



The Start of the Curve

Quantifying the impact of job automation

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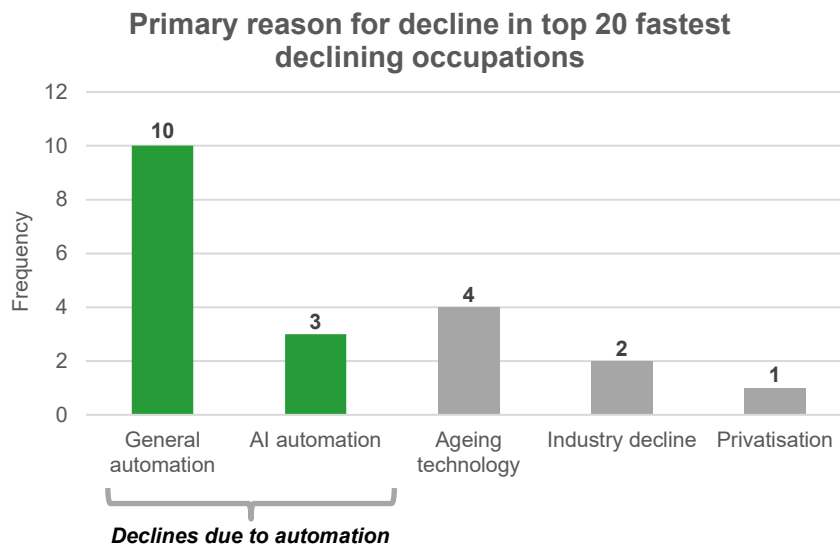
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Executive Summary

Recent studies exploring the effect of automation and AI on the job market make long-term predictions based on job or task characteristics. This white paper takes a different and complementary approach by quantifying real observed trends in UK job vacancies in recent years.

Our analysis of Adzuna's data from the last 26 months leads to three main conclusions:

- 1. 13 out of 20 of the fastest declining jobs have declined due to the effects of automation.** This includes 3 occupations which have had declines driven specifically by advancements in AI technology.



- 2. Observed vacancy changes over this period do not yet support the predictions made by Frey & Osborne in their 2013 paper¹.** Comparing their 'probabilities of computerisation' with actual changes in vacancies showed almost no correlation. Reasons for this result are discussed.
- 3. Although AI and automation have not affected job vacancies in the way predicted by recent studies, the evidence suggests an overall level of decline due to automation which indicates we are at the 'start of the curve'.** Expert opinion² is that this curve will lead to Artificial General Intelligence (AGI) around 2040.

As well as declining occupations, we include an analysis of those occupations and sectors showing the fastest growth. Combined, the data suggests that over the next few years the volume of new jobs created by automation will continue to largely balance out those that disappear. However, in our opinion, as AI technology becomes more powerful and pervasive we will see radical changes to this status quo.

¹The Future of Employment: How Susceptible are jobs to computerisation?', Carl Benedict Frey and Michael A Osborne, September 17 2013. (Later expanded and published as Technology at Work v2.0: The future is not what it used to be, Citibank, January 2016)

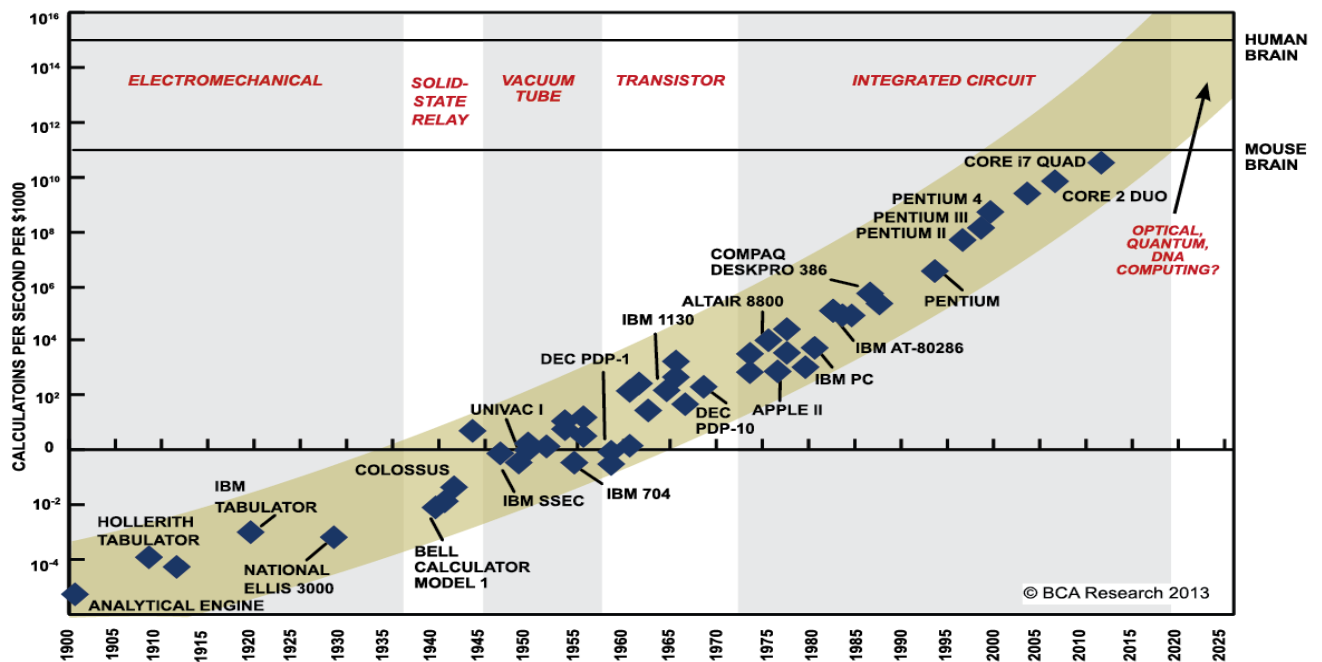
² <http://www.nickbostrom.com/papers/survey.pdf>

Introduction

Six recent studies have all predicted that advancements in automation and artificial intelligence (AI) will lead to a significant long-term reduction in the number of jobs. The table below summarises these predictions.

