions within and across sectors). The pathways are also scalable vertically as worker pathways can be aggregated to give company-, industry-, government-level views for strategy decisions and policy making. In addition, our discussions with union leaders suggest the task pathways can be used to change mindsets of workers and employers.

Our second strategy is to **improve technology adoption by helping workers overcome barriers to training and digital transformation**. Workers’ attitudes to the introduction of a new technology vary according to their positive or negative experiences with prevailing and previous technologies. However, older approaches to encouraging technology adoption often overlook this. The LKYCIC’s Technology Experience and Adoption Model (TEAM) takes this into consideration as a feedback loop to improve future experience and adoption of new technologies (see diagram below).



LKYCIC's Technology Experience and Adoption Model (TEAM)

These two strategies can also be combined to increase the value of what workers do. For example, with greater clarity on what new tasks workers need to be trained in, we can pinpoint the technologies that can increase the value of those tasks. We can target the training and adoption of these technologies to help workers become more productive.

3 Polarisation Risks. 4IR. These strategies will help workers tackle the three polarisation risks that workers face in the 4th Industrial Revolution (4IR).

Firstly, the 4IR is not a one-off development. It will have successive waves of innovation and disruption. Workers who cannot adopt the new technologies of each wave fast enough or have a bad experience with any of them, risk falling behind. No wonder then that The Straits Times in quoting Prime Minister Lee Hsien Loong reported that “Singapore can do much more when it comes to adopting new technology”.

Secondly, as the economy restructures with each wave of change, workers will need to be able to quickly pinpoint where they can transition to. This transition can be within their occupation or industry and can also be outside of it. Workers who cannot find clear pathways will risk falling behind. We already see signs of this in older Professionals, Managers, Executives and Technicians (PMETs) who are the “hardest hit by layoffs”.

Thirdly, as technologies replace tasks within jobs, workers must increase the value of what they do in the remaining tasks. They must also learn the new technologies needed for these tasks. Workers who fail in either will inevitably fall behind in their wages.

5 years. 6 recommendations. Our detailed recommendations for union leaders, policy makers and company managements for the next five years are thus built on the above:

Recommendations for Union Leaders, Policymakers and Company Managements (and rationale in brief)	Risks / Strategies		
	Adopt Better	Transition Better	Increase Value
1. Chart clear task pathways for targeted job transitions <i>If skills are a map to future jobs, tasks provide the GPS</i>	√	√	√
2. Identify, integrate and ensure direct worker benefits <i>Our TEAM survey shows workers faced difficulty identifying the value and benefits of training and transformation</i>	√	√	√
3. Identify and support Super Learners in companies <i>Our TEAM survey shows workers face barriers of time, money and training relevance when learning new technologies at work; Super Learners help overcome these barriers</i>	√		√
4. Build an accurate view of workers' attitudes <i>Our TEAM survey shows attitudes are the best predictors of workers' willingness to adopt new technologies</i>	√	√	
5. Expand job opportunities by helping our skilled workers thrive in global expert markets and platforms <i>Exploit matching services for workers with expertise that have a limited local market but potentially larger global demand</i>		√	√
6. Develop rigorous micro-case studies of Singapore workers'/organisations' training, transition and transformation <i>Many lessons on workers'/organisations' training, transition and transformation across sectors remain undocumented – these can be useful references for others</i>	√	√	√

Singapore's Global Rankings on Adoption-related Indicators

Tech readiness*	14 th
Firm tech absorption*	14 th
Adaptive attitudes [^]	20 th
Use of big data/analytics [^]	21 st
Agility of companies [^]	26 th

*WEF Global Competitiveness Report 2017–2018

[^]IMD World Digital Competitiveness Ranking 2018

Through our strategies and recommendations, this collaboration between LKYCIC at SUTD and OTCi aims to shore up workers' confidence by giving them clarity, certainty and choices. These help them adopt and transition better and can increase the value of what they do, thus building their confidence day by day.

A confident worker will be able to ride out any disruption, transformation and revolution.

RESEARCH REPORT

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CHAPTER ONE: 1 OBJECTIVE – HELPING OUR WORKERS OVERCOME 3 POLARISATION RISKS

Job polarisation has been observed in other countries. Given this trend, what is our way forward?

We tackled this question using a mixed methods approach. We developed and conducted the TEAM survey² in collaboration with OTCi (based on the TEAM model). We also conducted interviews and secondary literature reviews which we combined with insights gained from our previous research.

6-5-4-3-2-1. We propose **6 recommendations** to be implemented in the next **5 years** to navigate the **4th Industrial Revolution**. They are designed to tackle **3 polarisation risks** that our research has identified. They are based on **2 strategies** developed in the LKYCIC that have **1 singular objective** of helping our workers thrive.

Helping our Workers Stay on Top in Uncertain Times

Our workers face uncertain times. On one hand, workers are often told that if they are not able to keep up with new technologies, they risk being displaced from their jobs. For example, middle-skilled jobs such as clerks and machine operators have been found to be the most easily replaced by automation (Goos et al., 2014). At the same time, high-skilled jobs are likely to be enhanced by new technologies (Bárány & Siegel, 2018) while the lowest-skilled jobs such as cleaners and manual labourers will remain low skill and low wage as it is too expensive to fully automate them (Y. J. Kim et al., 2017). Job polarisation subsequently occurs, as wages and employment gains and losses will differ greatly across the high-, middle- and low-skilled workers as already seen in several countries such as those in North America and Europe (Autor, 2015; Jaimovich & Siu, 2012; Tüzemen & Willis, 2013).

On the other hand, workers are also told such fears of technology completely replacing humans at work (McClure, 2018) might be unfounded (Borland & Coelli, 2017). For example, a study conducted by Chng and Cheah (2019) found that respondents overwhelmingly preferred having human operators on board autonomous vehicles so that they can take control whenever needed. Klaus Schwab (2016) goes further to argue that the breakthroughs in technological development of the 4th Industrial Revolution will solve many of the world's challenges in unemployment, ageing workforce and stagnating productivity.

² The TEAM survey will be explained in Chapter Two – Improving Adoption with Technology Experience and Adoption Model.

So far, Singapore has responded robustly to help workers stay on top of these uncertainties. The Government has rolled out many labour market policies such as job matching services provided by Workforce Singapore and NTUC’s Employment and Employability Institute (e2i), continuing education and training programmes such as the SkillsFuture initiatives, job redesign schemes supported by the Work-Life Grant and employment support programmes such as the Wage Credit Scheme. The Government also acted swiftly in response to economic crises in the past, as was apparent with the roll-out of the Resilience Package announced for the 2009 Budget (Ministry of Finance, 2009).

Policy Tools to Help Workers

Governments around the world have many policy tools to help workers. We can divide them into four main groups.

The first group is labour market policy, which are government-funded programmes which target specific groups of workers within the labour market to help them find new jobs in a variety of ways (Clegg, 2015).

The second group is employment protection legislation which is a set of regulations governing the hiring and firing of workers to ensure job security (Cahuc & Koeniger, 2007).

The last two are wage legislation and social welfare, and in general these two groups of policies tackle income loss or income inequality which result from job loss.

On top of proactive labour market policies, the Government has put in place other measures to help workers such as maintaining standards in employment practices and providing basic support for workers in need. These include employment legislations and guidelines such as the Employment Act and the Tripartite Alliance for Fair and Progressive Employment Practices, wage legislations such as the Progressive Wage Model and various social safety net policies like ComCare. As a result, other than 2003 during SARS and 2009 during the Great Recession, Singapore’s unemployment rate has remained low³. Average monthly nominal earnings per employee has risen from \$3,134 in 2001 to \$5,229 in 2017⁴. Additionally, Singapore’s intergenerational income mobility is high compared to other countries (Ministry of Finance, 2015). In summary, Singapore has been responding robustly and has put in place a range of policy initiatives that cover the issues of employment and income.

³ Data from Department of Statistics, Singapore <https://www.tablebuilder.singstat.gov.sg> .

⁴ Data from Department of Statistics, Singapore <https://www.tablebuilder.singstat.gov.sg> .

3 Polarisation Risks: Restructuring, Pay and Adoption

But the 4th Industrial Revolution is far from over. While Singapore has so far stayed on top of the issues that have led to polarisation in several countries overseas, we need to remain vigilant against future polarisation risks. Our research has identified three potential polarisation risks that we need to help workers navigate. We need to:

- Help workers transition better before economic restructuring puts them at risk
- Help workers increase the value of what they do before pay polarises across jobs
- Help workers adopt technology better before they fall behind

Help Workers Transition Better Before Economic Restructuring Puts Them at Risk

The first risk arises from economic restructuring. According to the Committee on the Future Economy, Singapore has always restructured its “economy repeatedly, adapting to evolving global as well as domestic circumstances” (Committee on the Future Economy, 2017). With each restructuring, different segments of workers are affected differently. Data from 2007 to 2017, for example, shows that in past restructurings, re-entry rates of various retrenched workers have differed. Currently, the older PMETs are the group with the lowest re-entry rate: in 2017, the proportion of PMETs who were able to find employment within 6 months of being displaced was 62.1%, compared to over 70% of other worker groups (refer to Figure 1).

