‘The Fourth Industrial Revolution: Introduction and Overview’

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Topics for today

- What is the Fourth Industrial Revolution / Industry 4.0 [4IR]?
- How is it different?
- Developing countries
- Impact on employment
- State of the literature
- Thinking about policy implications

What is 4IR?

- Term apparently first used in 2016 by World Economic Forum (Klaus Schwab)
- Dramatic change in *pace and scope* of automation of tasks previously done by humans
- Blurring of boundaries between the physical, biological and digital spheres
- Robotics; Artificial Intelligence (AI); Internet of Things (IoT) and Industrial Internet of Things (IIoT); cyber-physical systems; augmented reality (AR); virtual reality (VR); biotechnology; nanotechnology; autonomous vehicles; cloud computing; 3D printing…

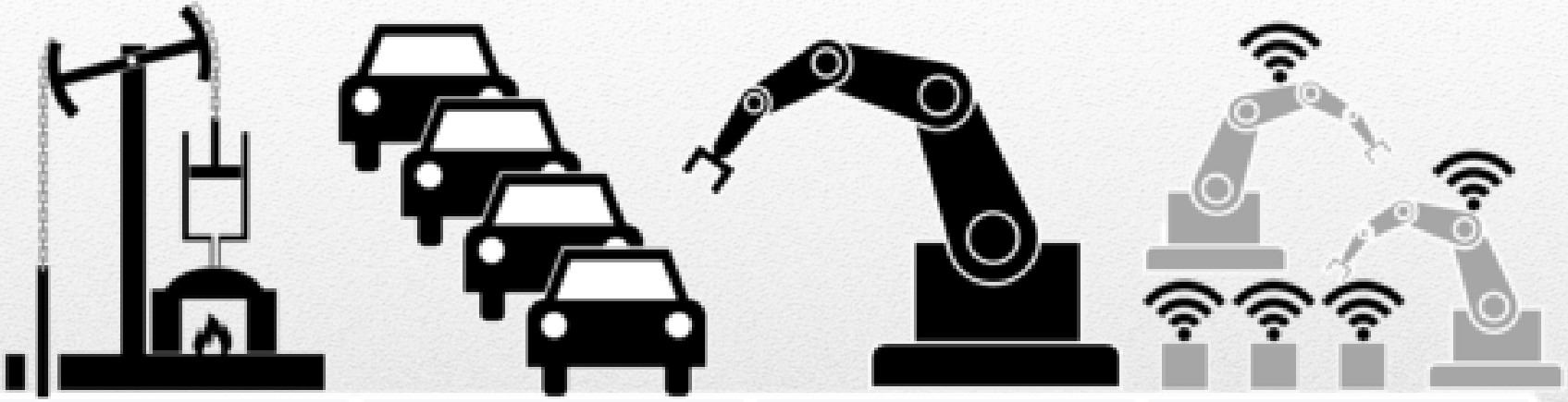
Historical background

- **First Industrial Revolution**
  - Late 18C and early 19C
  - Industrialisation
  - Use of water and steam to mechanise production
  - Steam engine

- **Second Industrial Revolution**
  - ± 1970 – 1914
  - Use of electricity for mass production
  - Electricity, combustion engine, steel, chemical synthesis, large factories, assembly lines

Historical background

- **Third Industrial Revolution**
  - 1980s onwards
  - ‘Digital revolution’
  - Use of electronics and ICT to automate production
  - ICT, internet and computers



1st	2nd	3rd	4th
Mechanization, water power, steam power	Mass production, assembly line, electricity	Computer and automation	Cyber Physical Systems

How is 4IR different?

- Is it really a “revolution” or just a lot of hype?
- Not linear stages
- But it is qualitatively different and new, and irreversible
- Distinguished by
  - Exponential *velocity*
  - Wide-ranging *scope*
  - *Systemic impact*

4IR in SA and developing countries

- We are still undergoing elements of earlier industrial revolutions
- 4IR still nascent
- International diffusion of 4IR is exponentially faster than earlier industrial revolutions
- “Estimates of how many jobs are vulnerable to being replaced by machine vary but it is clear that developing countries are more susceptible to automation compared to high-income countries.” (Millington, 2017)

How is employment likely to be affected?

- Multiple channels affecting
  - Overall number of jobs
  - Composition of employment (by skills level, sector etc.)
  - Nature of work, work processes and the workplace

Overview of literature

- Academic studies; policy reports; business press and media
- Deal with various aspects of 4IR from various disciplines (engineering, economics, politics etc.)
- Theoretical analyses; empirical analyses of what has happened sofar; projections of likely short- to medium-term impact; futuristic projections

Overview of literature – employment impact

- Recent burgeoning of studies analysing impact on employment
- Empirical studies mostly focus on advanced economies (especially USA and Germany)
- Little on practical policy options

Important contributions on the impact of 4IR on jobs include:

- Frey & Osborne (2017) ‘The future of employment: how susceptible are jobs to computerisation?’
- Brynjolfsson & McAfee (2014) *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*
- Autor (2015) ‘Why are there still so many jobs? The history and future of workplace automation’
- Acemoglu & Restrepo (2017) ‘Robots and jobs: evidence from US labor markets’
- Ford (2015) *The Rise of the Robots: Technology and the Threat of Mass Unemployment*

Emerging findings from the literature

- Impact on total employment
  - Lack of consensus
  - ‘Mass technological unemployment’?
  - Some argue that ‘dystopic’ future of job destruction is overestimated/alarmist
  - There will be job displacement/destruction and job creation (generally for different people)
  - Automation can potentially raise productivity and earnings for some people
  - But very strong evidence of **large net negative impact**

Emerging findings from the literature

- Impact on composition of employment
  - Clear that there will be uneven impact, by occupation, sector, skills level etc.
  - Certain types of jobs are most vulnerable
  - Growing number of empirical studies internationally, identifying jobs most likely to be affected
- Impact on distribution
  - Effect on incomes and quality of life depends on what happens to ‘surplus’
  - Likely rise in inequality

Which jobs most likely to be affected

- Depends on degree of *automatability* – how routine and codifiable are tasks
- Overall, lower-skilled jobs more vulnerable than high-skilled, but not straight correlation
- This is one difference from previous types of automation – some white-collar jobs now more vulnerable than some blue-collar jobs
- Less vulnerable jobs are those involving creativity, social interaction, high levels of dexterity, lot of variation amongst tasks

Policy implications

- Employment outcomes not cast in stone – policy can influence to some extent
- The less prepared and proactive a country is, the higher job losses likely to be
  - Direct due to changing nature of domestic production
  - Indirect due to loss of international market shares
- Should policy focus on
  - Minimising job losses, and/or
  - Reskilling workers in vulnerable jobs, and/or
  - How to distribute costs and benefits of 4IR?

Further work on this paper

- Literature review
- Organising, synthesising, summarising, critiquing the existing literature and drawing out particular implications for SA