Author(s)	<i>Frey and Osborne</i> ³	<i>World Economic Forum</i> ⁴	<i>OECD</i> ⁵	<i>McKinsey Global Institute</i> ⁶	<i>PWC</i> ⁷	<i>IPPR Scotland</i> ⁸
Job impact predictions	In the OECD, on average 57% of jobs are susceptible to automation over the next decade or two	A gross global employment impact of more than 7.1 million jobs lost to disruptive labour market changes between 2015–20	On average, 9% of jobs across the 21 OECD countries are automatable	50% of today's work activities could be automated by 2055	Up to ~30% of existing UK jobs could face automation over the next 15 years	Over 46% of jobs (1.2m) in Scotland are at high risk of automation by 2030

The results of these papers have been widely reported by the media, leading to a growing awareness of the long-term job market challenges that look certain to arise. The underlying driver is growth in computing power as illustrated by the chart below⁹:



³ 'The Future of Employment: How Susceptible are jobs to computerisation?', Carl Benedict Frey and Michael A Osborne, September 17 2013. (Later expanded and published as Technology at Work v2.0: The future is not what it used to be, Citibank, January 2016)

⁴ The future of jobs: Employment, skills, and workforce strategy for the fourth Industrial Revolution, World Economic Forum, January 2016

⁵ Arntz, M., T. Gregory and U. Zierahn (2016), "The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis", OECD Social, Employment and Migration Working Papers, No. 189, OECD Publishing, Paris. <http://dx.doi.org/10.1787/5jlz9h56dvq7-en>

⁶ <http://www.mckinsey.com/global-themes/digital-disruption/harnessing-automation-for-a-future-that-works>

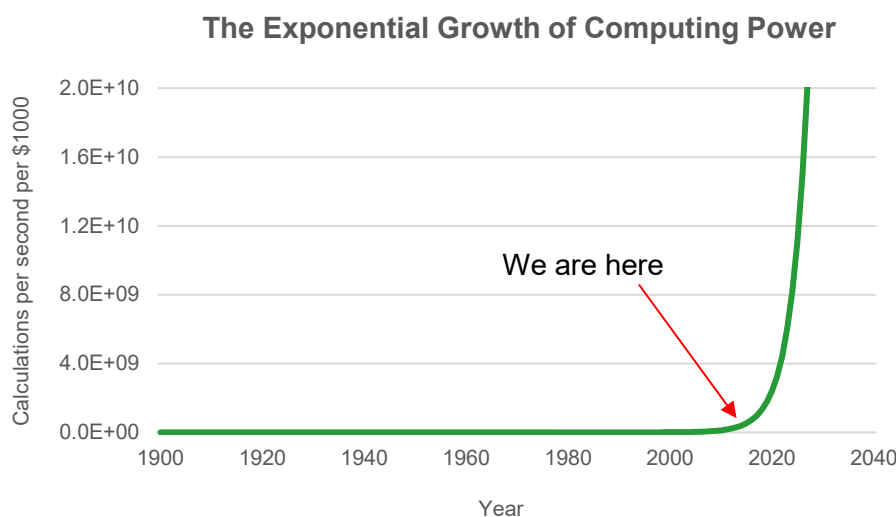
⁷ http://pwc.blogs.com/press_room/2017/03/up-to-30-of-existing-uk-jobs-could-be-impacted-by-automation-by-early-2030s-but-this-should-be-offse.html

⁸ http://www.ippr.org/files/publications/pdf/Scotland-skills-2030_May-2017.pdf

⁹ Source: Ray Kurzweil, 'The Singularity Is Near: When Humans Transcend Biology', P.67, The Viking Press, 2006. Data points between 2000 and 2012 are BCA estimates

If this trend persists, computing power will reach the level of a human brain in approximately 10 years. This raw computing power combined with AI software development is then expected to lead to Artificial General Intelligence (AGI). A survey¹⁰ conducted by Nick Bostrom in 2013 asked a panel of 550 AI experts about their expectations of when AGI would be reached: the median estimate of the experts was the year 2040.

For an alternative perspective on the sheer rate of increase of computing power, the same data from the previous graph¹¹ can be viewed on a conventional scale (rather than logarithmic):



The end of Moore's Law?

Moore's Law may be reaching physical limits in the next 10 years, but a fundamental slowdown in computing power is not expected within the timeframes for AGI¹². Furthermore, processing power per \$1,000 (a key factor governing the rate of AI development) is only indirectly linked to the number of transistors per integrated circuit which is predicted by Moore's Law.

Looking forward

The estimates set out by the previously published studies have wide margins of error (for example, it is an almost impossible task to model the scale of job growth resulting from the creation of new types of job). They do however all point to substantial and dramatic changes to the job market. It seems more a question of 'when' rather than 'if'.

Looking back

Instead of wrangling with predictive models, this paper seeks insight by looking in the opposite direction. If we are at the point of inflection of the curve, then should we already be able to see some early evidence for job losses caused by automation?

By examining vacancy levels since 2015, we aim to investigate whether we are truly now at the start of the curve.

¹⁰ <http://www.nickbostrom.com/papers/survey.pdf>

¹¹ Raw data here: <http://www.singularity.com/charts/page70.html>

¹² Even though it is inevitable that a physical limit to the minimum transistor size will be reached at some stage, it is expected that over the next 20-30 years these limitations will be offset by innovations such as 3D integration (essentially a form of parallelising) and graphene technology

Methodology

Data source

Over 79 million archived UK job adverts were extracted from Adzuna's database covering the period January 2015 to February 2017. Adzuna's business model as an aggregator of job adverts means that this data forms a comprehensive record of vacancies advertised in the UK during this period.

Selection of analysis period

Following the exponential trend, the greatest changes in computing power and AI technology have occurred most recently. On this basis it makes sense to focus on recent data since occupations showing significant recent declines are more likely to have automation as the primary driver. On the other hand, the job market is strongly seasonal and relatively slow-moving and therefore a reasonable period of time is desired in order to get meaningful sample sizes and trends.

A start date of January 2015 was selected which, at the time of the analysis, provided 26 months of data. Over this period (using the exponential growth curve outlined in the introduction) processing power per \$1000 increased by 84%. We also observe in the market a rapid growth of new AI products and automation tools over this period.

Data cleansing

The job adverts were first de-duplicated and the job titles were normalised to Adzuna's standardised set of occupations. Using this data, monthly counts of new vacancies were generated for ~5,000 unique occupations. These counts were then normalised to account for changes in the total number of job adverts live at any time (accounting for seasonal variations), and lastly rebased to a score of 100 in Jan 2015. This final step enables easier direct comparison of changes between occupations.

Occupation standardisation

Very similar occupations were identified and clustered (for example, occupations including *kitchen steward*, *kitchen team member* and *kitchen supervisor* were grouped as *kitchen staff*). This approach also mitigated the effect of job titles being renamed or 'rebranded' over time.

Data analysis

Using the cleansed data set, a linear regression model was run against the time series of each occupation. For the selection of top 20 declining and growing occupations, secondary cleansing was also implemented to only include occupations where:

- The correlation coefficient was >0.4 (this ensured that vacancy trends with very high volatility were excluded)
- All individual monthly counts for each vacancy time series were >20

The top 20 declining and growing occupations were generated by sorting by the average observed rate of monthly change (ie the slope of the regression line) for the normalised and rebased vacancy counts.

