AI, ROBOTS AND JOBS: ESTIMATION AND IMPLICATIONS

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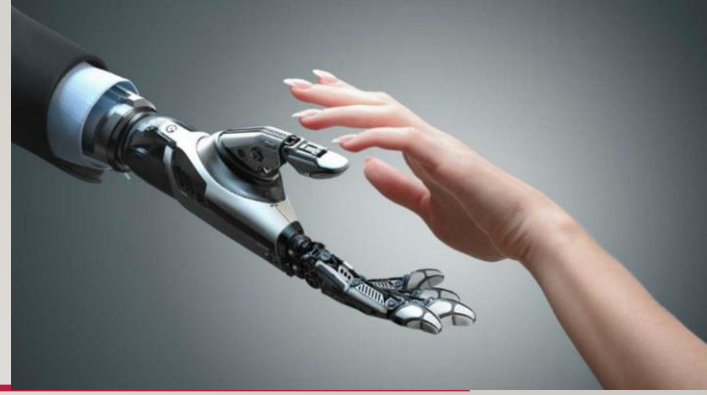
OUTLINE



- What AI can and cannot do
- Dire prediction
- Estimation methods and results
- Policy implications
- Case of Singapore

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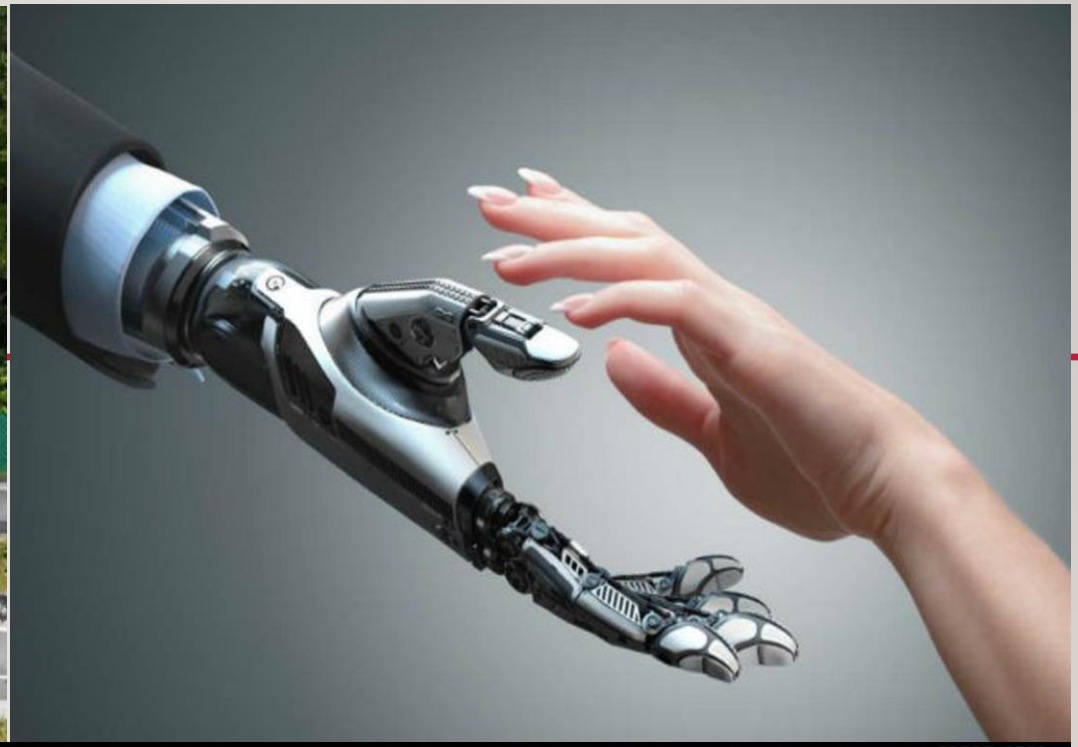
Amazon Go store finally open to public