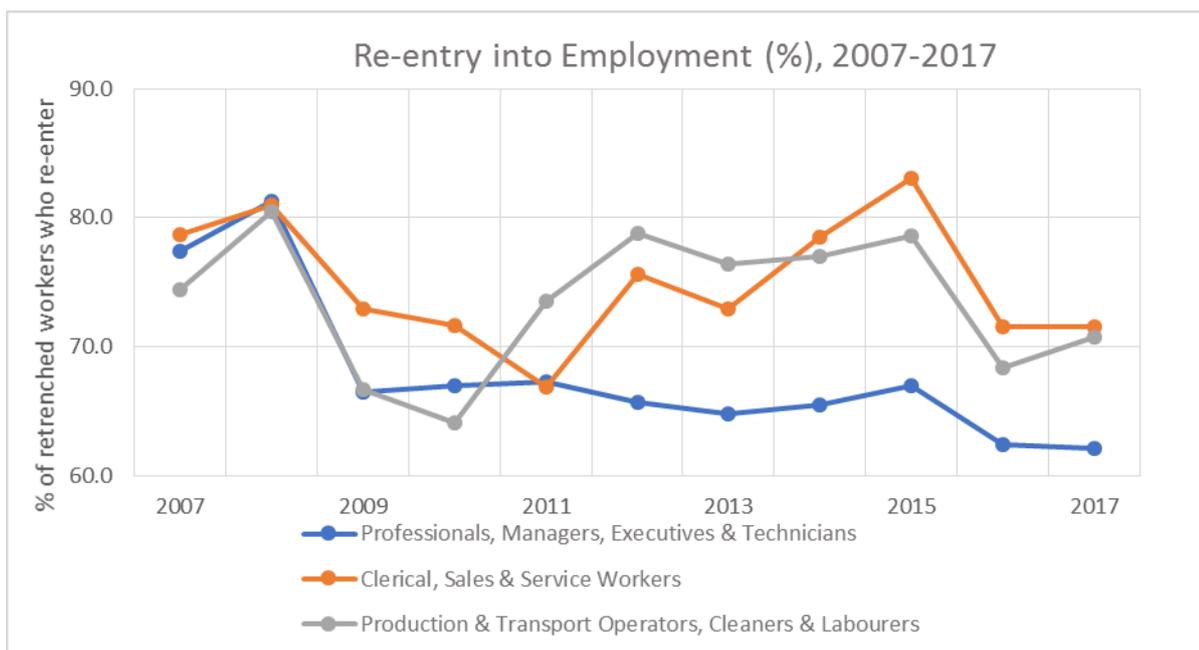


Figure 1: Rate of Re-entry into Employment, 2007-2017 (Department of Statistics Singapore)

Additionally, the rate of re-entry into employment for PMETs has been declining since 2008. One reason is companies find them too costly to retain and too old to hire, making it more difficult for them to find employment after being displaced from a job (Ng, 2016; Yang & Pang, 2016).

Workers who are displaced from their jobs face many challenges. By definition, displaced workers lose their jobs involuntarily because the job itself has disappeared due to it becoming redundant, or the workplace has moved or relocated (Kletzer, 1998). The first challenge is the persistent “scarring” effect of unemployment, reducing displaced workers’ future earnings (Arulampalam, 2001; Arulampalam et al., 2000; Malo & Muñoz-Bullón, 2008).

Secondly, job displacement also exacts a heavy toll on future employment prospects (Chan & Stevens, 2001; Ortego-Martí, 2017). Employment prospects become even slimmer once their unemployment spell becomes protracted (Van Belle et al., 2018). Thirdly, to make matters worse, job displacement also affects other aspects of life such as health (Hiswals et al., 2017; Kim et al., 2018; Voss & Chen, 2015) and on family-related issues such as fertility, spouses, children and divorce (Del Bono et al., 2015; Doiron & Mendolia, 2012; Liu & Zhao, 2014; Marcus, 2013). The challenges faced by older workers are more pronounced: they face more permanent earnings losses and are much more likely to drop out of the labour force entirely (Heisig & Radl, 2017; Kletzer & Fairlie, 2003; Lassus et al., 2015). They also suffer greater physical and mental health consequences compared to their younger counterparts (Gallo et al., 2000).

Thus, given the adverse impact of job loss on workers, it is imperative that we transition workers quickly before economic restructuring puts them at risk of job loss and subsequently polarisation.

Help Workers Increase the Value of What They Do Before Pay Polarises Across Jobs

The second risk is pay polarisation.

Data from the Department of Statistics (see Figure 2) shows that average wages in some industries are significantly higher than others. At the same time, some of the industries where the wages are lower have seen higher than average wage growth (this is likely due to the robust wage legislation policies which were mentioned in Page 17 of the report).

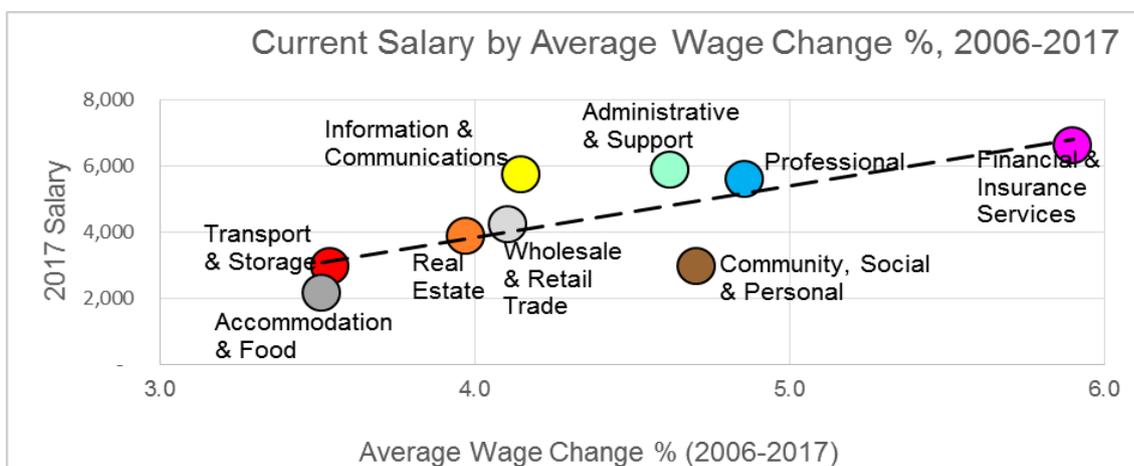


Figure 2: Current Salary by Average Wage Change Percentage within the Services Industry, 2006-2017 (Department of Statistics Singapore)

Whether workers achieve high average wage growth depends on their ability to add value to their work. In the 4th Industrial Revolution, as technologies replace tasks that workers used to perform within jobs, workers must thus be able to increase the value of what they do in the tasks that remain. They must also learn the new technologies needed for these tasks. Based on research evidence from the United States (Acemoglu, 1998; Katz & Murphy, 1992), Europe (Goos et al., 2009) and East Asia (Almeida, 2009), workers who fail in either will inevitably fall behind in their wages.

This potential pay polarisation will become even more acute if the workers who fail and fall behind are the medium- and low-skilled, both of whom – as mentioned earlier – are already at risk of falling behind in their wages. Increasing the value of what workers do in their work is thus an urgent priority.

Help Workers Adopt Technology Better Before They Fall Behind

The final polarisation risk is slow technology adoption. Prime Minister Lee Hsien Loong noted that despite the strides Singapore has made in implementing the Smart Nation measures, “...we really are not moving as fast as we ought to” (Sim, 2017). Singapore’s rankings on technology adoption and other related indicators suggest technology adoption can be improved. In IMD’s and WEF’s competitiveness rankings for example, Singapore is not in the top 10 in adoption-related indicators (see Figure 3). Market research also shows Singapore is lagging behind the average adoption rates in fintech and healthcare AI/robotics (see Figure 3) as compared to other countries.

Singapore's Global Rankings on Adoption-related Indicators		Fintech Adoption % (2017, EY)		Healthcare: Comfortable with AI/Robots (2017, Blackbox)	
Tech readiness*	14 th	Average	33%	Asia (all)	58%
Firm tech absorption*	14 th	Singapore	23%	Singapore	43%
Adaptive attitudes [^]	20 th	China	69%	Indonesia	40%
Use of big data/analytics [^]	21 st	India	52%	Japan	46%
Agility of companies [^]	26 th	UK	42%	Korea	60%
		USA	33%	China	70%

Figure 3: Singapore's Technology Adoption Ranking from Various Indexes

The 4IR is not a one-off development or single technology phenomenon. Because it will have successive waves of innovation and disruption, workers who cannot adopt the new technologies of each of these waves fast enough or have a bad experience with any of them, risk falling behind. Helping workers adopt technology better will help them keep up with the waves of innovation and technologies.

CHAPTER TWO: 2 STRATEGIES FOR THE 4TH INDUSTRIAL REVOLUTION

We propose **2 strategies** to help workers tackle the polarisation risks of economic restructuring, pay polarisation and lagging technology adoption. These are the basis of the recommendations that follow in the next chapter of the report:

- Our first strategy is to **use the LKYCIC task database and approaches to chart clear task pathways** for targeted skills/career paths. This **helps our workers navigate the uncertainties of the labour market and transition into new jobs** before and when polarisation happens.
- Our second strategy is to **use the LKYCIC's Technology and Experience Adoption Model (TEAM) to improve technology adoption**. The model takes into consideration workers' prevailing and previous experiences with technology, to better identify the barriers to training and digital transformation and how they can be overcome.

Additionally, as we have established earlier, workers who are falling behind in adapting to technological changes are also left behind in wage growth as mentioned in the previous chapter (Page 20). To combat this, we can combine the above two strategies to make work more valuable by adopting technologies that increase the value of selected tasks in their pathways (refer to Figure 4).

