

Automation, Artificial Intelligence,
On-demand Labour and Other
Flexible Forms of Labour in the New
IDB Employer Survey “Skills at
Work in LAC”

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Labor Markets Division

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Automation, Artificial Intelligence, On-demand Labour and Other Flexible Forms of Labour in the New IDB Employer Survey “Skills at Work in LAC”

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Abstract

Whilst there is an interest in recent surveys in understanding the impact of disruptive technologies on employment and the way in which skills might be a constraint on their take-up, this tends to be at an aggregate level with little consideration given to the types of job that may be affected or the specific skill needs that may arise. This report develops a set of suite of questions about: (i) how specific disruptive technologies may affect the demand of skills, occupations and employees; and, (ii) how the on-demand labour, crowd sourcing and other flexible forms of labour is undertaken. The resulting questionnaires serve as reference to the IDB's Skills at Work in LAC survey.

Keywords: employer survey, skills demand, disruptive technologies, crowd sourcing, on-demand labour, zero-hour contracts

JEL codes: J24, O14

1. Introduction

There is increasing interest in how a range of disruptive technologies might affect the demand for labour and skills. Disruptive technologies typically include, amongst other things, cloud computing, mobile internet, artificial intelligence (AI), robotics, automation, 3D printing, and so on. They are seen as having the power to transform traditional production systems across all sectors of the economy and not just manufacturing. And in doing so, they are seen as having a potentially transformative impact on the nature of work. They may well substitute for existing jobs as well as creating new ones (some of which are yet to be defined). As will documented below, many surveys of enterprises or establishments have tended to focus on the extent of disruptive technologies' diffusion throughout the economy. Whilst there is an interest in these surveys in understanding the impact of disruptive technologies on employment and the way in which skills might be a constraint on their take-up, this tends to be at an aggregate level with little consideration given to the types of job that may be affected or the specific skill needs that may arise.

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In this report consideration is given to the way in which issues related to AI/automation/robotics diffusion might be investigated through an employer survey. More to the point: how a suite of questions might be included in the IDB's Skills at Work in LAC survey (Hogarth, 2016). The issues relate, in part, to the types of skills that these technologies will create a demand for.

As well as developing a suite of questions which might be incorporated about potentially disruptive technologies, there is also an interest in new emerging forms of employment. The gig economy or on-demand labour is something which is increasingly of interest. In one form, it suggests that the traditional employment relationship between employer and employee is breaking down and being replaced by one where people move between employers in undertaking and completing tasks (c.f. the gig economy insofar as it affects professionals who move between a series of task contracts). In other guises, on-demand labour means the employee is only paid when the employer has work for them, but they are expected to be available for whenever that work is to take place (i.e. zero-hour contracts). Questions are suggested which offer some insight into the extent to which employers make use of practices associated with the emergence of the gig economy / crowd sourcing and the use of zero-hour contracts.

The remainder of this report is structured accordingly. First consideration is given to the indicators that the survey questions are designed to produce. This is followed by a review of surveys that have addressed disruptive technologies. A long-list of questions for inclusion in an employer survey is then presented. Next a review of survey questions related to on-demand labour is provided together with a long-list of questions. From the long-lists, a short-list of questions is then presented:

- For use in the IDB's Skills at Work in LAC survey
- For possible inclusion in the World Economic Forum's Future of Jobs Survey

Wherever possible questions are included which have been used previously in questionnaire surveys because this provides: (a) a degree of assurance that the questions will work in practice; and (b) potential points of comparison. But, as alluded to above, it has proved difficult to find questions that relate specifically to skills that might be included in the respective suite of questions.

The main surveys which have been consulted include:

- Technical change within organisations:
 - Eurofound Company Survey (EU)
 - Workplace Industrial / Employee Relations Survey (UK)
 - Community Innovation Survey (EU)
- Surveys of automation / AI / robotics diffusion within enterprises:
 - EU's annual survey of ICT Usage and E-commerce in Enterprises
 - EU Survey on Nanotechnologies, New Materials New production Processes and Devices
 - KPMG's survey used to produce *The Disruptors are the Disrupted: Disruptive technologies barometer* report

- Manpower's survey of digitization
- Narrative Sciences' survey of AI / robotics
- PWC's Disruptive Manufacturing Innovations Survey
- World Economic Forum Future of Work Survey
- On-demand labour:
 - ONS Business Survey (UK) – zero hours contracts
 - World Bank Enterprise Survey (global)
- Crowd sourcing:
 - Crowd Work in Europe Survey (UK, Sweden, Germany, Austria and the Netherlands)
- Flexible working time arrangements in enterprises:
 - Eurofound Company Survey (EU)
 - Work-life balance survey (UK)

Further details are provided in Appendix 1.

2. Indicators

In order to guide both the search for questions and the construction of new ones it is necessary to develop an initial list of indicators that the questionnaire survey should provide the data for. The principal indicators that might be derived include the following:

- **AI/automation/robotics**
 1. The number or percentage of employers currently using the relevant technologies
 2. The number or percentage of employers likely to introduce these technologies in the next two to three years
 3. The main reasons why employers introduced the new technologies
 4. Whether employment will increase, stay the same, or decrease as a consequence of introducing AI/automation/robotics
 5. The skills needs that AI/automation/robotics will give rise to
 6. Whether skill needs can be met
- **Crowd sourcing**
 7. Percentage of employers using crowd sourcing in outsourcing activities / functions that would previously have been undertaken in-house
- **On-demand labour**
 8. The number or percentage of employers using on-demand labour
 9. The number or percentage of employees affected by on-demand labour
 10. Whether employers outsource activities to the informal sector

Potentially there are other indicators too that might be constructed by combining new questions with existing ones in the IDB's Skills at Work in LAC survey.

