Tracking digital adoption
…footprints in the sand

Dr Dan Mawson
UK Department for Business, Energy and Industrial Strategy

Department for Business, Energy & Industrial Strategy

The digital economy is the result of successive waves of ICT technologies

1970s / 80s

First was the **personal computer** followed by more **portable laptops**

1990s

Then we had the **world wide web** and progressively faster internet connections

2000s

Now we have **mobile computing devices** with wireless internet access

2010s

Which can access remote computing power / devices in the **cloud**

2020s

With **AI / Machine Learning** based software and **robots** capable of increasingly complex tasks

First Wave: Data storage, processing, visualisation and communication technology which steady expanded into a wider range of tasks

"Dawn of the machines"

Second wave: Increasing accessibility / ease of use, convenience / mobility and interconnectedness

"Everything, Everywhere, All at Once"

Third Wave: Big Data, distributed / more autonomous technologies

"Rise of the Robots"

Given the ubiquity of digital technology in peoples' lives it is interesting that its diffusion across businesses remains uneven

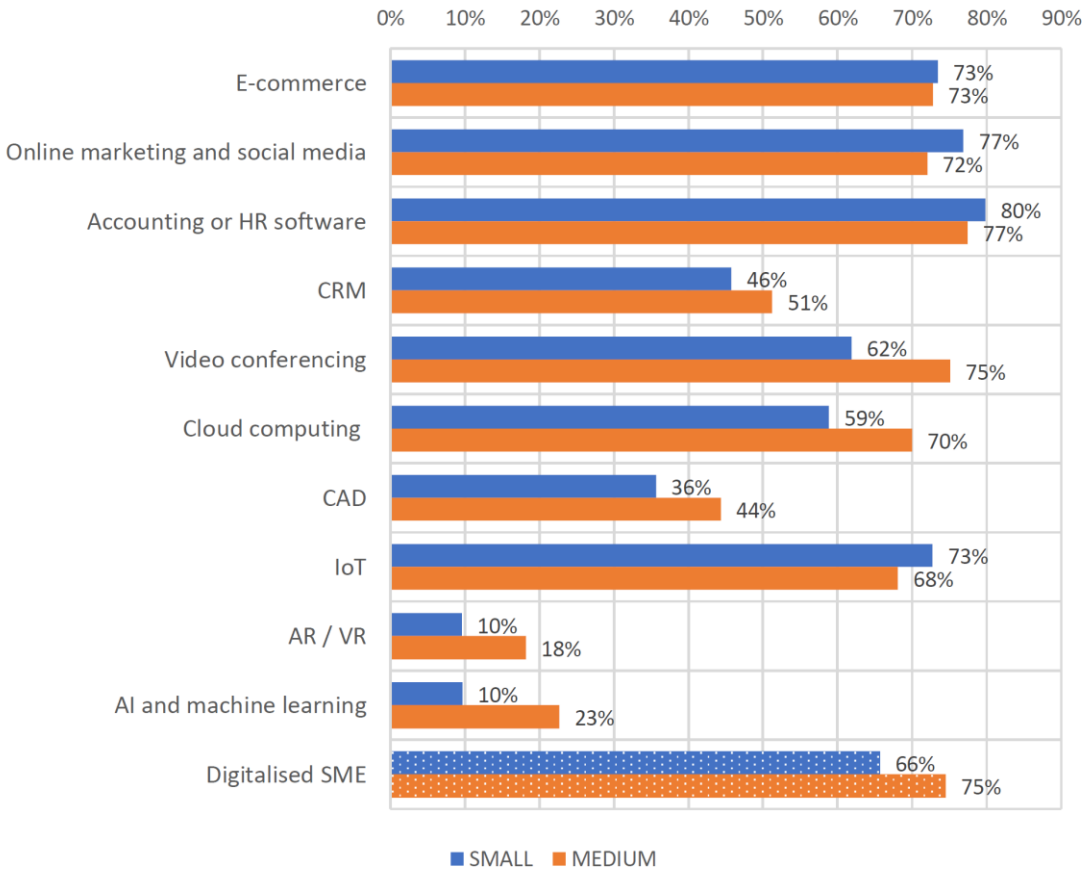
Part of this is the **relative maturity** of different waves of ICT technologies (The PC has been around for four decades)