UBER



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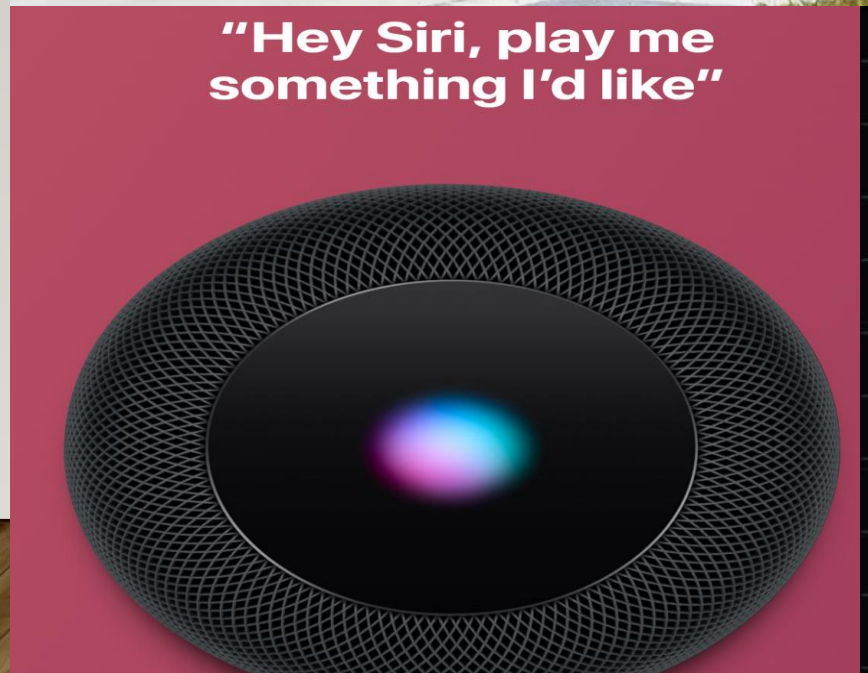

ADVANCED ANALYTICS

Behavioural analytics –

Examines how and why humans make decisions.

Data visualisation –

Encodes data and information as visual objects to ease the communication and presentation of insights, allowing audiences to grasp difficult concepts or identify new patterns effortlessly.

Network and cluster analysis –

Applies statistical classification to cluster objects or points into group based on their characteristics.

Sentiment analysis –

Discerns sentiment (i.e. positive, negative or neutral) from structured and unstructured data.

Text mining –

Analyses unstructured texts, and transforms them into useful insights.

Predictive analytics –

Develops understanding of the underlying relationship between input and outputs, analysing why something occurs, prior to determining future outcomes with greater confidence.

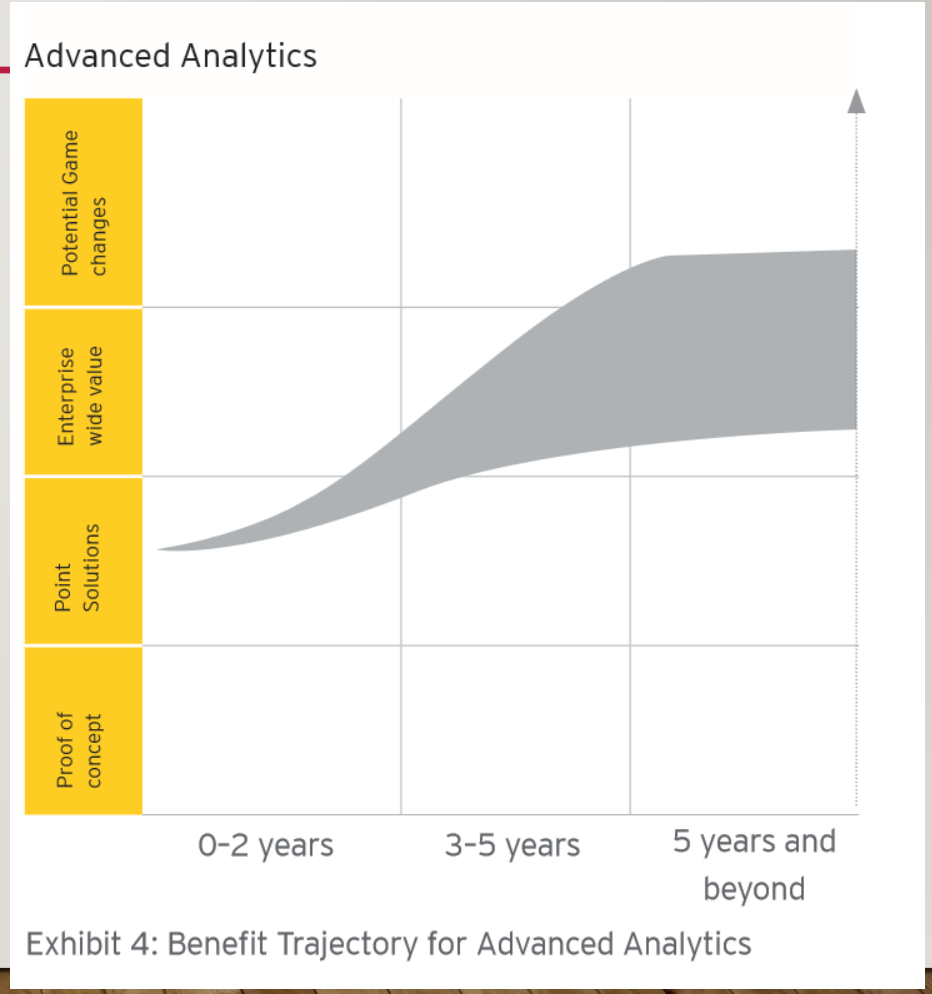

Exhibit 4: Benefit Trajectory for Advanced Analytics

ARTIFICIAL INTELLIGENCE

Natural learning processing (NLP) –

Gives machines the ability to read and understand the language that humans write or speak.