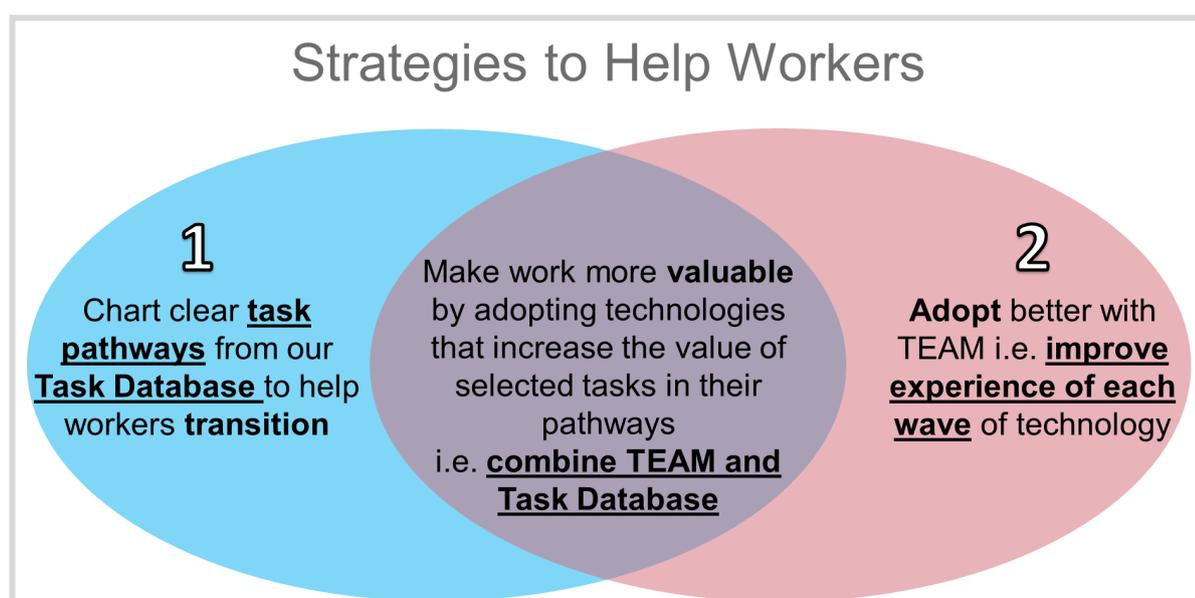


Figure 4: Strategies to Help Workers (LKYCIC)

In this section of the report, we will explain in detail the basis of these two strategies and the supporting evidence of their efficacy from the interviews and survey we conducted.

Charting Task Pathways for Targeted Skills/Career Paths

Our first strategy is to chart task pathways for targeted skills/career paths. Using task pathways add clarity and precision to existing skills and career pathways. This is because the emerging consensus amongst economists, think tanks, consultancies and technologists is that jobs are not disrupted job by job or even skill by skill, but task by task.

Workers want and need clear career pathways to help them navigate the transitions between jobs throughout the course of their career. This is because, as technology is increasingly replacing the tasks once done by human workers, workers are often told that they need to upgrade, but they are unsure what they need to upgrade to. They are also unsure of the benefits of upgrading (as we will show later in our TEAM survey, workers feel that training does not always lead to career progression or salary increase).

There is thus a lack of clarity and purpose which lowers motivation to go for job training. Task pathways give that clarity. That is why around the world, academics have recognised the usefulness of a task approach at the level of macro-economic analysis. The Oxford Handbook of Productivity Analysis (Grifell-Tatjé et al., 2018) describes task approaches as a “particularly appealing avenue for new analysis” of worker productivity. Enrique Fernandez-Macias and Martina Bisello (2016) analyses tasks as a better way of understanding structural changes in the labour market and general employment trends.

International organisations including the World Bank (Bussolo et al., 2018; Dutz et al., 2018; Islam, 2018) and the International Labour Office (Gemmel, 2016; International Labour Organisation, 2018) have also acknowledged and adopted the language of tasks when discussing the future of work. Interestingly, even the World Economic Forum has also increased its focus over the years from job skills to job tasks (World Economic Forum, 2016, 2018).

Why are tasks increasingly becoming the unit of analysis for jobs around the world?

Traditional methods see skills and tasks as equivalent. Traditional methods use a skills framework to match workers to occupations: workers are matched to jobs according to their skills and vice versa. As jobs become more high-tech, demand will increase for high-skilled workers, while low-tech work continues to be done by low-skilled workers.

Now that jobs are not disrupted job by job – or even skill by skill – but task by task, skills and tasks are not necessarily equivalent. As leading economists Acemoglu and Autor (2010) argue, “the distinction between skills and tasks becomes particularly relevant when workers of a given skill level can perform in a variety of tasks and change the set of tasks that they perform in response to changes in labour market conditions and technology”. In other words, as technology changes, the given skill may not change but the task you apply the skills to may change. To understand what workers need to do in response, the right unit of analysis is to look at tasks.

The task analysis can be used to understand job transitions at the worker, company and city scales. This is clear from the diagram below (Figure 5)⁵.

In Figure 5, the Information Security Analyst (ISA)’s job is broken down into its constituent tasks. These are the dots at the left-hand side of Figure 5. Each dot represents one task in the job role.

⁵ Adapted from *Living Digital 2040* (Poon et al., 2017), the report of a LKYCIC Future of Cities project examining the future of work, education and healthcare that was funded by the National Research Foundation and the Ministry of National Development. Please see Appendix for more details.

At the individual and job level, the task approach helps us do two things:

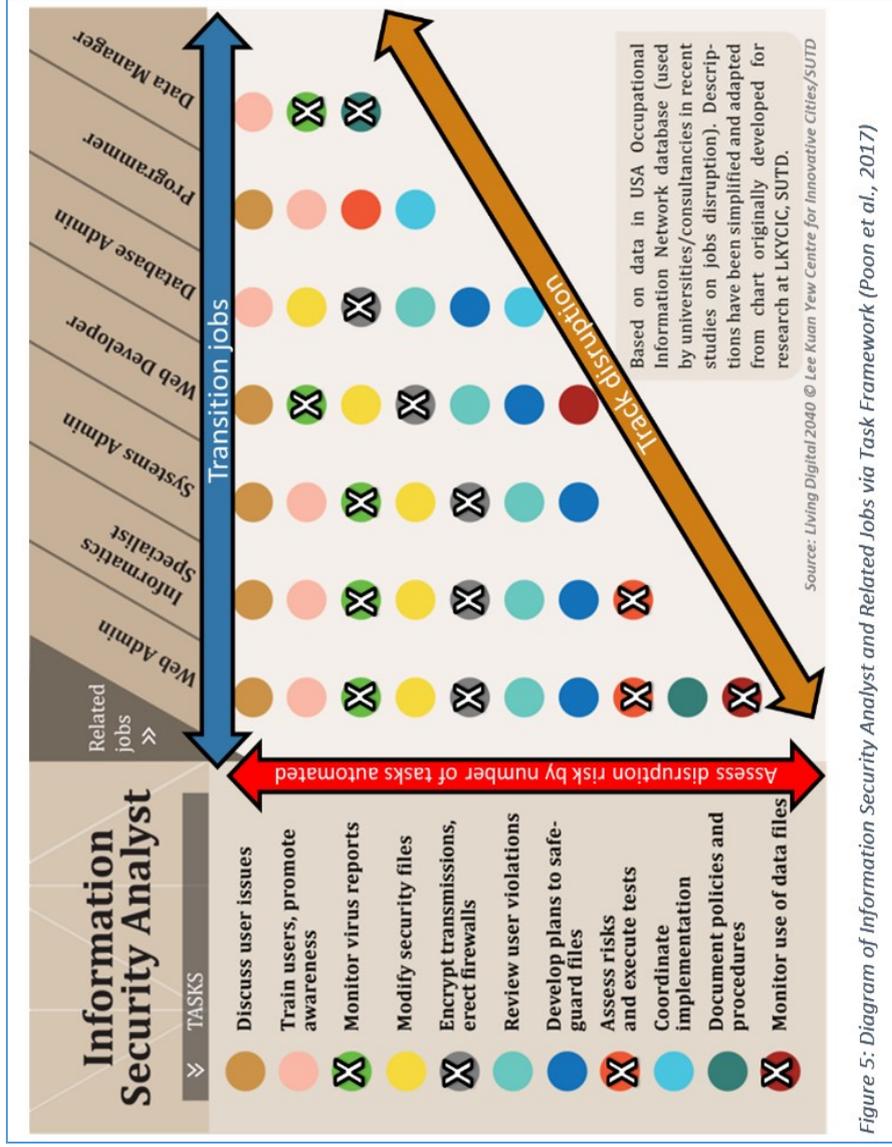
1. **Identify the speed and scale of disruption on the job** (indicated by the red arrow). As jobs are replaced task by task, by seeing which tasks are disrupted and when this happens, we have a sense of the risk profile of that job (indicated by the white X covering the dots for the Information Security Analyst).
2. At the same time, because other occupations share similar tasks to the Information Security Analyst, **we can identify potential jobs for the ISA to transition into** (indicated by the blue arrow).

At the company-level, management can use the task approach to track disruption across occupations.

By seeing which similar tasks across occupations are disrupted and when these happen, **we can know the speed and scale of automation across jobs within a company/industry/sector** (indicated by the brown arrow) within Information Communications and **we can then use this information to decide where and how to transition workers**. For example, besides transitioning them to other jobs, we can choose to invest in technologies that increase the value of the remaining job tasks that are not disrupted. **We can also redesign jobs by combining remaining tasks.**

Union leaders can use all of these ways mentioned to help workers:

- Use tasks to track the speed and scale of disruption
- Identify specific tasks that workers need to upgrade to and pinpoint the training needed
- Chart the task pathways to transition workers into new jobs
- Use technologies to increase the value of the tasks and therefore their jobs
- Use the tasks that remain to redesign new jobs



At the city-level, governments can analyse the economy as “a collection of tasks” to understand more clearly the speed and scale of technological disruption. **They can also explore how tasks are similar across occupations**. For example, the Netherlands Bureau of Economic Research (Kok & Weel, 2014) found that cities with more work tasks connected to each other had higher employment growth.