Similarly **not all technologies are applicable** to all firms (e.g. Computer Aided Design, AR / VR)

But still see **differential patterns** within waves

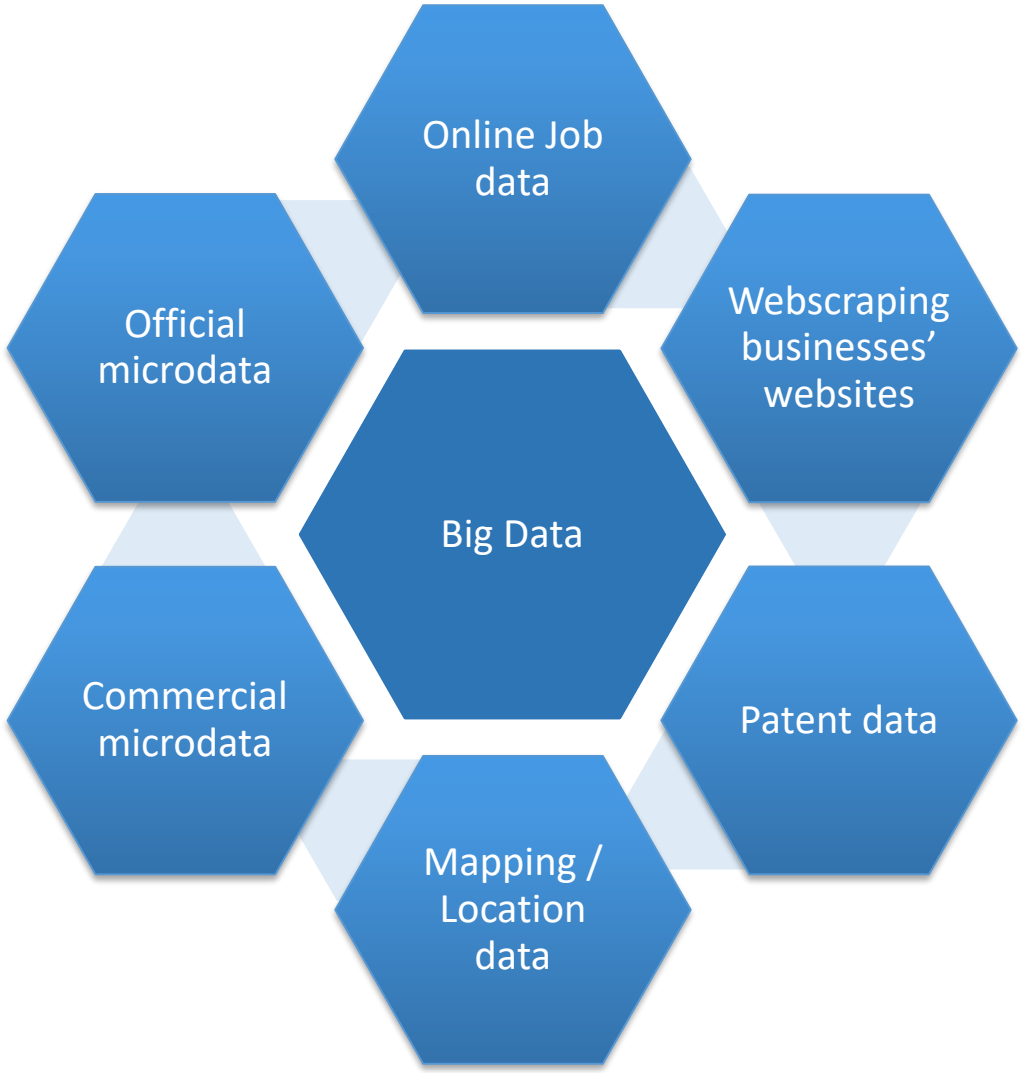
- **Wave 1:** Personal computers are basically ubiquitous, but not all firms use the available tools (accounting software)
- **Wave 2:** Smartphones ubiquitous, but use of e-commerce, online marketing etc. less so
- **Wave 3:** Moderately high take-up of cloud computing, but use of AI / Machine Learning is fairly niche

