



# A GUIDE TO JOB REDESIGN IN THE AGE OF AI

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TECHNOLOGY AND DESIGN

Lee Kuan Yew  
Centre for Innovative Cities



# CONTENTS

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<b>FOREWORD AND PREFACE</b> .....	4
<b>INTRODUCTION</b> .....	6
<b>OBJECTIVE</b> .....	8
<b>PREMISE</b> .....	11
<b>TRANSFORMING JOBS — PUTTING TASKS TO WORK FOR PEOPLE</b> .....	16
Break Jobs Down into Tasks .....	18
Assess the Potential Impact of AI on Each of These Tasks .....	20
Assess if AI Should be Implemented for Each Task .....	21
Consult Managers and Employees About Which Tasks Are Valuable to Them .....	24
Decide the Appropriate Time Frame to Implement AI .....	26
Recombine and Reconstruct the Transformed Tasks into a Future Job .....	27
Case Study: Live with AI, DataRobot, Companies, LKYCIC .....	29
<b>CHARTING CLEAR PATHWAYS BETWEEN JOBS</b> .....	41
Standardise Definitions of Tasks Across Jobs and Competency/Skill Levels .....	42
Use Shared Similar Tasks to Generate Potential Pathways to Other Jobs Within an Organisation .....	44
Identify the Tasks That Are Not Similar for Training and Skills Development .....	45
Re-Examine Assumptions About Jobs to Begin Changing Mindsets .....	45
Case Study: OTCi, Unions, LKYCIC .....	48
<b>CLEARING BARRIERS TO DIGITAL TRANSFORMATION</b> .....	51
Case Studies: Dairy Farm, Google, Grab & Microsoft, Norton Rose Fulbright and Healthcare .....	54
<b>ENABLING EFFECTIVE COMMUNICATION BETWEEN EMPLOYERS AND EMPLOYEES</b> .....	61
Communicating “Why” We Need to Transform .....	62
Case Study: Ensuring Alignment Around a Realistic Understanding of Current Tasks .....	64
Communicating “What” Needs to Transform .....	65
Case Study: Consider Explicit and Subtle Changes in Current and Future Tasks .....	66
Communicating “How” Transformation Will Happen .....	66
<b>CONCLUSION</b> .....	70
<b>ANNEX A   COMPLEMENTARY RESOURCES</b> .....	71
<b>ANNEX B   THE ROLE OF “TASKS” IN FUTURE OF WORK RESEARCH BY SUTD</b> .....	72
<b>ANNEX C   BACKGROUND BRIEF ON TECHNOLOGY ADOPTION AND WORK PRACTICES</b> ....	81
<b>ACKNOWLEDGEMENTS</b> .....	83

# FOREWORD



Artificial Intelligence (AI) is regarded as a transformational technology that can generate exponential economic growth, spawn business innovation and improve quality of life in the new millennium. As AI becomes pervasively embedded in applications and devices, it has ubiquitously entered into many aspects of our lives, affecting how we think, work and interact. However, quite understandably, increasing anxiety over the impact of AI is being felt by many because of its ability to not only automate many routine tasks but, significantly, also because of its use in place of the cognitive process of decision-making.

Such anxiety has been exacerbated by the necessity to go digital to minimise contact and maintain physical distancing amidst the ongoing COVID-19 pandemic. Time has been compressed. Aspects of technology that would ordinarily have taken years to incorporate into our daily lives now take place over a matter of months. This accelerated pace of incorporating digital technologies such as AI will likely increase. There is therefore a need to help our workforce embrace these technologies and equip them with skills of the future to be effective and competitive in today's volatile environment.

The key to embracing new technologies is trust in its use. Businesses ought to implement AI ethically and build trust with their customers and consumers. An uncompromising priority is the building of trust with employees through understanding and anticipating their concerns about AI's impact on their work and helping them evolve. This will help foster a more conducive and inclusive environment in which the workforce can both improve and benefit from.

The Guide to Job Redesign in the Age of AI seeks to catalyse thinking about redesigning employees' jobs when a business implements AI solutions. It is a guide and does not pretend to have a monopoly on wisdom or all the answers.

The Advisory Council on the Ethical Use of AI and Data supports this initiative in helping companies and employees be better prepared for the future of work.

**Mr VK Rajah SC**

*Chairman of Advisory Council on the Ethical Use of AI and Data*

# PREFACE



Last year, cognisant of growing anxieties in Singapore around the impact of digital technologies such as AI on work, the Advisory Council on the Ethical Use of AI and Data invited the Lee Kuan Yew Centre for Innovative Cities at the Singapore University of Technology and Design to suggest ways to facilitate the adoption of such technologies in the workplace.

The Guide to Job Redesign in the Age of AI — the first of its kind — is informed by our research at the Centre. We found a way for businesses to implement digital technologies while also enabling our workforce to thrive. This is distilled into a single word: task. In this sector-agnostic, step-by-step Guide, tasks form the basic unit of analysis. This is because the direct impact of AI will be on how these tasks are performed, rather than the job itself.

A task-based approach has many benefits. Organisations are able to assess the consequences of AI on specific tasks at a granular level, yielding valuable insights into the transformation of job roles over time. The approach also places employees at the centre of the decision-making process and helps them to understand how AI may benefit their work. This minimises resistance arising from uncertainty, strengthens trust, and promotes commitment to transformation. Finally, as both employers and employees examine the changes that AI may bring, they may discover new possibilities and opportunities for their work and workplaces.

The outcomes of technological change are not preordained. They will be mediated by the decisions we make. Through this Guide, we hope to have shown how businesses can embrace digital technologies in ways that inspire and elevate our workers.

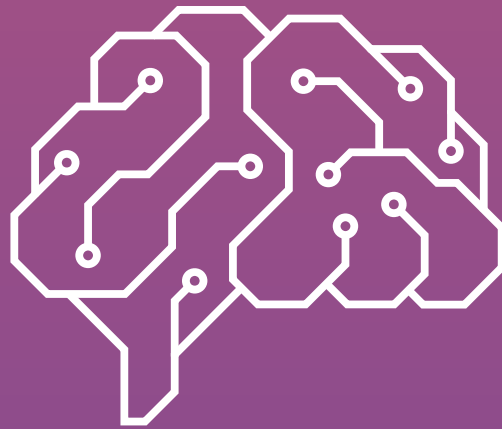
## **Professor Chan Heng Chee**

*Ambassador-at-Large and Chair*

*Lee Kuan Yew Centre for Innovative Cities*

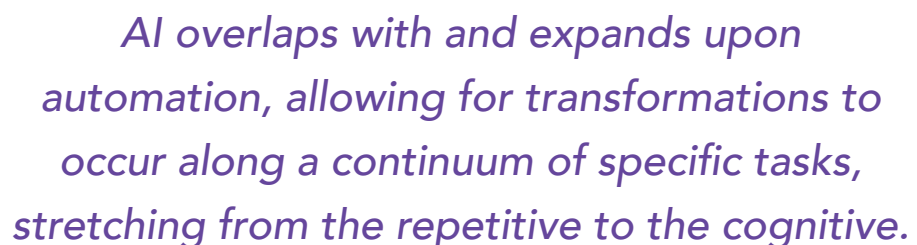
*Singapore University of Technology and Design*

*Member, Advisory Council on the Ethical Use of AI and Data*



# INTRODUCTION

- 1.1 Since the First Industrial Revolution, the nature of work has evolved with technological advances. In this Fourth Industrial Revolution, the exponential growth in data and computing power has fuelled the advancement of data-driven technologies such as Artificial Intelligence (AI). Like other technologies, AI can boost efficiency and drive economic growth through the creation of new products and services. It overlaps with and expands upon automation, allowing for transformations to occur along a continuum of specific tasks, stretching from the repetitive to the cognitive. Tasks such as analysing trends and learning from experiences can be transformed, augmenting human performance and decision-making processes. Hence, AI goes beyond mere automation and execution of specific repetitive tasks to being able to perform cognitive work.
- 1.2 As AI has the potential to shape skill demands and influence how we work in the near future, organisations need to prepare for the future of work in a manner that prioritises the dignity of their employees. Historically, people have shown greater resistance to new technologies if they perceive greater risks to themselves while the benefits accrue to only the few.<sup>1</sup>
- 1.3 Singapore's Model AI Governance Framework<sup>2</sup> provides guidance to private sector organisations on how to deploy AI in a responsible manner. As organisations embrace AI, it is also important to provide guidance on how organisations can redesign jobs to fully harness the transformative potential of AI in workplaces and bring benefits to employees. This guidance must take into account the similarities and differences with past Industrial Revolutions (see a summary of these based on previous studies conducted by Lee Kuan Yew Centre for Innovative Cities (LKYCIC), Singapore University of Technology and Design in Annex B).



*AI overlaps with and expands upon automation, allowing for transformations to occur along a continuum of specific tasks, stretching from the repetitive to the cognitive.*

<sup>1</sup> This argument is put forward in Calestous Juma's 2016 book *Innovation and Its Enemies*.

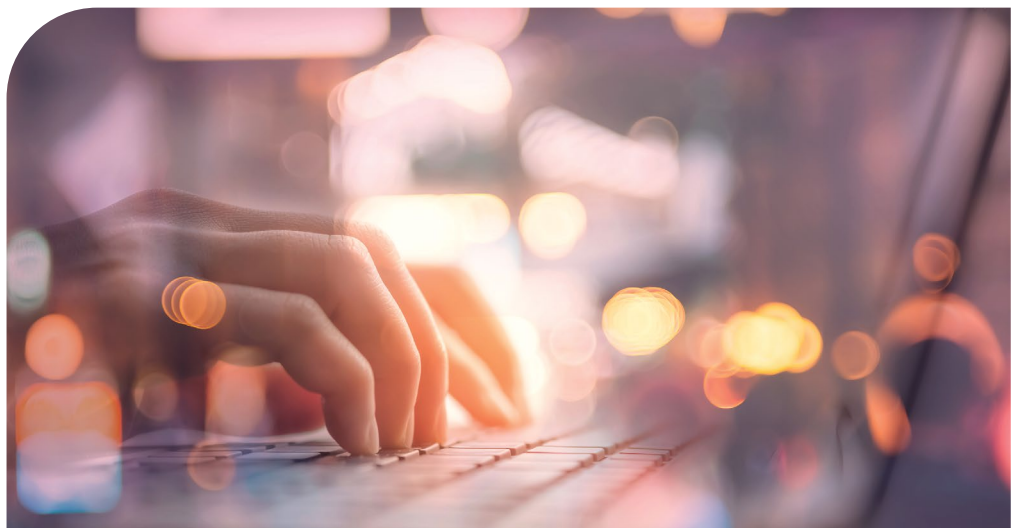
<sup>2</sup> The Model AI Governance Framework can be downloaded from [go.gov.sg/AI-gov-MF-2](https://go.gov.sg/AI-gov-MF-2).



# OBJECTIVE



- 2.1 The Guide is intended to assist organisations that are using or considering using AI at scale, to prepare for the future of work. This Guide suggests that **organisations can consider adopting a practical and human-centric approach in redesigning jobs when implementing AI so as to augment their employees' cognitive capacity**. For organisations that are considering investing in AI technologies, this Guide will catalyse thinking about redesigning work when using AI, serve as a reference for them to prepare their employees for the integration of AI into their work processes, and facilitate meaningful and valuable work for them.
- 2.2 Different organisations e.g., Multinational Corporations (MNCs), Large Local Enterprises, and Small and Medium-sized Enterprises (SMEs) have varying needs and priorities as they are of different sizes and in different sectors. For example, change management in MNCs may take longer as there are more employees, while SMEs have limited resources to embark on digitalisation efforts. Hence, this document accounts for this diversity by focusing on the needs that are common across these differences. These include the need for a **structured** and **systematic** way to address job redesign that is also **standardised** to improve communication, coordination and collaboration across relevant internal and external stakeholders. By suggesting an approach that consists of these three key common dimensions, the Guide can help organisations adopt AI and redesign jobs in a scalable and timely manner.
- 2.3 After the organisation has decided which part of its business operations it intends to implement AI in, the Guide suggests practical steps in **four areas** of job redesign. It also provides guidance to organisations to consider areas of work where value-add of humans (e.g., creativity, empathy and emotional intelligence) should be preserved or where there is value to retain human experience instead of using AI to replace employees.



2.4 This Guide is a living document, and is expected to evolve with the advancement of AI technologies and their increasing adoption. It is not intended to:

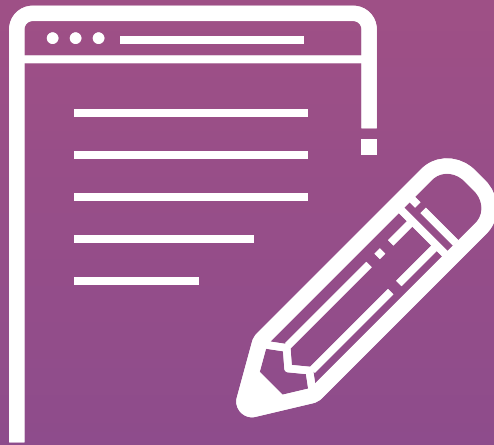
- a. Be prescriptive or taken as a set of steps towards redesigning work rigidly;
- b. Suggest that AI should be applied in a manner that ensures no job loss;
- c. Suggest a moral standard in job redesigning or moral obligation against retrenchment;
- d. Cover the ethics of hiring or firing practices;
- e. Address general job displacement issues resulting from automation or broader AI evolution; or
- f. Help displaced workers find jobs.

2.5 As this Guide is sector-agnostic, it provides a baseline set of considerations and measures for organisations operating in any sector to adopt. Specific sectors or organisations may choose to include additional considerations or adapt this baseline set to meet their needs.

### **Who Should Use This Guide and How?**

2.6 Senior Management may use this Guide, and the strategic considerations therein, to plan for the deployment of AI in a manner that allows the organisation to benefit from AI while retaining and enhancing employees' roles. HR professionals and line division managers may use this Guide to develop an evidence-based, systematic process to analyse jobs impacted by AI deployment, and help their employees embrace AI technologies to increase their value-add. At the same time, organisations can consider collaborating with unions throughout the job redesigning journey, from identifying training needs and charting new career pathways to minimising displacement or retrenchment. Employees can also step up to advocate and encourage job transformation.

2.7 This Guide aims to introduce a new and integrated task-based approach with practical case studies, as well as an introduction to the research that underpins the approach to redesigning jobs.



# PREMISE

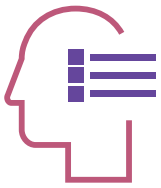
- 2.8 AI refers to a set of technologies that seek to simulate human traits such as knowledge, reasoning, problem solving, perception, learning and planning; and, depending on the AI model, produce an output or decision (such as a prediction, recommendation, and/or classification).<sup>3</sup>
- 2.9 At the same time, views differ on whether a clear line can be drawn between AI and automation. For example, automation often focuses on streamlining repetitive and instructive tasks. It is worth noting that automation is typically the first step for organisations before they adopt machine learning (ML), natural language processing (NLP) and deep learning solutions. In addition, digital technologies, such as the Internet of Things (IoT), are often adopted in tandem with AI in many organisations' digital transformations, and organisations might assess the impact of the entire digital spectrum on their businesses. **While this Guide focuses on helping organisations to address the impact of AI on jobs that have cognitive elements, some considerations are not unique to AI, and could be applicable to other automation or digitalisation efforts.**
- 2.10 The Guide integrates the growing evidence and case to use tasks as the basis for analysis, enabling organisations to assess AI's impact on all job roles across an organisation, from entry-level employees to senior management, in a granular and systematic manner. Even roles such as consulting or artistic direction, that may seem fluid or bespoke, can be broken down into tasks which describe the actions that comprise the specific role. Organisations will have a clearer idea of where AI would be beneficial to the work processes (i.e., in which tasks), if it is consistent with the senior management and employees' values, as well as how these changes could be executed given the time the organisation has for planning and implementation.



## TASKS BREAK DOWN JOBS

- 2.11 Evidence has indicated that AI, as a technology, is likely to remain narrow in the foreseeable future and specialised to perform specific tasks. This means work would be transformed task-by-task, and not job-by-job. By analysing which tasks would be automated or augmented, organisations can determine exactly how each job would be affected.

<sup>3</sup> This definition of AI follows the definition in the Model AI Governance Framework. It should not be taken to be an authoritative or exhaustive definition.



## TASKS COMPLEMENT SKILLS

2.12 While skills remain important in understanding the capabilities necessary for a role and can help employees stay resilient, tasks have become a central part of a skills framework. Skills, in current practice, are typically defined more generally (e.g., creativity or communication). This often presents a challenge. For instance, creativity for a product designer is different from a graphic designer, and communication is different for technical presentations and business presentations. Transferability across contexts is not always assured. On the other hand, tasks take into account the context, and give different levels of specificity in describing what can be done with a certain skill. Hence, tasks and skills must be used in tandem to achieve an optimal outcome for workers.

2.13 For example, some skills<sup>4</sup> of a Nurse Clinician's or Clinical Nurse Specialist's job are "Change Management", "Strategy Management", "Patient Care Delivery", and "Patient Empowered Self-care". While these skills provide a good understanding of a nurse's knowledge and capabilities, knowing the nurse's tasks will provide a more comprehensive understanding of the role. Some tasks<sup>5</sup> in this role include:



a. Develop and maintain departmental policies, procedures, objectives, or patient care standards, based on evidence-based practice guidelines or expert opinion;



b. Participate in clinical research projects, such as by reviewing protocols, reviewing patient records, monitoring compliance, and meeting with regulatory authorities;



c. Provide direct care by performing comprehensive health assessments, developing differential diagnoses, conducting specialised tests, or prescribing medications or treatments; and



d. Observe, interview, and assess patients to identify care needs.

<sup>4</sup> From the Nurse Clinician's Skills Map from the Skills Framework for Healthcare.

<sup>5</sup> Tasks here refer to a selection of those listed under Clinical Nurse Specialist in the O\*NET Database.

- 2.14 Having such granularity is important as AI is disrupting a wide spectrum of tasks and skills, beyond the routine, non-creative, or non-interpersonal ones affected in past Industrial Revolutions. By adopting a task-based and human-centric approach, organisations will be better able to simplify and integrate how they transform work and redesign jobs:

#### Human-centric

Tasks make it possible to create step-by-step pathways and roadmaps that improve certainty, build confidence, and enhance employer-employee communication.

#### Simplify

Instead of juggling multiple considerations, organisations can now focus on tasks, including their interactions and impact on each other, as the building block for understanding the impact of AI, charting career paths, planning upskilling for employees, and communicating within an organisation.

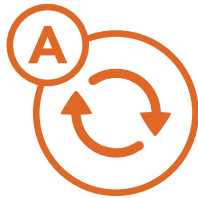
#### Integrate

Tasks can be used to integrate an organisation's efforts with other national, sector, and industry initiatives.

- 2.15 In addition, using actual tasks an employee performs as the basis of analysis facilitates an employee-centric discussion. This creates a shared vision for both the senior management and employees in an organisation.

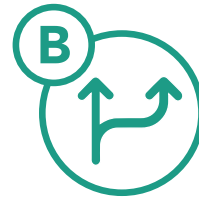
*Having such granularity is important as AI is disrupting a wide spectrum of tasks and skills, beyond the routine, non-creative, or non-interpersonal ones affected in past Industrial Revolutions.*

2.16 The Guide provides guidance on measures to redesign jobs that organisations could adopt through four key areas:



### **TRANSFORMING JOBS**

Assess the impact of AI on tasks, including whether each task can be automated or augmented by AI or remain in human hands, and decide which jobs can be transformed within an appropriate time frame.



### **CHARTING CLEAR PATHWAYS BETWEEN JOBS**

Chart task pathways between jobs within an organisation and identify the tasks employees would need to learn to transition from one job to another.



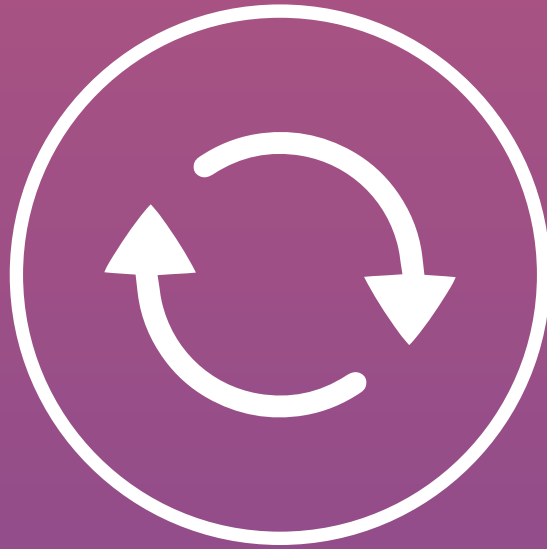
### **CLEARING BARRIERS TO TRANSFORMATION**

Suggest ways to address potential challenges and support employees when implementing AI.