Machine learning –

The development of computer algorithms that improve automatically through experience.

Deep learning –

A sub-field of Machine Learning, creates an "artificial neural network" and trains the machine to learn on its own to perform human-like tasks, such as recognising speech, making predictions, identifying images[10] – simply through recognising patterns using layers of processing.

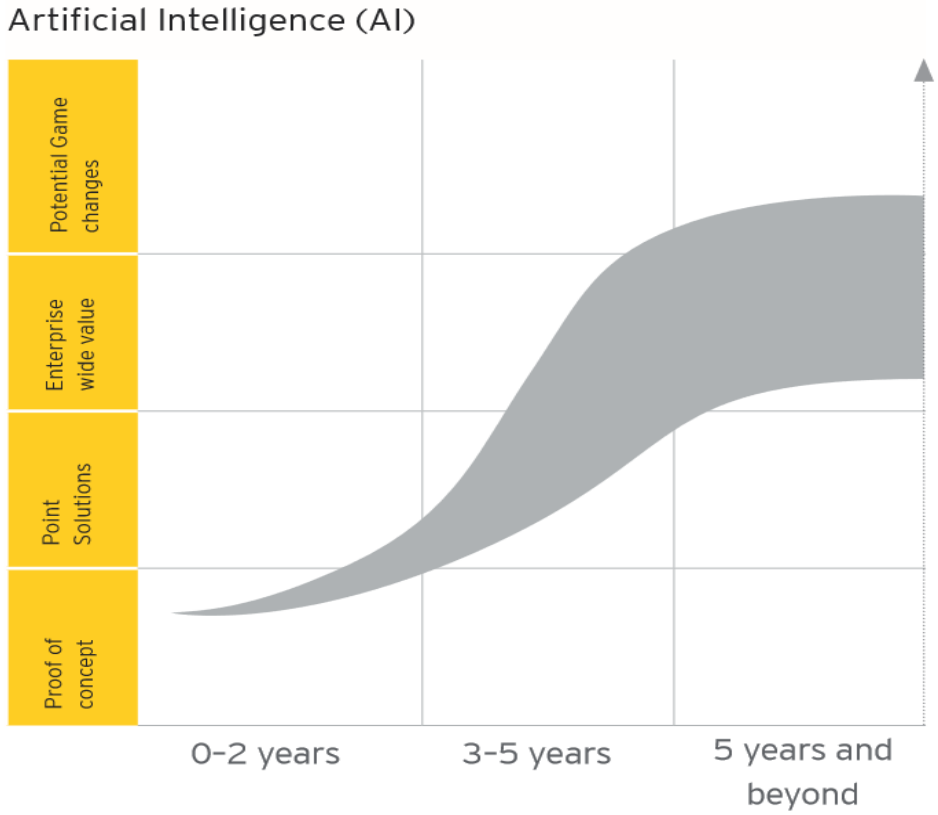

Exhibit 5: Benefit Trajectory for Artificial Intelligence

DIRE PREDICTION

- High unemployment / under-employment
- Fighting for small pool of jobs
- Gig economy → lack of social safety nets
- Income / wealth inequality
- social / political problems

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ESTIMATION METHODS

Benedikt, F. C., & Osborne, M. A. (2013). The future of employment: How susceptible are jobs to computerisation. *Oxford Martin School, University of Oxford, Oxford*.

Methodology

Probability of computerization of 702 occupations taken from O*NET, an online service developed by US department of labour.

Expert judgement used to categorize if the jobs can be computerized. The study labelled 70 of the 702 jobs manually as either "automatable" or "not automatable".

Impact on Jobs/Tasks/Industry

- **47% of US occupation are placed in high risk category**
- **33% of US occupations are placed in low risk category**
- **19% of US occupations are placed in medium risk category**

High Risk Examples: Services, Sales, Office administration, Farming, Fishing, Construction, Production, Transportation,

Medium Risk Examples : Services, Office administration, Installation, Maintenance and repair

Low Risk Examples: Management, Business, Finance, Computing, Engineering, Legal, Arts, Education ,Media, Healthcare

COMMENTS

1. **Made no attempt to quantify how many jobs will be affected**
2. **Does not account for future wage levels, capital prices, and labour shortages**
3. **Avoids saying anything about regulatory or legislative support or barriers to computerization**
4. **Prediction for near future and not for long term**
5. **Does not account for within occupation variation among different tasks**

Hawksworth, J., Berriman, R., & Goel, S. (2018). Will Robots Really Steal Our Jobs? An International Analysis of the Potential Long Term Impact of Automation. PWC Report.