The clear task pathways have an added benefit. They can be a single reference document for conversations between workers, employers, union leaders and Government agencies. This can facilitate the following:

- Better alignment between levels of stakeholders in the company (employers and employees) and outside of it (between employers, unions and Government agencies).
- Improved coordination, communications and collaboration between the different levels of stakeholders, which in turn can lead to a more open culture.
- Better return on investment on training and transformation as different levels of stakeholders are better aligned and coordinated, with better communication and collaboration.

Examples of how the task approach can be applied in job transition will be provided in Chapter 3 where we detail the recommendations.

Improving Adoption with Technology Experience and Adoption Model (TEAM)

Our second strategy is to **improve adoption of technology by helping workers overcome barriers to training and digital transformation**. Workers' attitudes to the introduction of a new technology vary according to their positive or negative experiences with prevailing and previous technologies. TEAM is built on decades of extensive and established theories of technology adoption and diffusion such as the Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003), the Technology Acceptance Model (Davis et al., 1989) and the Innovation Diffusion Theory (Rogers, 1983).

However, these older approaches towards understanding and encouraging adoption often overlook how the worker's past experience interacting and adopting new technology influences the current technology adoption at hand. For instance, Davis et al.'s Technology Acceptance Model does not account for past experience. In addition, none of the theories look at what forms the experience (be it negative or positive) of current adoption and how it goes on to influence future adoption decision. For example, Venkatesh et al. only theorised experience as a moderator of adoption decisions but does not explain how these arise and what we can do to change adoption experiences.

The LKYCIC's TEAM, in comparison, takes workers' experiences with technology, past and future, as key determinants of adoption and looks at technology adoption as an ongoing and continuous process.

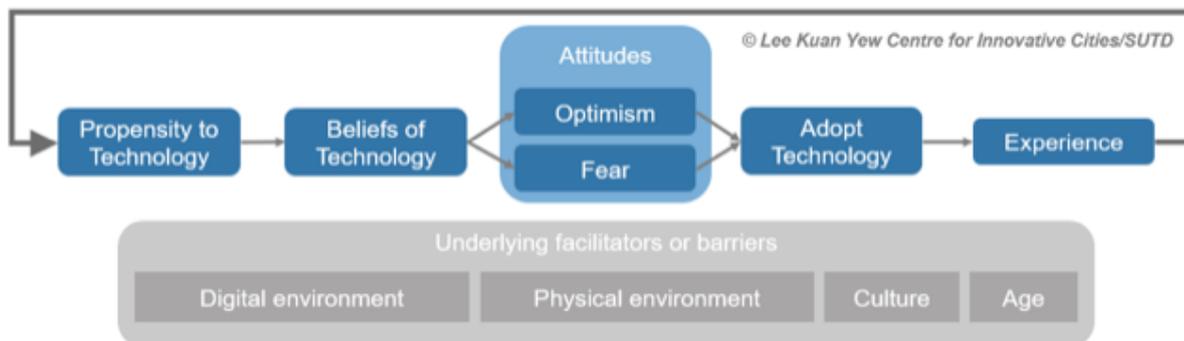


Figure 6: Technology Experience and Adoption Model (LKYCIC)

There are four main parts to TEAM (refer to Figure 6):

- **Past beliefs of technology.** Firstly, previous/past experiences with technology and workplace transformation shape workers' existing beliefs about technology. Workers' beliefs include: i) the perception of ease when using the technology; ii) its potential effectiveness in improving their work; and iii) how it will complement the tasks they do at work.
- **Attitudes.** Secondly, these beliefs about technology are formative in determining the workers' attitudes toward technology, which include optimism towards and fear of what the technology might bring.
- **Willingness to adopt technology.** Thirdly, these attitudes then influence the workers' willingness to adopt new technologies.
- **Influence on future experience.** Finally, the workers' current experience of adopting a new technology goes on to influence technology beliefs and adoption in subsequent waves of transformation and this is reflected in a feedback loop within TEAM.

In addition to these personal factors above, TEAM also considers other **interpersonal and external factors that influence technology adoption**. These include organisational support (e.g. management, training environment), culture (e.g. certain cultures are more open to older people learning and retraining), age, gender and the physical and digital environment (e.g. infrastructure to support technology and training/learning).

We incorporated the TEAM model into a survey, conducted in collaboration with OTCi, which we will henceforth refer to as the TEAM survey. The TEAM survey collected insights from the working population in Singapore regarding their experience with technology in the workplace.

Using TEAM to guide our interviews and surveys, two insights stood out:

- **Workers are demanding more justification on how the new technologies can benefit both their work efficiency and productivity, and also how the new technologies can benefit them directly.** This is seen in the first part of the Technology Experience and Adoption Model (TEAM) where workers' existing beliefs about technology are influenced by whether the technology is easy to use, is effective in improving their work, and how it complements their work.
- **Workers want more clarity as to how attending training will guarantee career progression or salary increase.** In other words, workers do not just want to see benefits of new technologies and transformation, they also want to see direct benefits of the training they have to undergo.

Our findings and recommendations are shared in Chapter Three of the report (with the survey design and methodology in the Appendix).

CHAPTER THREE: 6 RECOMMENDATIONS – AND RELATED FINDINGS – FOR THE NEXT 5 YEARS

Building on our **2 strategies** of: i) charting task pathways for targeted skills/career paths and ii) improving adoption with Technology Experience and Adoption Model (TEAM), we developed **6 recommendations** to help workers in the next **5 years**.

These 6 recommendations are designed to be actionable, concise and focused on workers' needs. They integrate insights from the TEAM survey, interviews, the task approach and secondary literature.

The research team has noted the setting up of NTUC's Company Training Committees (CTCs) comprising management and union leaders. The CTCs plan and implement programmes to help workers stay resilient and employable. As such, the CTCs will be in a good position to implement some of these proposed recommendations.

Recommendation 1: Chart Clear Task Pathways for Transition

Our first recommendation is to create clear task pathways for workers to transition to new jobs if they are displaced from their current job. As technology replaces jobs task by task, workers know they have to upgrade. They are however often unclear on how to do so.

Why it Matters

Task pathways provide that clarity (see Chapter 2, especially Figure 5). Early stage testing of these task pathways with several union leaders confirmed this. The union leaders also felt that the task pathway is a potentially useful tool to help displaced workers move to different occupations and industries.

Take for example, the machinist, a typical job in the manufacturing sector. A machinist job is made up of a set of 23 tasks represented by the grey dots on the left-hand side of Figure 7. We can compare a machinist job with other jobs based on the number of similar tasks they share.

Using the LKYCIC task database (see Appendix for background of the LKYCIC task database), we can identify jobs with which a machinist shares similar tasks to. Here is an example of two such jobs (see the orange dots in Figure 7):

- i) Medical equipment manufacturer (within sector)
- ii) Conveyor technician (outside of sector)

Machinists can draw on their expertise in these similar tasks if they were to transition to one of these jobs. This will ease the transition. At the same time, the new job will have tasks that the machinist will need to be trained in (represented by the blue dots in Figure 7).

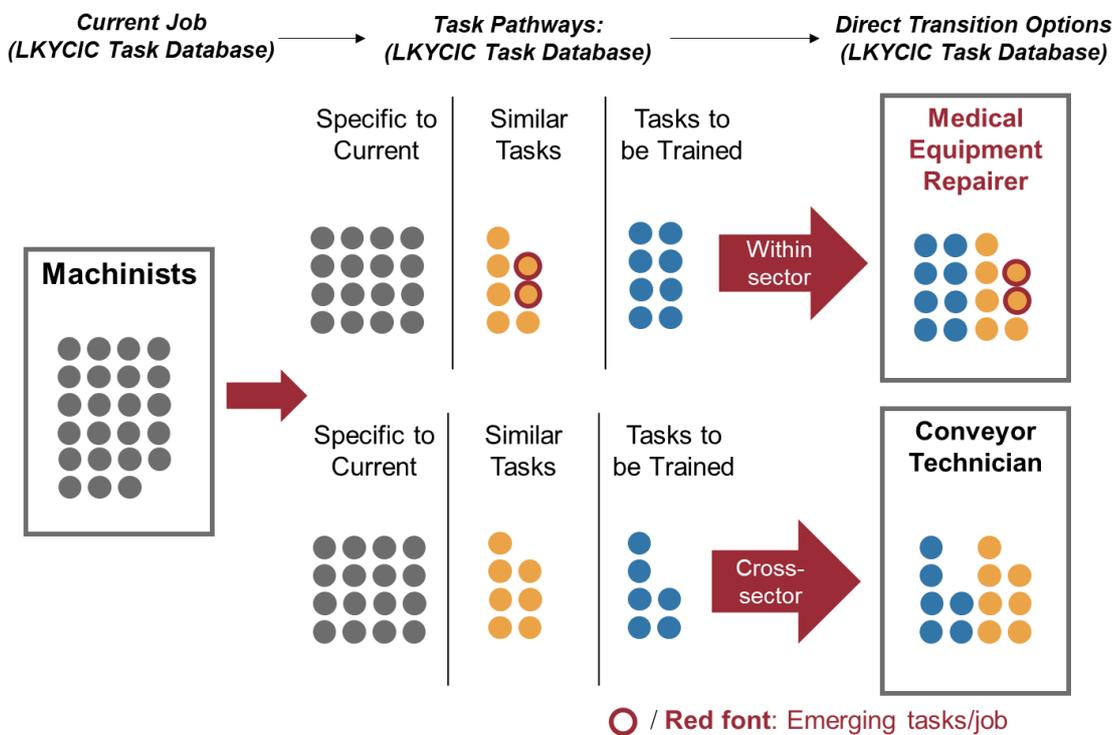


Figure 7: Task Pathways Example - dots with red outline refer to emerging tasks (LKYCIC)

From this example, five benefits of the task approach are clear:

1. Workers can plan **specific interventions** as they can pinpoint the
 - Shared tasks they can draw on.
 - Specific tasks they need to be trained in to transition from one job to the other.