### **ENABLING EFFECTIVE COMMUNICATION BETWEEN EMPLOYERS AND EMPLOYEES**

Building a shared understanding within the organisation on “why”, “what”, and “how” AI will augment human capabilities and empower employees in their career.

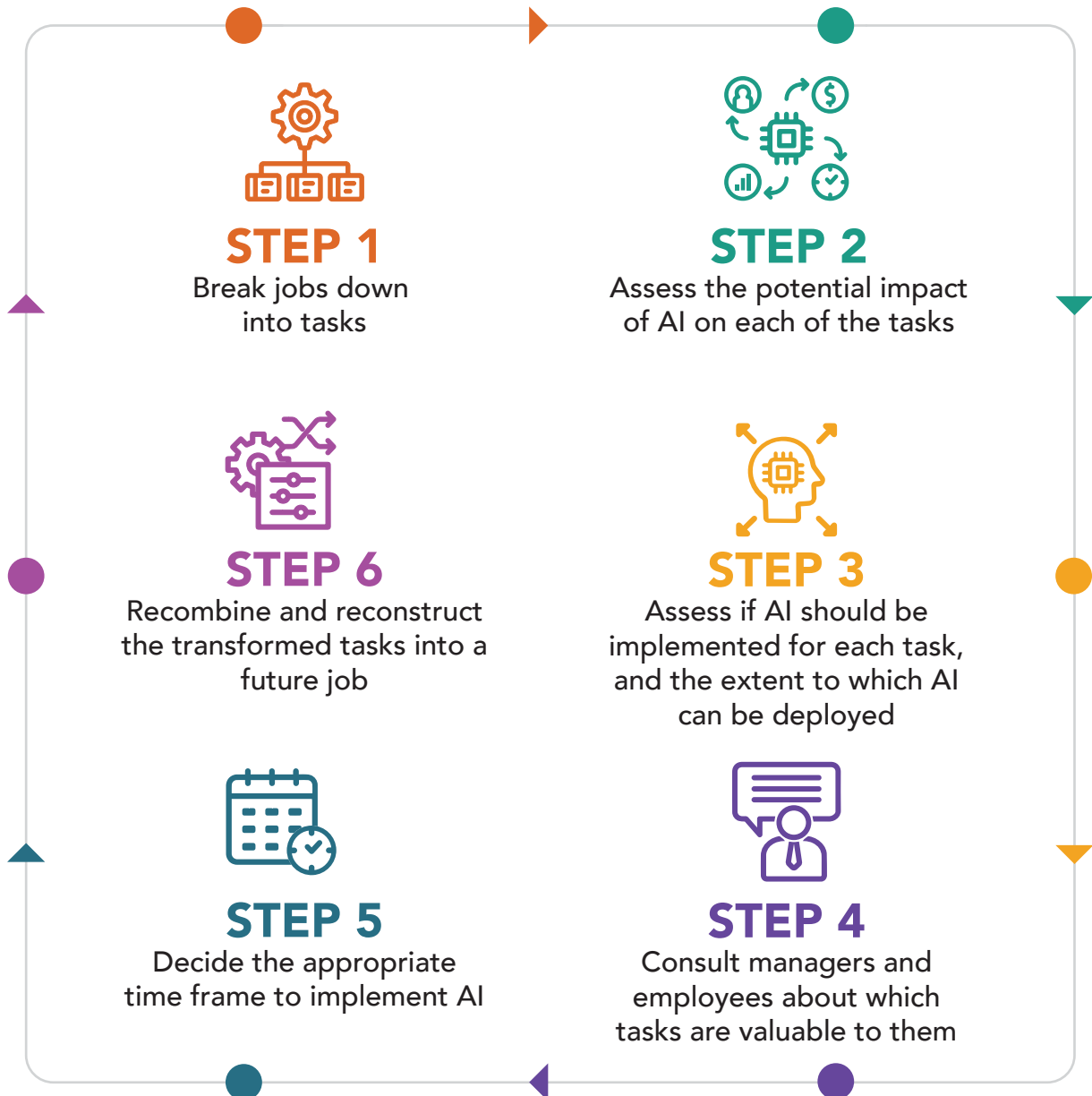


# **TRANSFORMING JOBS**

## **— PUTTING TASKS TO WORK FOR PEOPLE**

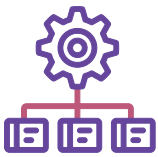


- 3.1 **This section<sup>6</sup> is intended to guide organisations in assessing the impact of AI on jobs within their organisation to chart task-based job transformation roadmaps.** This is done after the organisation has decided which part of its business operations they intend to implement AI in, based on their business objectives. There are six steps:



<sup>6</sup> This section draws heavily on future of work research conducted since 2014 by the Lee Kuan Yew Centre for Innovative Cities at the Singapore University of Technology and Design. Specific references are provided in the footnotes of the following sections.

- 3.2 Through these steps, organisations are able to make a decision on which jobs can be transformed into more valuable and meaningful roles in the future. Organisations are encouraged to use these job roadmaps as the basis to set specific goals, timelines, and initiatives to support employees in their job transformations. It should be noted that this process is not always unidirectional — it can be an iterative process as new tasks and roles may emerge with the use of AI over time, and across business processes.



## BREAK JOBS DOWN INTO TASKS

- 3.3 Transforming a job role begins with understanding the tasks it comprises. This in turn allows an organisation to assess which tasks will likely be impacted and when they are expected to be impacted.
- 3.4 Tasks are made up of a specific action performed, object(s) involved, and purpose intended. Organisations can refer to existing job descriptions or operating procedures, or glean them from employee interviews or observations to better understand the specific tasks for each job role. This will provide organisations with a holistic view of all the tasks done by the employee and highlight any variations between individuals, teams, and locations that may have evolved through time. It is important to isolate descriptive statements of the actions an employee performs in order to fulfil their role, and other details such as the skill needed or overall job responsibilities. For example, an Information Security Analyst's job role (see Figure 1 below) can be broken down into the following 11 constituent tasks:

- Discuss user issues
- Train users, promote awareness
- Monitor virus reports
- Monitor security files
- Encrypt transmissions, erect firewalls
- Review user violations
- Develop plans to safeguard files
- Assess risks and execute tasks
- Coordinate implementation
- Document policies and procedures
- Monitor use of data files

- 3.5 Breaking a job into constituent tasks allows organisations to build a detailed and practical risk profile for the job role that shows the number of tasks that can be replaced or augmented by AI, which in turn reflects the expected speed and scale of disruption by AI. As business decisions often require taking into account the organisation's operating context, the profile will need to be sufficiently specific to the business, technology, and industry that the organisation is operating in. At the same time, organisations could consider mapping tasks to standardised task frameworks (e.g., LKYCIC Tasks-Skills Stack<sup>7</sup>) which would allow the tasks to be compared across jobs, companies, and industries.

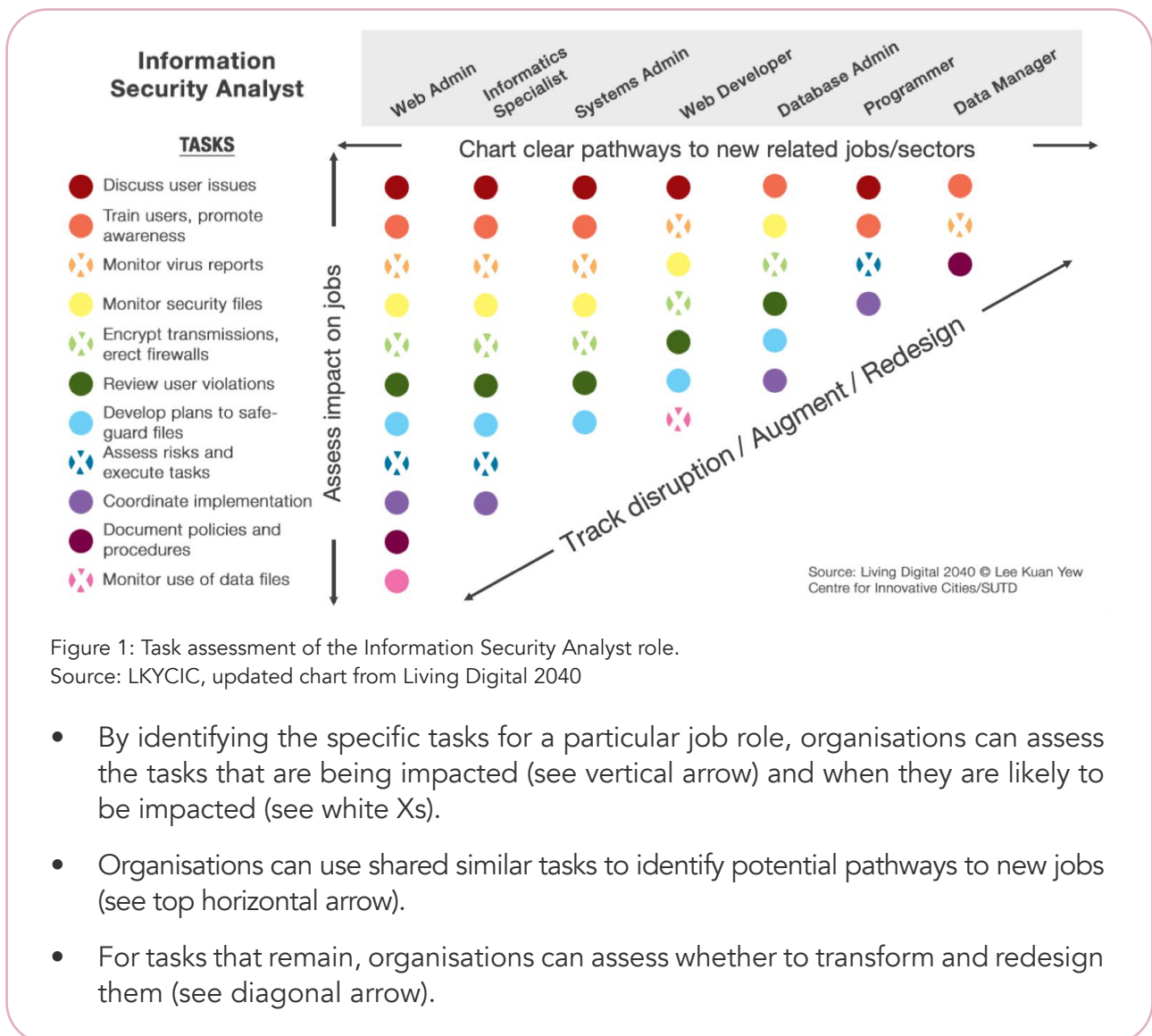
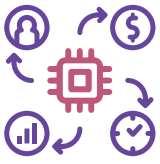


Figure 1: Task assessment of the Information Security Analyst role.

Source: LKYCIC, updated chart from Living Digital 2040

- By identifying the specific tasks for a particular job role, organisations can assess the tasks that are being impacted (see vertical arrow) and when they are likely to be impacted (see white Xs).
- Organisations can use shared similar tasks to identify potential pathways to new jobs (see top horizontal arrow).
- For tasks that remain, organisations can assess whether to transform and redesign them (see diagonal arrow).

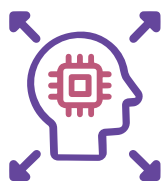
<sup>7</sup> The LKYCIC Tasks-Skills Stack is made up of many databases — populated with data on jobs, skills, competencies, courses, etc. — stacked together, with tasks data as the backbone that connects them all. It is structured to allow for analysis of factors such as the impact of AI disruption, pathways for transitioning between jobs, and potential for job redesign. These analyses can be conducted at the individual, company, industry, and country levels. More information on this resource can be found at: <https://lkycic.sutd.edu.sg/research/future-digital-economies-societies/>



## ASSESS THE POTENTIAL IMPACT OF AI ON EACH OF THESE TASKS

- 3.6 After constituent tasks have been identified, the next step would be to assess which tasks will likely be impacted by AI and when they are expected to be impacted. To evaluate if a task can be automated, organisations should work with relevant internal and external experts (where necessary) to assess how well an AI solution is able to perform the task. This can include looking for viable use cases within their industry such as a competitor, supplier, or customer who may have pioneered the adoption of the solution. Where no such use cases exist, organisations are encouraged to look at other industries that may have similar processes, and/or review with their experts the estimated time frame required to implement the solution. In the above example of the Information Security Analyst role, the tasks such as monitoring virus reports, assessing risks, and executing tasks are likely to be disrupted by AI.
- 3.7 To further assess the feasibility of implementing AI in the role, organisations should consider assessing *when* AI will have an impact. To enable a robust judgment of the impact of AI on each task, organisations should consider seeking views of experts on the application of relevant AI technologies as well as stakeholders (e.g., employees, line division managers, and business managers) regarding the needs of the role.





## ASSESS IF AI SHOULD BE IMPLEMENTED FOR EACH TASK

3.8 Having clarity on the objective of using AI is a key first step in determining whether AI should be implemented for each task, and the corresponding extent of human oversight. While this Guide is not meant to guide organisations on how to implement AI responsibly (refer to the Model AI Governance Framework), organisations should decide on their commercial objectives (e.g., improve operational efficiency and reduce costs), risks, values, and impacts<sup>8</sup> of using AI on individuals (e.g., probability and severity of harm on employees and end-users) at the outset. Organisations can adopt two high-level guiding principles that promote trust and understanding in the use of AI when deciding whether AI should be implemented:

- a. Organisations using AI in decision-making should ensure that the decision-making process is explainable, transparent, and fair; and
- b. AI solutions should be human-centric.

3.9 Besides analysing whether a task can be automated, organisations should consider whether the task should be augmented by AI. As the use of AI increasingly shifts towards human-machine collaborations,<sup>9</sup> organisations could consider using AI to develop a more sophisticated approach to how they address repetitive and non-routine tasks with the diverse spectrum of human skills such as:



### Critical Thinking

(e.g., assessing the merits and trade-offs for different actions)



### Creativity

(e.g., generating alternative designs)



### Emotional Intelligence

(e.g., analysing customers' preferences)

The goal is to make work more human-centric.

<sup>8</sup> This should be read in conjunction with the Model AI Governance Framework (Section on Determining the Level Of Human Involvement in AI-Augmented Decision-Making).

<sup>9</sup> See for example The Future of Services: Services and Digital Economy Technology Roadmap published by IMDA (<https://www.imda.gov.sg/-/media/Imda/Files/Industry-Development/Infrastructure/Technology/Technology-Roadmap/SDE-TRM-Main-Report.pdf>).

- 3.10 For example, complex considerations of the customer journey, employee workflows, and business goals may mean that while a task is fully automatable in theory, it should only be partially automated, or augmented, by AI to retain a higher degree of human input. Conversely, a task that may require a disproportionately large amount of investment to be automated may still be beneficial if it offers significant improvements to employee safety.
- 3.11 This assessment to consider if AI should be implemented is highly context-dependent and requires discussion between all relevant parties. For instance, it might be technically feasible for a bank to leverage AI when making financial product recommendations to their clients. However, the bank would need to consider other factors such as key events impacting their clients, as well as the clients' risk preference — possibly only made known through human interaction. While AI may augment human capabilities in recommending financial products, building trust and developing clientele will ultimately require an interpersonal touch. At the same time, deciding which tasks could and should be automated by AI can often be customer-driven. With a task-based approach, it is easier for organisations to take a customer-centric and employee-centric approach as a basis to identify which tasks could and should be automated, with minimal cost and disruption.
- 3.12 Although there are certain tasks that could be fully automated by AI, it is important to avoid deskilling humans and recognise the value of retaining human experience. For example, pilots still need to accumulate sufficient flying experience so that they can intervene decisively and prevent over-reliance on automation, especially in extreme situations if the autopilot function fails.

*Although there are certain tasks that could be fully automated by AI, it is important to avoid deskilling humans and recognise the value of retaining human experience.*

- 3.13 In determining whether AI should be implemented, another consideration would be how the time allocated for each task could be optimised, which could help businesses accelerate their growth and/or lower their cost. For example, in law firms, the use of AI to proofread standard contracts and conduct pre-trial discovery could free up time for lawyers to do higher value work such as in-depth legal research, deal structuring, dispute resolution, and client relationship management or business development. While organisations may not want to implement AI due to legal hurdles (e.g., AI is not legally allowed to provide legal advice directly), AI is still able to assist lawyers with lower value legal work, thus allowing them to work more efficiently.
- 3.14 For tasks that are not impacted by AI, organisations could assess whether there is a need to transform and redesign them. Using the illustration of the Information Security Analyst, organisations may consider investing in AI to augment the tasks currently not impacted by AI (e.g., allowing the job to be more valuable and meaningful to both the organisation and the employee).
- 3.15 Organisations could also consider regrouping the remaining tasks in new and different ways — combining two roles to create a new role, or reimagining the tasks that a particular role performs. For example, an Information Security Analyst could spend more time providing personalised user support, or redesign how they work with the web admin to monitor security.
- 3.16 When implementing new technologies, organisations may often face trade-offs due to resource constraints. Investing in a new AI solution to improve efficiencies and lower cost may require organisations to upskill their employees to use AI, resulting in additional overhead costs. On the other hand, the benefits of redesigning jobs are the value and impact it has on the end-users and/or end-customers (e.g., enhanced customer experience). Hence, it is important for organisations to take into account their business strategy, financial resources, industry changes, competitive pressures, regulatory requirements, and available government support schemes before deciding whether to invest in AI.





## CONSULT MANAGERS AND EMPLOYEES ABOUT WHICH TASKS ARE VALUABLE TO THEM

3.17 Besides engaging experts to assess the impact of AI on tasks and whether AI should be implemented, it is critical to consult relevant employees impacted by it. Organisations are encouraged to ask employees:

- a. Which tasks they value most;
- b. Their preferences for which tasks are to be fully or partially automated;
- c. Which tasks could be done differently by leveraging AI; and
- d. Their views about changes in their jobs and/or industries.

For example, an investment consultant may find developing and maintaining relationships the most engaging part of their job, while an art director can provide insight into their concerns over using recommendation engines for marketing. These findings would offer senior management an in-depth understanding of which tasks keep employees engaged with their work, allowing them to consider how these features can be preserved and/or enhanced throughout upcoming changes. Moreover, if what the employee values happens to be something that can be automated or performed better with AI, management would have to be more perceptive to the required employee engagement. It is critical to understand any differences between what the employee and manager value, as the engagement of the employee could be negatively affected if AI were implemented for a task they highly valued.







3.18 By asking employees about the tasks they value, be it through surveys, interviews, or other methods, employees can provide insight into how well a proposed AI solution fits the tasks they perform. Critically, they will be able to identify pain points and articulate what might be lost if technology is implemented; such as the loss of domain knowledge and/or accumulation of work experience by employees due to the use of automated models and decisions (such as in audit and accounting),<sup>10</sup> the reduced sense of scale when using computer-aided design (such as in architecture and design),<sup>11</sup> or the missing non-verbal cues and face-to-face social interactions from online communication.

<sup>10</sup>Balasubramanian, G., Lee, H., Poon, K. W., Lim, W. K., & Yong, W. K. (2017, July). Towards Establishing Design Principles for Balancing Usability and Maintaining Cognitive Abilities. Book Chapter in: Design, User Experience and Usability: Theory, Methodology and Management. LNCS Vol. 10288 (19<sup>th</sup> International Conference on Human-Computer Interaction, 2017), p3–18.

<sup>11</sup>Ibid.