Methodology

Analysed the job tasks of 200K workers in 29 countries

27 OECD countries plus Russia and China

Identified three waves of technological change

- **Algorithmic wave is already underway**
- **Augmentation wave will mature in 2020s**
- **Autonomy wave will mature in 2030s**

Impact on Jobs/Tasks/Industry

Industries Impacted:

- More than 50% of jobs can be impacted in transportation and storage
- 45% manufacturing / Between 35% to 40% in construction
- 35% in administration and support / 30% to 35% in wholesale and retail
- 30% to 33% in public administration and defence / 30% in financial and insurance
- 25% to 30% in information and communication / 25% professional, scientific and technical
- 20% to 25% accommodation and food services / 20% human health and social work
- Less than 10% in education

Tasks Impacted (Tasks likely to be replaced by automation):

- Manual tasks 39%
- Routine tasks 35% to 40%
- Computation tasks 30% / Management tasks 25% to 30%
- Social skills 15% to 17% / Literacy skills 15%

Demographic Impact

- Male 33%
- Female 26%
- Less than 25 years of age 32%
- 25-54 years of age 29%
- 55 plus years of age 32%
- Low education level 45%
- Medium education level 35%
- High education level 10%

OECD: Arntz, M., Gregory, T., & Zierahn, U. (2016). The risk of automation for jobs in OECD countries.

Methodology

Took a task based approach unlike Frey and Osborne (2013) which considered jobs as whole.

First measured relationship between US workplace tasks and automatibility then applied the process to OECD job tasks for 21 OECD countries.

Used a survey data for a comprehensive list of tasks that people actually perform at workplace

Used Generalized Linear Model for estimation.

Used the data from the International Assessment of Adult Competencies (PIAAC)

Takes into account that not whole occupations but specific jobs are exposed to automatibility

Impact on Jobs/Tasks/Industry

- An occupation whose 70% tasks can be automated is considered highly vulnerable to automation
- 9% of Jobs in US face high automatibility
- Share of workers whose automatibility is 70% range from 12% for Germany and Austria and 6% for Korea and Estonia
- Low income and low skills jobs face a high risk of automation
- Routine tasks are more threatened by automation and cognitive tasks are less
- Automatibility of same tasks may vary between countries depending on country's adoption of new technologies, its economic and educational structure and workplace organization.
- Automatibility decreases with level of education. Less than 1% Workers with a masters/PhD are vulnerable to automation while for those with a primary or less education this can go up to 55%
- The estimates are for technological capabilities rather than actual utilization.

CHINA: Net impact of AI and Related Technologies on jobs in China, PWC (2018)

Methodology	Impact on Jobs/Tasks/Industry
Build on the research by Frey and Osborne (2013) and OECD Study **Done at Industry level**	Job losses: • Services 21% or 72 million • Construction 25% or 15 million • Industry 36% or 59 million • Agriculture 27% or 57 million • Total 26% or 204 million Job gains : • Services 50% or 169 million • Construction 48% or 29 million • Industry 39% or 63 million • Agriculture 16% or 35 million • Total 38% or 297 million AI and automation will create more jobs then they will displace AI impact will not be spread evenly across industries There are many factors creating uncertainty Enhanced social safety net and increased rural support is needed

CRITICISMS OF CONVENTIONAL APPROACHES

- Occupation based methods / Task based methods
- Focus on one to one job replacement
- Ignores ground –up industry wide disruptions (retail, fintech, journalism, uber)
- Outdated (2013) estimation of technical capabilities of AI (Oxford, PWC, OECD)
- Risk of automation / AI ….NOT ACTUAL LOSSES

FACTORS THAT COULD SLOW DOWN JOB DISRUPTION

- political economy
  - taxi drivers / labour unions
- regulations / legislations
- labour shortage / wage levels
- societal norms
  - digital payment
  - credit cards
  - MOOCS