They can assess what existing skills they can use and what new skills they need to pick up. As an analogy, if skills provide a map, tasks provide the “GPS” to help workers navigate the map.

2. Task pathways are **agile**. In our example above, we show how we can start with an existing job to identify a future job based on similar tasks shared between them. We can also flip the process. We can start with a future job (e.g. in a new business that a company wants to build, or in a new industry the Government is developing) and work backwards to identify which existing jobs have the most number of shared similar tasks. This demonstrates the agility of the task pathways, as companies can plan more strategically with an end goal in mind, while workers can prepare themselves for their preferred future job.
3. Tasks are **scalable vertically**. We can aggregate the task pathways of individual workers across a department, company, industry and sector for organisational-, industry-, sector- and government-level views for strategy decisions and policy making.
4. Tasks are also **scalable horizontally** across occupations. Usually, workers look for job transition opportunities within their occupation or sector. Figure 7 and Figure 8 show how the task approach can also chart task pathways outside the sector, helping workers look for job transition opportunities outside their current sector. Additionally, our task approach can also be used to generate multiple transition options for workers. As seen in Figure 8, we can generate multiple task pathways for workers based on the similarity of tasks between the current job and the potential jobs. At the same time, for each new task pathway and each new potential job, additional multiple task pathways and additional jobs can be generated. This gives flexibility for workers not just to choose the next job but to choose the next series of jobs that can become their career path.
5. Task pathways are **stackable**. For example, to be proficient in a task within a certain job, workers might need prerequisite educational qualifications and relevant accreditation; workers would also want to know which training courses they need to attend. Information such as prerequisites, accreditations and training courses can be overlaid on top of the task pathways – provided the information was originally structured in a way that can be overlaid (e.g. in a structured database) – thus becoming a comprehensive resource for workers when transitioning into a new job.

Changing Mindsets

Our discussions with union leaders suggest that one of the most powerful benefits of the task pathway is the potential to change mindsets of workers and employers. This potential stems from two characteristics of task pathways:

- **Breaking down the job transition into smaller steps reduces apprehension.** By laying out clearly the tasks – and thus the steps – needed, it reduces perceived effort and magnitude of change for the job transition, thus reducing the workers’ fears to change. This also assures workers that some of the tasks they are experienced in are still relevant and will be helpful when they transition into a new job, further reducing their fears to change.
- **Breaking down into smaller steps and tasks also introduces unexpected options.**

For example, in Figure 8, there is a pilot occupation as a job transition option for a bus driver.

- o At first glance, this transition might seem too big a leap. But as one union leader pointed out, if the pilot’s job is broken down into tasks and the bus drivers can perform some or all of these tasks, it changes our minds about what is possible.
- o For example, besides the conventional pilot job, we could consider jobs such as drone pilots, a likely growth area as drones are likely to be more widely deployed in cities in the future.
- o Or take the safety-related tasks that bus drivers are trained and skilled in. They could be the safety officers for drone trials – and even autonomous vehicles – that many smart cities are conducting (and where safety remains one of the top regulatory concerns).

Recommendation 2: Union Leaders and Government Agencies to Work with Companies to Identify, Integrate and Ensure Direct Worker Benefits

We need to ensure that there are direct benefits to the workers because our TEAM survey suggests that they are now feeling **disappointed** and **disconnected** by the training and transformation initiatives which have **disrupted** their work.

Why it Matters

Workers are **disappointed** in the transformation and training outcomes, on top of the **disruption** they already face (see Figure 9, left chart). We asked our TEAM survey respondents to select as many barriers to adopting new technology at work that apply to them. The diagram below shows the ranking of the barriers based on how many respondents selected that particular barrier. The top four barriers show clear disruption of technology on work. The next two barriers in the ranking, where new technologies do not add value and do not fit their work, cause disappointment (barriers 5 and 6 in Figure 9, left chart).

Workers also feel **disconnected** by how their work has changed due to the introduction of technology (see Figure 9, right chart). According to the TEAM survey, this is because the areas where the worker would have benefitted personally have remained the same (such as wages, work hours, recognition and value of the job). What has increased are those areas where the companies benefit (efficiency, productivity, workload and job scope) and any benefits to the workers are largely indirect⁶.

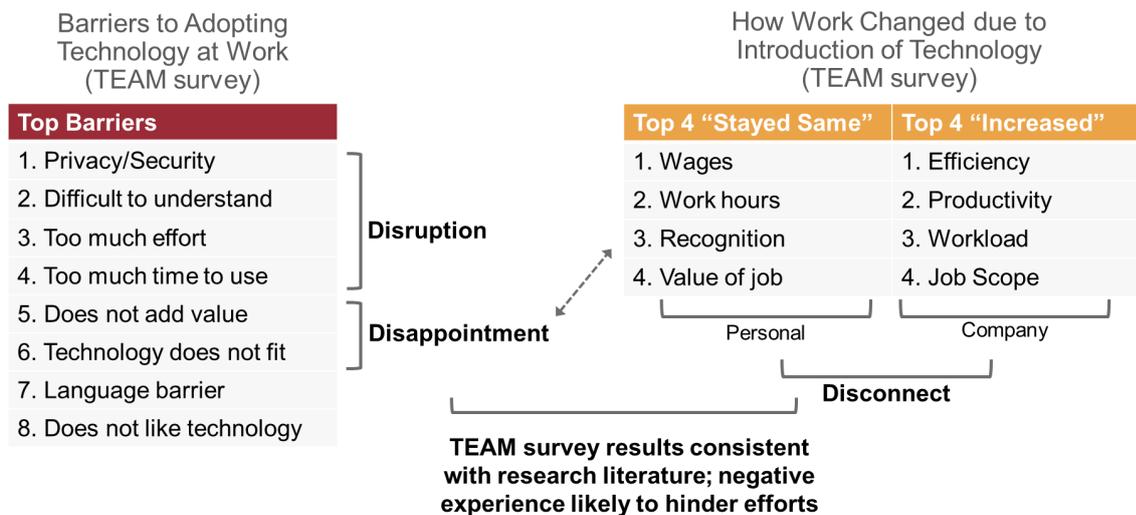


Figure 9: Top Barriers to Adopting Technology at Work + How Work Changed due to Introduction of Technology (TEAM Survey)

⁶ The ranking results are similar across occupation groups and industries.

The same sentiments are echoed in training outcomes. Workers’ expectations of what training could do for them were often not met by reality, with especially big gaps between the two in career progression, pay, productivity and new opportunities (see Figure 10)⁷.

Training Outcomes	Expectations (%)	Reality (%)	Gap
Better career progression	64.4	15.3	49.1
Better pay	56.7	10.2	46.5
Higher job productivity	58.7	16.6	42.1
New job opportunities	53.9	13.6	40.3
Keeping my job	37.9	12.2	25.7

Figure 10: Training Outcomes (TEAM Survey)

A Simple Solution That Builds on What Has Been Done

How can we avoid this triple whammy of **disappointment**, **disruption** and **disconnect**? We propose a simple solution. Employers can simply spell out and ensure that transition, transformation and training are targeted and yield specific and direct benefits to workers. For example, employers can detail how workers will benefit directly from the training and transformation in one or more of the following areas: wages, work hours, recognition, career progression and opportunities.

The Government, employers and unions are in a good position to do the above. Many organisations already have their own digital transformation strategies and plans (or can refer to those created by the Government such as the Industrial Transformation Maps) which they can adapt to address the triple whammy of disappointment, disconnect and disruption faced by workers. Furthermore, in the latest Budget speech (Ministry of Finance, 2019), Finance Minister Heng Swee Keat called on all companies to “ensure that the benefits of enterprise transformation are passed on to our workers”. The Finance Minister also announced that from April 2020 onwards, “all transformation efforts” which are funded by the Enterprise Development Grant⁸ “must include positive outcomes for workers, such as wage increases”.

⁷ The expectation-reality gap is similar across occupation groups and industries.

⁸ The Enterprise Development Grant supports Singaporean companies in projects to: 1) upgrade their business foundations; 2) innovation and productivity; 3) and reach into overseas markets. The grant covers up to 70% of the project cost.

Another example is NTUC LearningHub’s empathy map which we came across in our interviews. The empathy map is used to find out how the workers feel about the skills they decided were needed to learn (refer to Figure 11). The map would then be given to the trainers to give a sense of the needs and wants of the workers, as well as their hopes and fears.

We can build on the empathy map to include how workers can benefit from training and transformation. In fact, because empathy maps help us understand the workers’ hopes and fears, we can be even more targeted in spelling out the benefits to workers. For example, using the sentiments seen in the top right quadrant of Figure 11, companies can plan training and transformation to better meet workers’ retirement plans whilst staying safe and secure in their current job.

<ul style="list-style-type: none"> • Desktop MS apps • Chat groups with TigerText • Challenging to use MS Excel formulae • Challenging to use MS PPT slides preparation & presentation • IT system slows down when many people using • Only supervisor know how to fix error code in reports • Need time to practise after attending training course • Learner’s pace very different, better to participants according to learning pace • Will attend workshop when available 	 Said	<ul style="list-style-type: none"> • Reflecting on what to do in the future • Planning to retire in next few years • Hopefully still have job after go paperless • Maybe will cut down staff when all digitalised • The age group (45-54) should be still safe and secure with a job 	 Thought
<ul style="list-style-type: none"> • Start of session, serious looking • Slowly, relax posture and smile • Readily answer question and talk freely 	 Did	 Felt	<ul style="list-style-type: none"> • Feel good about future • Cheerful, optimistic, positive • Look forward to know about digital trends • Apprehensive about job future
Observed ← ----- → Inferred			

Figure 11: Empathy Map Example from HSEU and NTUC LearningHub

In conclusion, identifying, integrating and ensuring direct benefits to workers help to overcome the triple whammy of disappointment, disconnect and disruption that comes from existing transformation and training initiatives.