To analyse the occupations from the Frey & Osborne paper, the job titles were matched against the titles in Adzuna's ontology. To eliminate any potential bias only exact text matches were allowed. This resulted in 63 matching occupations for which there was data on both probability of computerisation and average observed monthly changes.

Declining Occupations

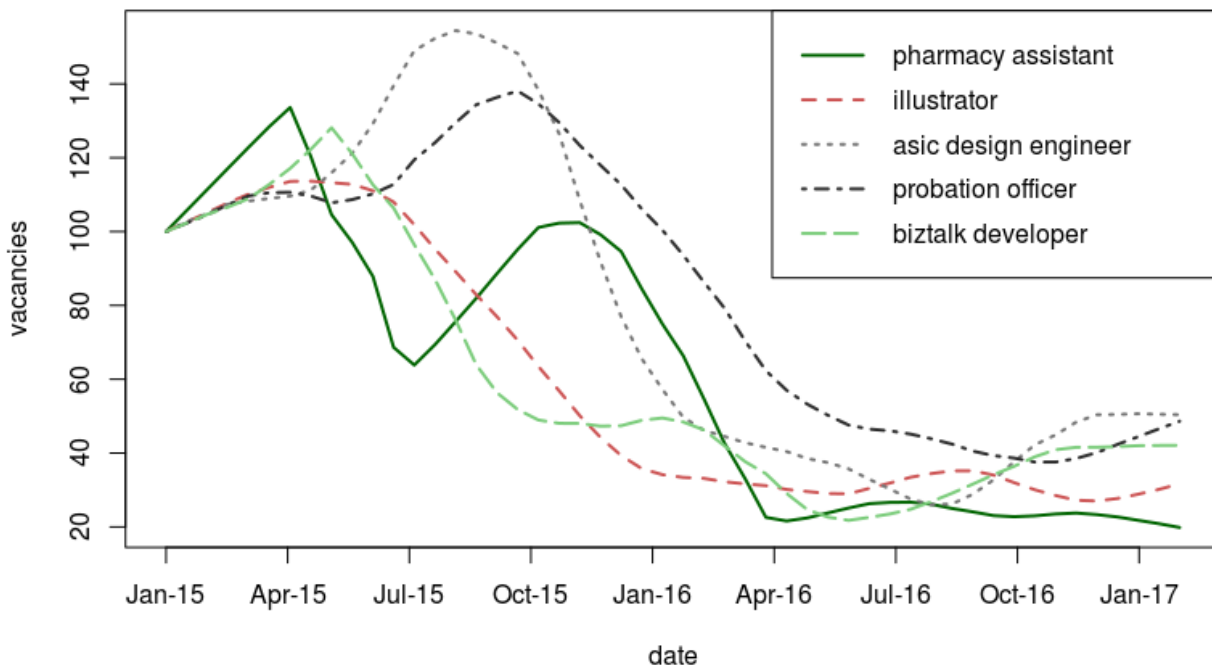
Results

The table below shows the top 10 fastest declining job titles (see appendix for extended table). The assigned categories are Adzuna's opinion of the primary reason for decline based on the details given in the discussion section below.

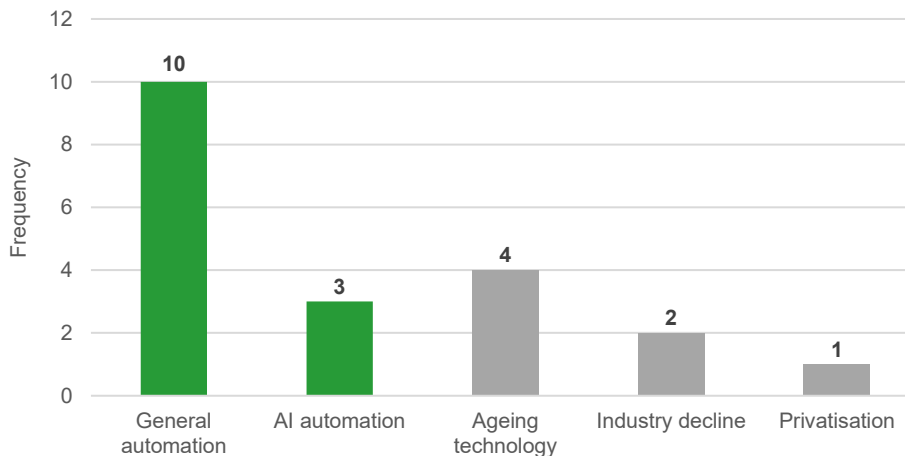
Rank	Occupation	Category	Average monthly decline*	Vacancy count Jan-2015
1	pharmacy assistant	General automation	-4.50	1407
2	illustrator	General automation	-4.36	457
3	ic/asic design engineer	General automation	-4.20	251
4	probation officer	Govt funding	-4.11	255
5	biztalk developer	Ageing technology	-4.04	289
6	translator	AI automation	-3.99	1393
7	writer	AI automation	-3.98	1797
8	travel agent	General automation	-3.96	221
9	case handler	General automation	-3.85	624
10	vba developer	Ageing technology	-3.82	123

* Average rate of decline per month from normalised level of 100 in January 2015

The chart below shows the individual trends for the top five of these occupations, with vacancy counts rebased to 100 in Jan 2015. (Time-series are smoothed with a fitted first-order loess curve).



Primary reason for decline in top 20 fastest declining occupations



Discussion

The chart categories reflect our opinion of the primary reason for the decline of each occupation. Evidence and justification for these is given below for a sample of occupations. The content of this section is based on research of third party information rather than from our data.

Side-note: Impact of the gig economy

A common secondary reason for decline is the effect of the gig economy, which has enabled companies to more easily employ ad-hoc contractor staff. Although this type of work is commonly understood to consist of cheap, routine mini-tasks (eg Amazon's Mechanical Turk) there are also platforms (eg Upwork, Freelancer) which let employers procure more complex one-off pieces of work such as writing reports and creating graphics. Whilst Adzuna advertises a proportion of these gig economy jobs, it is not comprehensive in this sector and therefore for some occupations this effect is likely to be an important secondary reason for vacancy declines.

AI automation

Three of the occupations - Translators, Writers and IT Support Analysts - are areas where there is substantial investment into AI software design approaches. Below we briefly explore some of the specific AI technologies now being used in each of these areas.