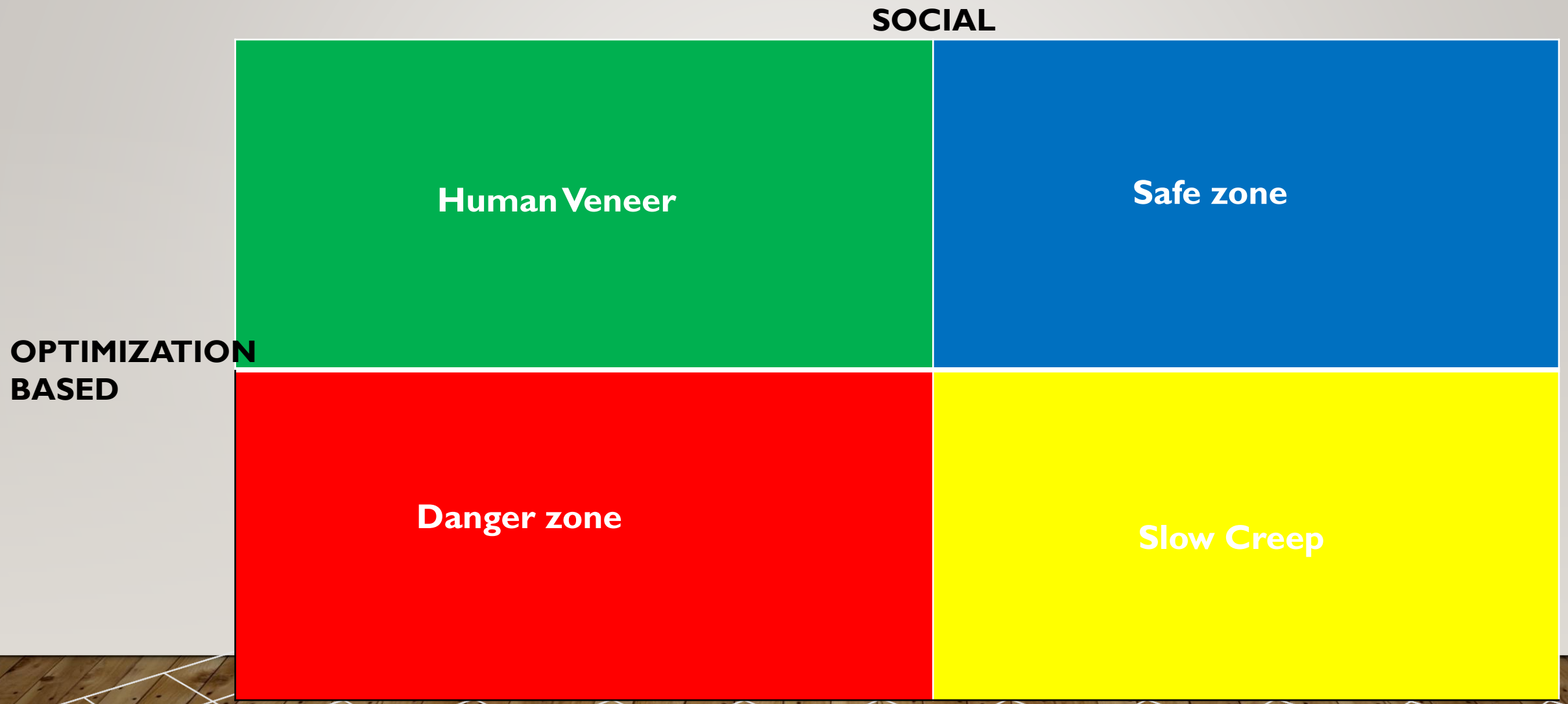
WHAT ABOUT JOB GAINS?

- Data scientists
- Robotics technicians
- Product photographers
- Cybersecurity experts
- Freelance experts (accounting, architecture, para-legal,\
- On-line professionals
- Computer, math, engineering, architecture