3. Automation, Artificial Intelligence and Robotics

3.1 Automation

There a multitude of surveys which monitor the take up of new technologies by companies (as outlined in the Introduction above and as set out in Appendix 1). The surveys tend to address three issues:

1. The current take-up of new technologies and their expected future introduction
2. The impact of new technologies on employment
3. The resulting skill needs from new technology introduction and whether these are being met (or whether concerns over likely skill needs discourages investment in new technologies)

It tends to be (1) where there are the most surveys, though the more recent interest in how robotics and AI will impact upon employment has tended to focus attention on (2).² In general (3) has received less attention.

As the micro-electronics revolution was taking hold at the end of the 1970s, surveys of employers tended to regard 'new technology' as a single entity. For example, the UK Workplace Industrial Relations Survey 1984 asked (Daniel, 1987):

Are you using the new microelectronics technology here in any of your products?

Are you using the new microelectronics technology in any of your production processes here, including computer controlled plant machinery or equipment?

A similar type of approach is still used in the European Union's Community Innovation Survey (CIS), though its focus is upon innovation rather than technology per se (European Commission, 2012). First of all it describes innovation:

A product (good or service) innovation is the market introduction of a new or significantly improved good or service with respect to its capabilities, user friendliness, components or sub-systems.

And then goes on to ask:

During the three years 2010 to 2012, did your enterprise introduce:

Goods innovations: New or significantly improved goods (exclude the simple resale of new goods and changes of a solely aesthetic nature

Service innovations: New or significantly improved services

A similar approach is used in the European Company Survey – undertaken by Eurofound – in that it contains a single contextual question on technology:

Does this establishment monitor external ideas or technological developments for new or changed products, processes or services?

² See for example: Furman, J. (2016); Frey and Osborne (2013).

- Yes, using staff assigned specifically to this task
- Yes, as part of the responsibilities of general staff
- No
- Don't know

The types of question outlined above are useful in setting the context in that they give an indication of the extent to which investments in new technology – in products and processes - have taken place, but increasingly the focus is upon the impact of specific technologies. In particular, the impact of robots has received a considerable amount of attention not least because of their potential to substitute for workers (Freeman, 2014).

3.2 Specific technologies

If the generic approach outlined above is considered to be too broad brush, then there is a need to identify specific technologies and identify how they have been addressed in employer surveys. In this area many of the surveys are particularly concerned with the impact of ICT / digitalisation on employers. A major survey in this regard is the EU's annual survey of ICT Usage and E-commerce in Enterprises that asks employers (enterprises) about their computer usage, links to the internet, and its role in e-commerce, invoicing, etc (European Commission, 2016). It also specifically asks about 'big data' and 'cloud computing'. For example:

During 2015, did your enterprise analyse big data from any of the following data sources? (Please refer to the definition of big data above; include big data analysis conducted by external service providers)

- a) Enterprise's own data from smart devices or sensors (e.g. Machine to Machine - M2M- communications, digital sensors, Radio frequency identification tags RFID, etc.) (in the context of big data)
- b) Geolocation data from the use of portable devices (e.g. portable devices using mobile telephone networks, wireless connections or GPS) (in the context of big data)
- c) Data generated from social media (e.g. social networks, blogs, multimedia content sharing websites, etc.) (in the context of big data)
- d) Other big data sources not specified above

And in relation to cloud computing:

Cloud computing refers to ICT services that are used over the internet to access software, computing power, storage capacity etc., where the services have all of the following characteristics:

- are delivered from servers of service providers
- can be easily scaled up or down (e.g. number of users or change of storage capacity)
- can be used on-demand by the user, at least after the initial set up (without human interaction with the service provider)
- are paid for, either per user, by capacity used, or they are pre-paid

Cloud computing may include connections via Virtual Private Networks (VPN).

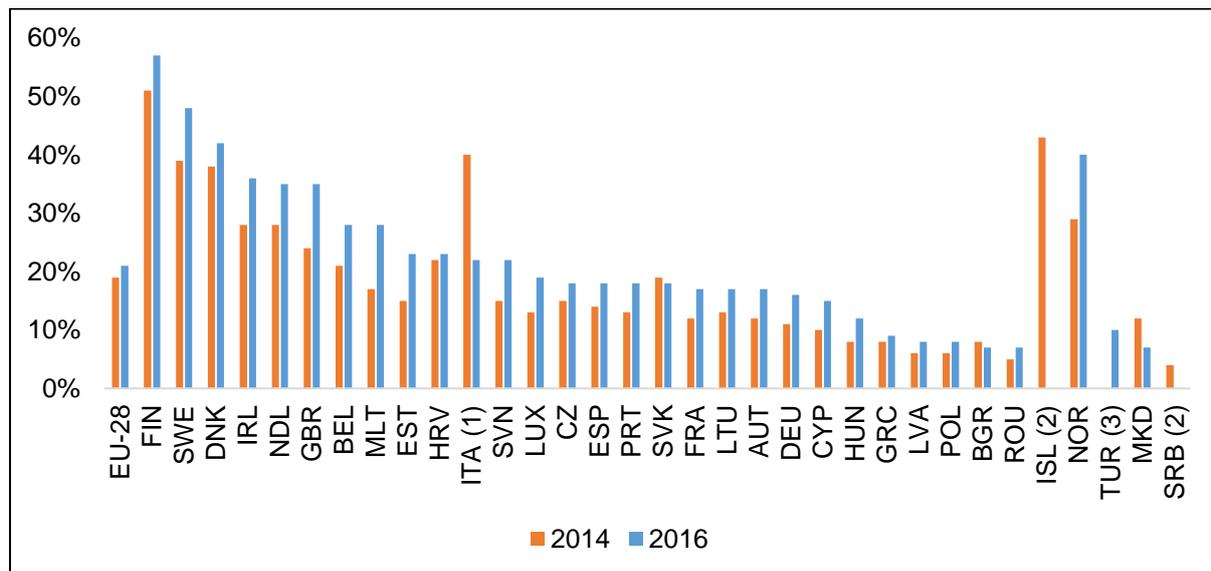
Does your enterprise buy any cloud computing services used over the internet? Yes / No

Does your enterprise buy any of the following cloud computing services used over the internet?