## EXAMPLE OF A SURVEY QUESTIONNAIRE FOR EMPLOYEES

	Core importance of the task to the job	Not important	1	2	3	4	Very important	5
	Frequency of the task	Not frequent	1	2	3	4	Very frequent	5
	Effort required for the job (in terms of time) versus impact	Minimum effort	1	2	3	4	Maximum effort	5
	Views on whether the task could or should be automated:							
	Client satisfaction	Low client satisfaction	1	2	3	4	High client satisfaction	5
	Importance of client interaction for the specific task	Low importance	1	2	3	4	High importance	5

- 3.19 Using the example of an Information Security Analyst, the automation of monitoring and risk assessment could create an over-reliance on AI, lowering vigilance to cybersecurity threats. Furthermore, such consultations with managers and employees will help mitigate resistance to change and identify changes in work priorities with the adjustments in tasks. During these consultation sessions between manager and employee, it might be useful for a HR professional to facilitate these discussions. Lastly, collaborating and co-designing of tasks should be a long-term effort and there should be a feedback-loop process — regarding the success and pitfalls of AI-adopted tasks, training, environment changes, as well as transitions to new job roles.



## DECIDE THE APPROPRIATE TIME FRAME TO IMPLEMENT AI

- 3.20 If organisations decide to invest in AI to augment their employees' capabilities, it is also important to assess the number of phases required for the transformation — whether the transformation should be attempted in one step or through a phased approach.
- 3.21 To determine the number of phases expected to complete the transformation, organisations may segregate the tasks that they have broken down into phases, according to the following considerations:
- a. How much change can be implemented at any one time;
  - b. Capability to support the use of AI;
  - c. Resources to support the transformation;
  - d. Organisational culture to change;
  - e. Employees' readiness for AI.
- 3.22 While there is a possibility for the transformation to be attempted in one step (e.g., when the change is simple), organisations should consider implementing AI gradually, in sync with tasks identified in the transformation roadmap. This would allow employees to incrementally adjust to the use of new technologies in their work processes, and improve long-term acceptance of AI. Implementing a phased approach will not disrupt critical employee- and customer-facing processes, nor cause a sudden displacement of critical jobs or knowledge. More importantly, as each of the tasks is a tangible area of work to the employees, it allows employees to identify with the implementation of AI and how it benefits them. This ensures that the digital transformation remains human-centric.



## RECOMBINE AND RECONSTRUCT THE TRANSFORMED TASKS INTO A FUTURE JOB

3.23 A future job role may be the product of the following:



Tasks that could and should be automated;



Tasks for which AI should augment the employee; and/or



Tasks that should remain in human hands.

- 3.24 Once new tasks and skills have been identified for the new job role, organisations could consider mapping their existing internal capabilities to these roles and identifying the training needs for relevant employees. By having a clearer picture of how the tasks that make up the role and the skill sets required for the new job role will change, employees and employers will be better able to reimagine the future of work. It is also useful for organisations to consider the necessary qualifications, skill sets, aptitudes such as learning agility and resilience, as well as personality types of employees to assess their fit for the new or evolving job roles. Organisations can consider using psychometric evaluations, which could provide insights about the employees' unique cognitive, social, and emotional traits, to measure their inherent potential and optimise retraining.
- 3.25 Employers should strive to ensure that employees would benefit from the new job role. For example, if the organisation experiences increased efficiency and productivity from the transformation effort, but the employees face stagnating wages, spikes in workload, or unreasonable Key Performance Indicators, a disconnect will arise between senior management and employees regarding the benefits or necessity of change transformation.
- 3.26 Given the various considerations outlined above, organisations are encouraged to deliberate on ways to prioritise investments in AI as well as in their employees, while balancing the interactions between the two. By using the tasks that employees are performing, organisations have an accurate and employee-centric basis for their discussions and decisions. This will ensure that the role will not just be transformed technologically but in alignment with the employees' needs and career goals, as well as business goals and customers' experience.

## SUMMARY OF SECTION ON TRANSFORMING JOBS

### STEP 1

Break jobs down into tasks

Job X

- Refer to existing job descriptions or operating procedures
- Glean from employee interviews and observations

Task A Task B Task C

### STEP 6

Recombine and reconstruct the transformed tasks into a future job

Redesigned Job

Task A' Task B'' Task C

- Role transformed technologically
- Align with employees' needs and career goals
- Align with business goals and customers' experience

### STEP 5

Decide the appropriate time frame to implement AI



#### Depends on

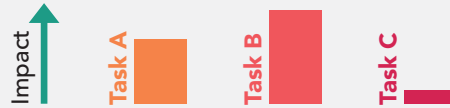
- How much change can be implemented at any one time
- Capability to support the use of AI
- Resources to support the transformation
- Organisational culture to change
- Employees' readiness for AI

#### Recommended: Phased approach

- ✓ Allow employees to adjust to the use of AI at work and understand how it benefits them
- ✓ Not disrupt critical employee- and customer-facing processes
- ✓ Improve acceptance of AI

### STEP 2

Assess the potential impact of AI on each of the tasks



- Work with relevant experts and stakeholders
- Look for viable use cases within or outside the industry
- Assess when AI will have an impact
- Review the estimated time frame required to implement the AI solution

### STEP 3

Assess if AI should be implemented for each task, and the extent to which AI can be deployed

#### Considerations

- Improve efficiencies and lower cost
- Value and impact of job redesign on the end-users and end-customers
- Need to upskill employees to use AI
- Alignment with business strategy and regulatory requirements
- Availability of financial resources and support schemes

Task A



Recommend to Automate

Task B



Recommend to Augment human capabilities

Task C



Recommend to Remain in human hands

### STEP 4

Consult managers and employees about:

- Which tasks they value most
- Their preferences on which tasks could be fully or partially automated
- Which tasks could be done differently by leveraging AI
- Their views about changes in their jobs and/or industries

Gain insights

Identify pain points or what might be lost if solution is implemented

Mitigate resistance to change

Identify changes in work priorities




## CASE STUDY: LIVE WITH AI, DATAROBOT, COMPANIES, LKYCIC


- 3.27 Motivated by a shared desire to better understand how AI will impact jobs, the LKYCIC collaborated with Live with AI, a French-Singaporean think tank and foundation; DataRobot, an AI software firm; and four global companies; to analyse occupations across four diverse industries — advanced manufacturing, advertising, private banking, and insurance.<sup>12</sup>
- 3.28 Each of these occupations brought a unique context: the art director’s concerns over the integrity of their profession in an age of AI-enabled design; a relationship manager’s hope that many of their regulatory tasks could be better augmented by AI, to name a few. From each organisation’s job descriptions of the eight occupations, the LKYCIC used its task database to map the tasks to a standardised task data framework. The mapping was verified with employees, and in some cases, with the managers through interviews.
- 3.29 The potential for each task to be disrupted by an AI-related technology was initially evaluated individually by Data Robot on two dimensions:
- a. Degree to which the task would be disrupted; and
  - b. Time horizon for the technology to be implemented.
- 3.30 This was followed by a discussion between relevant partner organisations to finalise the evaluation and include an assessment of the impact on the time taken to do that task in the future. The outcome was a “lollipop diagram”, an analysis of the impact of technology on the job over the next 20 years (see the following illustrations from pages 31 to 40). These analyses focus on the impact of AI technologies, such as ML and NLP, as well as the impact of digital technologies — such as robotic process automation (RPA) and the IoT — that are often adopted in tandem with AI in many organisations’ digital transformations.

<sup>12</sup> For full details on these analyses and the illustrations that follow, please see Live with AI’s publication at <http://livewithai.org/read-live-with-ai-white-paper-2019/>.

- 3.31 These diagrams were then expanded to account for the human and organisational factors that will affect automation, determined through the above-mentioned interviews. These factors include identity, motivation, and satisfaction, and enabled the possibility of evaluating which tasks may be automated or augmented by AI, and which may remain in human hands.
- 3.32 With this information, senior management concluded the process by developing a synthesised point of view on how the role would change as a result of automation and AI (seen under the heading 'How the Role will Change' in the illustration below). The entire evaluation highlights that disruption is a matter of decisions (e.g., whether to automate the task or use AI to augment the employee), not just of technological progress. The quality of these decisions will ultimately be determined by the quality of the discussions between employers, employees, and relevant experts. While the case studies could shed light on specific tasks that could be automated, augmented, or remain in human hands in specific scenarios, the analysis could differ between organisations even in the same industry due to various factors and contexts, including those mentioned in paragraphs 3.16 and 3.21.

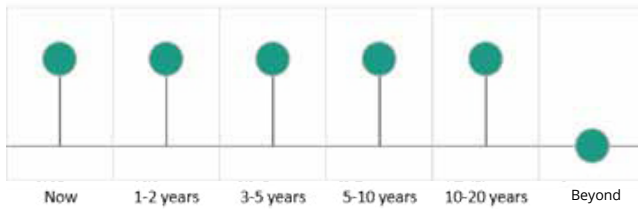


*The entire evaluation highlights that disruption is a matter of decisions, not just of technological progress. The quality of these decisions will ultimately be determined by the quality of the discussions between employers, employees, and relevant experts.*



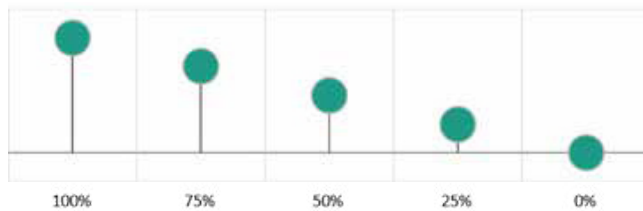
## How to read our graph:<sup>13</sup>

When can a task be disrupted?



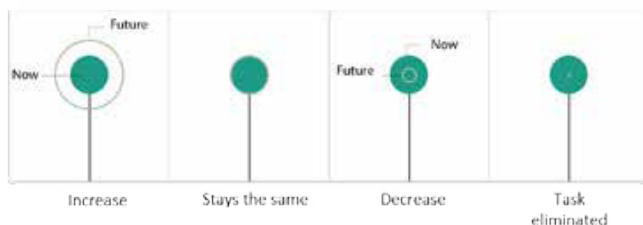
The position on the horizontal axis reflects when the first use case in the industry will be implemented, from “now” (pioneers in this industry are already starting), to implementation in 10-20 years in the future, and beyond.

Can a task be automated?



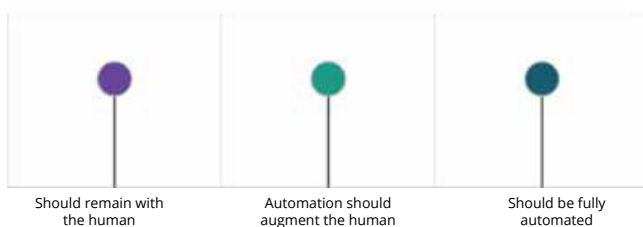
The height reflects a technological assessment of the percentage of the task that can be impacted by AI, from 100% to 0%.

Comparison of the time taken between now and future



The filled circle represents the task as it exists now and the ring depicts the task in the future; comparing them shows whether the time taken to do the task will increase, stay the same, decrease, or if the task will be eliminated.

Should the task be automated or done by a human?

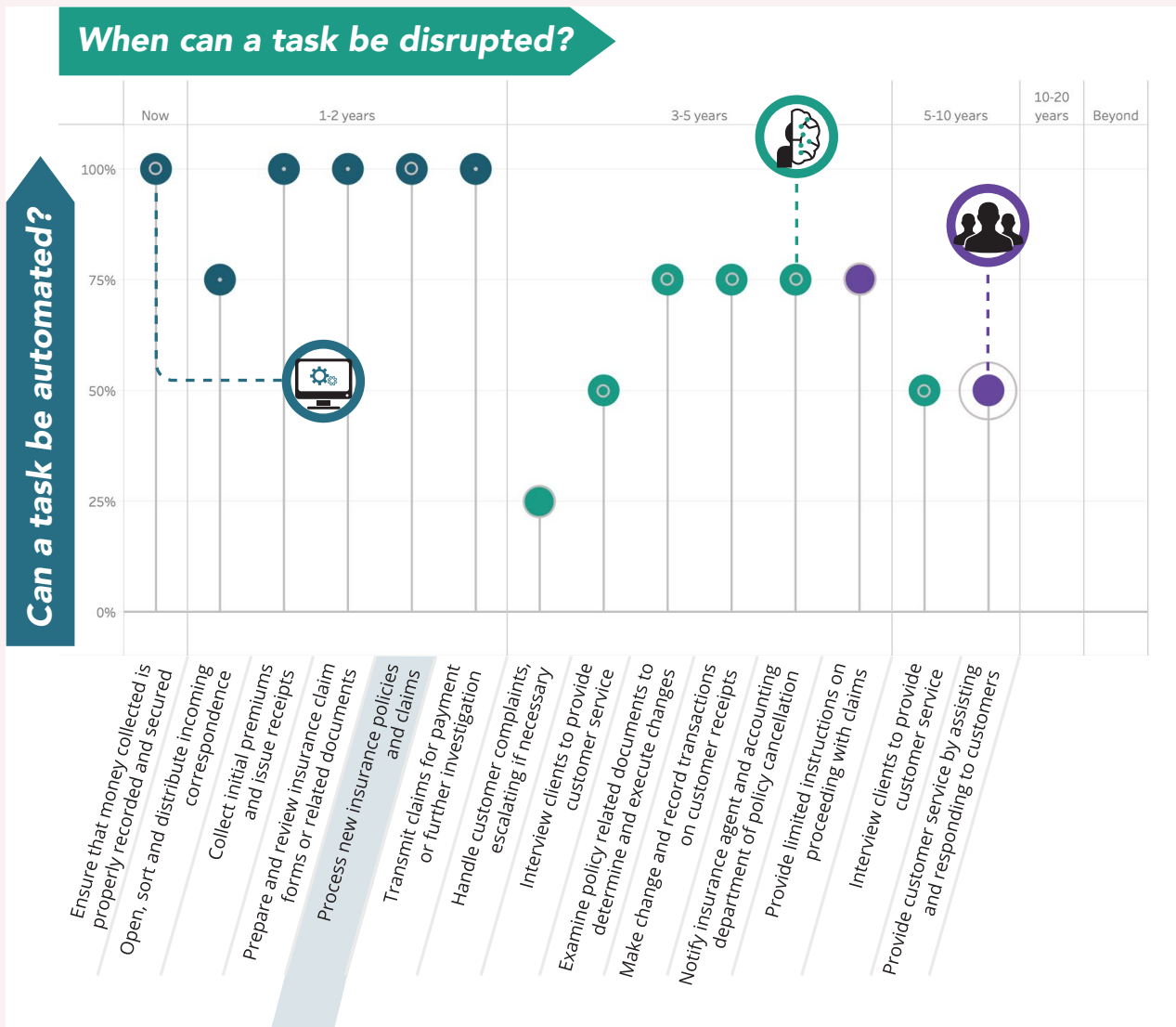


The color represents whether the task should remain with the human, be fully automated, or if automation should augment the human.

<sup>13</sup> In addition to showing the time frame and potential for automation, the expected change in time taken is represented by the size of the overlapping grey ring for each task circle. A ring larger than the circle shows that the time spent will increase, while a ring smaller than the circle shows that the time taken will decrease.

# SPECIALIST (CUSTOMER SERVICE) (INSURANCE)

The Customer Service Centre Specialist in a certain insurance firm provides a dedicated one-stop insurance service for all customers, including intermediaries and advisers. The job scope covers responding to customer enquiries, policy servicing, handling customer complaints, and ensuring all tasks are completed within a stipulated service turnaround time and processed accurately.



This task can be 100% automated in the next 1-2 years as generating cover notes and policies for new businesses, renewals, and extensions can be done through RPA. The time required to complete this task will decline by 50%.



## Should a task be automated by AI?



### RECOMMEND TO AUTOMATE

Ensure that money collected is properly recorded and secured, especially when the cash register is not working.



This task can be fully automated as numerous cashless payment options and automated transaction systems are available — saving time for the Customer Service Centre Specialist. In addition, the task does not offer much value to employees. However, the demand for customers to have face-to-face interaction provides value in building and/or preserving the customer relationship. Thus while this task may be fully automated, it will likely still consume some time. Although this automation may not rely on AI, the volume of transaction data generated could be analysed through AI to build new business insights.



### RECOMMEND TO AUGMENT HUMAN CAPABILITIES

Notify insurance agent and accounting department of policy cancellation.



Sending the cases could be done by AI, depending on customer preference. In turn, this would decrease the number of walk-in cases, allowing employees to focus on complex cases that require problem-solving skills and experience.



### RECOMMEND TO REMAIN IN HUMAN HANDS

Provide customer service by greeting and assisting customers, and responding to enquiries and complaints.



Although technologies such as AI-enabled chatbots could partially automate this task, tasks that require empathy and involve customer experience should be preserved. In doing so, customer relationships should shift from being highly transactional to more personalised experiences.

Employees would need to adapt their sales and customer relationship process and mindset. This would allow them to focus on what they value the most: providing relevant customer service.



### WHICH TASKS DID THE CUSTOMER SERVICE CENTRE SPECIALIST VALUE?

Providing helpful assistance to customers by responding to customer enquiries and complaints.

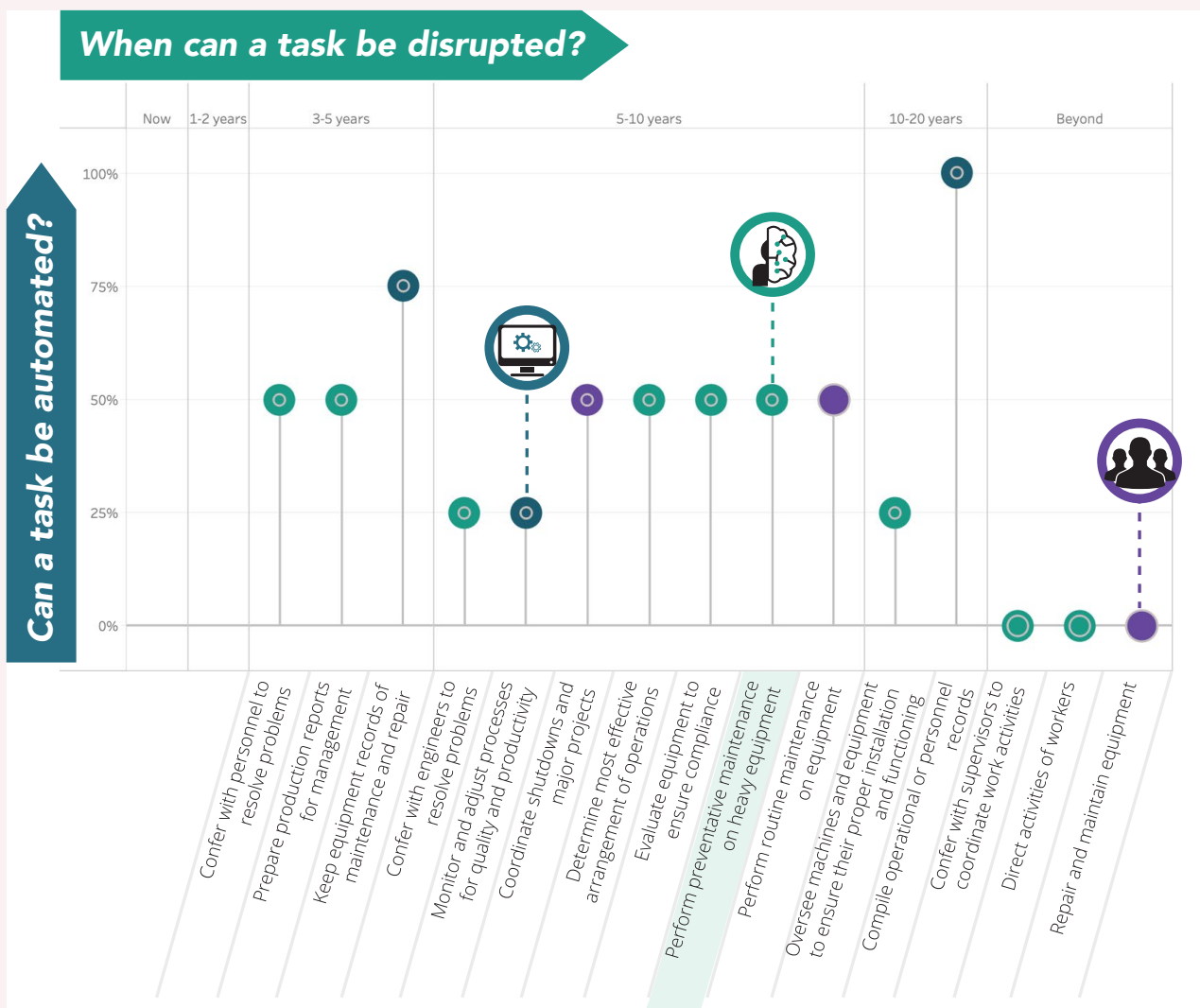
*“This is not about being motivated by a particular task, but more of an overall focus on completing the job well and ensuring that the customer is satisfied.”*

## How does the role change?

1. The Customer Service Centre Specialist would need to be trained on specific new customer relationship tools in order to oversee all customer relationships, as they are delivered partially by the machine. This would require switching between the different channels and tools used by different types of customers.
2. Rapid automation of the data entry tasks should be planned for in order to transfer the time spent on those tasks to the more customer-facing ones.