Recommendation 3: Union Leaders and Government Agencies to Identify and Support Super Learners in Companies

Our third recommendation is for union leaders and Government agencies to identify and support Super Learners. Super Learners are workers who are highly passionate about learning. They have taken ownership of their training by seeking out opportunities for upgrading and are willing to share what they have learned with their colleagues. Through our interviews with workers in the hospitality, manufacturing and healthcare sectors, we know that there are such workers in every organisation. They go the extra mile to expand their skills and knowledge.

Why it Matters

Super Learners can help overcome the major barriers towards learning new technologies at work. In the TEAM survey, we asked respondents to rank the barriers to learning new technologies at work.

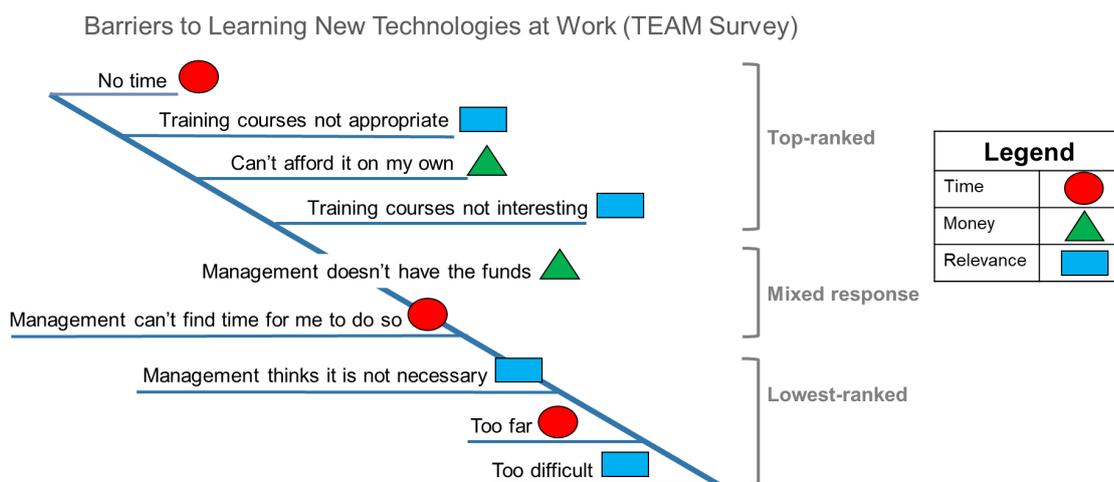


Figure 12: Barriers to Learning New Technologies at Work (TEAM Survey)

The Government has rolled out many policies to tackle the issue of workforce training and upgrading, such as SkillsFuture, the Continuing Education and Training Masterplan, Workforce Skills Qualifications (Ministry of Manpower, 2018) and the Enterprise Development Grant (Enterprise Singapore, 2018). However, our survey shows that the top issues of time (e.g. “No time”), money (e.g. “Can’t afford it on my own”) and relevance of training (e.g. “Training courses not appropriate”) remain top barriers to learning new technologies at work⁹.

This suggests more can be done. Our Super Learners recommendation aims to address all three types of barriers.

⁹This is consistent with research literature which covers extensively the issues of time taken to train, access to resources and training relevance cited as major barriers in both the workplace (Butler & Sellbom, 2002) and classroom (Bingimlas, 2009).

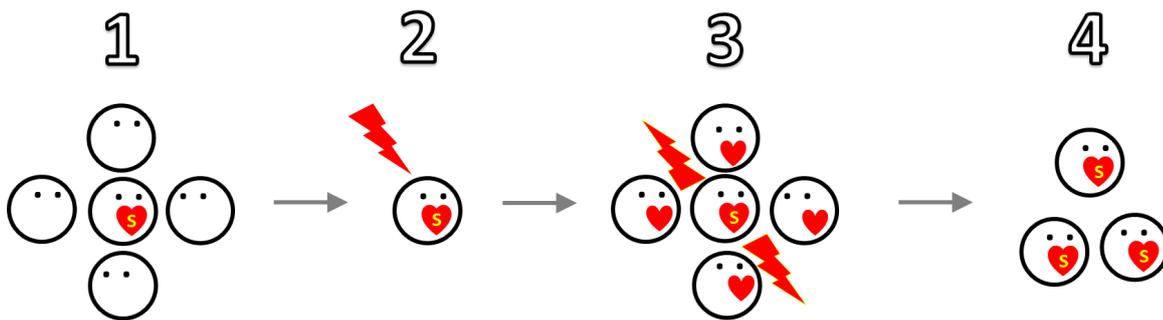


Figure 13: Super Learners Process (LKYCIC)

The Super Learner process can be explained in four steps as shown in the diagram above (Figure 13):

1. Unions and Government agencies can identify these Super Learners together with company managements and send them for training programmes/courses.
2. Super Learners attend training programmes/courses.
3.
 - i) When the Super Learners return to their organisation, they can be tasked with training their peers or mentoring fellow workers on the training.
 - ii) Sending only Super Learners for training and getting them to train/mentor their fellow workers saves **time** and **money** for both company managements and fellow workers.
 - iii) Also, when Super Learners train/mentor their fellow workers, they will have to contextualise the training and make it interesting for their fellow workers, therefore making the training more **relevant** for the workers.
 - iv) Super Learners can potentially address the issue of workers not having the urgency to go for training, as peer support is important in rallying workers to upgrade themselves.
4. To encourage Super Learners to step up and take the lead, unions, employers and Government agencies can work together to have the Super Learners certified, recognised, accredited and/or rewarded for their efforts. This can also provide a future career pathway for Super Learners to become trainers, increasing the quality of training in Singapore over time.

An additional step that Government agencies, unions and employers could take would be to consider recognising the support and sacrifices of the Super Learners' families. This is because it takes time for Super Learners to go for training and to share the training with colleagues. This usually means time away from their families which in turn will require the family's understanding, support and even sacrifice.

In closing, identifying and supporting Super Learners who can contextualise training for their peers benefits the company, the workers and the Super Learners themselves. Super Learners can help overcome the three types of barriers of time, money and relevance of training when it comes to workers' learning and using new technologies.

Recommendation 4: Union Leaders and Government Agencies to Work with Companies to Build an Accurate View of Workers' Attitudes

Our fourth recommendation is for union leaders, Government agencies and companies to work together to build an accurate view of workers' attitudes.

Why it Matters

It is important to get an accurate view of workers' attitudes for three reasons:

Firstly, among the many established predictors of willingness to adopt new technologies in our Technology Experience and Adoption Model (TEAM; see Figure 6), we found that **attitudes towards new technologies are the best predictor for workers' willingness to adopt new technologies.**

In our TEAM survey we found that attitudes towards new technologies introduced in workplaces explained about 21% of workers' readiness to use new technologies when they are introduced over and above the socio-demographic factors. In addition, an ongoing study conducted by LKYCIC in Singapore suggests that attitudes towards new technologies alone explained at least 50% of workers' willingness to adopt three studied new technologies (automation, cloud services and data analytics). Workers with more positive attitudes are more willing to adopt new technology than those with negative attitudes. Having an accurate view of workers' attitudes helps us increase the odds of success of our training and transformation strategies.

Secondly, the **attitudes of workers towards new technologies can be quite complex.** Workers can be both optimistic and fearful to varying degrees of the changes new technologies could bring into the workplace (refer to Figure 14).

For example, 32.1% of our TEAM survey respondents hold both high optimism and fear¹⁰ towards new technologies (group 3 in Figure 14), while an almost similar percentage of 28.2% hold high optimism and low fear (group 9 in Figure 14). These profiles of workers cannot be simply identified via demographic variables (such as age, gender, education level, industry and occupation) and hence need to be systematically tracked.

¹⁰ Our TEAM survey respondents answered two questions each about their optimism for and fear towards new technologies. The answer options for fear and optimism were a 5-point Likert Scale from Strongly Disagree (1), to Disagree (2), to Neutral (3), to Agree (4), to Strongly Agree (5). We combined the responses for optimism and fear to determine if the respondents have High (5 or 4), Neutral (3), or Low (2 or 1) levels of fear/optimism.

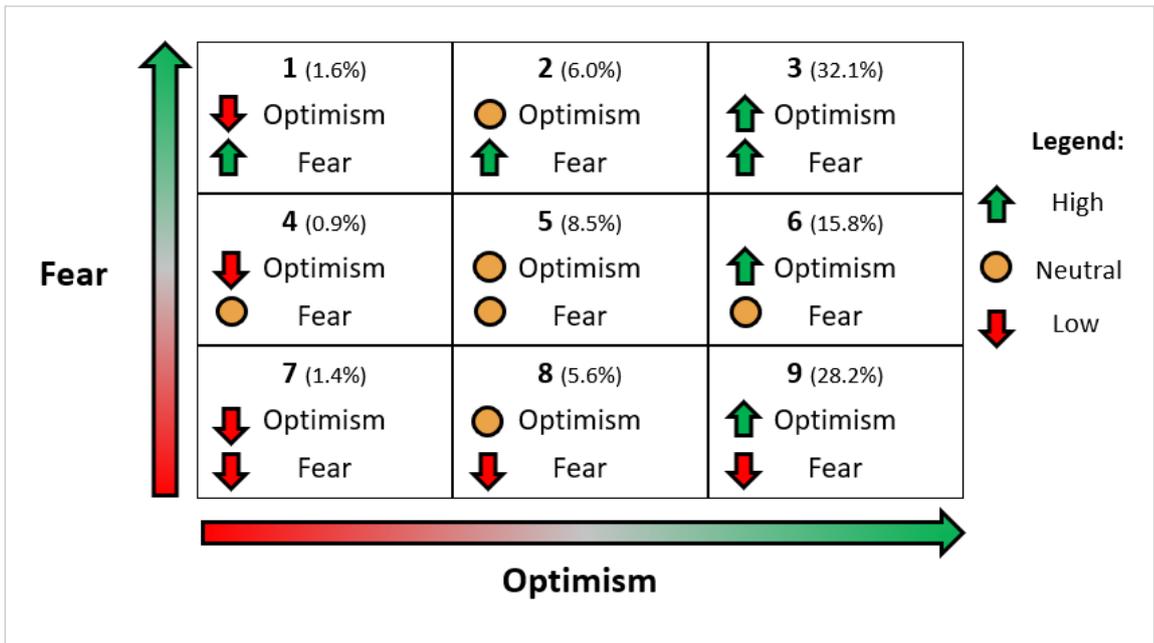


Figure 14: Profile of Optimism and Fear Respondents (TEAM Survey)

Having two seemingly opposing attitudes towards new technologies is in fact consistent with research showing that optimism and fear are partially independent of one another, instead of being mutually exclusive (Chang et al., 1994; Peterson, 2000). For example, a worker might be optimistic that attending training to learn how to use a new technology will benefit them in several ways. However, the worker can also be fearful about the adverse impacts of the training and technology transformation such as the triple whammy of disappointment, disruption and disconnect as discussed in Recommendation 2.