- a) E-mail (as a cloud computing service)
- b) Office software (e.g. word processors, spreadsheets, etc.) (as a cloud computing service)
- c) Hosting the enterprise's database(s) (as a cloud computing service)
- d) Storage of files (as a cloud computing service)
- e) Finance or accounting software applications (as a cloud computing service)
- f) Customer Relationship Management (CRM, software application for managing information about customers) (as a cloud computing service)
- g) Computing power to run the enterprise's own software (as a cloud computing service)

By way of example to show what this survey delivers, Figure 3.1 below reveals the use of cloud computing.

Figure 3.1: Enterprises using cloud computing services, 2014 and 2016 (% of enterprises)



1/ Break in series

2/ 2016: not available

3/ 2014: not available

Source: Eurostat (online data code: isoc_cicce_use)

There is also an interest in key enabling technologies. For example, the EU Survey on Nanotechnologies, New Materials New Production Processes and Devices (NMP) provides the respondent with a definition of each NMP technology (European Commission, 2012) and then asks a series of questions about their introduction and use:

Are either nanotechnology, new materials or new production technologies important for your company at this moment?

(Multiple answers are possible)

Yes, nanotechnology

Yes, new materials

Yes, new production technologies

No, none of the elements of NMP are currently important for our company

And then asks about the future:

Do you expect nanotechnology, new materials or new production technologies to become (more) important for your company in the future?

(Multiple answers are possible)

Yes, nanotechnology

Yes, new materials

Yes, new production technologies

No, I do not expect that any of the elements of NMP to become (more) important for our company

A series of questions then follow about the impact of these technologies on employment and skills.

It is apparent that as one becomes more specific with respect to the technology being considered, a definition or explanation of the technology needs to be provided. This is especially the case where the survey respondent is the person responsible for human resource / personnel issues and is unlikely to be familiar with specific technologies. This poses a challenge as the text below will demonstrate.

There are several enterprise surveys – often based on relatively small sample sizes – that investigate the take-up of various technologies within firms. These rely upon responses of senior personnel with enterprises who are knowledgeable about specific technologies. For example, the KPMG survey (2015) of disruptive technologies asks:

To what extent are each of the following technology areas changing how you run your operations (i.e., driving productivity, running workflows, moving goods and services, operating infrastructure, and other internally focused business activities)? (Moderate or significant impact)

Data analytics (77 per cent)

Cloud (Software as a Service (SaaS) delivered over the Internet) (74 per cent)

Mobile (mobile devices and applications) (74 per cent)

Marketing platforms (digital media, advertising platforms) (73 per cent)

Internet of Things (smart, connected devices and systems) (71 per cent)

Social media (social networking and collaboration platforms) (71 per cent)

Artificial intelligence/cognitive computing (smart software systems) (71 per cent)

Digital payments and currency (e.g., mobile payment systems, etc.) (69 per cent)

On-demand marketplace platforms (66 per cent)

Virtual reality/augmented reality (smart head-mounted displays/glasses) (67 per cent)

Robotics (physical systems of automation, including driverless cars) (64 per cent)

Wearable devices (for workforce/customers) (63 per cent)

3D printers (63 per cent)

The KPMG survey goes on to ask employers why they introduced these technologies (KPMG, 2016).

When investing in disruptive technologies what are your company's most important business goals?

Improving quality of goods and services (41 per cent)

Reduce overall costs (37 per cent)

Improve competitive advantage (36 per cent)

The above were the three most important answers provided. In relation to employment and skills, the following were also mentioned:

Reduce personnel costs (28 per cent)

Recruit better talent (27 per cent)

Respondents were also asked:

To what extent do you agree or disagree with the following statements?

The statements that had an employment or skill dimension included the following.

Investing in disruptive technologies helps us to attract, retain and motivate the workforce (57 per cent)

We have technology skills embedded throughout our organisation (57 per cent)

Our organisation has increased training to relevant employees to help take advantage of disruptive technologies (57 per cent)

Our organisation plans to hire new talent specifically chosen to help us implement disruptive technologies (56 per cent)

We are concerned about skill shortages related to disruptive technologies (48 per cent)

It is hard to hire and retain the right talent (44 per cent)

Some of the surveys are concerned with digitisation. The Manpower Survey (2016) on digitisation provides information about the impact on skills. It asks respondents: how will digitisation affect headcount?

- Increase (19 per cent)

- No change (64 per cent)
- Decrease (12 per cent)
- Don't know (per cent)

It suggests that the introduction of digitisation will result in:

- Provision of internal training (74 per cent)
- External training (62 per cent)
- Recruitment of new skill sets in addition to existing employees (44 per cent)
- Outsource business to third parties (23 per cent)

Whilst the surveys mentioned above are comprehensive in dealing with specific technologies, there has to be some doubt about whether a respondent not savvy with the latest technological developments would be know much about, for instance, the Internet of Things, let alone how it might affect the demand for skills in the workplace or enterprise. A more generic approach might be required that tries to simply the technology dimension.