- **Translators:** the most well-known and accurate automated translation software is powered by one of the biggest tech companies in the world: *Google*. It is also free. In November 2016 they quietly announced in a blog post¹³ a big upgrade to the model using machine-learning technology which achieves close to human levels of accuracy. They also offer a 'cognitive augmentation' toolkit¹⁴ for even better results. It is no surprise that companies would now be reluctant to recruit translators except for specialist applications.
- **Writers:** the rise of huge social media platforms has changed the writing profession immensely. Automated writers are already here. Whilst they cannot yet challenge the creativity of human writers, they perform well at building factual narratives from structured data sources. The *Associated Press* already uses software¹⁵ to write corporate earnings reports and *Yahoo* uses similar technology to create fantasy sports reports for its users.

¹³ <https://blog.google/products/translate/found-translation-more-accurate-fluent-sentences-google-translate/>

¹⁴ <https://translate.google.com/toolkit>

¹⁵ <http://www.theverge.com/2015/1/29/7939067/ap-journalism-automation-robots-financial-reporting>

Additionally a swathe of new AI-powered report writing software has become available such as *Yseop*¹⁶, *NarrativeScience*¹⁷ and *AutomatedInsights*¹⁸.

- **IT Support Analysts:** this is another area where the march of new AI companies appears to be having a real and measurable impact. Customer support chatbots such as those from *Amelia*¹⁹, *Twyla*²⁰, *TrueAI*²¹ and *BicycleAI*²² are all configurable for IT support applications and are being successfully used right now in companies to handle first-line support. Other factors are also driving this trend, such as general improvements in software and hardware reliability, the increased popularity of BYOD (*Bring Your Own Device*) to work and a working demographic which is increasingly comfortable with technology.

General automation

For many of the roles the decline in vacancies is driven by the ongoing march of software improvement and it can be hard to distinguish between this and what is (or was) 'AI'. Software that can automate the design of an integrated circuit would once have been seen as requiring artificial intelligence, yet it is now considered normal software. The same applies to creating 3D animations. This is known as the *AI Effect*²³. Douglas Hofstadter, an American professor of cognitive science, concisely expresses the AI effect by quoting Tesler's Theorem: "*AI is whatever hasn't been done yet.*"²⁴

The methods of general automation for the two fastest-declining roles are summarised below.

- **Pharmacy Assistant:** this role typically combines administrative work with dealing with customers and handling payments etc. There is a growing number of pharmacy automation solutions available - both pure software²⁵ and, to a lesser extent, robotic²⁶ which reduce the necessity for an in-store pharmacy assistant. A secondary driver is also important in our view: NHS funding cuts announced in early 2016. An average community pharmacy, as opposed to one within a hospital, receives about £220,000 in NHS funding each year²⁷ and so these cuts will be drivers for substantial cost-savings within pharmacies.
- **Illustrator:** illustrators work in two growing sectors: 3D animation and 2D digital artwork. Powerful software²⁸ is now available to automate much of the previously laborious process of 3D animation – for example automating the complex frame-by-frame calculations required for lighting and shadows. For 2D images, freely available or low cost software combined with huge online databases of clip-art and stock images has enabled high quality artwork to be produced with lower levels of artistic skill and experience than ever before.

¹⁶ <https://yseop.com/>

¹⁷ <https://www.narrativescience.com/>

¹⁸ <https://automatedinsights.com/>

¹⁹ <http://www.ipsoft.com/amelia/>

²⁰ <https://www.twylahelps.com/>

²¹ <http://www.trueai.io/>

²² <http://bicycleai.com/>

²³ The AI effect: https://en.wikipedia.org/wiki/AI_effect

²⁴ As quoted by [Hofstadter, Douglas](#) (1980), *Gödel, Escher, Bach: an Eternal Golden Braid*, p. 601

²⁵ Examples include: <http://jac.co.uk/>, <http://www.scriptpro.com/>, <https://www.icarehealth.co.uk/pharmacy/>

²⁶ <http://www.pharmacyautomationsystems.com/>

²⁷ <http://www.bbc.co.uk/news/health-35418556>

²⁸ For example <https://www.maxon.net/en/> and <https://www.blender.org/>

Ageing technology

Four of the roles - *Biztalk Developer*, *VBA Developer*, *ASP.net MVC Developer*, and *Unix Systems Administrator* - reflect the natural lifecycle seen within technology. All of these technologies are ageing and so the job titles themselves are becoming obsolete, even though the underlying technologies may still be in use and morphing into different platforms. This transition into technological redundancy is of course nothing new. We no longer see adverts for switchboard operators and video store staff however the underlying activities of phoning and watching films remain more popular than ever. Crucially, technological change has generated jobs as well as automating them.

Industry decline

For some occupations, the primary reason for change is underlying industry decline. Two specific examples are given below.

- **Metallurgists:** the major industries employing metallurgists are gas, oil, and mining companies which have been on a declining trend in the UK for many years.^{29,30} Globally the steel industry has also seen a significant dip in production over the last 2 years (which is only now beginning to show signs of recovery³¹).
- **Regulatory Affairs Officers:** the majority (>85%³²) of advertised Regulatory Affairs Officers are within the pharmaceutical and biotech sectors rather than finance or energy and the UK pharmaceutical industry has seen a marked decline since 2009³³. The NASDAQ Biotech index, which is one of the more stable measures of this extremely volatile sector, has also had a significant drop since a peak in mid-2015³⁴. A secondary driver for the decline of this role is due to the growth in regulation automation software - dubbed '*Regtech*'³⁵. This software can automate regulatory procedures - for example by using pattern detection to alert for non-compliant documentation or events. Regtech is currently being deployed across financial services as well as the pharmaceutical industry^{36,37}.

Privatisation

One of the top five fastest declining roles over the last 26 months has been *Probation Officer*. Our view is that the primary driver for this was the privatisation of the National Probation Service in 2014. Since then, the private sector has sought to cut costs and seek efficiencies. This has included increasing the average caseload for probation officers, resulting in a drop in the number of officers being recruited³⁸.