ALTERNATIVE METHODOLOGY

BASED ON OPTIMIZATION, SOCIALIZATION AND DEXTERITY

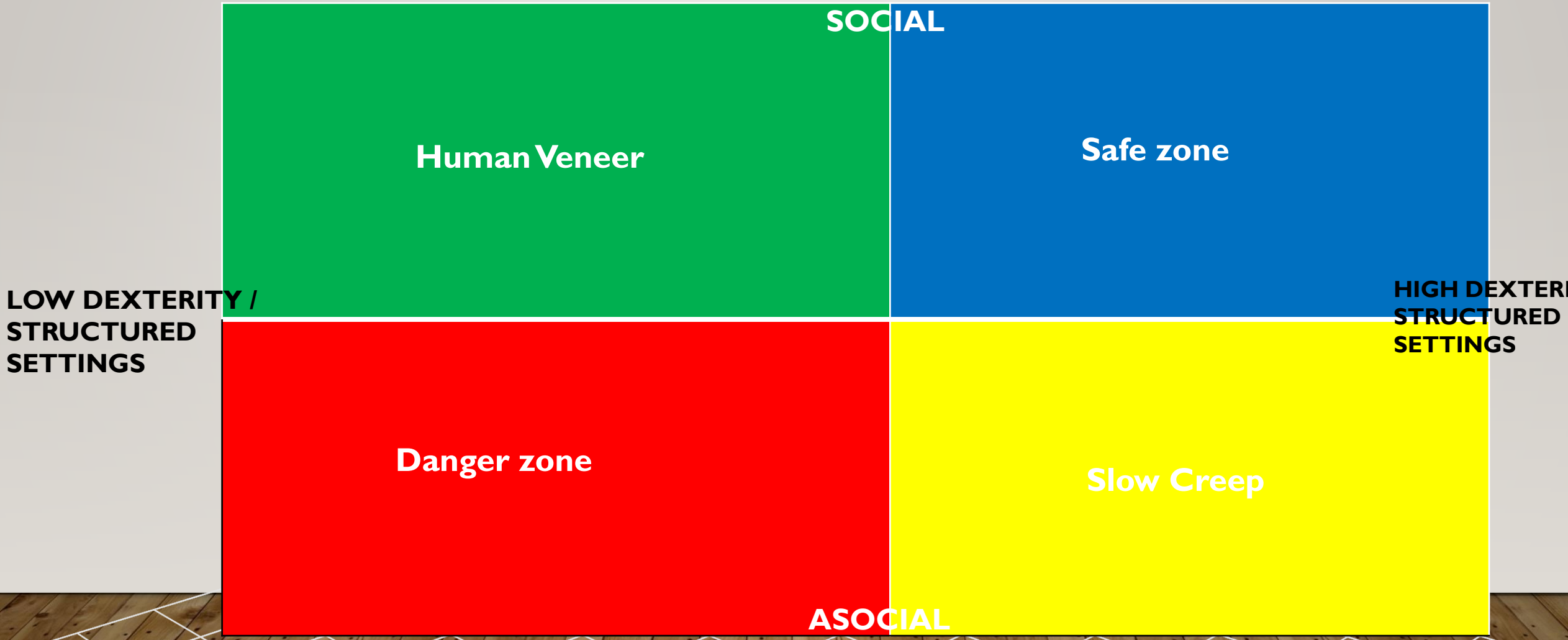
COGNITIVE OCCUPATIONS



WHAT IS THE RISK OF THESE JOBS REPLACED?

❑ Wedding planner ❑ Financial planner ❑ Telemarketer ❑ Radiologist ❑ Customer service representative ❑ Teacher ❑ Doctor (GP) ❑ Concierge ❑ Social worker ❑ Graphic designer	❑ Medical researcher ❑ CEO ❑ Criminal defense attorney ❑ Artist ❑ Scientist ❑ Pyschiatrist

PHYSICAL OCCUPATIONS



WHAT IS THE RISK OF THESE JOBS REPLACED?

❑ Bartender ❑ Night watch security guard ❑ Taxi driver ❑ Café waiter ❑ Plumber ❑ House cleaner ❑ Physical therapist ❑ Teller / cashier	❑ Dishwasher ❑ Fast food preparer ❑ Restaurant cook ❑ Dog trainer ❑ Home construction worker ❑ Hair stylist ❑ Elderly home care taker ❑ Garment factory worker

IMPLICATIONS: 3R

- REDUCE
- RETRAIN
- REDISTRIBUTE

IMPLICATIONS FOR POLICY / EXAMPLES FROM SINGAPORE

- Implications labor / immigration policy
  - Reskilling / upskilling / skills certification / professional conversion
  - Selective migration policy
  - Re-employment for older workers (Singapore)
  - Monitoring of high risk industries / occupations / workers
  - Flexible labour market (retirement / progressive wage / flexiwork)
  - Social safety nets for freelancers
  - New labour market statistics / prediction / research