3.3 Artificial Intelligence and Robots

Artificial intelligence (AI) and robots are sometimes used interchangeably in the available literature. From the respondent's perspective, there is not necessarily a consensus on what is meant by AI. Specifically, in relation to AI, Narrative Science's State of Artificial Intelligence and Big Data in the Enterprise Report (2015), based on a survey of enterprises, found a wide variety of responses from relatively knowledgeable senior executives in organisations on what was understood by the concept. It asked the respondent to define AI and obtained the following responses:

- Technology that thinks and acts like humans (31 per cent)
- Technology that can learn to do things better over time (25 per cent)
- Technology that can understand language (7 per cent)
- Technology that can answer questions for me (4 per cent)
- Anything that passes the Turing test (1.5 per cent)

The evidence from the survey showed that AI was being used in organisations for machine learning, acting as virtual personal assistants, systems used for decision support, automated written reporting and/or communications, analytics-focused applications, robotics. In another study on AI, it was noted that a distinction needs to be made between enterprises that use AI and those that use solutions that rely upon AI techniques (Narrative Science, 2016). The former tended to be a relatively small group, whilst the latter was much larger.

The definitional issue is a complicated one. In his definition of robots, Freeman defines them with respect to their use of AI:

"The term "robots" refers broadly to any sort of machinery, from computers to artificial intelligence programs, that provides a good substitute for work currently performed by humans. It does not matter whether a robot/machine has a humanoid appearance, as long as it can perform human functions. Advances in computer power and artificial intelligence that can assess information and make decisions are rapidly improving the

ability of machines to perform complicated tasks that seemed impossible just a decade or so ago” (Freeman, 2014, pág. 2).

It is apparent that any survey that looks to find out about AI will need to provide a definition to the respondent that is communicated in lay terms. It may be easier to ask about robots since there may be a greater intuitive understanding of this term. Certainly, employer surveys that ask about robots tend to utilise a simpler language. For example, PWC (2014a; 2014b) looked at the use of robots in manufacturing from a number of different perspectives:

If you are using robotic technology, what is its primary application?

Assembly (25 per cent)

Machining: Tasks that require high levels of dexterity and precision (26 per cent)

Warehousing: Materials handling/packaging (6 per cent)

Performing highly dangerous/onerous tasks (6 per cent)

Not using robotic technology (41 per cent)

Looking ahead to the next 3 years, in which areas do you expect to make the highest capital investments in robotic technology?

None, we don't plan to use robotic technology (32 per cent)

Assembly (27 per cent)

Machining: Tasks that require high levels of dexterity and precision (26 per cent)

Carrying out dangerous task (22 per cent)

Warehousing: Materials handling/packaging (16 per cent)

Other (3 per cent)

What will be the biggest impact of robots on the US manufacturing workforce in the next 3–5 years?

New job opportunities to engineer advanced robots and robotic operating systems (35 per cent)

Replacement of workers (28 per cent)

More demand for talent to manage the robotic workplace (26 per cent)

Creation of more jobs as a result of increased manufacturing (9 per cent)

Other (2 per cent)

Looking ahead to the next 3 years, what would limit your future investment in robotic technology?

Nothing, we will start/continue investing in robotic technology (28 per cent)

Not cost effective (26 per cent)

Insufficient resources and expertise (14 per cent)

Displaces workers and lowers morale (5 per cent)

Do not see a need for robotics (27 per cent)

Based on the above, it is suggested that a series of questions be constructed on AI and robotics that address the following:

- technology context – the extent to which the workplace might be considered a technology rich environment
- the current use of AI and robotics
- future perspectives
- what might limit the take-up of AI robotics in future (e.g. lack of skills)
- impact on employment and skills

Robotics and AI are often listed under the heading of disruptive technologies. So there is the potential to ask about disruptive technologies in general.

3.4 The World Economic Forum's Future Jobs Survey

The World Economic Forum's Future Jobs Survey has its own classification of technologies. These are:

- Mobile Internet and cloud technology
- Advances in computing power and the rise of Big Data
- The Internet of Things
- **Artificial Intelligence and Machine Learning**
- **Advanced robotics and autonomous transport**
- **Advanced manufacturing and 3D printing**
- Advanced materials, biotechnology and genomics
- New energy supplies and technologies

If the aim was to include questions in their survey then there is probably a need to work with this classification of technologies or a sub-set of them. The ones outlined in bold may be the most pertinent if the interest is in automation / robotics / AI.

The WEF asks the respondent about three most important drivers of change from a long list. Many of the drivers are unrelated to technology. So, there is no guarantee that responses to the technology drivers will be included in the data set. The list of drivers is far longer than the one listed above and includes, for example, rising geopolitical instability and a wide range of other topics unrelated to technology. It also tends to ask about the drivers in relation to certain sectors and certain jobs, when the interest here is potentially slightly different in that there is an interest in the impact on the (a) employer (not the sector) and (b) all employees, not just specific ones as signalled out in the WEF (via the filtering questions). Where the three most important drivers are mentioned it asks about employment and skills but in general terms. No data are available from the survey as yet.

3.5 Conclusion

The questions that are asked in the various surveys explored above tend to be asked of senior executives (C-suite ones) often with a technology responsibility. They also tend to ask about employment or skills as single entities rather than considering what sections of the workforce or which skills are likely to be affected. The presumption is that the employment and skill effects are, for the most part, confined to technology / engineering staff. In developing questions for inclusion in the IDB's Skills at Work in LAC survey there is an interest in knowing about the impact on employment across the workforce and the related skill needs that new technology introduction gives rise to. Moreover, there is a need for the questions to be phrased in such a way that they could be answered by the person with responsibility for human resources / personnel rather than a technology expert. In this way, when implementing the IDB's Skills at Work in LAC survey there will be no need for more than one respondent in a single enterprise / establishment.

4. A long list of potential questions on automation, AI and robotics

Before providing a short-list of questions, first a long list of questions is provided. There may be a preference for just asking about automation. This is based on the fact that modern automation subsumes robots and AI routines and it may be easier for the respondent to answer questions about automation. This then avoids needing to define robots and AI. That said, a suite of questions is provided on robots and AI in case there is a wish to collect information on them separately.

4.1 Automation

I would now like to ask you some questions about innovation and change in this workplace [or company].