²⁹ https://en.wikipedia.org/wiki/Oil_and_gas_industry_in_the_United_Kingdom#/media/File:UK_Oil_Production.png

³⁰ <http://www.bbc.co.uk/news/business-34581945>

³¹ <http://www.eulerhermes.com/economic-research/blog/EconomicPublications/metal-global-sector-report-feb17.pdf>

³² Based on Adzuna sector classifications in March 2017

³³ <https://www.ons.gov.uk/economy/grossdomesticproductgdp/timeseries/kn3i>

³⁴ <https://www.ft.com/content/e25c209a-4d4d-3871-852c-00d5849e914b> (*subscription may be required to view content*)

³⁵ <https://www.ft.com/content/fd80ac50-7383-11e6-bf48-b372cdb1043a> (*subscription may be required to view content*)

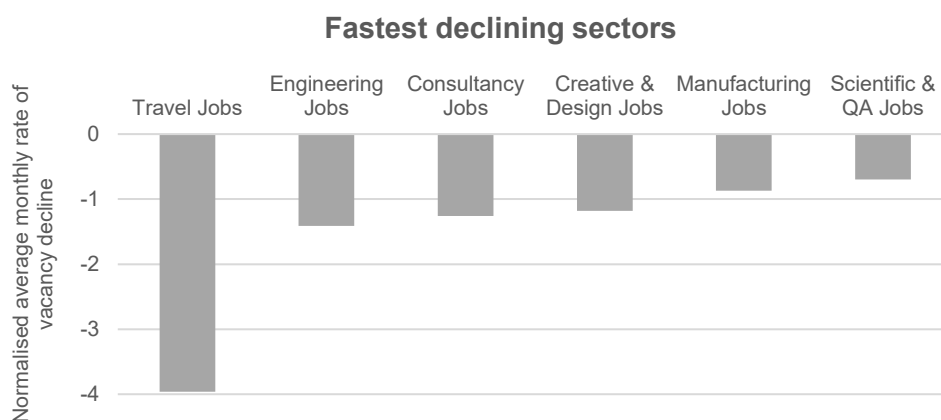
³⁶ <https://www.ideagen.com/industries/pharmaceutical/>

³⁷ <http://www.spartasystems.com/solutions/pharma-biotech-regulatory-affairs>

³⁸ Sodexo, which runs six of the 21 new rehabilitation companies, last year warned its staff to expect 30% job cuts (<https://www.theguardian.com/public-leaders-network/2016/feb/23/privatisation-probation-service-stressed-job-cuts>)

Sector-level analysis

By assigning individual occupations to standard industry categories, it was possible to analyse sector-level trends³⁹. Using this metric, the six fastest-declining sectors are shown in the chart below.



The five recent job automation studies referenced in this paper reach a broad consensus for the industry sectors in which job automation is expected to hit hardest. These sectors are: administration, sales, manufacturing, retail and transportation.

However, comparing this with the sector analysis results in the chart above, it appears that the only sector with strong overlap is manufacturing.

There are various possible explanations for this. One is that the automation trends have not yet had time to take effect (noting the studies' forecasts are generally projected for the next 10 to 20 years). Another is that exogenous factors have had a stronger influence in the short term. Further, the type of automation which has led to the decline in, for example, travel and engineering jobs may have been excluded by the authors of the papers as just 'normal' automation rather than AI automation. This would be another example of the AI Effect, which makes it difficult to make formal distinctions between AI automation and 'normal' or general automation.

³⁹ See appendix for the full list of industry sectors

Growing Occupations

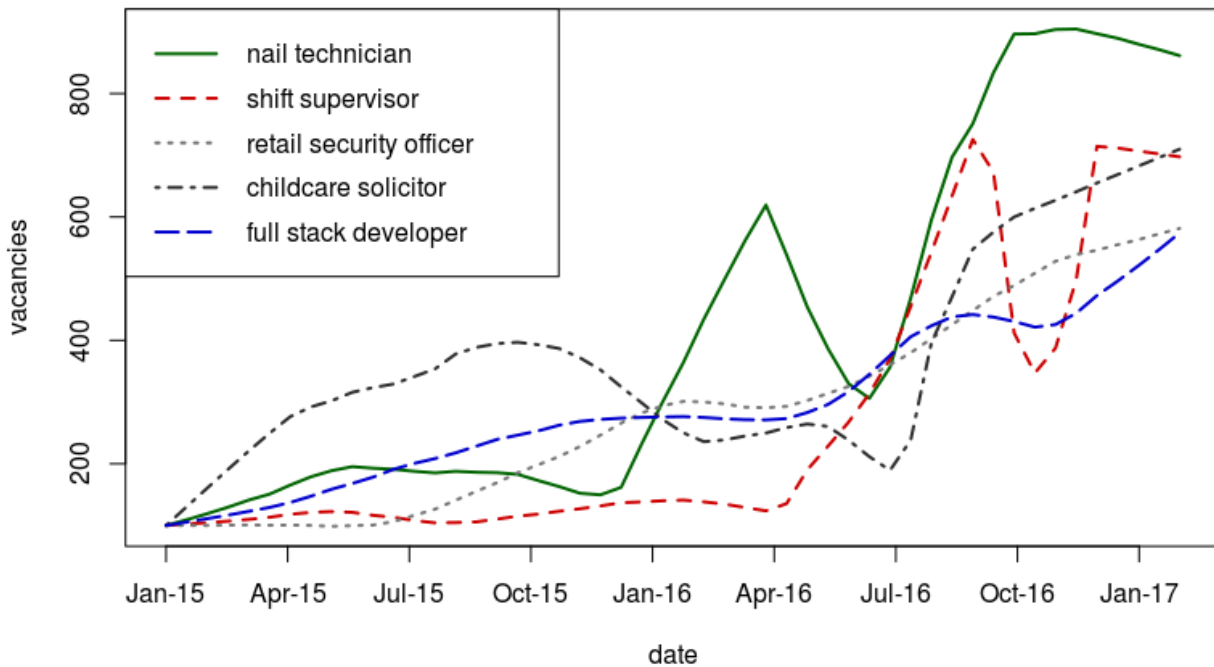
Results

The table below shows the top 5 fastest growing job titles (see appendix for extended table).

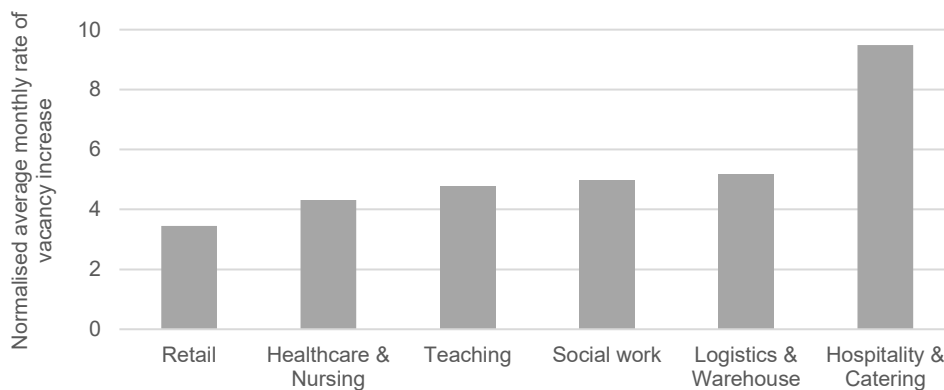
Rank	Occupation	Average monthly growth*	Vacancy count Jan-2015
1	nail technician	45.94	77
2	shift supervisor	28.67	372
3	retail security officer	21.51	350
4	childcare solicitor	18.42	24
5	full stack developer	16.22	489