# MAINTENANCE TECHNICIAN (ADVANCED MANUFACTURING)

The Maintenance Technician in a certain advanced manufacturing firm serves at the frontline to maximise the performance of operation facilities and ensures compliance with health, safety, and environmental policies and regulations. This role involves monitoring and managing machinery conditions in the field, troubleshooting problems, and performing repairs on-site in collaboration with relevant teams and subject matter experts. The technician needs to execute regular inspections as well as preventive/predictive/risk-based maintenance actions. In terms of career trajectory, when their domain knowledge and experience develops to a sufficiently high level, they can be promoted to maintenance engineers.



Prescriptive analytics began with condition-based triggers to create a proactive maintenance program, versus calendar-based preventative maintenance. With the help of AI, prescriptive analytics bridges the gap between anomaly detection and the actions needed for resolution — enhancing workforce productivity and improving safety, reliability, quality and security, and potentially saving millions of dollars through early catches. This task could be 50% automated in the next 5-10 years, decreasing the time spent on this in the future.

## Should a task be automated by AI?



### RECOMMEND TO AUTOMATE

Monitor and adjust production processes or equipment for quality and productivity.



The work process for daily monitoring and adjustments can be tedious and cause work fatigue for the technician. Technologies such as ML can partially automate this task, especially by giving predictions of future issues.

Automating the monitoring, reporting, and standard operation could free up human resource for more creative and effective tasks.



### RECOMMEND TO AUGMENT HUMAN CAPABILITIES

Receive predictive, prescriptive, and prognostic guidance in order to perform accelerated preventive maintenance on heavy equipment.



Due to ML and process mining, early warning insights can be delivered to the employees, including predictive, prescriptive, and prognostic guidance. They can leverage this rich data source to perform accelerated preventive maintenance on heavy equipment.

The technician then becomes part of the business development process, leveraging recommendations from specific software and sensors.



### RECOMMEND TO REMAIN IN HUMAN HANDS

Repair and maintain equipment, making emergency adjustments or assisting with major repairs as necessary.



This refers to the field work that is carried out physically by technicians. Although there could be enhancements from augmented robotic arms or other advanced machinery tools, this work includes on-site investigation with all actions taken specifically to address particular problems. For example, underwater remote operation machines could help to inspect the offshore platform scaffolds, but a technician is still required to pilot these remotely.

PERFECT MATCH



### WHICH TASKS DID THE TECHNICIAN VALUE?

Gaining experience from repairing and maintaining equipment, making emergency adjustments, or assisting with major repairs as necessary.

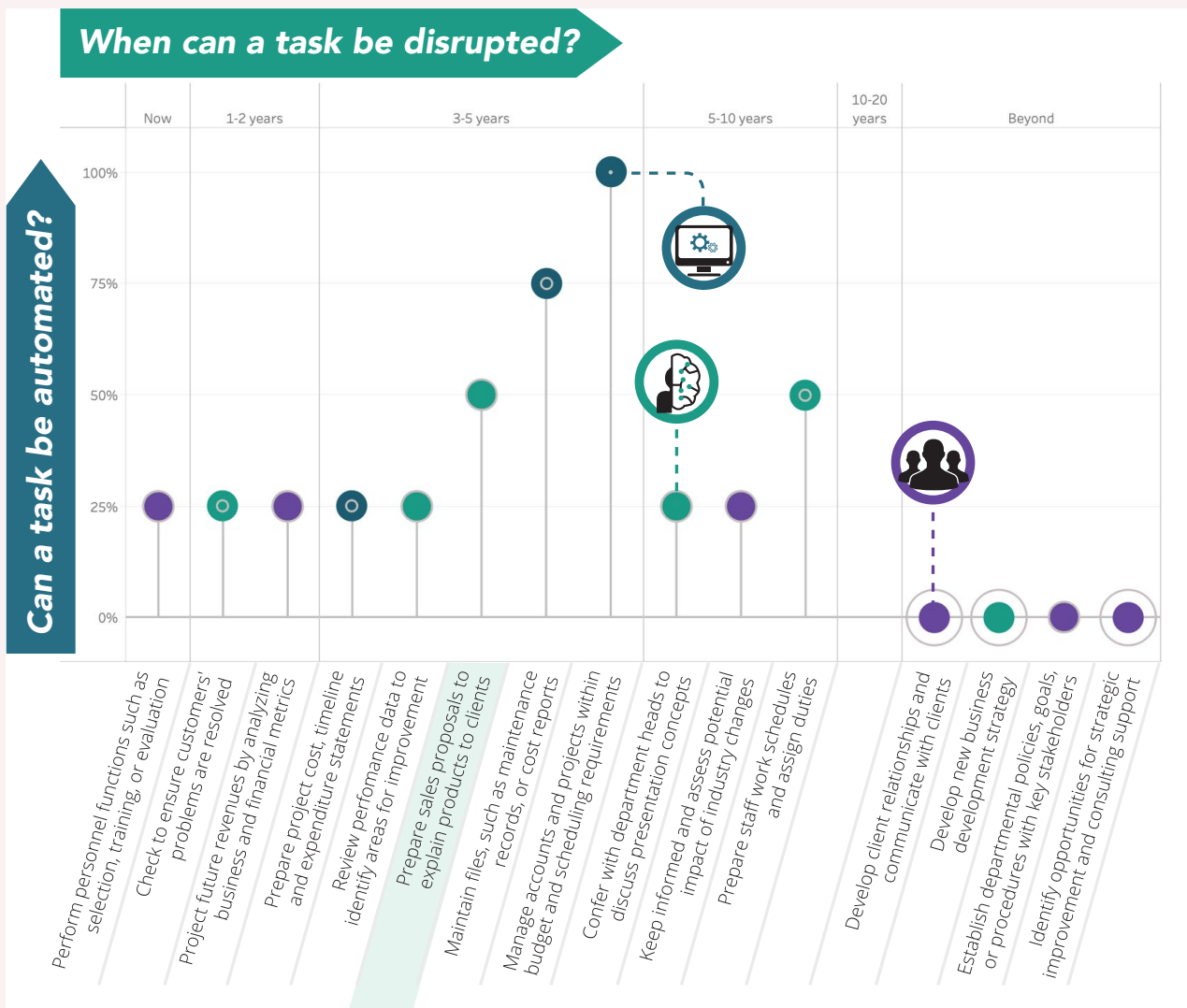
*"This task was one that motivated me, because it involves solving a problem and gives a sense of accomplishment."*

## How does the role change?

1. It was highlighted during the interview with the firm that tasks that can impact the safety of personnel must be automated for employee security, and also because of the potential impact an incident or accident may have on society. A factory explosion that contaminates the water source of a city due to a lack of regular controls is an example of an incident that could have been avoided.
2. The Maintenance Technician would need to be prepared for deeper involvement with virtual augmentation in their work, for example, dealing with early warning of an equipment's integrity from its digital twin, or reviewing prescriptive suggestions of potential areas for inspection from a virtual assistant powered by AI.
3. The automation of monitoring and reporting processes could be a win-win solution for management and frontline operations. Managers would obtain timely and updated reports, while the frontline workers would be relieved from repetitive work that provides low satisfaction. The data archived may also be used as a source for further AI development on machine maintenance.

# ACCOUNT DIRECTOR (CREATIVE AGENCY) (ADVERTISING)

The Account Director in a certain creative agency is the key point of contact for strategic marketing communication initiatives for a group of clients. The job scope includes directing and leading several clients' businesses, as well as developing and executing plans with consulting, creative, and operational partners using all the appropriate channels. The latter includes interactive and direct marketing channels, but also regularly extends into advertising, loyalty, and other aspects of the marketing mix. This position has revenue generating and financial tracking responsibilities for the assigned client base. The person manages an account team and collaborates with many other group resources on behalf of clients, developing best practice knowledge over time.



AI will support the Account Director in presentation generation, by gathering content and critical elements. At least 50% of such a task might be automated over the next 3 to 5 years based on the agency's investment, though the Account Director will spend the same amount of time on such work.

## Should a task be automated by AI?



### RECOMMEND TO AUTOMATE

Manage own accounts and projects, working within budget and scheduling requirements to ensure quality.



All project and budget management tasks might be automated in the near future. AI would be able to generate dashboards and reports based on the organisation's management expectation.



### RECOMMEND TO AUGMENT HUMAN CAPABILITIES

Confer with creative, art, copywriting, or production department heads to discuss client requirements and presentation concepts, as well as to coordinate creative activities (mostly related to leading the creation and development of creative briefs).



For example, NLP could potentially automate the creation of a creative brief by combing through relevant previous work of the agency, but it would also need to be adapted by the Account Director based on what they know about the client.

Even if full automation were possible, it would be practical for this creative agency to maintain some expertise in creating briefs, in order to retain its capacity to assess the quality of the briefs created. At some point in the future, digital giants (e.g., GAFAM and BATX) may serve the Account Directors with more insights and suggested ideas. However, humans would still need to consider how to reframe the briefs as well as how to drive their creative teams and software.



PERFECT MATCH

### RECOMMEND TO REMAIN IN HUMAN HANDS

Develop client relationships and communicate with clients to explain proposals, present research findings, establish specifications, or discuss project status.



Relationship building would need to be left in the hands of the Account Director. Relevant tasks require thinking, expertise, experience; and the personal touch will create the difference between companies and auto-generated creative services provided by tech companies.



### WHICH TASKS DID THE ACCOUNT DIRECTOR VALUE?

Developing client relationships and communicating with clients to explain proposals, present research findings, establish specifications, or discuss project status.

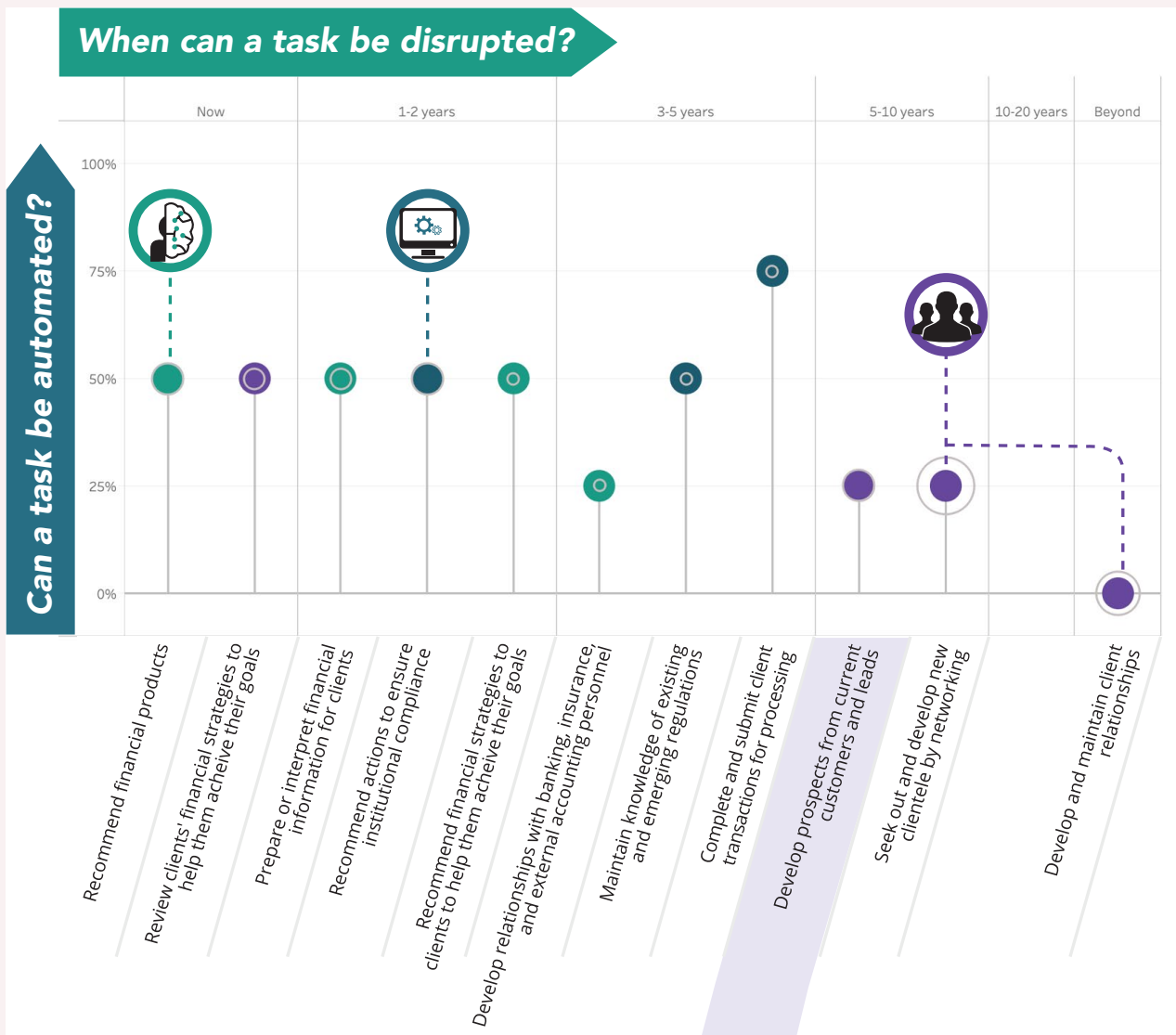
*“What I love the most in my job is my connection with clients and internal partners. I wish I could take more time to interact with my clients in the future.”*

## How does the role change?

1. The task of developing client relationships and communicating with clients requires individual personalisation. It is a task that can be better performed by empowering employees with more tools and time, to provide better service experience for their clients.
2. In addition, an Account Director would be able to dedicate more time to consulting their creative strategists and generating unique value in their marketing and branding campaigns for clients.
3. Empowered with time savings through the use of AI, Account Directors would be able to divert their time and attention to developing their client base and analysing business data to nourish their strategic and creative thinking. However, they will also have to sharpen their judgement and problem solving skills in order to make faster decisions, based on the multiplied sources of accessible information.

## RELATIONSHIP MANAGER (BANKING)

The Relationship Manager (RM) in a certain financial institution is the main interface between the bank and its high net worth clients and prospective clients. An RM endeavours to become a “trusted adviser” of the client or prospective client, with an understanding of their needs and aspirations. This allows the RM to curate the offerings of the bank to the client, ensuring that the right global products and services are offered to the clients at the right time, and that the client is able to access expertise and relationships from across the bank’s global organisation to realise their goals.



This task could be 25% automated in the next 5-10 years as ML can process objectives and strategies for prospects. However, given the sophistication of many clients, this task should remain in human hands and will continue to take the same amount of the RM's time.

## Should a task be automated by AI?



### RECOMMEND TO AUTOMATE

Recommend actions to ensure compliance with laws and regulations, or to protect the solvency of institutions.



Many tasks that ensure generic compliance and disclosure obligations are met can be partially performed by AI, often in tandem with other digital technologies. Automating these tasks could increase efficiency and reduce the risk of compliance breaches for the RM and the bank.

In the short term, human oversight over compliance and disclosure automation will be needed to ensure accurate disclosures and required approvals are obtained. Many clients have complex needs and investment portfolios which increases the demands of this task. One of the employees interviewed commented that this was a low value task that was time-consuming.



### RECOMMEND TO AUGMENT HUMAN CAPABILITIES

Recommend financial products.

Recommend strategies to clients in areas that help them achieve their financial goals and requirements.



AI can help to ensure that RMs are notified of events impacting their clients' financial interests, and allow them to develop strategies and ideas for responding to these events more promptly.

Many clients have complex wealth management needs that require balancing multiple objectives and influences. RMs can still provide useful assessments on whether the ideas and insights provided by the technology are a good fit for the client's overall needs and objectives.

In recent years, robo-advisory has assisted in making wealth management services available and affordable to clients in the affluent and retail segments; with algorithmic portfolio management tools capable of generating higher risk-adjusted returns than human portfolio managers. While it may be technically feasible for a bank to leverage AI to offer a financial product recommendation for its clients, this does not necessarily mean it should do so (refer to para 3.11). In interviews with a private bank, the RM shared that their clients preferred interpersonal communications — noticing that clients approach them with more bespoke requests. Overall, the role of human interaction could remain central, with AI technology augmenting the RM's role.



PERFECT MATCH

### RECOMMEND TO REMAIN IN HUMAN HANDS

Seek out new clients by networking.

Build trust in client relationships through an understanding of clients' broader wealth management needs and curation of the bank's offerings to address them.



Although AI-related technologies such as graph analytics may be able to augment this task, the main component of this task is developing and maintaining client trust — by forming good personal relationships. Networking is fundamentally about human connection, and web scraping is one of the many ways to identify new leads. One employee exhibited preference towards leveraging their network to get referrals — as this was a better base to build client relationships.

Building a client relationship and helping navigate an increasingly complex financial environment may often require strong trust between the client and RM. This is the core of the RM's role and cannot be completely automated.





### WHICH TASKS DID THE RM VALUE?

Seeking out new clients by networking.  
Developing and maintaining existing client relationships.

*“The most human part of this job is communicating with the client, spending time on building trust and building the relationship.”*

### How does the role change?

1. The core role of the RM is to build a deep and trusting relationship with the client on behalf of their bank, which requires human interaction. AI could enable RMs to focus more of their attention on building relationships with customers by automating the more process-related elements such as fulfilling compliance obligations.
2. AI may also help an RM proactively reach out to clients to manage emerging risks or suggest opportunities that are a good fit for the client's needs and objectives.

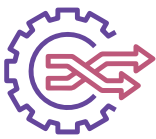
*The core role of the RM is to build a deep and trusting relationship with the client on behalf of their bank, which requires human interaction.*





# CHARTING CLEAR PATHWAYS BETWEEN JOBS

- 4.1 This section is intended to guide organisations in charting task pathways between jobs and identifying the tasks employees would need to learn to transition to other jobs.
- 4.2 The following steps explain how to do so while supporting the employee's confidence throughout the process:
  - a. Standardise definitions of tasks across jobs and competency or skill levels;
  - b. Use shared similar tasks to generate potential pathways to other jobs;
  - c. Identify the tasks that are not similar for training and skills development; and
  - d. Re-examine assumptions about jobs to begin changing mindsets.



## STANDARDISE DEFINITIONS OF TASKS ACROSS JOBS AND COMPETENCY OR SKILL LEVELS

- 4.3 In order to chart clear pathways, it is key for organisations to standardise how tasks are defined across jobs and skill and/or competency levels. This data must span different levels including, but not limited to:



- 4.4 If tasks are not standardised, it will pose some difficulties in determining which tasks are similar and shared, and/or critical to charting potential pathways (see next section). This step is crucial as it offers an advantage of powerful possibilities of using algorithms to rigorously and rapidly generate these pathways.
- 4.5 Not only must the task data be standardised across different levels, there is value for the databases containing this data to be linked and integrated with other sources of workforce, industry, and company data. The LKYCIC, for example, has put together a tasks-skills stack that references, aligns, and draws on data from Singapore’s national data sources, the United States O\*NET, and Singapore-based companies’ job descriptions (see Figure 2 below).