POLICY IMPLICATIONS

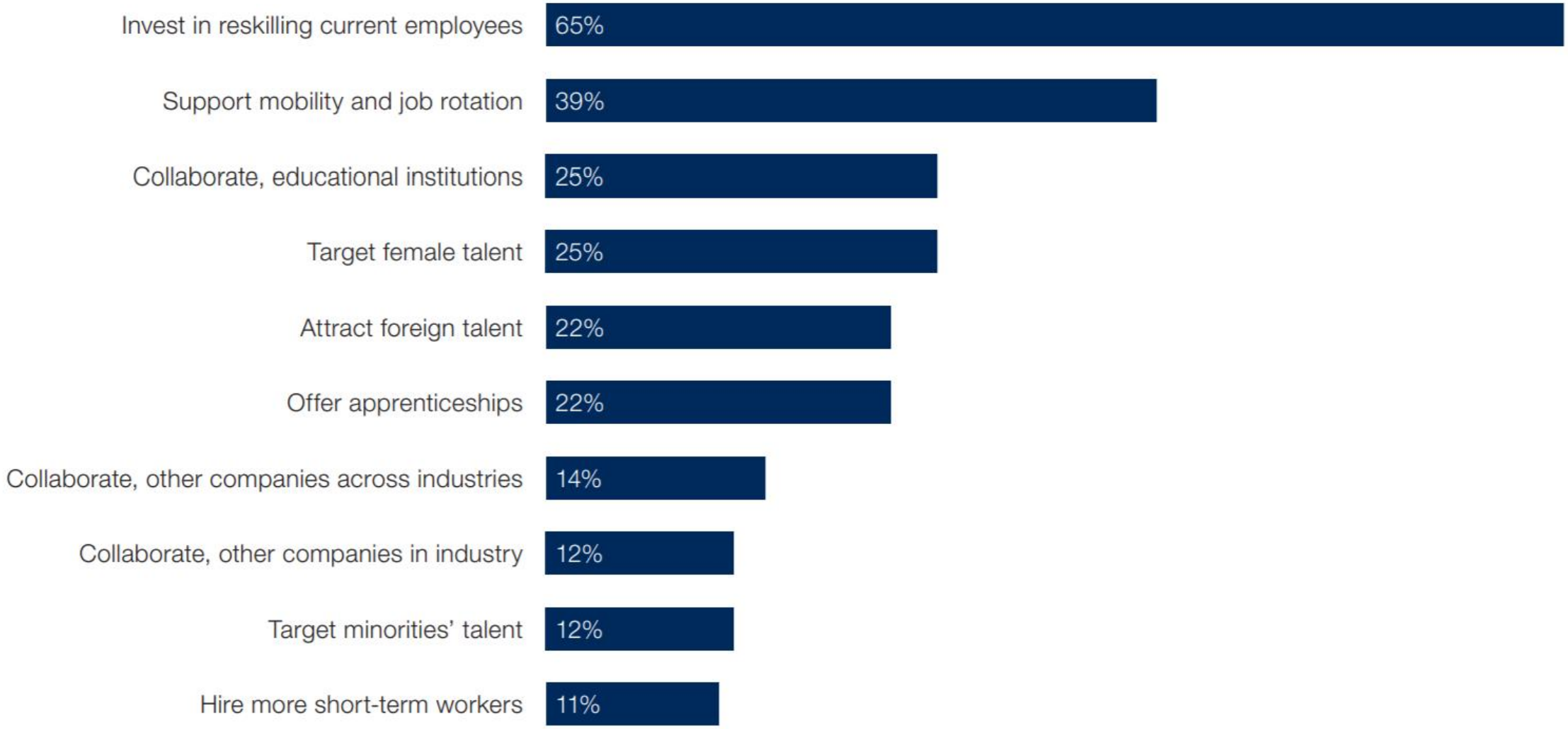
- Rethinking education policy / models
  - Pre-employment vs. post –employment
  - Rethinking university education (30 year contracts)
  - Incentivizing life long learning (Skills Future Singapore)
  - Lego model of learning (SCALE Singapore)
  - Education vs. certification (Humanities vs. applied)
  - University-industry partnership
  - Blended learning (NUS Model: Classroom+ MOOCs)

POLICY IMPLICATIONS

- Implications for tax and expenditure policy
  - Robot tax ? How much?
  - Universal Basic Income
    - How affordable?
    - Effect on incentives
    - Meaning of life?
  - Subsidies / cost sharing for training / re-employment
  - Social investment stipend
    - Care, service, education

Future workforce strategies, industries overall

Share of respondents pursuing strategy, %



Source: Future of Jobs Survey, World Economic Forum.
Note: Names of strategies have been abbreviated to ensure legibility.

Foundational skills

Data and digital skills

Business skills

*Domain Knowledge and job specific skills

Interpersonal skills

WHAT SKILLS TO TEACH?

Foundational Skills	
Adaptability	Ability to change strategies and actions to conform to diverse situations while maintaining effectiveness
Basic Communications	Ability to convey information to others verbally and in writing as well as ask questions and pay attention to what others are saying to gain additional information
Basic Digital Literacy	Use ICT tools, equipment and software to create, evaluate and share information digitally with others
Basic Mathematical and Statistical Analysis	Ability to understand the language of math and reason with statistics as well as data
Collaboration	Working cooperatively with others, virtually and physically, to build consensus and to take collective action to achieve common objectives
Critical Thinking	Apply reasoning to evaluate statements, separating truth from falsehoods, and assess the strengths and weakness of different options of solution, conclusion and approach
Decision Making	Assemble information to form a well-rounded understanding of complex situations
Empathy	Establish and sustain relationships by identifying and valuing feelings of others, accurately interpreting others' emotions and working style without judgment, leveraging insights to effectively manage own responses so that one can mindfully interact with others to achieve intended results