*Average rate of growth per month from normalised level of 100 in January 2015

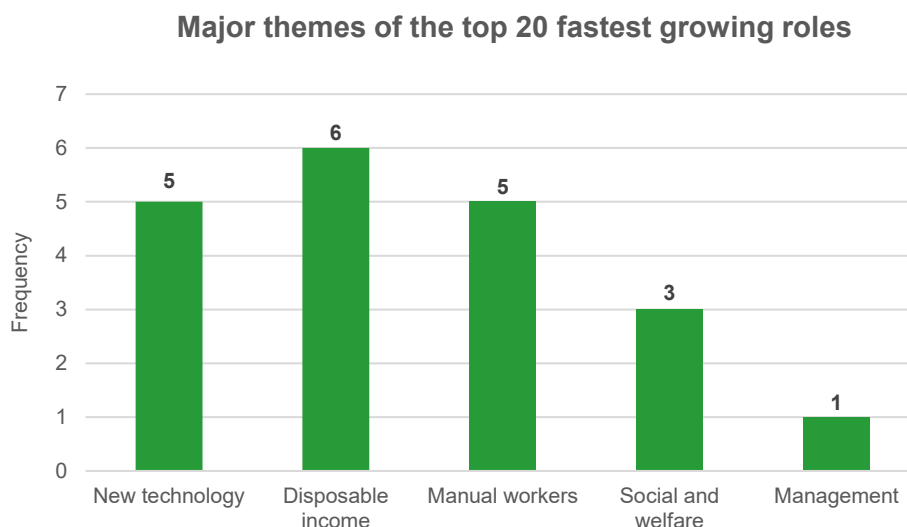
The chart below shows the individual trends for the top five occupations, with vacancy counts rebased to 100 in Jan 2015. (Time-series are smoothed with a fitted first-order loess curve)



Fastest growing sectors



Themes



Whilst the main focus of this paper is analysis of occupations showing declines due to automation, it is also instructive to consider those occupations which have shown significant growth over the period.

The twenty fastest-growing roles were assigned themes which represent our opinion based on third party information and not based on our own data. We explore the three prevalent themes.

1. New technology roles

Five of the top 20 rising occupations directly reflect the technology that is being used to automate many of the jobs, including *Big Data Engineer* and *Cloud Engineer*.

2. Roles created by increased disposable income

According to recent ONS statistics⁴⁰, over the last two years the UK median disposable income has increased by 5.8% in real terms⁴¹. This increase in disposable income can be seen as an underlying driver for many of the faster growing vacancies, from beauty treatment (nail technician) to personal finance services (personal banker and financial planner) through to increased expenditure throughout the leisure and entertainment sector⁴² (kitchen staff, chefs, and bar staff). Indeed, the hospitality and catering sector has shown the fastest growth of all sectors over this time period.

3. Manual worker roles

A range of manual 'blue collar' roles have shown substantial rises over the period. This trend can also be seen in the broader sector-level analysis where the second fastest growth sector is 'Logistics and Warehouse Jobs'. These may be related in part to the continuing strength of the UK construction industry⁴³. However, this theme is also contrary to the core predictions made by most

⁴⁰<https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/incomeandwealth/bulletins/householddisposableincomeandinequality/financialyearending2016>

⁴¹ This is after equivalisation using the consumer prices index including owner-occupiers' housing costs (CPIH)

⁴² <https://www2.deloitte.com/uk/en/pages/press-releases/articles/leisure-sector-grows-to-117-billion.html>

⁴³<https://www.ons.gov.uk/businessindustryandtrade/constructionindustry/bulletins/constructionoutputingreatbritain/jan2017andnewordersectodec2016>

of the recent studies which is that the routine, manual and low-skilled jobs will be the first to be automated.

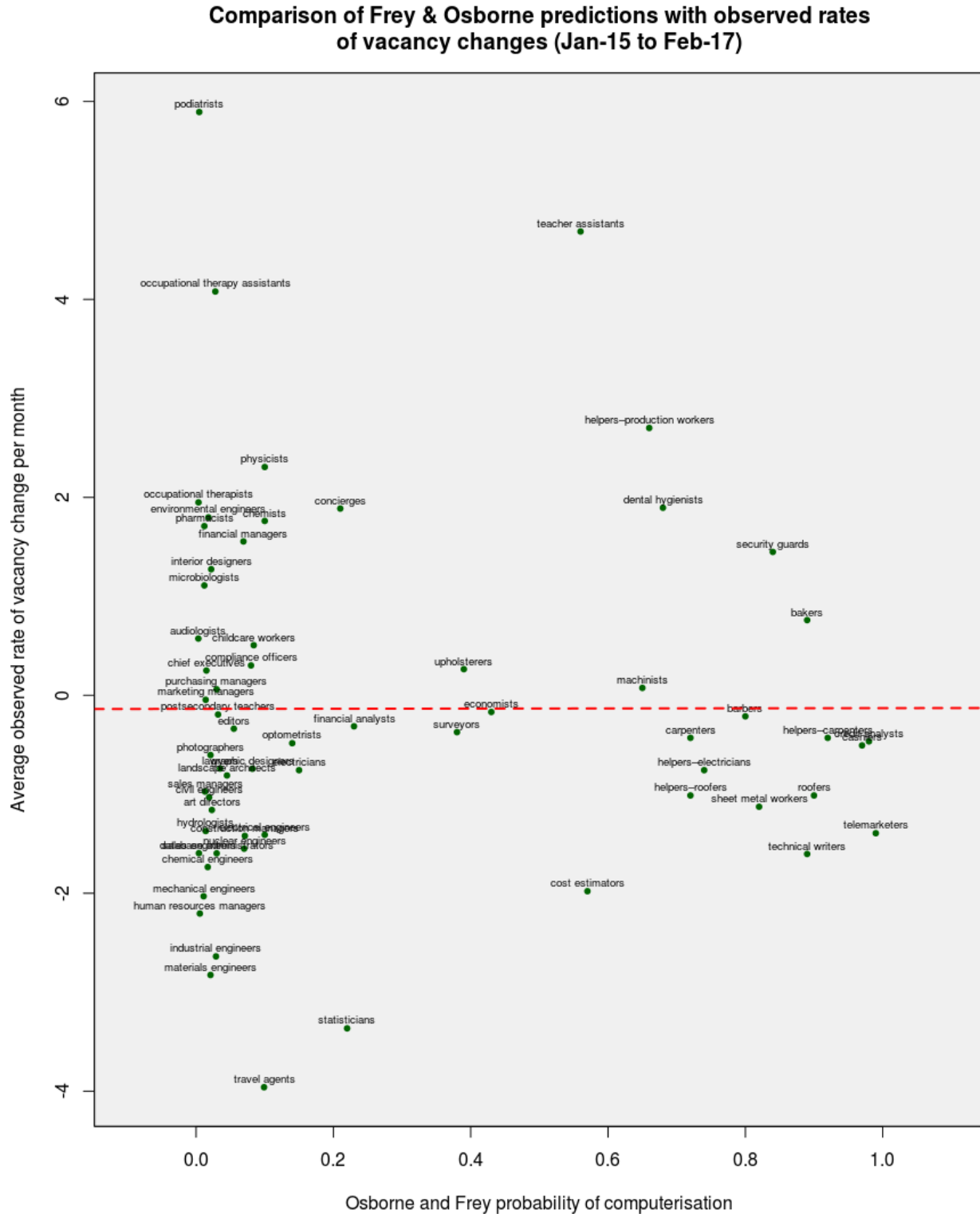
We suggest that this is symptomatic of a widespread issue, which is the conflation of AI and robotics. These are two separate disciplines advancing on different timescales. Specifically, our view is that the rate of advancement of robotic hardware will be slower than AI software⁴⁴ and our data suggests that currently, for many manual jobs it is simply more attractive for companies to employ humans than use robots. We cannot be certain why this is, but we can speculate that this may be because the economics don't make sense or perhaps because the robotic technology doesn't yet exist.