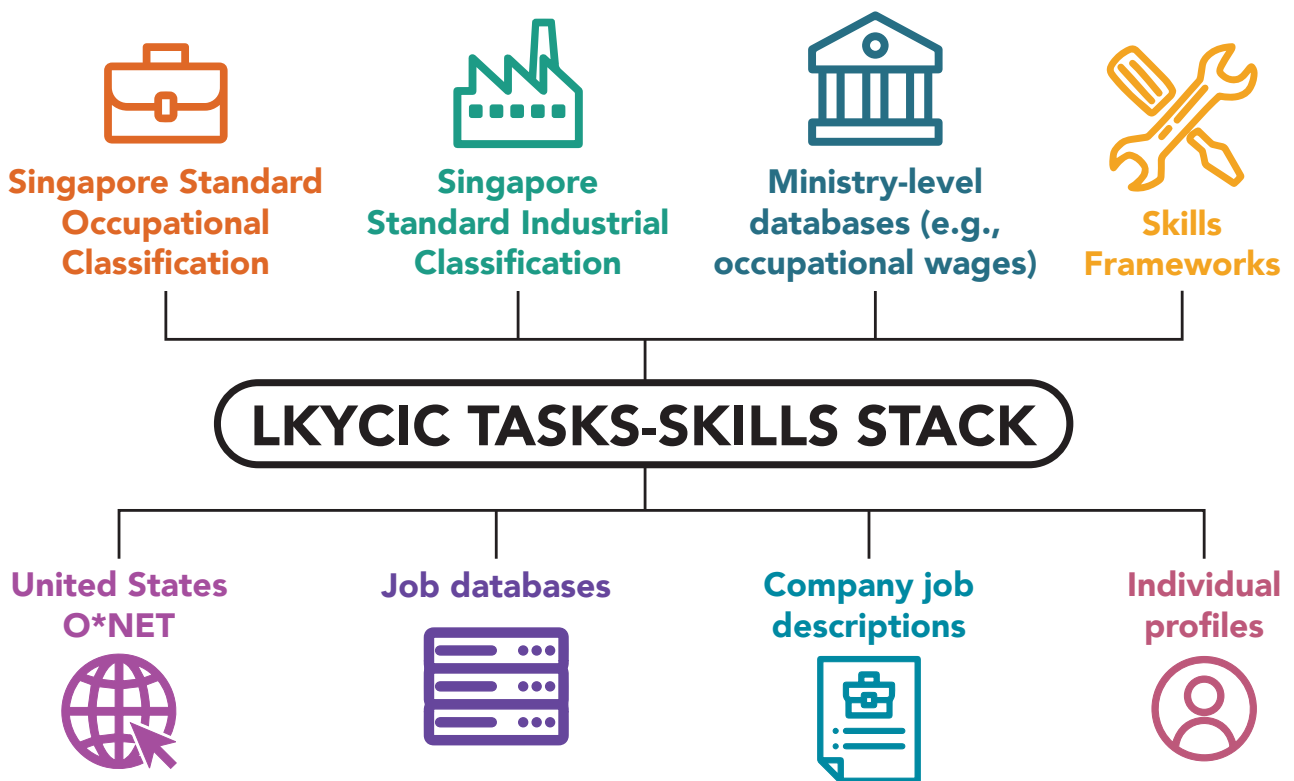


Figure 2: The databases and sources the LKYCIC Tasks-Skills Stack draws from. Source: LKYCIC



## USE SHARED SIMILAR TASKS TO GENERATE POTENTIAL PATHWAYS TO OTHER JOBS WITHIN AN ORGANISATION

- 4.6 Many jobs share similar tasks; this is especially so within the same profession or industry. By categorising specific tasks into more general task statements that can be applied across jobs and industries, the LKYCIC Tasks-Skills Stack enables organisations to use shared similar tasks to identify potential jobs for employees to transition into, within the organisation. However, it does not preclude job transitions across organisations or industries.
- 4.7 For example, the roles of finance professionals who buy and sell financial instruments include a strong emphasis on cognitive skills, including analysing business data, market and industry conditions, financial risks, as well as to process data in order to improve operations. These tasks are shared by risk management specialists, creating a potential pathway between these two jobs. Moreover, with the COVID-19 crisis, an additional pathway based on these similar tasks can be created for a role to analyse the risks beyond financial transactions, such as those in supply chains, business value chains, health and safety, and other aspects of a company's operations to mitigate crises. This is a risk management role that is likely to grow in importance in the coming years.
- 4.8 By expanding the options to include transitions outside of the profession and industry, employers have more room to manoeuvre when supporting their employees, with employees likely to be more hopeful in navigating an uncertain future. Companies are expected to be more socially responsible and supportive of employees in finding new opportunities that can build companies' reputations as employers — especially in the context of difficult economic circumstances (e.g., brought on by COVID-19). This could be an opportunity to build their brand by exercising their role as responsible stakeholders in society.
- 4.9 Organisations can also assess these new jobs by their risk profiles, for example, by assessing which tasks within these jobs are likely to be impacted, and when that will happen (similar to the approach in Chapter 3). They can then determine which pathways are most feasible and least risky for their employees.



## IDENTIFY THE TASKS THAT ARE NOT SIMILAR FOR TRAINING AND SKILLS DEVELOPMENT

- 4.10 Every job transition will include tasks that are unfamiliar to the employee. These form a clear set of tasks for organisations to focus on in their training. At the same time, organisations would need to identify the new skills required and where exactly these new skills would be applied. Using the example of a finance professional transitioning to become a risk management specialist, they would have to be trained on tasks such as developing risk-assessment models, devising scenario analyses for severe market events, and meeting with clients to answer their queries.



## RE-EXAMINE ASSUMPTIONS ABOUT JOBS TO BEGIN CHANGING MINDSETS

- 4.11 Even with the standardisation of tasks to allow for algorithmic generation of pathways, the job transformation process still requires human analysis and decision-making. After an algorithm has constructed the pathways, organisations may deem some of the proposed transitions unconventional and unexpected. In such situations, organisations are encouraged to use this opportunity to re-examine assumptions about different jobs. Through this process, organisations can better train and deploy their employees, and make better use of their employees' skills and talents.
- 4.12 In addition, this process creates opportunities for organisations to seed and spur additional transitions that could lead to emerging jobs in new industries. As these are still evolving and less well-defined, human creativity and insights are necessary to map the transitions to these emerging jobs. For example, the task of identifying underlying biases may exist in data sets or in algorithms, auditing algorithms for accuracy and objectivity, and achieving traceability and explainability of AI tools.

## SUADE LABS

### AN EXAMPLE OF A NEW JOB ROLE CREATED

Suade Labs is a RegTech firm that operates globally and is a World Economic Forum Technology Pioneer. Suade provides an AI-enabled solution that allows financial institutions to process large volumes of granular data and generate the required regulatory data, calculations, and reports with the necessary controls and governance.

Suade Labs appoints a Project Governance Lead when developing and deploying ML and AI tools. Due to the increase in development and deployment of ML and AI in its organisation, Suade Labs recognised the need for an individual responsible for project governance tasks. This is to ensure that AI and ML tools are deployed responsibly. Effective governance mechanisms need to be in place to achieve this. Suade Labs aligns itself to Singapore's Model AI Governance Framework (2<sup>nd</sup> edition) and the Project Governance Lead is responsible for assessing and achieving its continued alignment. The tasks of the Project Governance Lead's role include determining the appropriate level of human involvement in AI-augmented decision-making and overseeing data management to ensure accountability and traceability.

*Due to the increase in development and deployment of ML and AI in its organisation, Suade Labs recognised the need for an individual responsible for project governance tasks.*

## SUMMARY OF SECTION ON CHARTING CLEAR PATHWAYS BETWEEN JOBS



**Standardise definition**  
of tasks across jobs



**Job X**

**Job Y**

**Job Z**

**Task A**

**Task A**

**Task A**

Task B

Task B"

Task B"

Task C

Task D

Task E



Use shared similar tasks  
to **generate potential**  
**pathways** for jobs within  
the same organisation



**Job X**



**Job Y**

Identifying similar tasks or  
experiences that are valuable  
or relevant to a new job can  
make difficult transitions easier

**Job X**



**Job Z**



Identify the tasks that  
are not similar between  
jobs for **training and**  
**skills development**



Identify new  
skills for

**Job Y**

**Job Z**

Identify new  
tasks for training

Task B" Task D

Task B" Task E



Re-examine  
assumptions and  
**change mindsets**



- To better train and deploy employees
- To make better use of employees' skills and talents
- To seed and spur additional transitions that could lead to emerging jobs



## CASE STUDY: OTCI, UNIONS, LKYCIC

- 4.13 Driven by a shared conviction to guard against the risks of jobs polarisation, the LKYCIC collaborated with the Ong Teng Cheong Labour Leadership Institute (OTCi)<sup>14</sup> and union leaders to chart task transition pathways for workers who are likely to have their jobs transformed by AI or other Fourth Industrial Revolution technologies. While some analyses might tackle this question using skills or competencies, this case study sought to use similar tasks as a method of discovering possible transitions that might not have been considered. Tasks thus work hand-in-hand with skills and/or competencies, giving granularity to the skills and/or competencies required for a successful transition. For example, a bus driver's job has the potential to be disrupted by AI as autonomous vehicle technology matures. These technologies can augment or replace not only bus drivers' manual motor tasks, but also the cognitive skills of navigation, safety compliance, adjustment of routes, and interaction with consumers.<sup>15</sup>
- 4.14 Using its task database (the predecessor of the current Tasks-Skills Stack), the LKYCIC applied AI-driven algorithms to find potential jobs for those workers based on the shared similar tasks between the current and the potential jobs. Figure 3 below shows the array of starting jobs (on the left side) and the transition options generated (on the right side), with the similar tasks in the middle. These options include roles within and outside the starting sector — by using tasks as a basis, possibilities can be expanded for workers.

*Tasks thus work hand-in-hand with skills and/or competencies, giving granularity to the skills and/or competencies required for a successful transition.*

<sup>14</sup> The OTCi's vision is to be "the principal leadership development institution of Singapore's Labour Movement, equipping our leaders with strong values, knowledge and competence to serve and improve the lives of working people in Singapore with commitment and effectiveness".

<sup>15</sup> The cognitive requirements of transportation can be seen through studies that have demonstrated the impact of GPS navigation technologies on taxi drivers' cognitive capacity. [See: Balasubramanian, G., Lee, H., Poon, K. W., Lim, W. K., & Yong, W. K. (2017, July). Towards establishing design principles for balancing usability and maintaining cognitive abilities. In International Conference of Design, User Experience, and Usability (pp. 3-18). Springer, Cham.]



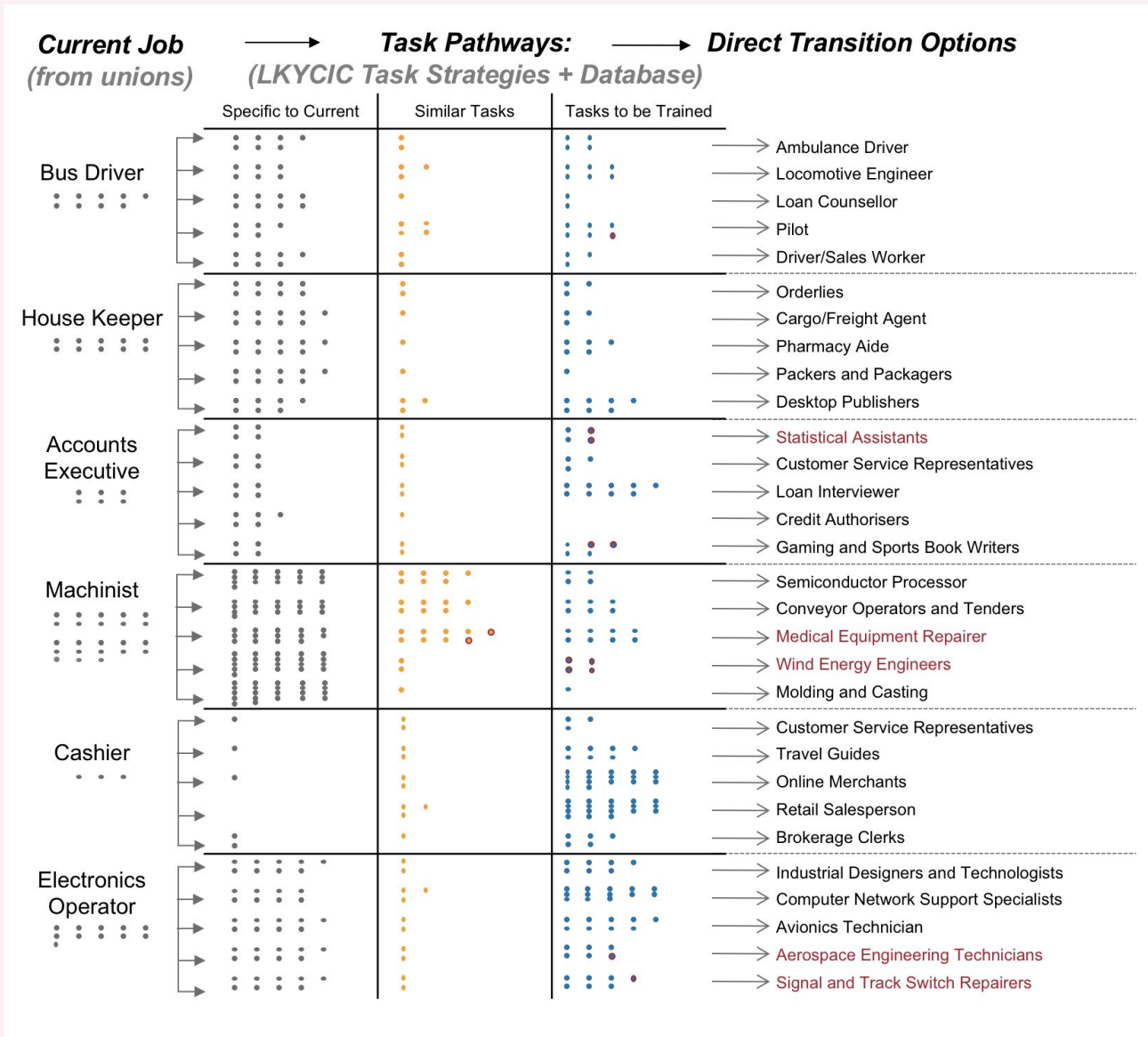


Figure 3: Using the task approach to expand options for workers. Source: LKYCIC

4.15 When reviewing these transitions, union leaders suggested that the granularity of this approach could also have a deeper positive effect — lowering workers’ fears of change. By providing a task-by-task breakdown of a potential transition, workers are able to understand how much of their past experience they can draw on, how much they will need to pick up, and the incremental steps they can take.

- 4.16 Union leaders also suggested that the task transition pathways had the potential to change mindsets. As Figure 3 shows, the task-based, algorithmic approach can lead to surprising and unconventional options that initially might not seem reasonable — such as transitioning a bus driver to become a pilot. But as one union leader pointed out, this presents a concrete opportunity to create a mindset change. He suggested asking the bus driver, or their managers, to first consider which of the pilot’s tasks the bus driver is able to perform without revealing to them that these are the tasks of a pilot. If they have a positive response to performing those tasks, a “big reveal” that the tasks are those of a pilot could engender a mindset change about what is possible, expanding both the workers’ and managers’ sense of the available opportunities.
- 4.17 Furthermore, it is possible to generate transitions to jobs not even in the current database. With regard to the bus driver example, it is well-known that bus drivers have expertise in safety, navigation, road and vehicle-related regulatory tasks, especially in the urban setting. Additionally, organisations could apply the contextual knowledge that drones will likely be increasingly deployed in urban settings, but are currently held back by urban safety concerns. There is the possibility of mapping a transition from bus driver to urban drone pilot due to the bus driver’s daily tasks including safe urban navigation.<sup>16</sup>

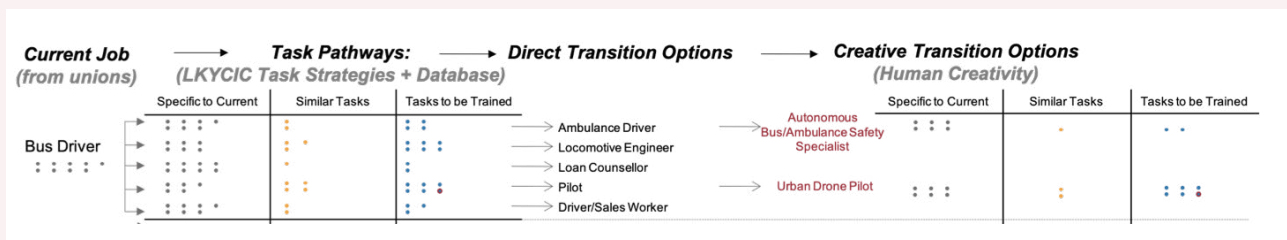


Figure 4: Transition from bus driver to urban drone pilot. Source: LKYCIC

It is thus possible to chart pathways to new jobs in new growth areas.

- 4.18 Aligned with research evidence, beginning from similar tasks, even if only a handful, is a powerful learning strategy. In adult learning, or “andragogy”, it is recognised that the greatest resource adult learners have is their past experiences. In contrast to how a young student may learn, mid-career workers learning on the job have a “living textbook” of experiences to draw from.<sup>17</sup> By identifying similar tasks or experiences that may be particularly valuable or relevant to a new position, difficult transitions can be made easier.

<sup>16</sup> This was initially an illustrative example on how tasks can be used to change mindsets in concrete ways, but the research team has encountered an individual who successfully moved from being a private driver to becoming a pilot! This reinforces the breadth of possibilities available that we may not initially consider.

<sup>17</sup> These observations on adult learning come from Merriam, S. B., & Bierema, L. L. (2013). *Adult learning: Linking theory and practice*. John Wiley & Sons.



# CLEARING BARRIERS TO DIGITAL TRANSFORMATION

- 5.1 This section is intended to guide organisations in pinpointing and clearing barriers to transformation that they may encounter, to ensure a successful digital transformation. Besides transforming jobs through clear roadmaps and charting clear pathways between jobs, organisations can also use tasks to identify specific barriers and clear them effectively to support their employees during transformation.
- 5.2 The barriers to transformation span across the technical to the human, with the ability to occur concurrently in varying degrees along the dimensions of organisation, occupation, technology, and phase of transformation (e.g., lack of skills, lack of resources to manage the transformation, and employees' resistance to change). The challenge for organisations is to pinpoint which dimensions are most pertinent and the extent to which the barriers occur.
- 5.3 Organisations may encounter challenges when training employees for new tasks. From the management and HR professional's perspective, they would need to carry out job redesign and put in place training, without disrupting existing business flow. Additionally, they would need to consider whether the trainings are targeted enough to truly impart new skills and abilities for new tasks. Employees, on the other hand, may have varying levels of capacity for new training, while Professionals, Managers, Executives, and Technicians (PMETs) may have little time for training due to tight schedules. Acknowledging these potential barriers would allow organisations to establish appropriate plans such as:

- a. Creating a dedicated team of innovation champions to identify pain points and opportunities (e.g., standardise work processes and suggest new ways of working). Organisations can also leverage existing infrastructure to drive digital transformation;
- b. Phasing out implementation and providing training in small batches to ensure business is as usual;
- c. Providing relevant training and learning for the precise task(s); and
- d. Ensuring that the training would be clearly applicable and available in an accessible form.

- 5.4 While automation has mainly affected blue-collar jobs, AI technologies will increasingly and extensively be used for cognitive work and are poised to impact white-collar jobs such as professional services. Such occupations have never been impacted significantly by the previous generations of technologies, as compared to blue-collar jobs. As employees are not always aware of the AI technologies available to augment their work, they may perceive that a task cannot be automated. Thus, it is important to create and raise awareness of the latest AI technologies and start educating employees on the opportunities and benefits, should their job roles be enhanced. It is also pertinent to prepare them to learn new skills that can facilitate the use of AI technologies at work. While the organisation can do its part, employees can take ownership of their learning and development to better harness the benefits of AI, and enable them to remain relevant as AI technologies continue to develop.
- 5.5 The benefits of educating employees and clearing barriers to transformation are two-fold: Firstly, employees who understand the objective will more likely commit to the transformation journey. Secondly, organisations and their stakeholders, such as unions, can take more targeted steps in clearing the barriers and further strengthening the commitment of the employees.
- 5.6 As part of ensuring and maintaining a successful transformation, organisations would need to consider outcomes for the employees after training and job redesign. Some employees might have the perception that job redesign equates to more work. Besides addressing what needs to be transformed and the reasons for job redesign, it is useful for organisations to think about paying their employees fairly, pegged to market rate, for the new and enhanced job role. At the same time, organisations would need to think ahead about the downstream effects, such as employees' productivity, and review employee performance metrics as well. In this way, it could also spur organisations to redesign the job in a way that aligns with their own transformation agenda and productivity initiatives.

*It is important to create and raise awareness of the latest AI technologies and start educating employees on the opportunities and benefits, should their job roles be enhanced.*



## CASE STUDIES: DAIRY FARM, GOOGLE, GRAB & MICROSOFT, NORTON ROSE FULBRIGHT AND HEALTHCARE<sup>18</sup>

- 5.7 There are multiple ways for organisations to clear barriers to transformation, redesign jobs, and empower employees. The five case studies below show some of these ways.