At the same time, having an accurate view gives us insights on how to navigate the workers' complex attitudes. When we aggregate the data from Figure 14, we can see that workers are overall more optimistic than fearful about the changes new technologies will bring to their jobs (see Figure 15). This means we can work from a position of strength if our transformation and training initiatives can draw on this optimism while acknowledging and addressing their fears concurrently.

% Optimistic How Technology Will:	% Fearful How Technology Will:
Change what I do in my job (74%)	Change what I do in my job (42%)
Help me in my job (71%)	Make me lose my job (27%)

Figure 15: Aggregate of Optimism and Fear towards New Technology (TEAM Survey)

Overcoming Stereotypes

Thirdly, **an accurate view of workers’ attitudes helps us to overcome assumptions that could get in the way of training and transformation efforts.** Inaccurate views of attitudes (e.g. misleading stereotypes) might lead to certain workers not receiving the appropriate organisational support and thus facing a harder time learning and adopting new technologies as part of transformation in the workplace.

For example, take the stereotype of older workers being unwilling or afraid to use new technologies at work. In our TEAM survey, we found no differences across age groups for the level of optimism towards new technologies. This finding is in line with our interview responses as union leaders felt that age is not an issue if the worker was keen to keep up with new technologies. This is also corroborated by studies showing that older workers are eager to pick up computer-related skills (Chin et al., 2008) and that in general, older adults have a positive attitude towards new technologies (Mitzner et al., 2010). An accurate view thus avoids such unhelpful stereotypes and compels us to consider if we are providing the appropriate organisational support to different profiles of workers.

Currently, tracking of workers’ attitudes to training and digital transformation in the workplace (at the worker, company and industry levels) is not typically conducted. This tracking is often not even part of current training programmes’ evaluation. Thus, we suggest that employers specifically track workers’ attitudes over time towards new technologies in three phases:

- 1) Before the training and transformation process
- 2) During the training and transformation process
- 3) After the training and transformation process is completed

The LKYCIC Technology Experience and Adoption Model (TEAM) – explained in Chapter 2 – can be the basis of such a tracking tool. Questions asked can focus on the barriers to learning and training, level of optimism and fear towards new technology, or how the tasks they do at work are affected by the training they received.

Ultimately, with more clarity on workers’ attitudes, employers can improve technology adoption to increase workers’ efficiency and raise workers’ motivation. The value of their work will then increase.

Recommendation 5: Union Leaders and Government Agencies to Expand Job Opportunities by Helping our Skilled Workers Thrive in Global Expert Markets and Platforms

The fifth recommendation aims to help workers whose deep expertise has a limited local market but a potentially much larger global demand.

While government policies usually focus on helping companies expand regionally, there is a need to help high-skilled workers venture into the regional and even global markets via new digital platforms.

This recommendation could complement current government policies and initiatives which aim to help local companies venture overseas. Examples include Enterprise Singapore's initiatives such as the Market Readiness Assistance Grant, the Enterprise Development Grant, the Plug and Play Network, Internationalisation Finance Scheme and the Innovation Agents Programme.

Why it Matters

There are workers who have built up decades of expertise in manufacturing (and might even have helped to train workers in the region as companies expanded from Singapore). However, the industry or sector they were in scaled down over time in Singapore. Thus, there was less demand for their expertise locally, even as that same expertise is still highly valued regionally and globally.

This is clear from PMET employment figures. Taking 2009 – the year after the global financial crisis – as the starting point, PMET employment in the economy grew from 1.26 million workers in 2009 to 1.58 million workers in 2018. In stark contrast, PMET employment in manufacturing showed a downward trend from 223,000 workers in 2009 to 181,000 workers in 2018. This happened in the same period that PMET re-entry into employment dipped and stayed below 70% (see Chapter One - Figure 1)¹¹.

We should help such workers (with deep expertise profiles) promote and pitch their expertise in global expert markets and platforms. Such platforms – such as Guidepoint, Expertera, DeepBench, LinkedIn – match supply and demand like gig platforms but are at the higher end of the skills spectrum.

¹¹ An example of such workers would be highly-skilled hard disk engineers who lost their jobs.
Source: <https://www.techgoondu.com/lessons.pdf>.

By doing so, unions and Government agencies can expand options for our workers, especially if the options in Singapore are limited (or do not pay as well). Our workers could take on opportunities to be consultants/advisors/employees that could be regional and global in scope. This would have the added benefit of growing a pool of workers with regional and even global experience.

If there are enough workers participating in these platforms, they could help to review the efficacy of these different platforms. Their reviews would then help other workers in the future. For example, the German union IG Metall is spearheading the development of platform review systems for gig platforms, that can be easily adapted for the global expert markets and platforms mentioned earlier. IG Metall is a German union which represents workers from the information communications technology sector (Informationstechnologie & Telekommunikation, 2012). They developed a novel way to crowdsource the aggregate experience of workers to benefit other workers, collated it into a website and subsequently improved on it (<http://faircrowd.work/>). IG Metall also surveyed 256 workers across 7 digital labour platforms (Fair Crowd Work, 2017). The survey questionnaire included questions on their general experiences as a platform worker, pay, communication with the clients and the platform providers, the kind of tasks available on the platform, as well as their general preference to the work they are doing on the platform.

Matching demand and supply for specific sets of expertise in global digital platforms will likely become more prevalent in the 4IR. We should exploit such platforms early and use the lessons learnt to help our skilled workers thrive in them, thus expanding their future opportunities.

Recommendation 6: Develop Rigorous Micro-Case Studies of Singapore Workers' and Organisations' Training, Transition and Transformation

Our sixth and final recommendation is for unions, Government agencies and employers to develop micro-case studies of how: 1) workers transition; 2) organisations support workers during technology adoption; and 3) direct worker benefits are ensured.

Examples of micro-case studies such as pre-emptive upskilling and transition journeys were showcased during NTUC's Future Jobs, Skills and Training Forum 2019 i.e.

- i. Customer Service Officers (CSOs) in the financial services sector reskilled and upskilled to take on higher value-added tasks. This reskilling took away repetitive and menial counter tasks such as answering incoming calls, and allowed CSOs to now use technology to improve customer service experience and serve customers through new digital channels such as live chat, video teller machines, emails and social media.
- ii. Patient Service Associates (PSAs) in the healthcare sector were given opportunities to take on supervisory roles through the provision of professionally structured training and job redesign under the PSA Framework. With the new job redesign scheme and the introduction of competency based learning roadmap, PSAs are now performing value-added services which include clinical support, phlebotomy, administration/management and training/education.

Why it Matters

The case studies that exist today tend to be from overseas and are usually lengthy (e.g. such as those used in many business schools). From our research work in this project and other projects, we have noticed a growing demand for local and shorter case studies. This is consistent with regional trends as well. What these suggest is that in times of transformation, just as workers would like their training and learning to be contextualised and interesting (see Recommendation 3), leaders and managers are looking for ideas and lessons that they can quickly adapt and apply to their own situations.

In our interviews across the manufacturing, hospitality, healthcare and transport sectors, we came across many good insights based on their experiences so far. These are however not documented and widely shared yet. If they can be turned into case studies, they would be extremely valuable for others to learn from.

The micro-case studies should be constructed in a systematic and rigorous manner. There are benefits to this approach:

- A rigorous method – based on sound pedagogical and research methods – of documenting the knowledge and experiences **will make it easier for subsequent dissemination via classes and learning platforms** (e.g. for micro-learning). These are a quick way for workers to upgrade themselves by learning from best practices and can improve organisational productivity (Alwis & Hartmann, 2008).
- Rigorously developed case studies can also serve a dual purpose: **they can be used to compare experiences across sectors, industries and companies for in-depth insights** for future transformations.

Building up micro-case studies in Singapore will be a good way to improve the overall quality of knowledge and skills transfer within and across workers, companies, unions, industries and sectors.

CONCLUSION

6-5-4-3-2-1. We have proposed **6 recommendations** to be implemented in the next **5 years** to navigate the **4th Industrial Revolution (4IR)**. They are designed to tackle the **3 polarisation risks** that our research has identified. These recommendations are based on **2 strategies** developed in the LKYCIC and have **1 singular objective** of helping our workers thrive.

The 4IR has brought a lot of uncertainty into our lives. Workers are especially affected, and we need to help them transition into new jobs better, adopt technology better, and increase the value of their work. Our **6 recommendations** provide concise and actionable steps for unions, employers and Government agencies to help workers do so.