⁴⁴ based on (i) the relatively slower rate of improvement of physical hardware and sensor design when compared to the growth of computing power per \$1000 and (ii) the larger barriers to entry for research and development

Comparison with Frey & Osborne probabilities of computerisation

Results

The scatter plot below shows the correlation between the probabilities of computerisation (from the appendix of the Frey & Osborne paper) and the observed average monthly changes in vacancy counts from Adzuna data.



The vertical axis shows the average observed monthly rate of change referenced to a normalised level of 100 in Jan 2015. The red dashed line is the best-fit linear model.

As can be seen there is almost zero correlation ($R^2=2.1e-6$) and therefore this data does not appear to support the predictions from the Frey & Osborne paper.

Why is this? Timeframes and small sample sizes

The Frey & Osborne paper does not give a specific timescale for the consequences of computerisation to take effect. Rather, an indicative period of 10-20 years is stated. Therefore it may be that the 26 months of data analysed is not long enough to see a general emergence of the predicted trends. The marked absence of correlation does however suggest there may be other factors at play.

One such factor may be variability within the sample size. 9% of the 702 predicted occupations were matched and this proportion is approximately the same as the 10% sample used within the Frey & Osborne paper as the training data set. It is possible that the combined variability arising from these two sample sizes is masking underlying trends.

Conclusion

Rather than making predictions, this paper has analysed recent trends the UK job market.

Our analysis did not show significant evidence that the 2013 Frey & Osborne predictions are starting to materialise, although it can be concluded that this is due (at least in part) to the fact that the timeframe of those predictions are 10-20 years, whereas this analysis has looked at changes only over the last 26 months.

Despite this surprising result, we found strong evidence in our own data that automation is starting to cause measurable vacancy declines in certain occupations.

We found that 13 of the top 20 most rapidly declining vacancies are due to the effects of automation. Of these, we believe improvement in AI technology is the primary reason for decline for 3 of the occupations, but we note that there is grey line between what was and is now considered to be AI. For example, is fuzzy text and automatic synonym search on a travel website an AI feature or just 'normal' software intelligence?

Looking at the growth trends, we find that a substantial proportion of the high-growth occupations are being created by new (and often AI-related) technology. Contrary to the longer-term predictions of other recent studies there appears to be little current evidence for any decline in vacancies due to the automation of routine, low-skill manual tasks. This is less surprising when one considers that the pace of robotic hardware advancement is slower than for software. We expect these low-skill manual jobs to be automated over a far longer time scale.

Overall, from the analysis of our own data, we believe the evidence is supportive of an accelerating level of automation. Automation is starting to replace jobs right now. Currently this is focussed on a small number of areas using narrow artificial intelligence. However, given the continuing exponential growth in computing power and advances in AI methods, we believe we are sitting at the start of the curve.

Opinion: The next 10 to 20 years

In our view, as the pace of technology accelerates, more and more jobs will decline due to automation and advances in AI. At the same time demand for other jobs will grow and new ways of flexible working will emerge. There will also be new occupations emerging which don't exist today (consider how *App Developers* and *Social Media Managers* were almost unheard of 10 years ago).

Early trends in the data suggest that these two effects will largely balance out over the next decade, and this is supported by historical patterns. However this balance will not remain forever. In the years leading up to 2040 we expect to see a substantial portion of all desk-based jobs becoming automated, resulting in dramatic and significant changes to the job market and our wider society.

About Adzuna

Adzuna.co.uk is a search engine for job adverts used by over 10 million visitors per month that aims to list every job, everywhere.

Adzuna.co.uk was founded in 2011 by Andrew Hunter and Doug Monro, formerly of eBay, Gumtree, Qype and Zoopla and is backed by leading Venture Capital firms Passion Capital, The Accelerator Group and Index Ventures.

Adzuna's mission is to be the best place to start looking for a job using the power of technology to help match people to better, more fulfilling jobs and keep Britain working.

Further information

Contact details are as follows:

- For technical enquiries about this paper: **james@adzuna.com**
- For general press enquiries: **becky@adzuna.com**

Appendix

Top 20 fastest declining occupations

Rank	Occupation	Category	Average monthly decline*	Vacancy count (Jan-2015)
1	pharmacy assistant	General automation	-4.50	1407
2	Illustrator	General automation	-4.36	457
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4	probation officer	Govt funding	-4.11	255
5	biztalk developer	Ageing technology	-4.04	289
6	Translator	AI automation	-3.99	1393
7	Writer	AI automation	-3.98	1797
8	travel agent	General automation	-3.96	221
9	case handler	General automation	-3.85	624
10	vba developer	Ageing technology	-3.82	123
11	IT support analyst	AI automation	-3.57	209
12	service operations manager	General automation	-3.45	136
13	regulatory affairs officer	Industry decline	-3.44	277
14	Animator	General automation	-3.43	508
15	Metallurgist	Industry decline	-3.41	116
16	document manager	General automation	-3.38	207
17	website developer	General automation	-3.32	458
18	net mvc developer	Ageing technology	-3.26	301
19	contracts engineer	General automation	-3.21	293
20	unix systems administrator	Ageing technology	-3.18	133