Interpersonal Skills	
Conflict Management	Rationally handling conflict and attempting to mitigate fallout including determining key takeaways for future learnings
Develop Others/Coaching	Help others to learn and develop capabilities to enhance performance and achieve both personal and professional goals
Global Perspective	Display openness to and awareness of diversity across global culture and market trends
Influencing and Negotiation	Ability to convince others to take appropriate actions or being able to reach a mutually satisfactory agreement
Lead Virtual Teams	Use appropriate technologies, methods and interpersonal styles to form, develop, guide, and motivate remote, teams to attain successful outcomes and business objectives
Stakeholder Engagement	Manage stakeholder expectations and relationships through effective communication, networking and strategic alignment

Business Skills	
Advisory	Apply a long-range view on problem or situation and use in-depth knowledge to advise on potential actions
Business and Financial Acumen	Gain clarity on business goals, market situation and develop expertise in financial matters, evaluate the financial performance and position of the organisation over time
Business Report Writing	Analyse, select and organise ideas to write a clear, concise, correct and complete business report
Change Management	Manage various resources using available tools and techniques to assist organisation in making successful transitions, resulting in adoption and realisation of changes
Complex Problem Solving	Incorporate related information and past experience into the evaluation of options and development of solutions
Customer Mindset	Build cohesive end-to-end customer journey and experience to engage a population of customers with changing profiles, demands and buying patterns
Investigation	Gather and ascertain evidence and information, use logic and reasoning to uncover potential missing information and/or identify suspicious behaviors to determine root cause
Lateral Thinking	Identify opportunities by interpreting information and connect insights from various sources, incorporate a creative approach to develop actions

Process Excellence	Identify critical business processes and seek opportunities to achieve efficiency
Product Awareness	Establish strong understanding of various products and services offered in an organisation, peer groups, as well as regional/global market
Project Management	Plan and manage all aspects of a project including the allocation of resources (people, budget, time), close engagement with stakeholders and resolution of project concerns
Research	Interpret information to obtain deep understanding of specific field or area, integrate the findings into recommendation
Risk Awareness	Identify, assess and prioritise risks and apply resources to mitigate risks and impact of incidents. Understand impact of latest global regulatory development on business strategies
Strategy Planning	Identify and prioritise organisational objectives to support the business vision, including evaluating decisions to assess the resources necessary to achieve desired results. This also considers global/macro changes and its impact on local markets
Systems Thinking	Apply a holistic approach to analysis that focuses on the way that a system's constituent parts interrelate and how systems work over time and within the context of larger systems
Targeted Technical Sales	Customise product and service proposals to address unique customer needs, demonstrating in depth technical product knowledge to target customer preferences

Data and Digital Skills	
Advanced Digital Acumen/Literacy	Sophisticated understanding of technology and software features used to analyse and manipulate data and use ICT to organise and share information clearly
Analytics and Computational Modelling	Develop, select and/or apply algorithms and advanced computational methods to enable systems or software agents to learn, improve, adapt and produce desired outcomes or tasks, also include application of data modelling techniques to explore and address a specific requirement
Automation Management	Oversee automation systems to ensure operation requirements are met as well as propose strategies for the automation systems performance improvement
Cybersecurity	Understand cyber security threats and potential weaknesses for prioritisation of managing security risks
Data Engineering	Develop efficient and stable processes to collect, store, extract, transform, load and integrate data at various stages in the data pipeline ensuring that it is ready for use and analysis according to business requirements
Data Interpretation and Analysis	Extract, analyse and make sense of information to form a holistic perspective and generate insights

Data Storytelling	Blend the world of hard data and human communication. Use a combination of visualisation(s) and narrative(s) in a format that suits a particular need, and augment the full comprehension of new information.
Programming and Coding	Technical capability required to write programs to be processed by computers
Technology Design	Create solutions and strategies to implement technology incorporating emerging technology trends to meet current and future business needs
Technology Troubleshooting	Ability to problem solve basic technical issues and identify root cause of problems, including determining when to escalate issues
Threat Intelligence and Detection	Monitor intelligence-gathering and anticipate potential threats to an ICT system proactively, this involves the pre-emptive analysis of potential perpetrators, anomalous activities and evidence-based knowledge and inferences on perpetrators' motivations and tactics
User Experience Design	Understand prototyping and able to contribute in wireframing website features that appear logical and usable on any device – with the objectives to improve customer loyalty and satisfaction through ease of use and utility provided in the interaction with an end-product

WHAT DOES THIS ALL MEAN FOR BRAZIL?

THANK YOU