1. First of all, thinking about the good or services you produced during the past three years, did this workplace [or company] introduce any new innovations in the goods and services it produces

Goods innovations: New or significantly improved goods

Service innovations: New or significantly improved services

NOTE TO INTERVIEWER: A product, either a good or a service, innovation is the introduction of a new or significantly improved good or service with respect to its capabilities, user friendliness, components or sub-systems.

2. Have there been any new technologies introduced into the processes you use to produce those products and services over the past three years?

Yes

No

Don't know

3. On a scale of 1 to 10, where 1 means that the processes you use to produce your goods and services is wholly automated, and 10 means that all processes are manually carried out, where would you place this workplace [or company]?

1 Wholly automated	2	3	4	5	6	7	8	9	10 Wholly manual
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4. Over the next two years, will you introduce automation in to the systems you use to produce your goods and services? Please think about all aspects of automation including that which might be introduced in office systems as well as production ones.

- Yes, very likely CONTINUE
- Yes CONTINUE
- No GO TO END OF SECTION
- Don't know

5. [IF YES VERY LIKELY OR YES @ Q4] What will be the overall impact on the total number of people employed at this workplace as a result of automation [or company]?

- Employment will increase
- Employment will stay the same
- Employment will decrease
- Don't know

6. In which jobs do you expect automation to increase employment? [READ OUT]

- IT
- Human resources
- Customer service / customer facing jobs
- Administrative and office jobs
- Production and manufacturing jobs
- Finance and accounting
- Other – please specify
- None

7. [FOR EACH JOB MENTIONED @ Q6] Do you expect that to be a large, medium or small increase?

8. Do anticipate any difficulty in being able to recruit people to these jobs?

- Yes, it will be very difficult
- Yes, it will be difficult
- No
- Don't know

9. What skills do you expect to be difficult to recruit?

10. In which jobs do you expect automation to decrease employment?

IT

Human resources

Customer service / customer facing jobs

Administrative and office jobs

Production and manufacturing jobs

Finance and accounting

Other – please specify

None

11. Will automation replace...[TICK ALL THAT APPLY]

activities within jobs?

full jobs?

Don't know

12. Will automation lead to the creation of new jobs with new skills in the workplace?

Yes

No

Don't know

13. Will the introduction of automation lead to any of the following...

recruitment of staff with new skills to replace existing staff?

recruitment of staff with new skills in addition to existing staff?

bringing in outside experts to transfer skills to employees?

outsourcing of some business functions?

14. Will automation lead to more training of existing employees?

Yes CONTINUE

No

Don't know

15. [IF YES @ Q12] Will this be delivered through:

off-the-job training?

on-the-job- training?

Don't know

16. And will you deliver the training in-house or use external training organisation?

In-house

External training organisations

Don't know

17. Do you expect any difficulties in being able to supply the training needed?

Yes, very much so

Yes, some difficulty

No

Don't know

18. [ASK ALL WHO HAVE INTRODUCED /WILL INTRODUCE AUTOMATION] Why have you / why will you introduce the new technologies? [READ OUT OR SHOW CARD / TICK ALL THAT APPLY]

Need to increase productivity / efficiency with which we produce goods and services

Need to keep up to date with the way we produce our goods and services

Instructed to do so by head office

Because of difficulties recruitment people

Because of difficulties recruiting the skills we need

In order to reduce personnel costs

Other (please specify) _____

4.2 Artificial Intelligence

The above deals with automation in general, but there may be a preference for asking about specific technologies, such as AI. A long-list of AI question is provided below.

I would now like to ask you a few questions about artificial intelligence or AI as it is sometime called. AI refers to the capability of machines to learn and engage in problem solving that in some respects mimics the behaviour of human intelligence.

1. Are you currently using AI in the processes you use to produce your goods or services? [READ OUT]

Yes, to a great extent

Yes to a moderate extent

No

Don't know

2. In the next three years, how likely is it that you will introduce more artificial intelligence into your production systems? [READ OUT]

Very likely

Likely

- Not likely
- Not at all likely
- Don't know

3. [If 'not likely' 'not at all likely' at Q2] Why do you say that? [SHOW CARD]

- No demand for it in business
- Not skills in business to introduce it
- Not sure what it is or what it can do
- A shortage of investment capital
- Other

4. ASK ALL LIKELY OR VERY LIKELY AT Q2] What do you think the impact will be of increased use of AI on employment at this workplace?

- Employment will increase
- Employment will stay the same
- Employment will decrease
- Don't know

5. [IF EMPLOYMENT DECREASES @ Q4] Which groups in the workforce will be most affected by the decrease in the number of people employed?

6. [IF EMPLOYMENT INCREASES AT Q4] Which groups in the workforce will experience an increase in employment?

		Q6	Q7
1	Managers		
2	Professionals		
3	Technicians and associate professionals		
4	Clerks		
5	Service workers and shop and market sales workers		
6	Skilled agricultural and fishery workers		
7.	Craft and related trades workers		
8.	Plant and machine operatives and assemblers		
9.	Elementary workers		

7. [ASK ALL] In order for more AI to be introduced into this workplace what will be critical skills required to do so?

4.3 Robotics

Just as the above set of questions asks about AI, the questions below ask specifically about robotics.

I would now like to ask you about a particular form of new technology: robots. By robots is meant a machine capable of carrying out a complex series of actions automatically, especially one programmable by a computer. They can be embedded in telephone help lines that provide you with the information you request, be programmed to carry out surgery and other medical procedures, or be used in the manufacturing process.

1. Are you currently using robots in the production of your good or services?

Yes CONTINUE

No GO TO Q3

Don't know

2. [IF YES @ Q1] In what tasks are robots engaged?

Assembly

Tasks that require high levels of dexterity and precision

Materials handling/packaging

Performing highly dangerous/onerous tasks

Telephonic systems

Customer service

Other (please specify)

3. [If not using robots at Q1] Why do you say that?