### CASE STUDY 1: DAIRY FARM

Dairy Farm Singapore is collaborating with the Food, Drinks and Allied Workers Union (FDAWU) and the LKYCIC to plan job transformation and provide training for more than 5,000 workers. The multi-stakeholder collaboration will use tasks to analyse the changes in various jobs, the training required, and the potential barriers. As the goal is to develop confidence and commitment in workers, **multi-stage pathways will be created to show the possibility of further transitions.**

These multi-stage pathways offer a view of the medium- to long-term transformation plans, making them relatable to the employees. It also shows them that they too have a stake in the future of the company.

### CASE STUDY 2: GOOGLE

Google is a multinational technology company with a mission to organise the world's information and make it universally accessible and useful. It aims to bring the benefits of AI to everyone, including its employees and the general public. In particular, Google uses ML widely and believes that advancements in ML technologies are likely to augment its employees, enable them to accomplish more, and produce value across the organisation.

*Advancements in ML technologies are likely to augment its employees, enable them to accomplish more, and produce value across the organisation.*

<sup>18</sup> These case studies describe projects that are currently in progress within each of these organisations.

Over the past several years, Google has worked to become an AI-first company and realise the benefits of AI across all its products. To encourage increased application of ML in products and systems, and establish a strong long-term ML culture within Google engineering, Google made a scaled effort to launch versatile ML education programmes. As Google also recognised the need to provide a holistic education experience for Googlers, external developers, and customers, Google has created educational materials on ML which include:

- a. A 6-month immersive programme for Google engineers to work in Google's Research Organisation. This enabled the engineers to gain first-hand experience in developing and launching ML systems within Google, which they could bring back to their product teams. Besides raising awareness on the latest AI/ML technologies, these training programmes enabled Googlers to pick up new skills that facilitate the use of AI at work, and helped them be redeployed within Google. Many Googlers who participated in this programme went on to find new enhanced roles in Google Research, moving on to contribute to foundational AI research.
- b. AI Principles Issue Spotting, which is a self-study course available to all its employees, covers the intent behind Google's AI Principles and examples of them in practice. Designed for technical and non-technical users, the training includes **guidance on how to spot and refer AI Principles concerns to the proper teams and processes within Google.**
- c. Technology Ethics Training, which is designed to help Googlers understand and practise ethical thinking in their project work at Google. Available to all employees, this self-study course **coaches employees on asking critical questions to spot potential ethical issues**, such as whether an AI application might lead to economic or educational exclusion, or cause physical, psychological, social or environmental harm.
- d. ML Crash Course, which is an online course that features a series of lessons with video lectures, real-world case studies, and hands-on practice exercises. Google invested technical resources to create interactive environments that enable users to run ML models and alter certain parameters. After making this course publicly available, millions of people outside Google, including 65,000 users from Singapore, have taken it.
- e. People + AI Guidebook, which aims to help UX designers and product managers bring a human-centred approach to AI product teams. It includes examples, exercises, worksheets, and resources to help turn guidance into action.

As advocated in Singapore's Model AI Governance Framework and this Guide, Google believes that staff training on AI and its ethical deployment is crucial in creating a culture that can consider ethical issues as its employees conduct research and use AI to build helpful products for everyone.

### CASE STUDY 3: **GRAB & MICROSOFT**

Sharing a vision to empower every worker for the digital economy, Grab and Microsoft will create a Skills for Employment pilot programme for approximately 100 driver-partners to pursue tech-enabled roles. Collaborating with Generation: You Employed (Generation), a global organisation that seeks to bridge skills gaps through “train and place” programmes, Ngee Ann Polytechnic, Temasek Polytechnic, and SkillsFuture Singapore, they will bring driver-partners, including mid-careers with varying industry backgrounds, through a practicum-based curriculum designed to **address employers’ biggest skills needs for a specific job role** (both technical and “soft” skills). The tasks from the LKYCIC will be used to inform the screening of driver-partners applying to the programme. Learners can also work on an industry project and be matched with employers to interview for specific tech-enabled roles such as digital marketer and back-end software developer across Grab, Microsoft, and Generation’s ecosystem of partners.

This approach seeks to clear several barriers for the driver-partners. For example, the employer-centric approach to curriculum development focuses on **preparing learners to perform the most critical tasks needed on the job**, which aims to give employers confidence in the graduates’ abilities despite the relatively short training duration (3 to 6 months). In addition, bias towards older job applicants exists among many employers, which requires targeted placement support to be an integrated part of the training programme. The joint effort illustrates the need for a collaborative approach among public, private, and not-for-profit organisations to clear these barriers to transformation.



#### CASE STUDY 4: **NORTON ROSE FULBRIGHT**

Norton Rose Fulbright (**NRF**) is a global law firm with over 4,000 lawyers and legal staff providing full business law services.

##### **Barriers to Adopting AI in the Legal Sector**

Legal advice is, by its nature, novel, and the expertise of a lawyer lies in applying legal knowledge and experience to the unique set of facts for any given matter. As a lawyer needs to provide bespoke legal advice and effectively advocate on behalf of the client, this intrinsic variability could be seen as a barrier to adopting AI.

There may also be the misperception that AI could replace, rather than augment, the role of a human legal adviser, which could raise ethical concerns. On the contrary, the experience and knowledge of highly skilled lawyers could help their organisations and clients identify specific operational pain points that may benefit from the standardisation of legal-related tasks through AI — thereby reducing time and cost, and increasing profitability.

##### **Identifying Opportunities for Firm and Employees**

As a law firm, NRF recognises the importance of changing mindsets to effectively adopt AI. NRF established a new group, NRF Transform, to identify new opportunities, challenge its lawyers to rethink the delivery of legal services, and facilitate the adoption of AI technologies.

Working alongside legal subject matter experts, this new department focused on identifying specific operational pain points that could be improved with AI technologies. Design workshops and process re-engineering laid the groundwork for common tasks to be standardised and dealt with through the use of technology. NRF also mapped out each stage of the end-to-end process and identified appropriate workflow efficiencies, by having the right people and technologies doing the right tasks, at the right time and in the right location for the lowest possible cost. In this regard, NRF Transform has **created new opportunities for employees to upskill, redeploy their skillsets appropriately, and redesign work**, such as process engineers, legal designers and technologists.

*The experience and knowledge of highly skilled lawyers could help their organisations and clients identify specific operational pain points that may benefit from the standardisation of legal-related tasks through AI.*

### **Changing Mindsets and Breaking Barriers**

To facilitate understanding and drive adoption of these approaches at a faster pace at its various offices, NRF created a Transform Ambassador Programme. Under this programme, Transform Ambassadors, including lawyers from various practice groups and business service professionals, received in-depth training at a Transform Academy in the U.K. The training helped them:

- a. Better understand the technology tools available, including AI tools;
- b. Rethink and redesign legal services to make them more streamlined and efficient; and
- c. Learn a framework for proposing new ideas to address clients' business problems.

After this training, the Transform Ambassadors served as on-the-ground advocates for using technology and finding new ways to deliver legal services such as leveraging AI to augment lawyers at work.

### **Using AI Chatbots to Augment Lawyers at Work by Optimising Time**

NRF has created a number of chatbots that utilise AI to sieve through the data and address queries. This gives NRF's lawyers and their clients direct access to answers to the more routine and straightforward questions, and automates internal compliance processes such as routine approvals for certain activities (e.g., obtaining approvals for gifts and hospitality). These chatbots have the capacity to streamline and improve internal processes. Besides effectively triaging the questions and issues and freeing up the human adviser to discuss the further details or unique circumstances for which the chatbot is unable to address, the AI chatbot also provides a reliable means of tracking and ensuring compliance with internal processes.

### **Using AI to Expedite Contract Review**

To deal with regulatory changes, companies would typically have to review and amend a huge volume of documentation across multiple jurisdictions, and undertake a remediation and repapering exercise in order to comply with new regulatory requirements. The sheer volume of documentation and firm deadlines means AI could be usefully deployed to expedite the early stages of the process to identify, triage and sort the documents, and to then implement certain automated and standard amendments to the documentation. This allows the lawyers to deal with the more complex and non-standard clauses and amendments, which are necessarily human-centric as they would usually require specific review and input from the clients.

For example, NRF is assisting its clients with the review and amendment of contracts as a result of Interbank Offer Rates cessation, by using AI to accurately extract the relevant data points that will be impacted by the relevant changes across multiple jurisdictions. Such data is then categorised accordingly and logged in a repository to facilitate and expedite the human reviewer's manual review of the contract, escalating it further where necessary. This allows NRF to determine the most appropriate tools and optimal blend of both technology and human expertise. The use of AI places NRF in the unique position of being able to offer more than a traditional legal perspective, thereby creating greater demand for its services and more opportunities for its employees.

Beyond providing legal services, driving change and deploying AI solutions to augment its staff's cognitive capacity help NRF to better position itself as an innovative and responsible law firm in today's digital economy.

#### CASE STUDY 5: **HEALTHCARE**<sup>19</sup>

Healthcare facilities have begun tapping into AI technologies that can improve their service, such as AI-powered chatbots for patients or staff as well as "command, control, and communications" systems that can optimise patient flow. These innovations are able to relieve communication and coordination tasks that may have previously been handled by frontline employees, such as Patient Service Associates (PSAs).

With technology and other factors posing job changes, one of Singapore's hospitals **offered their PSAs the opportunity to transform their roles from manual and clerical tasks to new job tasks**. Workshops and meetings were convened at multiple levels to allow PSAs to identify the new tasks they would like to be trained in. The PSAs largely chose human-centred and higher value-added tasks, such as drawing blood and providing assistance to elderly patients. After training in these tasks, the PSAs were deployed in their new and augmented roles.

The hospital's management supported the PSAs throughout the entire transformation process of engagement, feedback, training, and implementation. By taking on these new tasks, the PSAs found new career options and also freed up time for nurses who might have previously been responsible for these tasks.

<sup>19</sup> For further discussion of this case study, see: Goh, Z. A. G. (2019). Can the future of workers be better in the age of AI? Live with AI Industry White Paper 2019.

## SUMMARY OF SECTION ON CLEARING BARRIERS TO DIGITAL TRANSFORMATION



### CONSIDERATIONS

- Lack of awareness of how AI technologies can augment work



### POTENTIAL SOLUTIONS

- Raise awareness of the latest AI technologies
- Educate employees on opportunities and benefits of enhanced job roles
- Provide training and encourage employees to take ownership of their learning and development

- Resistance to change



- Create a dedicated team or nominate innovation champions to identify pain points and opportunities

- Potential for job redesign and training to disrupt existing business flow



- Phase implementations
- Ensure business as usual with small batch trainings

- Trainings not targeted to impart new skills and abilities for new tasks
- Varying capacity levels for training
- Little time / tight schedules



- Provide relevant training and learning for the precise task(s)
- Ensure training is applicable and available in an accessible form

- Lack of resources to manage transformation



- Leverage existing infrastructure to drive digital transformation

- Uncertainty of outcomes for employees after training and job redesign
- Perception that job redesign equates to more work



- Share reasons for job redesign and what needs to be transformed
- Review remuneration and employee performance metrics for new and enhanced roles



# ENABLING EFFECTIVE COMMUNICATION BETWEEN EMPLOYERS AND EMPLOYEES

- 6.1 This section is intended to guide organisations to take appropriate steps to build trust and communicate effectively with their employees about job redesign and how AI can augment their capabilities.
- 6.2 It is important to have clear communication between employees and employers about the future of work, due to the public anxiety that AI may make jobs obsolete. Communicating through the use of tasks avoids the alarmist rhetoric of one's entire job "disappearing" altogether, as well as the utopic language of entire jobs or industries being perfectly "safe". Organisations should focus on communicating which parts of the job will be automated, augmented, or will remain in human hands. This will allow employees to have a clear understanding of which existing tasks will require them to pick up new skills for, new tasks that they will have to learn to do, and where exactly these skills will be applied.
- 6.3 With that, employers and employees can build a shared understanding of the "whys," "whats," and "hows" of investing in AI, as well as be able to "co-own" the transformation, and be committed to "co-create" the future right from the start, paving the way for greater success.



## COMMUNICATING "WHY" WE NEED TO TRANSFORM

- 6.4 Co-creating the future together from the outset also ensures that the transformation or job redesign, and the corresponding communication, will not come as a surprise to the employees. Organisations may use the transformation roadmaps for tasks (Section 3) and transition pathways for jobs (Section 4) for this purpose. In doing so, employers can also understand their employees' experiences at work, manage their employees' expectations of the transformation (e.g., the impact on their productivity and engagement levels), and reinforce the rationale of the transformation for the organisation (e.g., the vision and mission) as well as the importance of job redesign for the employee. Communicating the rationale at the task level gives both the employer and employee a shared and concrete understanding of the transformation.
- 6.5 In addition, organisations are encouraged to clearly communicate how job redesign or transformation would benefit employees in their work. For example, explaining how the job redesign may help their employees to spend more time on tasks they value, and how it can promote growth in the longer term. Through this, organisations can build commitment and empowerment in their workplaces.

- 6.6 Employers could seek to understand which tasks are energising or exhausting for their employees. Early research from the field of occupational psychology shows that workers desire to incorporate energising tasks (i.e., tasks that they enjoy doing) in their redesigned job role while reducing exhausting tasks.<sup>20</sup> Clearly communicating how workers would be able to spend less time on exhausting tasks, such as repetitive or tedious ones, after job redesign can motivate them to participate in the company's transformation.
- 6.7 In addition, employers can highlight any opportunities for employees to learn and develop new skills through the transformation of their role. By understanding how the new skill learnt can be applied to specific new tasks, particularly tasks that energise them, employees will be more motivated to go for training. As employees tackle new tasks, the associated skills may also be transferable to future opportunities.
- 6.8 Beyond consulting managers and employees on the tasks that are valuable to them at the outset (see paragraphs 3.17 to 3.19), continuous dialogue and feedback should also be a priority. Besides regular communication at each step of the transformation process, organisations can consider implementing an avenue for feedback or dialogue to address underlying tensions, which could facilitate a more successful job redesign for employees.
- 6.9 Organisations should also take note of new-found opportunities to increase the odds of success for the transformation. Employee-employer engagement about how tasks would be expected to change for a particular role may reveal surprising gaps between senior management's and employees' understanding of how those tasks are currently performed and how they would change. Facilitating conversations between senior management and employees can in turn improve alignment between employers and employees in the direction of organisational transformation.

*By understanding how the new skill learnt can be applied to specific new tasks, particularly tasks that energise them, employees will be more motivated to go for training.*

<sup>20</sup> For example, the LKYCIC is adapting existing and established occupational psychology frameworks for application at the task level.



## CASE STUDY: ENSURING ALIGNMENT AROUND A REALISTIC UNDERSTANDING OF CURRENT TASKS

Researchers at the LKYCIC conducted observations of the daily routines of professionals, noting the impact of AI and other new technologies. They discovered that managers and colleagues in other departments commonly have an incomplete and often overly simplified perception of a professional's work (see Figure 5 below, left). The professional's work is usually more multifaceted, with many explicit and subtle interactions forming a network (see Figure 5 below, right).

Closing the gap between the two visions improves understanding and alignment, in turn forming a firm basis on which subsequent decisions can be made. It is clear that implementing a new AI solution based on a perception like the one on the left would be unproductive, or even counter-productive, for any organisation.

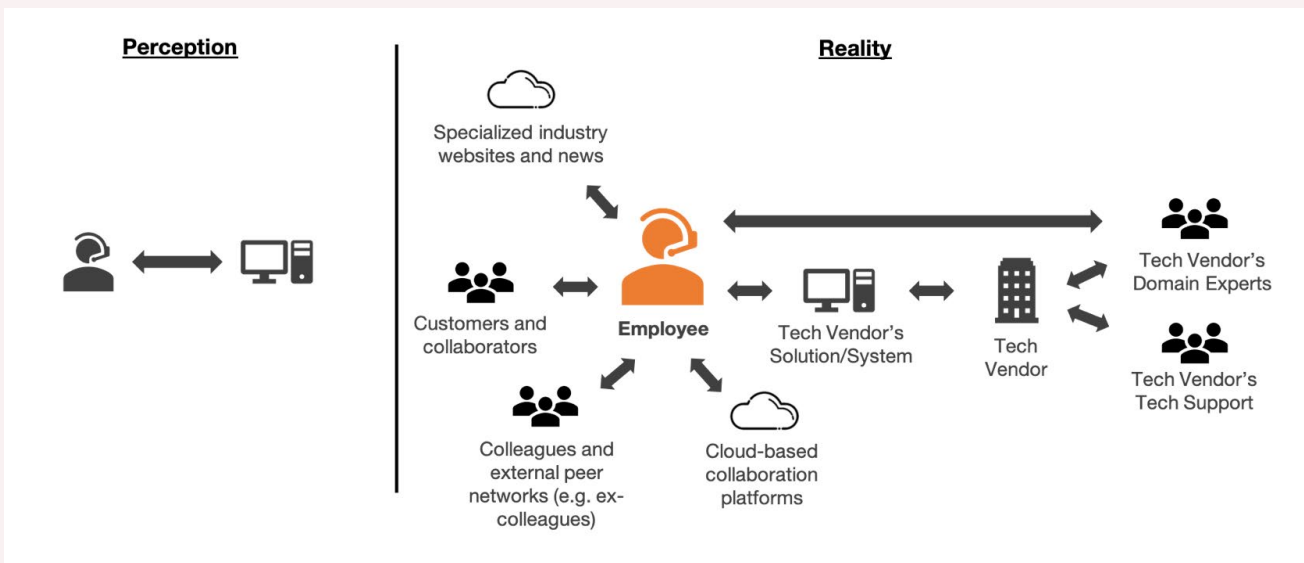


Figure 5: Gap between perception and reality of how an employee's role is performed. This diagram is a composite of examples from across the LKYCIC's research. Source: LKYCIC





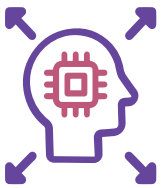
## COMMUNICATING “WHAT” NEEDS TO TRANSFORM

- 6.10 It is important to explain to employees the AI solution to be implemented. This could include explaining how the AI functions and arrives at a certain prediction, whether the use of the AI solution is consistent with the organisation’s core values and/or societal expectations as well as the internal governance structures and measures to oversee the ethical deployment of AI. If the AI solution was procured from a third-party AI solution provider, the organisation can consider requesting assistance from the AI solution provider to explain how the solution functions, its limits, and potential risks.
- 6.11 Having a clear understanding of the current and future tasks, and how a new AI solution will fit these tasks could improve employees’ willingness to adopt and adapt to new technology. Employers would also find it easier to explain the investment in a particular AI solution to their employees. They can better articulate the value to the organisation, the value to the employee’s particular role, and the way in which specific tasks will change or stay the same. More specifically, employers can take the opportunity to define clear roles and responsibilities for their employees, as well as share about the risk management and internal controls to address the risks involved when using the AI solution in order to use it more responsibly.
- 6.12 Additionally, when the entire change process is broken down into proper implementation phases and plans, prioritising changes and the sequence in which they will unfold would become clear. This would make it easier for employers and employees to discuss expectations, needs, resources, timelines, and priorities. Both the senior management and employees can better align how they work with each other, with a clear understanding of what each party needs to do differently at each step of the transformation. This facilitates a shared discussion and decision-making between employers and employees, and improves transparency.



## CASE STUDY: CONSIDER EXPLICIT AND SUBTLE CHANGES IN CURRENT AND FUTURE TASKS

Research at the LKYCIC has found that when an algorithmic system automates one or more tasks of an employee's job, the employee's work often increases in complexity — new tasks are added, and/or the focus of the job shifts to different tasks. In addition, because the job has been augmented by an automated system, the scope of work expands along with the number of actors involved.<sup>21</sup> A task analysis comparing current and future tasks can help to uncover and understand the explicit and subtle ways the job is shifting, changing, and growing.



## COMMUNICATING "HOW" TRANSFORMATION WILL HAPPEN

- 6.13 Employees' existing attitudes towards technology provide a good indication of their readiness to adopt new technologies.<sup>22</sup> It is important for organisations to understand and track these attitudes to question their existing assumptions about employees and better tailor the support they provide.
- 6.14 Employers should be careful not to perceive their employees as being simply optimistic or fearful about technology — most workers hold a mixture of both attitudes. As shown in Figure 6 below, fear and optimism are not mutually exclusive. These attitudes may come from different causes — for example, employees can be optimistic about how a new technology will increase the quality of their work, while simultaneously being fearful of how it may change their established work practices.<sup>23</sup>

<sup>21</sup> Findings from research conducted for a Government-Linked Company and work with Live with AI.