* Average rate of decline per month from normalised level of 100 in January 2015

Top 20 fastest growing occupations

Rank	Occupation	Theme	Average monthly growth*	Vacancy count Jan-2015
1	nail technician	Disposable income	45.94	77
2	shift supervisor	Management	28.67	372
3	retail security officer	Manual workers	21.51	350
4	childcare solicitor	Social and welfare	18.42	24
5	full stack developer	New technology	16.22	489
6	kitchen staff	Disposable income	15.82	4079
7	clinical psychologist	Social and welfare	14.78	172
8	cloud engineer	New technology	14.45	140
9	personal banker	Disposable income	13.77	99
10	financial planner	Disposable income	12.14	135
11	bar staff	Disposable income	11.36	8350
12	chef	Disposable income	11.25	8630
13	night care worker	Social and welfare	10.69	31
14	unity developer	New technology	10.43	37
15	runner	Manual workers	10.36	46
16	strip fitter	Manual workers	10.33	106
17	big data engineer	New technology	10.16	109
18	traffic marshal	Manual workers	10.16	144
19	forklift truck driver	Manual workers	10.04	82
20	content marketing executive	New technology	9.77	67

* Average rate of growth per month from normalised level of 100 in January 2015

Summary of recent studies into job automation

Author(s)	<i>Frey and Osborne</i>	<i>World Economic Forum</i>	<i>OECD</i>	<i>McKinsey Global Institute</i>	<i>PWC</i>	<i>IPPR Scotland</i>
Title	Technology at Work v2.0 (<i>an update to their original 2015 paper</i>)	The Future of Jobs.	The Risk of Automation for Jobs in OECD Countries	A Future that Works: Automation, Employment, and Productivity	UK Economic Outlook	The Future of Work and the Skills System in Scotland
Date	Jan-2016	Jan-2016	June-2016	Jan-2017	Mar-2017	May-2017
Job impact predictions	In the OECD, on average 57% of jobs are susceptible to automation over the next decade or two	A gross global employment impact of more than 7.1 million jobs lost to disruptive labour market changes between 2015–20	On average, 9% of jobs across the 21 OECD countries are automatable	50% of today's work activities could be automated by 2055	Up to ~30% of existing UK jobs could face automation over the next 15 years	Over 46% of jobs (1.2m) in Scotland are at high risk of automation by 2030
Predicted highest risk sectors	Office and Administrative Support, Sales and Related, Service	Office and Administrative, Manufacturing and Production, Construction and Extraction	None provided	Accommodation and food services, Manufacturing, Transportation and Warehousing, Agriculture, Retail, Mining	Transportation and storage (56%), manufacturing (46%) and wholesale and retail (44%)	Process and machine operatives, skilled trades, administrative / secretarial
Other	Section predicting main sectors for new job creation.	Also covers the gender gap issue. Based on a survey, top technological driver of change is mobile internet and cloud technology (34%), the second is advances in Computing and Big Data (26%)	Highlights issue of job polarisation. Argue that jobs involve multiple tasks and therefore are generally less automatable than Frey and Osborne predict.	Like OECD, focuses on tasks within jobs and argues few jobs are fully automatable.	Includes analysis of recent and forecast CDP and consumer growth	Recommendation to create an Open Institute of Technology: a new mid-career learning route combining online and offline methods.

See page 6 for references to individual reports.

Adzuna Job Sectors

Adzuna Category	Proportion of live job adverts (Mar 2017)
Healthcare & Nursing Jobs	12.0%
Accounting & Finance Jobs	10.2%
IT Jobs	8.9%
Engineering Jobs	6.7%
Teaching Jobs	5.8%
Sales Jobs	5.4%
Admin Jobs	5.3%
Hospitality & Catering Jobs	5.2%
Trade & Construction Jobs	5.1%
Other/General Jobs	4.4%
Retail Jobs	3.9%
Logistics & Warehouse Jobs	3.1%
Part time Jobs	2.8%
Social work Jobs	2.6%
Customer Services Jobs	2.5%
Consultancy Jobs	2.3%
Legal Jobs	2.2%
Graduate Jobs	1.8%
HR & Recruitment Jobs	1.6%
Scientific & QA Jobs	1.2%
Manufacturing Jobs	1.2%
Property Jobs	1.2%
Creative & Design Jobs	1.0%
PR, Advertising & Marketing Jobs	0.8%
Charity & Voluntary Jobs	0.8%
Travel Jobs	0.6%
Energy, Oil & Gas Jobs	0.5%
Domestic help & Cleaning Jobs	0.5%
Maintenance Jobs	0.4%

Table: Frey & Osborne probabilities of computerisation

Occupation	Probability of computerisation	Average rate of change per month (from normalised level of 100 in Jan-2015)
Audiologists	0.0033	0.573
occupational therapists	0.0035	1.949
sales engineers	0.0041	-1.596
Podiatrists	0.0046	5.893
human resources managers	0.0055	-2.205
mechanical engineers	0.011	-2.030
Pharmacists	0.012	1.709
Microbiologists	0.012	1.110
sales managers	0.013	-0.973
hydrologists	0.014	-1.372
marketing managers	0.014	-0.045
chief executives	0.015	0.250
chemical engineers	0.017	-1.735
environmental engineers	0.018	1.798
civil engineers	0.019	-1.031
materials engineers	0.021	-2.826
photographers	0.021	-0.604
interior designers	0.022	1.274
art directors	0.023	-1.159
occupational therapy assistants	0.028	4.080
industrial engineers	0.029	-2.638
database administrators	0.03	-1.597
purchasing managers	0.03	0.060
postsecondary teachers	0.032	-0.194
lawyers	0.035	-0.740
landscape architects	0.045	-0.810
editors	0.055	-0.337
financial managers	0.069	1.555
nuclear engineers	0.07	-1.550
construction managers	0.071	-1.420
compliance officers	0.08	0.302
graphic designers	0.082	-0.742
childcare workers	0.084	0.506
travel agents	0.099	-3.960
electrical engineers	0.1	-1.409
chemists	0.1	1.761
physicists	0.1	2.307
optometrists	0.14	-0.484
electricians	0.15	-0.756
concierges	0.21	1.887
statisticians	0.22	-3.365
financial analysts	0.23	-0.313

surveyors	0.38	-0.372
upholsterers	0.39	0.264
economists	0.43	-0.169
teacher assistants	0.56	4.686
cost estimators	0.57	-1.979
machinists	0.65	0.075
helpers–production workers	0.66	2.701
dental hygienists	0.68	1.895
helpers–roofers	0.72	-1.012
carpenters	0.72	-0.430
helpers–electricians	0.74	-0.756
barbers	0.8	-0.212
sheet metal workers	0.82	-1.126
security guards	0.84	1.449
bakers	0.89	0.760
technical writers	0.89	-1.603
roofers	0.9	-1.012
helpers–carpenters	0.92	-0.430
cashiers	0.97	-0.506
credit analysts	0.98	-0.466
telemarketers	0.99	-1.393