No demand for it in business

Not skills in business to introduce it

Not sure what it is or what it can do

A shortage of investment capital

Don't know

4. [ASK ALL] In the next three years, how likely is it that you will introduce more robotics into your production systems?

Very likely

Likely

Not likely

Not at all likely

Don't know

5. [IF YES VERY LIKELY OR YES @ Q4] What do you think the impact of that will be on employment at this workplace [or company]?

Employment will increase

Employment will stay the same

Employment will decrease

Don't know

6. [IF EMPLOYMENT DECREASES @ Q5] Which groups in the workforce will be most affected by the decrease in the number of people employed?

7. [IF EMPLOYMENT INCREASES AT Q5] Which groups in the workforce will experience an increase in employment?

		Q6	Q7
1	Managers		
2	Professionals		
3	Technicians and associate professionals		
4	Clerks		
5	Service workers and shop and market sales workers		
6	Skilled agricultural and fishery workers		
7.	Craft and related trades workers		
8.	Plant and machine operatives and assemblers		
9.	Elementary workers		

8. And what do you think the impact will be on the skills needed in this workplace [or company]?

Will increase the demand for skills at all levels

Will increase the demand for high level engineering and IT employees

Will have no impact on skills

9. [ASK ALL] What are the critical skills required to introduce robots into this workplace?

4.4 Alternative questions on specific technologies

If there is interest in specific technologies the following can be asked. It will provide an indication of the types of technology in situ in the workplace.

1. To what extent are each of the following technologies in place in your workplace?
[SHOW CARD]

	Yes, very much so	Yes, a little	No	Don't know
Nanotechnologies				
New materials				
The Cloud - software as a Service delivered over the Internet				
Mobile devices and applications				
Marketing platforms (digital media, advertising platforms)				
Social media (social networking and collaboration platforms)				
Artificial intelligence (smart software systems)				
Digital payments and currency (e.g., mobile payment systems, etc.)				
Robotics (physical systems of automation, including driverless cars)				
3D printers				
Big data				

2. [FOR ALL MENTIONED AT Q1] What are the key skills required in using the technology in the workplace?

3. Over the next three years, which technologies is it likely that you will be investing in...
[SHOW CARD]

	Yes, very likely	Yes, probably	No	Don't know

Nanotechnologies				
New materials				
The Cloud - software as a Service delivered over the Internet				
Mobile devices and applications				
Marketing platforms (digital media, advertising platforms)				
Social media (social networking and collaboration platforms)				
Artificial intelligence (smart software systems)				
Digital payments and currency (e.g., mobile payment systems, etc.)				
Robotics (physical systems of automation, including driverless cars)				
3D printers				
Big data				

4. [ASK ALL]. Will any of the following inhibit you introducing any of these technologies?

No demand for it in business

Not skills in business to introduce it

Not sure what it is or what it can do

A shortage of investment capital

Don't know

4.5 Conclusion

Provided in the preceding section is a bank of questions that might be used in a survey to gauge their impact on skills demand. A long list has been provided in case there is an interest in a specific technology, such as robotics. In which case, there is a suite of questions available. In Section 7, the questions listed above are reduced to a short-list for potential inclusion in the IDB's Skills at Work in LAC survey.

5. On-demand labour, crowd sourcing, and flexible work arrangements

5.1 Introduction

On-demand labour, from the employer perspective, can be regarded as the means by which the supply of labour (and skills) can be better matched to demand in the workplace. In essence, one is concerned with observing the way in which working time is arranged (and

possibly remunerated) so that its supply to the workplace is optimised in some way. In Europe this subsumes two inter-related policy areas:

- Flexible working time
- Work-life balance

In the first instance, the interest is in being able to identify working practices and / or forms of employment contract that allow the employer some leeway in being able to ensure that labour is available when it is required. The work-life balance policy area is more concerned with achieving a balance between the needs of the employer and the employee, respectively, in the organisation of working time arrangements.

Whether one is looking at work-time arrangements from the perspective of flexible working time or work-life balance, the interest tends to be in the same things:

- The duration of working time (total number of hours worked in a normal week)
- When hours are worked (night work, shift-work, working unsocial hours, etc.)
- Flexibility of when hours can be worked (e.g. flexitime, annualised hours, etc.)

5.2 On-demand labour

For the most part the discussion about the above has taken place in the context of their being a degree of regularity in the hours to be worked (both their duration and when they are worked). With the emergence of new forms of on-demand labour such as where there is no guarantee of any hours to be worked (i.e. zero-hour contracts). The zero-hour contract has been defined by the UK Chartered Institute for Personnel and Development as follows: “an agreement between two parties that one may be asked to perform work for the other but there is no set minimum number of hours. The contract will provide what pay the individual will get if he or she does work and will deal with the circumstances in which work may be offered (and, possibly, turned down)” (CIPD, 2015).

In the above, the implication is that there will be an employment contract in place. But is also apparent that on-demand labour may not be based on an employment contract but on some kind of service contract where the individuals supplying the services are self-employed but need to supply the hours of labour when required by the company with which the contract is in place, on-demand. In the UK – and other countries – there is a legal discourse over what constitutes actual self-employment versus forms of self-employment that essentially masquerade a dependent employment relationship.³ With the emergence of crowd sourcing / the gig economy, the way in which employers ensure that labour supply meets labour demand is taking on new contractual forms.

There is also a potential overlap:

- Between on-demand labour and labour that might be provided on a temporary basis when there is a peak in demand but which is predictable in some way so that employers can call on people to work for a given period of time rather than being on-demand
- Use of temps
- Crowd sourcing / new forms of self-employment

³ For example, in the UK see Pimlico Plumbers -v- Gary Smith (2017).

It is presumed for the purposes of the current assignment that the interest is in the use of people who are employed on on-demand contracts and thereby excludes the number of temporary staff, agency staff, and those in the workplace who are self-employed.