<sup>22</sup> For further discussion, see: Poon, K.W., Chng, S., Haridas, G., Willems, T., Bin Norhashim, n. H., Subhan, M. S., Gan, L. H. S., Goh, Z. A. G., Apsley, H. L. & Vinod, R. (2018). Polarizing of Job Opportunities: Charting New Pathways and Adopting New Technologies. Ong Teng Cheong Labour Leadership Institute (OTCi)/National Trade Union Congress (NTUS) Labour Research Conference.

<sup>23</sup> This is consistent with other psychological research on attitudes, as cited in OTCi and SUTD 2018 (ibid).

HIGH FEAR	1.6%	6%	32.1%
NEUTRAL FEAR	0.9%	8.5%	15.8%
LOW FEAR	1.4%	5.6%	28.2%
	LOW OPTIMISM	NEUTRAL OPTIMISM	HIGH OPTIMISM

Figure 6: Surveyed workers' attitudes of optimism and fear.  
Source: OTCi and LKYCIC

- 6.15 Thus, it is important to have an accurate view of these attitudes to enable the right communication, training, and transformation strategies to be crafted. For example, from Figure 6 above, the focus for the segment of 32% employees with “high optimism” and “high fear” might be very different from the 28% with “high optimism” and “low fear.” Organisations are encouraged to understand why employees with a high level of optimism have this attitude, and craft their actions accordingly. For employees with high levels of fear, organisations are recommended to engage with them to identify and address their particular fears.
- 6.16 An accurate view of attitudes can enable organisations to question unhelpful stereotypes. For example, many assume that older workers are less optimistic about new technologies. However, surveys conducted by the LKYCIC found no differences in optimism across age groups. This is corroborated by anecdotal evidence from union leaders and the LKYCIC’s fieldwork in various projects.<sup>24</sup> With an accurate view, more suitable and targeted solutions can be implemented.
- 6.17 Aside from the benefits of developing an accurate view, organisations could consider tracking the entire process of transformation — before, during, and after — to evaluate the effects of training on their employees’ attitudes towards adopting AI. This creates the opportunity for employers to provide tailored support to employees at the right time, and improves employee engagement within the organisation.

<sup>24</sup> Ibid.

- 6.18 Besides providing training opportunities to equip employees to transition into the new job role successfully, organisations are encouraged to share with their employees a holistic understanding of the AI used in the new role. For example, a customer relationship officer who may have to answer customer queries about an AI system, or a salesperson using an AI-enabled product to make a recommendation, should also be aware of and sensitive to the benefits, risks, and limitations of using AI. They would also need to be able to identify these risks and report potential ethical concerns to the relevant subject-matter experts within their organisations.
- 6.19 After the AI solution is implemented, certain tasks of a job role, which used to be performed by humans and formed part of the employee's on-the-job training, would have to be replaced with AI. For example, a new lawyer may spend the initial years of his career working on the task of drafting simpler contracts as part of his training to gain professional experience on contract drafting. However, if the contract drafting task for basic contracts is replaced with AI, the new lawyer, who does not have prior experience in drafting contracts, may be put in a situation where he may not have developed sufficient understanding of basic contract drafting to develop more complex contracts in future. Hence, organisations would need to explore other ways of training the employees for them to perform effectively with the assistance of AI.
- 6.20 In addition to empowering employees, organisations could consider empowering their managers to lead through the transformation. By equipping them with the information and resources to manage the job redesign, managers would be able to better support their teams and manage the change (e.g., employees' resistance to change). As part of embedding job redesign and upskilling within the organisation as well as creating a desire for employees to embark on the journey, organisations can consider featuring success stories and having change champions as alternate channels for communication.
- 6.21 Lastly, it would be useful for organisations to regularly conduct reviews around changing experiences after the job has been redesigned. As part of continuous dialogue and feedback, the discussion could cover two aspects: employee experience (e.g., increase in productivity and whether the job continues to be valuable and meaningful) and customer experience (e.g., increase in satisfaction levels). This could help to validate whether the organisation has successfully adopted a human-centric approach. Depending on the post-hoc assessment, organisations might have to review their objective of implementing the AI solution and fine-tune their process (e.g., refinement of AI models and review the level of human involvement in the AI-augmented decision-making process).

## SUMMARY OF SECTION ON ENABLING EFFECTIVE COMMUNICATION BETWEEN EMPLOYER AND EMPLOYEE



### Communicating with key stakeholders on job redesign



#### BEFORE

- Engage relevant experts to assess the potential impact of AI on tasks and job redesign
- Consult the line division managers and employees on which tasks are valuable to them



#### DURING

- Work with HR and line division managers to identify tasks that are not similar for training and skills development for the employee
- Collaborate with unions to chart new career pathways for employees and minimise displacement where possible
- Communicate to employees "why", "what" and "how" the job redesign will occur



#### AFTER

- Ensure continuous dialogue and feedback between senior management, HR, line division managers and employees



## CONCLUSION

- 7.1 Similar to any big digital transformation and process redesign efforts, redesigning work in the age of AI could be a resource-intensive effort as it may require a dedicated team to break down jobs into tasks and consider change management issues such as incentives. Thus, organisations need to be clear on the objectives and benefits of adopting AI responsibly and job redesign. Otherwise, efforts to disrupt and redesign business operations might appear impractical.
- 7.2 **We need to be prepared for the future of work.** Work plays an important role in people's lives — not only in the provision of income, but also to their identity and self-esteem, and offers a sense of contribution to society. The future of work is an issue that has to be tackled with care — social-political trends of the past decade are an indicator of the possible mishaps when there are significant gaps in people's ability to find satisfying, decent work in the midst of technological change.
- 7.3 Tasks can help us to tackle this challenge, with organisations creating high resolution roadmaps and pathways that align employees' and employers' visions for the future, while providing clarity and certainty in the transition. When applied in different combinations, these tools can help organisations and institutions clear the barriers they encounter, and devise solutions that employees will thrive in.



## ANNEX A | COMPLEMENTARY RESOURCES

### JOB REDESIGN AND FUNDING SUPPORT

#### General Job Redesign Initiatives to Spur Workforce Transformation

Workforce Singapore (WSG) has put in place sector-specific initiatives to spur workforce transformation (e.g., job redesign for the retail, food, and construction sectors).

#### WSG's Enterprise Portal on Jobs and Skills

Workforce Singapore provides job redesign toolkits and funding support for enterprises to work with pre-approved consultants to spur business transformation through redesigning work processes and making jobs more productive and attractive for employees.

#### Support for Job Redesign under Productivity Solutions Grant (PSG-JR)

#### WSG's Design Thinking Business Transformation Programme

The Design Thinking Business Transformation Programme equips enterprises with capabilities in business and process innovation, and job redesign to align the workforce to enterprise transformation. The programme is available at Singapore National Employers Federation, Singapore Furniture Industries Council and Nanyang Polytechnic.

#### Creating an Age-Friendly Workplace (Employers)

Tripartite Alliance for Fair & Progressive Employment Practices (TAFEP) provides guidance on how to create an age-friendly workplace that hires, manages, and engages employees meaningfully, including redesigning jobs.

#### Industry 4.0 Human Capital Initiative

Led by Singapore Business Federation, this is a programme dedicated to equipping companies with people management and job redesign skills required for successful Industry 4.0 transformation.

#### Legal Industry Technology & Innovation Roadmap Report

The Technology & Innovation Roadmap is a national plan by the Ministry of Law to promote innovation, technology adoption, and development in Singapore's legal industry up to 2030.

### AI TRAINING PROGRAMMES

#### Training for Employees

Employers can tap on Workforce Singapore's Professional Conversion Programmes (PCP) to hire new employees or reskill existing staff through structured and on-the-job training.

#### AI Training Programmes

AI Singapore's talent development programme helps students and PMETs to gain literacy in AI and for those interested, to progressively develop their skills and competencies to become certified AI Engineers.

#### Technology in Finance Immersion Programme

The Institute of Banking and Finance and Workforce Singapore, in consultation with the Monetary Authority of Singapore and the Info-communications Media Development Authority of Singapore, has developed an Attach-and-Train programme to help mid-career individuals embark on a new career in key technology areas such as Artificial Intelligence, Cloud Computing and Cybersecurity, Data Analytics and Full Stack Development through structured training and attachments with financial institutions.

## ANNEX B | THE ROLE OF “TASKS” IN FUTURE OF WORK RESEARCH BY SUTD

The future of work demands a societal response that will prioritise dignity for people. A close reading of the Fourth and First Industrial Revolutions shows where and why we must intervene (see Table 1).

	First Industrial Revolution	Fourth Industrial Revolution
<b>Similar</b>	<ul style="list-style-type: none"> <li>• People worry about job loss caused by technological change</li> <li>• Affected segments saw wages fall for decades</li> <li>• Disenfranchised riot and protest against changes</li> </ul>	<ul style="list-style-type: none"> <li>• People worry about job loss caused by AI and other technologies</li> <li>• Affected segments see wages stagnate, or can't find new jobs with similar pay</li> <li>• Disenfranchised riot, protest, and/or vote for change</li> </ul>
<b>Different</b>	<ul style="list-style-type: none"> <li>• Processes broken down into simpler tasks: required less skill, de-skilled artisans, but required more workers</li> <li>• More jobs eventually created than lost; distress confined to specific sectors</li> <li>• Distress disappeared after one or two generations through actions of governments, unions, and firms</li> </ul>	<ul style="list-style-type: none"> <li>• Processes broken down into a spectrum of tasks that disrupt and transform jobs across skills and skill levels</li> <li>• Risk: Disruption in multiple sectors as different skills/skill levels are affected; predictions on jobs vary widely</li> <li>• Risk: Distress could persist and become entrenched, dividing society further</li> </ul>

Table 1: Comparison of First and Fourth Industrial Revolutions. Source: LKYCIC



## SUMMARY OF RESEARCH: TASKS CAN BUILD BETTER MODELS OF CHANGE AT THE RIGHT RESOLUTION

The first task framework was developed in 2003, with the first economic model in 2011. Since then, the knowledge that jobs are transformed task-by-task, and not job-by-job has been a familiar concept to a larger population. Studies into AI have concluded that for the foreseeable future, AI will remain specialised to perform specific tasks. These studies, including several other seminal and illustrative studies (summarised in Table 2), clearly show the converging consensus on tasks that has been gaining momentum since 2016.

These new economic models that incorporate tasks explain trends in ways that conventional models relying on skills alone do not. For instance, they are able to show why there has been job polarisation and falling labour demand despite rising productivity in recent decades.

Many prevailing perceptions of jobs and skills are based on the conventional notion that as economies become more advanced, more skilled jobs would be created. Skilled jobs are more productive, command higher wages, and often require higher levels of education. This however needs updating — a study of the United States labour market illustrates why (see Figure 7 below).

Before 1989, the established relationship between skills and jobs was borne out by the data. Mid- and high-skilled jobs took up an increasing share of employment in the economy while the share of low-skilled jobs fell (see Figure 7). This relationship, however, began to shift in the 1990s. While high-skilled jobs' share of employment continued to increase, that of mid-skilled jobs fell. The share of low-skilled jobs, in stark contrast to previous decades, rose instead of falling. This is the U-shaped curve in Figure 7, and is the phenomenon that we now call "job polarisation".

In the 2000s, even as workers and policy makers were grappling with job polarisation, the relationship continued to change. It started to look like the inverse of the relationship before 1989 (see Figure 7). The share of employment of both mid- and high-skilled jobs fell, and only that of the lower-skilled rose.

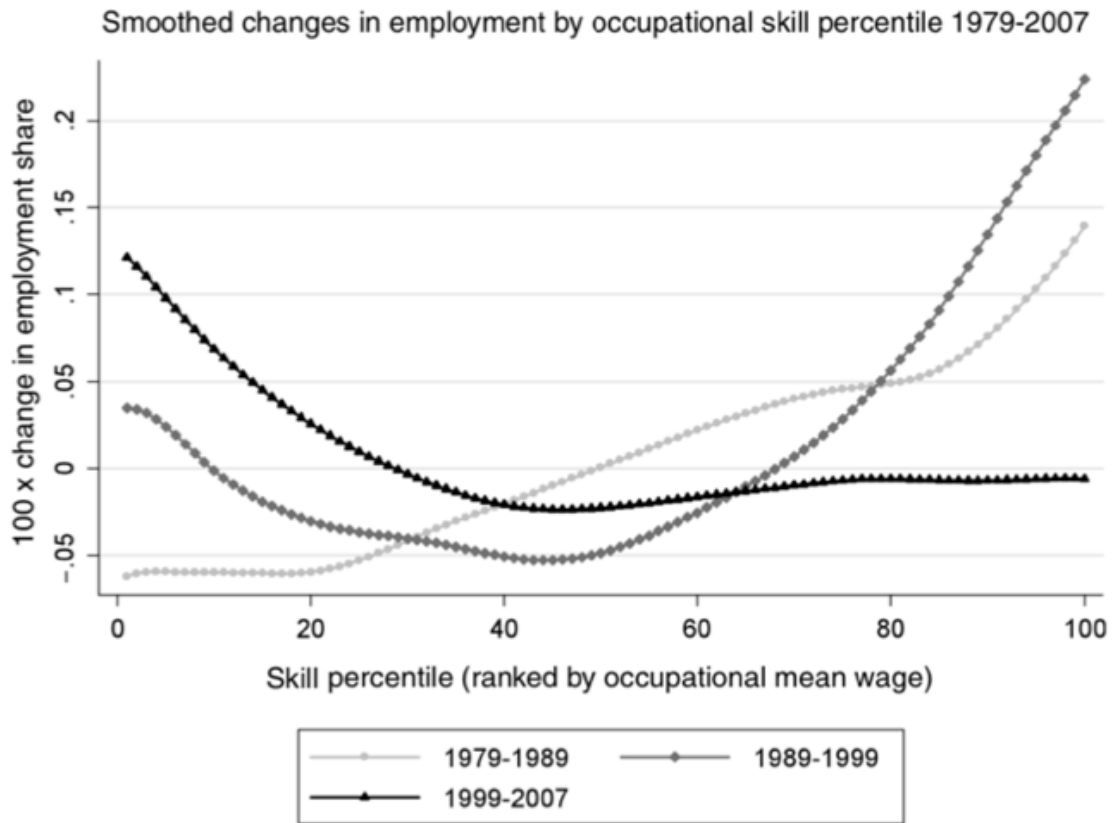


Figure 7: Acemoglu and Autor 2011<sup>25</sup>

Similar studies for this past decade are not available yet. But it is telling that many economies are still struggling with the effects of these shifts in relationships that started at least two decades ago. It is not clear if they have found the solutions and does not bode well for what we might learn about this most recent decade, lest for our future.

What has been the impact on workers? The impact of this shifting relationship over the decades is best illuminated by the resolution of tasks.

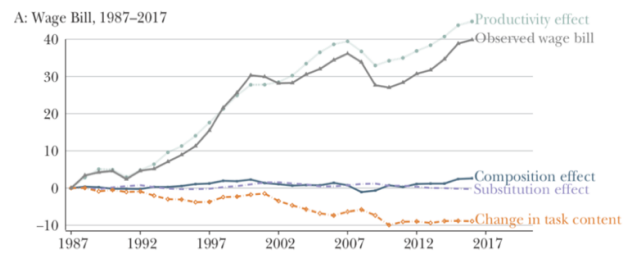
Up until 1987 (see Figure 8 below, left), the number of tasks reinstated for workers was more than those displaced by technology. Labour demand rose in tandem with productivity. In the decades leading up to 2017 (see Figure 8 below, right), this has been inverted. More tasks were displaced than reinstated, creating a gap between productivity and labour that resulted in the rise of productivity even as labour demand was muted.

<sup>25</sup> See: Acemoglu and Autor (2011) "Skills, Tasks and Technologies: Implications for Employment and Earnings" in Volume 4b of the Handbook of Labor Economics, available at [https://doi.org/10.1016/S0169-7218\(11\)02410-5](https://doi.org/10.1016/S0169-7218(11)02410-5)

Sources of Changes in Labor Demand, 1947–1987



Sources of Changes in Labor Demand, 1987–2017

Figure 8: Sources of changing labour demand, 1947-1987 and 1987-2017. Source: Acemoglu and Restrepo 2019<sup>26</sup>

When analysed at the granular resolution of tasks, it becomes clear why labour markets are the way they are today. In any case of technologies such as AI being applied to the work setting, it is crucial to understand its impact on tasks, and whether more tasks are created than displaced. As leading MIT economist Professor David Autor pointed out in 2013, the shifting allocation of tasks between capital and labour has played a “key role in reshaping the structure of labour demand in industrialised countries in recent decades”, and a task model “offers a potentially powerful framework for studying how changes in skill supplies, technologies, and trade and offshoring opportunities jointly shape the demand for labour, the assignment of skills to tasks, and the real wages commanded by workers of different skill groups”.<sup>27</sup>

## THE GROWING AND CONVERGING CASE FOR TASKS

Academics, international organisations, and consultancies are increasingly converging on the practice of using tasks as their unit of analysis for their studies on the skills or occupations needed for tomorrow. This reflects the extensive theoretical and applied research that has been conducted on tasks done in academic settings. The table below summarises seminal and illustrative research and reports, and this section will give a more detailed overview of the development of task frameworks and analysis as well as examples of how this thinking has been applied.

## TIMELINE OF SELECTED SEMINAL AND ILLUSTRATIVE RESEARCH AND REPORTS ON TASKS

Year	Significance of Research or Report
2003	First task framework showing how tasks give the level of detail needed to articulate how machines might ‘replace’ humans (Autor et al., 2003)

<sup>26</sup> See: Acemoglu and Restrepo (2019), “Automation and New Tasks: How Technology Displaces and Reinstates Labor” in Vol. 33, No.2 of the Journal of Economic Perspectives, available at <https://doi.org/10.1257/jep.33.2.3>

<sup>27</sup> These remarks from Autor (2013) “The ‘Task Approach’ to Labor Markets: An Overview” in the Journal of Labor Market Research, available at <https://doi.org/10.1007/s12651-013-0128-z>

Year	Significance of Research or Report
2011	<p data-bbox="325 416 1385 450">First economic model that incorporates tasks (Autor and Acemoglu, 2011)</p> <ul data-bbox="325 472 1445 667" style="list-style-type: none"> <li data-bbox="325 472 1445 539">• Argues that conventional economic models that rely on skills are unsuccessful in explaining job polarisation</li> <li data-bbox="325 562 1445 667">• Develops task-based framework acknowledging that workers of a given skill level often change the tasks they perform in response to changing conditions and technologies</li> </ul>
2013	<p data-bbox="325 701 1445 1032">Working paper assesses how tasks are affected by AI and other technologies as basis to project that 47% of US occupations are at high risk of automation (Frey and Osborne, 2013) captures attention of industry and governments. Ongoing research finds, “[Task reallocation has had a]... key role in reshaping the structure of labour demand in industrialised countries in recent decades” and task models “offer a potentially powerful framework for studying how changes in skill supplies, technologies, and trade and offshoring opportunities jointly shape the demand for labour, the assignment of skills to tasks and the real wages commanded by workers of different skill groups” (Autor, 2013)</p>
2014	<p data-bbox="325 1066 1445 1133">Report concludes, “Cities that have higher shares of connected tasks experienced higher employment growth.” (Netherlands Bureau of Economic Research, 2014)</p>
2016	<p data-bbox="325 1167 1445 1272">Consensus amongst experts that AI will remain narrow in the foreseeable future — “specialised to accomplish certain tasks” — and hence AI’s impact will be at the task level (Stanford University Artificial Intelligence and Life in 2030)</p>
2017	<p data-bbox="325 1290 1445 1435">First comprehensive report from a consultancy concludes that “no job will be fully replaced” and that studying “work activities [i.e., tasks shared by job families] rather than occupations is the most accurate way to examine the technical feasibility of automation.” (McKinsey, 2016)</p>
2018	<p data-bbox="325 1469 1445 1574">“New Tools Needed to Track Technology’s Impact on Jobs, Panel Says ... ‘We’re flying blind,’ [says MIT’s] Erik Brynjolfsson.” (NY Times/National Academies of Sciences, Engineering, and Medicine, 2017)</p> <p data-bbox="325 1597 1445 1704">“... automation tends to be task-based rather than job-based, allowing workers to pivot into new roles.” (UK Royal Society for the Encouragement of Arts, Manufactures and Commerce, 2017)</p>
2019	<p data-bbox="325 1738 1445 1843">Finding that transitions between jobs are more likely with similar intermediate work activities [i.e., tasks shared by job families] (Mealy, del Rio-Chanona, and Farmer, 2018)</p>
2019	<p data-bbox="325 1883 1445 1989">Creation of a model that incorporates tasks to explain the problem of falling demand amidst rising productivity, which was not captured by conventional economic models (Acemoglu and Restrepo, 2019)</p>

Table: Timeline of task research. Source: LKYCIC

## **FIRST TASK FRAMEWORK SHOWING HOW TASKS GIVE THE LEVEL OF DETAIL NEEDED TO ARTICULATE HOW MACHINES MIGHT 'REPLACE' HUMANS**

The first major work on the task model was put forward in 2003 by David Autor et al.<sup>28</sup> Their paper introduced a “task framework” that investigated how skills are assigned to tasks, and divided tasks into categories of routine and non-routine, as well as manual and cognitive. Using tasks as the unit of analysis supplied the authors with the level of detail needed to articulate how machines might “replace” humans with greater specificity. They concluded that “computer capital” would substitute for workers in cognitive and manual tasks with explicit rules and complement workers in “non-routine problem-solving and complex communications tasks”.