Adoption of different digital technologies by firm size (%)



Source: ERC (2021) Digital readiness, Digital adoption and Digitalisation of UK SMEs Amidst the Covid-19 crisis

Tracking diffusion and adoption of new technologies is hard – but creative use of Big Data is providing us with ‘footprints in the sand’



Standard approaches like surveys struggle as you **can only ask about technologies you already know exist**

Fortunately, the latest wave of ICT has handed us the tools we need to understanding it (**Big Data**)

This allows us to track diffusion by looking for ‘**footprints in the sand**’ – indicators of the consequences of adoption activity

These approaches are still in their **early days** however, and there are issues around

- Data quality and consistency (particularly over time)
- Methodological comparability
- Triangulation / linking across sources
- Interpretation

AI and Cloud adoption shows a strong STEM skill bias, with the top adopters pulling way from the rest

Approach

- UK data on **online job adverts** from large firms – identify use of particular technologies; break down by SIC / SOC / TTWA
- Analyse rates of **diffusion across firms** (extensive / intensive margin) controlling for **local skill availability**
- Cross check with alternative data on **PC adoption** to identify differences with cloud and AI / machine learning adoption

Results

- **Skills availability** is a key factor in the uptake of ICT technologies
  - Both **general skills** and **STEM skills** accelerate PC adoption
  - **STEM skills** significant drivers of Cloud / AI adoption
- Adoption of Cloud / AI in the top quintile of firms appears to be **accelerating away from the rest**

Questions and observations

To what extent is the STEM bias in Cloud / AI due to them being **less mature tech**, than PCs?

Or are there reasons to think they may be different?

'**Oxbridge**' as a control variable in robustness checks was significant for AI but not cloud

Indication that Cloud is a more mature technology than AI?

Given **scalability of AI / Cloud**, would we expect Intensive margin to behave differently to previous technologies?

e.g. smaller no of AI jobs for a firm of given size

In principle could e**xplore J-Curve effects** by looking for job ads with complementary skills

e.g. new business management techniques

Which matters because AI adopters are more productive, and following adoption become even more so

Approach

- **Merge surveys on ICT adoption** with employer-employee and standard accounting datasets
- Look at **changes in workforce composition** before and after AI adoption
- As well as **changes firm performance** before and after adoption

Results

- **Rapid diffusion of AI** into some sectors, predominantly services, less so manufacturing
- AI adoption has a **significant impact on workforce** – with firms hiring substantially more tech workers in preparation
- **Strong selection effects** – more productive firms more likely to adopt AI, and then become more productive as a result