Typically, Labour Force Surveys provide information on the number of people who provide on-demand labour (UK Office of National Statistics, 2016). From an employer perspective there is an interest in knowing:

- The percentage of employers that use on-demand labour contracts (and their characteristics)
- The number of employees who work on-demand (to provide corroboration of LFS estimates or where LFS-type data are not available)
- The types of employee (by occupation for instance) that provide on-demand labour
- The reasons why employers use this form of contract

The approach used in the UK in the Annual Business Survey is to ask questions about:

- The number of people employed on contracts with no-specified hours
- The number of employers providing such contracts
- Whether working hours were actually provided
- The reasons no work was provided

There is potentially an interest in knowing how many hours are worked, whether there is an exclusivity arrangement. The key questions ONS asks are included in the box below.

Box 1: ONS (UK) questions used in the Annual Business Survey to ask about zero-hour contracts

Does your company/organisation employ people who are on a contract which does not guarantee a minimum number of hours work? (this could be weekly, fortnightly, monthly or annually)

How many of your employees, including those on temporary contracts, are on a contract which does not guarantee them work?

How many of these employees worked in the fortnight commencing 9th May 2016?

If unable to answer for the fortnight commencing 9th May 2016, please accept a response for any fortnight between 1st April to 30th June. This can be recorded later by entering '2 - Answer given but for a different period'

Record the start date of period

Record the end date of period

Please record answer given

Can you provide an estimate or estimated proportion?

Record estimate

Record estimated proportion in percentage terms of the total number of employees

A Zero hour contract is a contract where the employer does not guarantee to provide the worker with work and will only pay the worker for those hours which are actually worked.

Whilst a zero-hour contract does not include a minimum hours work guarantee, it may include other obligations, e.g. a retainer (such as a retained fire officer).

Does your company/organisation employ any staff on zero hour contracts?

Does your company/organisation employ people on a contract that guarantees between one and seven hours work? (this could be weekly, fortnightly, monthly or annually)

Are any other type of employment contract used other than a standard Full Time or Part Time employment contract?

How many of your employees are on a contract that guarantees between one and seven hours work? (this could be weekly, fortnightly, monthly or annually)

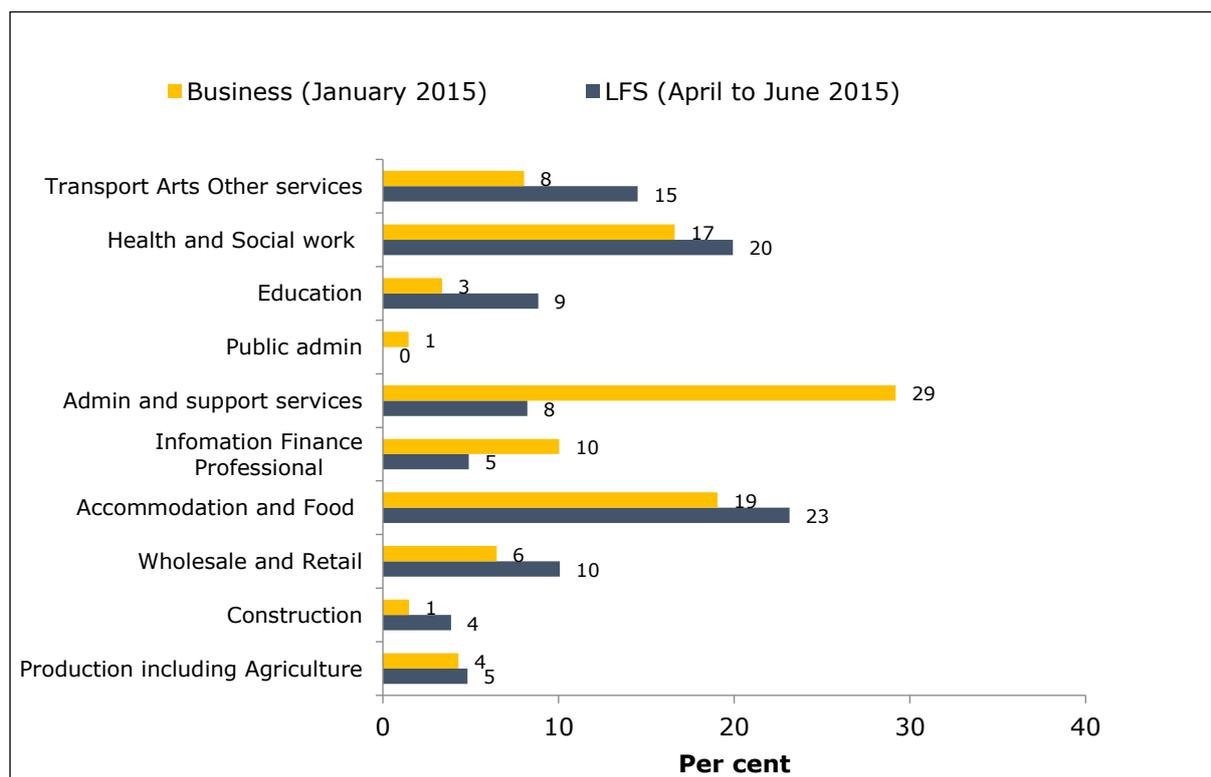
Can you provide an estimate or estimated proportion?

Record estimate

Record estimated proportion in percentage terms of the total number of employees

The Office of National Statistics (ONS) in the UK has derived estimates of employees who have no guaranteed hours: these are derived from the ONS Business Survey and from the Labour Force Survey. The latest estimate from the LFS shows that 744,000 people reported that they were on a “zero-hours contract” in the period April to June 2015, representing 2.4 per cent of people in employment. This is 120,000, or 19 per cent, higher than the reported figure from the same period in 2014 (624,000 or 2.0 per cent of people in employment) (ONS, 2016). The distribution of people on zero hour contracts by industry is show in Figure 5.1.