## **FIRST ECONOMIC MODEL THAT INCORPORATES TASKS: ARGUES THAT CONVENTIONAL ECONOMIC MODELS THAT RELY ON SKILLS ARE UNSUCCESSFUL IN EXPLAINING JOB POLARISATION; PROPOSES MODELS THAT INCORPORATE TASKS**

This line of inquiry expanded in scope to interpret macroeconomic trends, including the relationship between technology, labour, and productivity. Autor and Acemoglu’s 2011 work argues that conventional economic models that rely on skills are not successful in explaining observed trends just as job and employment polarisation.<sup>29</sup> These “canonical” models assume that workers’ skills are mapped exactly onto the tasks or work activities they perform, and that technology only complements workers’ skills, increasing their productivity and wages without replacing them.

To address this weakness, the authors developed a task-based framework, which makes a “clear distinction between workers’ skills and job tasks and allow[s] the assignment of skills to tasks to be determined by labo[u]r supplies, technologies, and task demands”. For clarity, the authors define tasks and skills as follows: “A task is a unit of work activity that produces output (goods and services). In contrast, a skill is a worker’s endowment of capabilities for performing various tasks. Workers apply their skill endowments to tasks in exchange for wages, and skills applied to tasks produce output.”

Their task-based framework acknowledges that workers of a given skill level often change the tasks they perform in response to changing conditions and technologies, creating a model that can adequately account for the impact technology has upon wages in the US and other markets. In the context of AI’s introduction to work processes this is highly relevant, as AI remains narrow and specialised to perform specific tasks, and hence their impact on jobs will be task-by-task.

<sup>28</sup> To access this work, see Autor et al. “The Skill Content of Recent Technological Change: An Empirical Exploration” in the November 2003 volume of *The Quarterly Journal of Economics*, available at <https://doi.org/10.1162/003355303322552801>

<sup>29</sup> For their full research, see Acemoglu and Autor (2011) “Skills, Tasks and Technologies: Implications for Employment and Earnings” in *Volume 4b of the Handbook of Labor Economics*, available at [https://doi.org/10.1016/S0169-7218\(11\)02410-5](https://doi.org/10.1016/S0169-7218(11)02410-5)

## CREATION OF A MODEL THAT INCORPORATES TASKS TO EXPLAIN THE PROBLEM OF FALLING DEMAND AMIDST RISING PRODUCTIVITY

Acemoglu and Restrepo build on these findings to address the problem of labour demand falling since the 1980s as productivity continued to rise — another phenomenon not captured by the canonical model.<sup>30</sup> Illustrated in Figure 9, the authors conceive production as comprising a spectrum of tasks; those above 'I' are done by Labour and those below 'I' are done by Capital (automation). When the number of tasks re-allocated to Capital from Labour is balanced by the number of new tasks introduced to Labour, as in the middle spectrum, the change in task content is zero. When tasks are re-allocated to Capital through automation, without being replaced by new tasks for Labour, the change in task content is negative. This structures the introduction of “change in task content” as a variable that impacts sector-level wages.

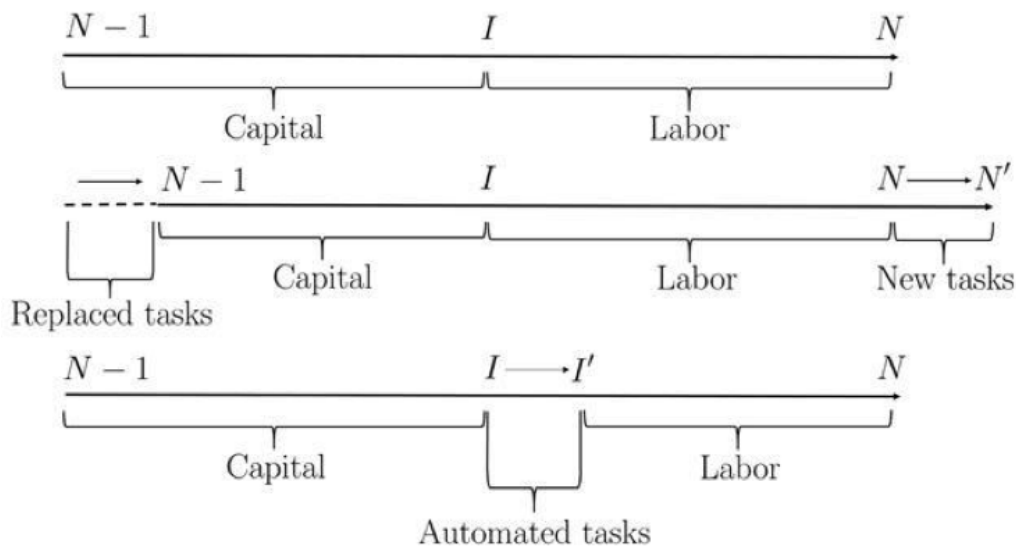


Figure 9: At top, status quo. Middle: The same number of new tasks are added to Labour (New tasks) as are re-allocated to Capital (Replaced tasks). Bottom: Tasks are re-allocated to Capital (Automated tasks) with no new tasks added to Labour. Source: Acemoglu and Restrepo 2019

The authors then model this impact, exhibiting the effect on wages that could possibly be attributed to the change in task content. Figure 10 below, left, thus illustrates how wages have fallen post-1980 even as productivity continues to rise, based on whether enough new tasks for Labour are reinstated to replace the tasks that are displaced to Capital. On the left of Figure 10 below, the wage bill (sector-level wages) keeps pace with rising productivity (Chart A), due to the balance between task displacement and reinstatement (Chart B). On the right of Figure 10 below, however, the wage bill dips below productivity (Chart A), as the rate of displacement outweighs reinstatement by ten percent for a change in task content of negative ten (Chart B).

<sup>30</sup> For their full research, see Acemoglu and Restrepo (2019), “Automation and New Tasks: How Technology Displaces and Reinstates Labor” in Vol. 33, No.2 of the Journal of Economic Perspectives, available at <https://doi.org/10.1257/jep.33.2.3>

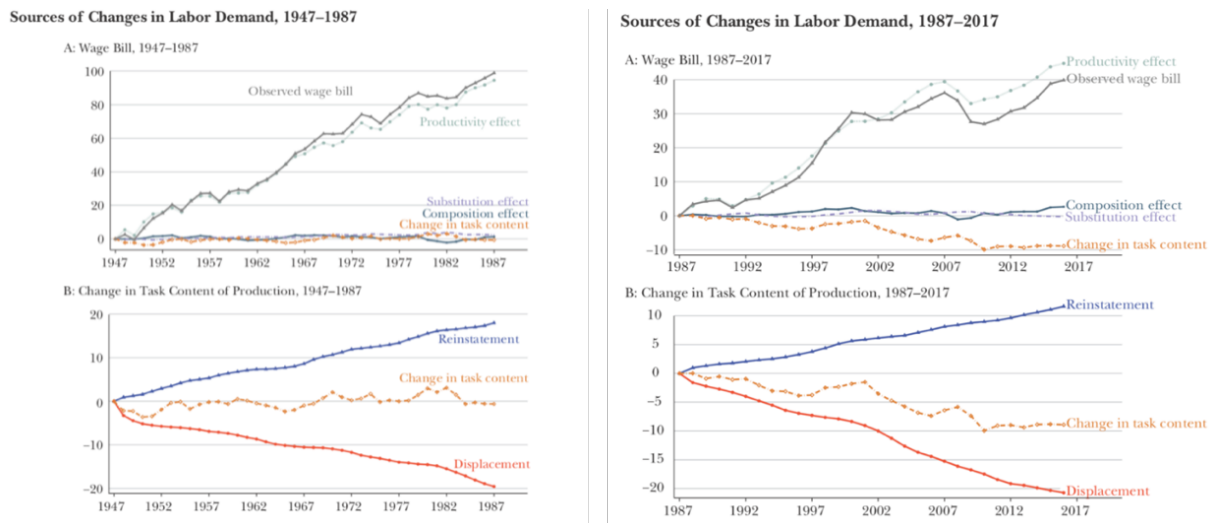


Figure 10: Changes in components of the wage bill. Source: Acemoglu and Restrepo 2019

This rigorous economic work provides a powerful argument for the significance of tasks in understanding economic trends — both at the job and the sector of economy level. As these frameworks continue to be developed and enriched, their concepts are increasingly applied to a variety of problems.

## CONSENSUS AMONGST EXPERTS THAT AI WILL REMAIN NARROW IN THE FORESEEABLE FUTURE AND HENCE AI'S IMPACT WILL BE AT THE TASK LEVEL

A task-based approach is suited to the challenge of identifying jobs at risk of automation, as “AI systems are specialised to accomplish particular tasks”.<sup>31</sup>

## ASSESSMENT OF HOW TASKS ARE AFFECTED BY AI AND OTHER TECHNOLOGIES PROJECTS THAT 47% OF US OCCUPATIONS ARE AT HIGH RISK OF AUTOMATION

Economists from the Oxford Martin School have thus expanded earlier work on tasks to incorporate the increasing capabilities of computers and computer-controlled equipment in the fields of AI and Mobile Robotics.<sup>32</sup> They argue that many non-routine tasks can now be automated, in addition to routine ones, and mark out the exceptions where humans are unlikely to be substituted by computers: complex perception and manipulation tasks, creative intelligence tasks, and social intelligence tasks (Frey and Osborne 2013). The authors used these distinctions to build an algorithm that would generate the “risk level” of an occupation being automated — they concluded that 47% of US occupations are in the “high risk” category of susceptibility to automation.

<sup>31</sup> For more on this consensus, see Stanford University's 2016 “One Hundred Year Study on Artificial Intelligence (AI100)”, accessible at <https://ai100.stanford.edu>.

<sup>32</sup> For their full work, see Frey and Osborne's 2013 paper, “The Future of Employment: How Susceptible are Jobs to Computerisation?”, available at <https://www.oxfordmartin.ox.ac.uk/publications/the-future-of-employment/>



## VIEW THAT NO JOB WILL BE FULLY REPLACED

Where the Oxford Martin research in the previous section speaks in terms of the overall risk for automation of an entire occupation, McKinsey researchers have identified jobs at risk by proportion of their work activities' (a more general level of task) susceptibility to automation.<sup>33</sup>

By organising their inquiry through activities rather than occupations, they arrive at a more nuanced picture of the impact automation is likely to have. They offer a breakdown of each work activity for an occupation, the percentage of the occupation's labour time it takes up, and the likelihood of this activity being automated. Where the Oxford approach uses task information to make their assessments of each occupation, McKinsey articulates how occupations are likely to be impacted by automation, in terms of the activities workers actually perform.

## JOB TRANSITIONS

In a working paper put out by the Oxford Martin School at the end of 2018, they found that transitions between jobs are likely more similar with intermediate work activities (i.e., tasks shared by job families) than with other dimensions such as skills.<sup>34</sup>

## FEARS OF "FLYING BLIND"

The US National Academies of Sciences, Engineering, and Medicine's report on Infotech and the US workforce warns that policymakers are "flying blind into what has been called the Fourth Industrial Revolution".<sup>35</sup> Accompanying a host of economic recommendations for the future of work, they called for new "data sources, methods, and infrastructures" that would be better suited to the challenges we face.

They identify a host of gaps in current data and call for an integrated information strategy that could connect and make accessible the many pools of data that do exist. In their view, to be prepared for the changes that technology is bringing, we must be able to map technological data to workforce and labour data.

<sup>33</sup> For their full work, see Chui, Manyika, and Miremadi, "Where machines could replace humans-and where they can't (yet)" in McKinsey Quarterly's July 2016 edition, available at <https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/where-machines-could-replace-humans-and-where-they-cant-yet>

<sup>34</sup> To read their full work, see Mealy, del Rio-Chanona, and Farmer (2018) "What you do at work matters: New lenses on labour", available at <https://ssrn.com/abstract=3143064>

<sup>35</sup> For more on their findings, see Mitchell and Brynjolfsson (2017) "Track how technology is transforming work" in *Nature*, 544(7650), available at <https://doi.org/10.1038/544290a>



## ANNEX C | BACKGROUND BRIEF ON TECHNOLOGY ADOPTION AND WORK PRACTICES

The prominent organisational theorist, Stephen Barley, emphasises the interconnectedness of social interaction, tasks, and tools in work settings.<sup>36</sup> Therefore the need to understand the technologies they use (or will need to use), and the practices that link workers, tools, and tasks together are required, to study the tasks employees perform. For those who might not be familiar with technology adoption and work practices, a background brief from the LKYCIC's work in these areas is provided below.

### LKYCIC RESEARCH ON TECHNOLOGY ADOPTION AND WORK PRACTICES

In parallel with task-based approaches, the LKYCIC also conducts research from two overlapping angles: psychological research on adoption of new technologies and organisational studies on changing work practices. Researchers at the LKYCIC have worked with Singapore companies to explore how employees react to and manage the introduction of algorithmic tools to their work. These findings inform an overall understanding of the complexity of introducing new technologies.

#### Technology Adoption

In a changing work environment where new technologies are being introduced, it is necessary to understand what factors influence workers' willingness to adopt these new tools into their work. To better understand the barriers to and enablers of adoption, researchers at the LKYCIC have built the Technology Experience and Adoption Model (TEAM). As shown in Figure 11, this model incorporates key factors in technology adoption that have been established through decades of psychological research, measuring exactly how these factors influence an individual's experience with technology.

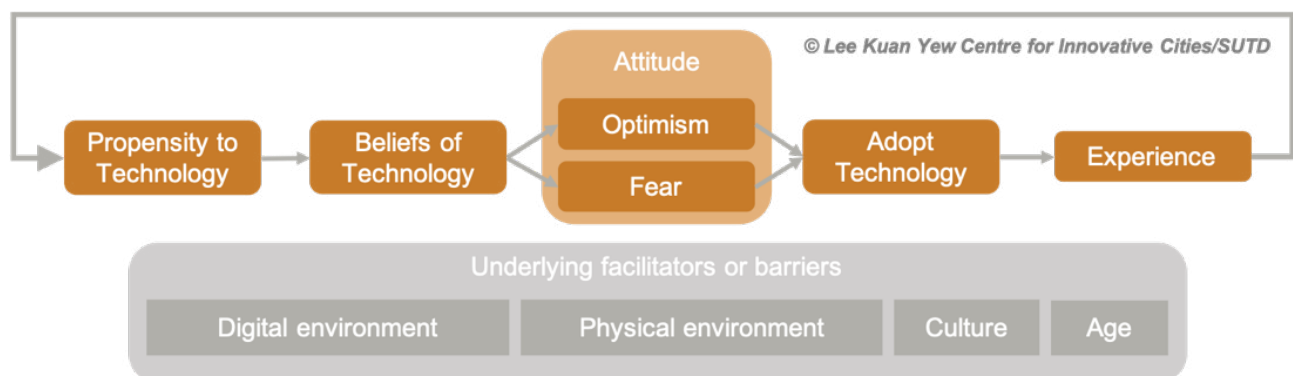


Figure 11: Technology Experience and Adoption Model

<sup>36</sup> For a fuller explanation, see his 25 October 2016 presentation as Saïd Business School, Oxford University. <https://www.youtube.com/watch?v=2OxeWVWF4qQ>

The TEAM expands on these prior models by incorporating the feedback loop of prior experience with new technologies. This appropriately treats adoption as an ongoing process experienced by the individual — something many of us can be sympathetic to as new technologies continue to arrive in waves. As an additional layer, TEAM includes the interpersonal and environmental factors that give context to this process — factors such as digital infrastructure, organisational support, cultural norms, and societal traits. This model has been tested in partnership with several organisations in Singapore and informs the insights on transforming jobs, improving communication, and implementing enablers in this Guide.

## Work Practices

From the discipline of organisational science, work practices are conceptualised as a network — each worker integrated with other actors, technologies, processes, and exchanges of information and/or materials. As Stephen Barley argued in 2001, in order to understand the shifts our economy has been undergoing, studies of organisations must shift from their focus on strategy and bureaucratic structures to understanding “what people actually do — the skills, knowledge, and practices that comprise their routine work.”<sup>37</sup>

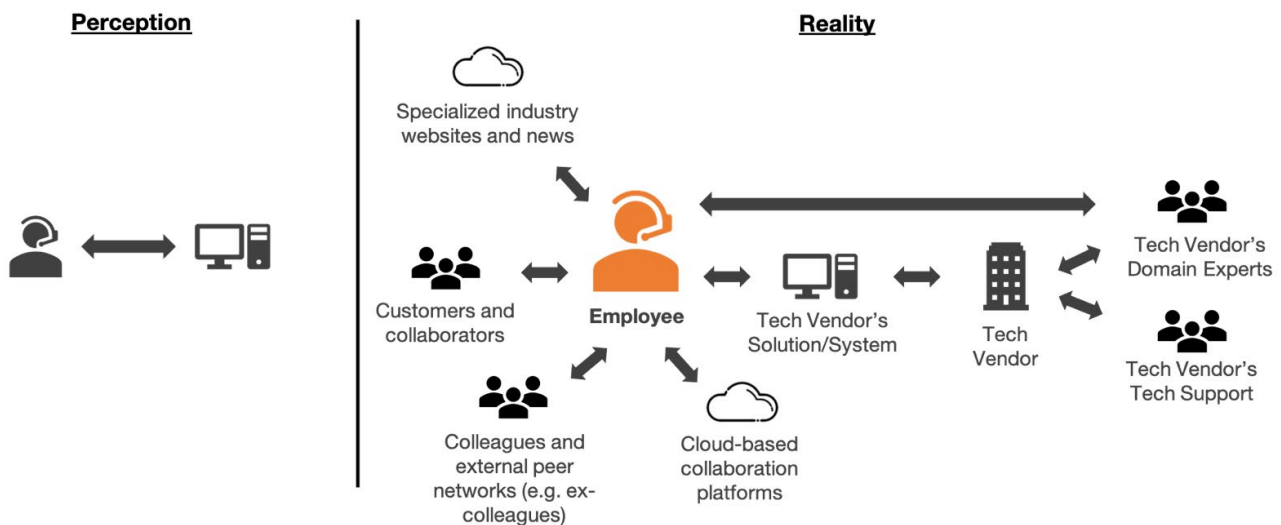


Figure 12: A diagram showing the gap between the perception and reality of work. This diagram is a composite of examples from across the LKYCIC's research. Source: LKYCIC

The difference between how a worker's work may be perceived and what the worker actually does illustrates the importance of understanding work practices. As seen on the left of Figure 12 above, managers or colleagues in other departments often have an overly simplistic vision of how a worker performs their work. In reality, what the worker does is multifaceted, integrated with other workers, technologies, processes, and exchanges (see Figure 12, right). Approaching work practices as a network is key to accurately understanding what workers do.

<sup>37</sup> Barley, S. and Kunda, G. (2001) Bringing Work Back In. *Organization Science* 12:1, 76-95.

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