Questions and observations

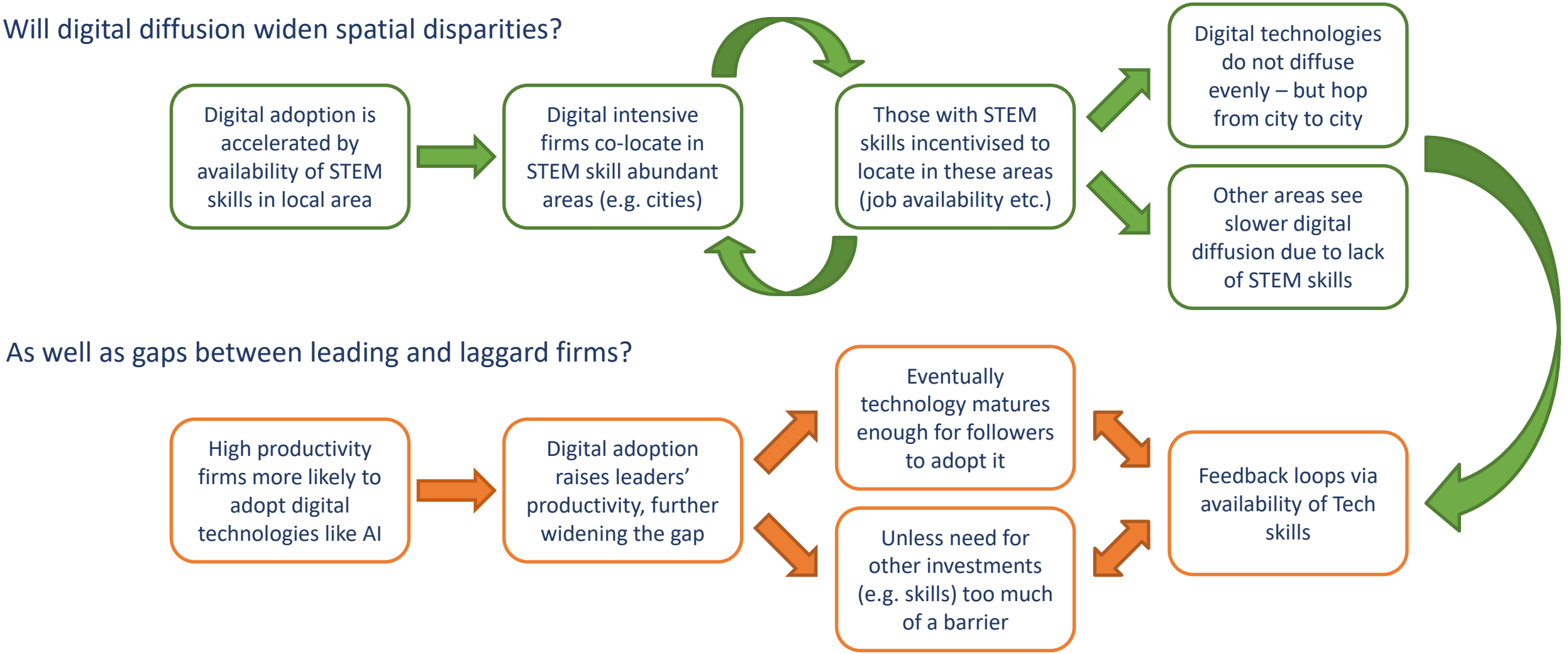
Differences in sector adoption rates provides evidence that **AI really is different** from previous waves of automation – as it reaches into more service type activities / tasks

Different maturities / waves of AI technologies? Non-ICT firms more likely to adopt off the shelf packages (workflow automation, text mining)

Changes in workforce composition – Are AI jobs displacing other jobs, any evidence of other composition effects?

Early vs late adopters – how different are they from other firms, not just in terms of productivity (e.g. location, size, age)?

Policy implications (1) – Digital adoption as a driver of widening spatial and firm level disparities?



Policy Implications (2) – The other big question around digital adoption is will it create complementary medium skill work?

Historically, urban areas in the USA provided opportunities for lower educated workers to find medium pay work
However since 1980 these opportunities have declined and have been replaced with lower paid work

Essentially as it matures will the latest wave of digital technology help create the medium skill jobs of the future, or will it kill them off?

*Source: Autor (2020) The Faltering Escalator of Urban Opportunity; *Occupational Employment Shares among Workers with and without Four-Year College Degree by Commuting Zone Population Density, 1980–2015: Level Relative to 1980 Mean*

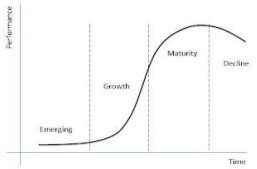
Key Takeaways

Big Data is a huge opportunity to improve our understanding of adoption and diffusion

- *But still a lot of methodological issues to be pinned down*

Digital adoption and diffusion could widen not reduce spatial and firm level disparities

- *In particular via feedback loops relating to the availability of required skills*



But technologies do also mature and become more accessible to non ‘power users’

- *The Mobile Computing revolution is an example of how a complex technology can be made accessible and useful to an extremely wide range of people*