As workers adopt and transition better, and increase the value of what they do, they will build their confidence day by day. With that confidence, they will be able to ride out any disruption, transformation or revolution.

Arising from the positive feedback from the Labour Research Conference in 2018, we are conducting focus group discussions and interviews to further refine and test our recommendations with union leaders and workers.

This forms part of our continuing research into the future of work, task approaches, technology adoption, workers' learning and mastery.

If you are interested to collaborate with us as well, please send us an email at (digitalsocieties@sutd.edu.sg).

APPENDIX

Survey Design and Methodology

In this appendix, we elaborate on how the TEAM survey conducted in collaboration with OTCi was designed and how the data was collected.

Target Sample

This survey aimed to gather insights from the working population in Singapore. Thus, our target sample population was adults (above 18 years old) who were employed or seeking employment in Singapore. Those who were seeking employment had to have been previously employed. This is because we wanted to gather insights from those who have employment experience. There were no additional restrictions to be eligible for this survey, including upper age limit or education, as we sought to be as representative as viable of the working population.

Data Collection

To reach out to the target sample, we employed two forms of data collection: snowball sampling and street intercept sampling. For snowball sampling, the survey was disseminated through Labour Movement's and OTCi's network, and LKYCIC's network. For street intercept sampling, we conducted surveys at public places with high human traffic (e.g. MRT stations and parks) where our researchers approached members of the public and invited them to participate in the survey. The survey was either administered on the spot using an iPad or via a QR code that allowed participants to complete the survey using their own devices at their convenience.

Survey Design

The survey comprised 60 questions arranged across six sections and took between 10 to 15 minutes to complete. This survey was anonymous and did not collect any contact information or identifiers. It was programmed and hosted on the Qualtrics Survey platform which allowed us to conduct both online and offline data collection, while ensuring mobile browser compatibility. The following summarises each section in the survey.

Section 1: Screening

Pre-survey screening of the participants was first carried out to ensure that we sampled only those who were currently employed or were looking for employment. Participants who were under the age of 18, did not live in Singapore, were not looking for a job, or had not worked previously, were not eligible for the survey and the survey ended at the end of this screening section where they were thanked for their interest and time. Participants who worked in more than one job concurrently were asked to answer the rest of the survey in regard to their main job.

Section 2: Demographics

Basic demographic information about the participants were gathered, including gender, age, marital status, residential status, ethnicity, education, disability and union membership status. This demographic data provides individual-level contextualisation of our findings.

Section 3: Job and employment history

We wanted a richer understanding of our participants' jobs and employment history, particularly those who had changed jobs previously. Thus this section gathered details about the participants' current job, if applicable, including details about their income, industry (according to the Singapore Standard Industry Classification), job role, job title and occupation group (according to the Singapore Standard Occupation Classification). If participants had changed jobs in the last ten years, they were also asked for similar details about their previous job and the circumstances leading to this change. The data from this section allows us to understand the individual's current and previous job circumstances and explore how it is related to the other aspects of jobs and digital transformation that we explore in the other sections in the survey.

Section 4: Job-related wellbeing and satisfaction

During transformation, it is important to understand its potential impact on the worker. To understand why workers feel the way they feel in their jobs, we used this section to explore how our participants perceived their autonomy at work, their ease of juggling between work and non-work commitments and their satisfaction with different aspects of their jobs. In addition, we ask participants to rank different aspects of a job according to their relative importance to understand our respondents' work motivation.

Section 5: Attitudes and perceptions of technology and digital transformation

Focusing on technology and digital transformation, this section explored how participants perceived of the technologies that were and are going to be introduced in their workplaces. We focused on identifying participants' understandings of these technologies and their perceptions of potential impact on their work (e.g. does it expand their job scope or does it improve their productivity). Going further, we explored their expectations when new technologies are introduced in their workplaces in future and compared it to what actually arose after the most recent introduction of a new technology in their workplace. Next, we focused on the challenges of adopting new technologies when they are introduced in the workplace by getting participants to share the barriers of technology adoption, including personal and organisational barriers. Lastly, we explored their attitudes towards the change that new technologies might bring to our participants' jobs.

Section 6: Training for digital transformation

The final section of the survey focused on understanding what workers thought was needed in terms of training to ensure that they will continue to thrive amidst digital transformation. We explored the utilisation of previous and/or current training schemes that are available, such as SkillsFuture, R3 (Recruit, Reskill, Retain) and in-house training, whether these training schemes were used to learn new technology for work, and if so, their experience attending these training. In addition, we asked participants what they found particularly useful and what could be improved in the training. The final part of this section focused on understanding the barriers to attending training to learn new technologies and who they thought was most responsible for identifying and supporting these trainings.

Survey Respondent Demographics

The sample size of the TEAM survey at the time of analysis is 932. The gender split is 49.7% male and 50.3% female. The age breakdown of our respondents can be seen in the population pyramid chart below. The respondents come from a range of educational backgrounds.

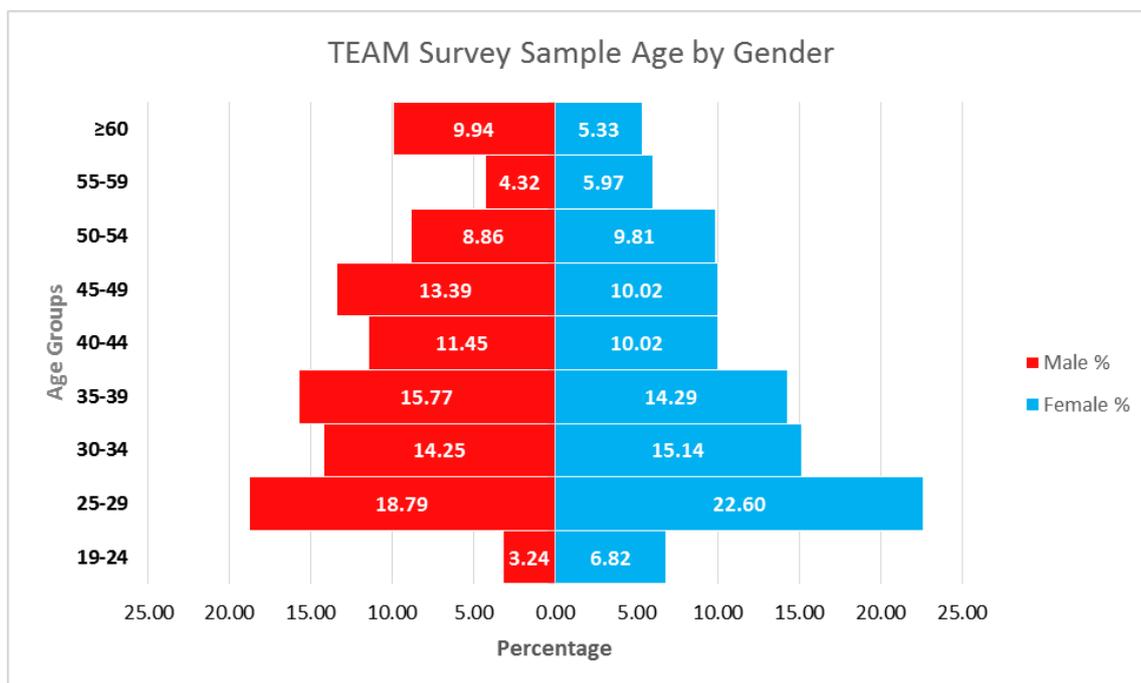


Figure 16: TEAM Survey Sample Age by Gender

All three sectors of the economy are represented in our survey sample of respondents. 83.6% of respondents are currently employed in the service sector. The remainder work in manufacturing (11.2%) and construction (5.3%).

Our respondents also cover a good spread of occupations. The majority of our respondents (69%) work in Professional, Managerial, Executives and Technician (PMET) occupations. Some of them (25%) are Clerical, Sales and Service workers. A minority of our respondents (3.2%) are Production and Transport Operators, Cleaners and Labourers. The remainder of our respondents work in occupations which fall under the Other category (2.8%).

Development of the LKYCIC Task Approach

The LKYCIC task approach was developed from a previous project which looked at the impact of digital technologies on the future of work, education and healthcare. The central recommendation for how to respond to the future of work was to use tasks as a unifying unit of analysis across all levels of economy – from the worker, through the company level and all the way up to the city and national level. More details of the previous project’s findings and recommendations can be found in *Living Digital 2040: Future of Work, Education, and Healthcare* (Poon et al., 2017).

To find out more about why tasks were selected as a unit of analysis and the benefits of using tasks to look at jobs, please refer to “Charting Task Pathways for Targeted Skills/ Career Paths” in Chapter Two.

To find out more about how task pathways can be used to improve job transitions, please refer to “Recommendation 1” in Chapter Three.

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ACKNOWLEDGEMENTS

The Research Project team would like to thank the following unions for their support:

1. Attractions, Resorts & Entertainment Union (AREU)
2. Education Services Union (ESU)
3. Food, Drinks and Allied Workers Union (FDAWU)
4. Healthcare Services Employees' Union (HSEU)
5. Metal Industries Workers' Union (MIWU)
6. National Transport Workers' Union (NTWU)
7. United Workers of Electronics & Electrical Industries (UWEEI)

Special thanks to the following for their support:

1. Toh Hwee Tin
Executive Secretary, Attractions, Resorts & Entertainment Union (AREU) and Food, Drinks and Allied Workers Union (FDAWU)
2. Ang Hin Kee
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4. K Thanaletchimi
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6. Lim Teck Chuan
General Secretary, Metal Industries Workers' Union (MIWU)
7. Dr Eugene Fidelis Soh
Chief Executive Officer, Tan Tock Seng Hospital Pte Ltd (TTSH)
8. Melvin Yong
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9. Tan Richard
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10. The workers and individuals who have taken the time to share with us their experiences.

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