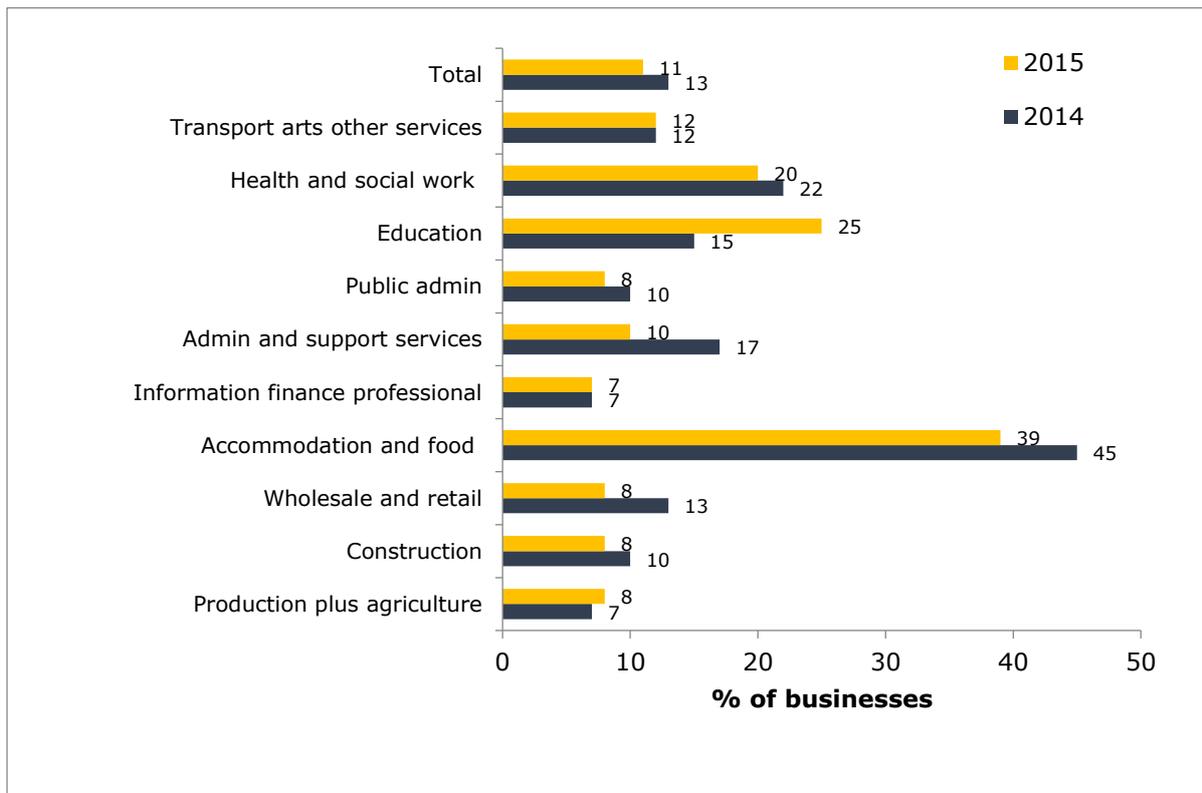
Figure 5.1: Distribution of workers on non-guaranteed hours contracts and “zero-hour contracts” by industry, 2015, UK



Source: ONS (2016).

The ONS also provides estimates of the number of employers who employee people with no guaranteed hours (see Figure 5.2 and Table 5.1).

Figure 5.2: Proportion of businesses using contracts that do not contain a minimum number of hours by industry. 2014 and 2015



Source: ONS (2016; 2015).

Table 5.1: Proportion of businesses using contracts that do not contain a minimum number of hours by size of business (January 2015 compared with January 2014, UK)

Size of business	% of Businesses	
	2014	2015
Under 20	12	10
20 to 249	28	27
250 or more	47	49
Total	13	11

Source: ONS (2016).

5.2 The Gig and Crowd Economy

There is now much interest in the gig economy or crowd economy / crowd sourcing (Davidson, 2015). There are no fixed definitions of these concepts and, in some respects, it seems little different to other forms of self-employment / temping albeit with more of an IT focus. A useful working definition of crowd working, from the perspective of the crowd source worker, describes it as “paid work that is organised by an online platform (in the knowledge that there may be situations where payment is withheld by the client). This work includes work that falls into two broad categories: first, work that is both managed online and carried out online, and thus capable of being delivered to clients anywhere in the world; and second, work that is managed online but carried out offline, and therefore restricted to labour markets that are

spatially accessible to the worker (although the platform itself may be located remotely)” (Huws, Spencer, & Joyce, 2016; Green, de Hoyos, Barnes, Baldauf, & Behle, 2014). The general view is that it is a form of work that has been taken up by professionals, but it has been shown that crowd sourcing can lead to task being undertaken in relation to the provision of household / individual services. It has not been able to identify a survey of employer use of crowd work / using the gig economy, but a number of salient issues can be identified from that which has been undertaken on individual workers:

- the types of employer that are making use of crowd working
- the types of tasks it is being used for
- why it is being used
- the employment status of those engaged in crowd working type activities

Table 5.2 below shows the extent of different online economic activity. It is derived from questions asked in an Omnibus online survey carried out in the Netherlands (NL), Austria (AT), Germany (DE), Sweden (SE), and the UK, and which is reported as being broadly representative of the populations in those countries (Huws, Spencer, & Joyce, 2016). Between a half and two thirds of those who regularly engage in online activities of a type listed below have a regular job. So it is not simply the case that people are engaging in these types of activity as a substitute for regular paid employment.

Table 5.2: Participation in the online economy as a source of income, by country (% of respondents)

Type of activity	Country				
	NL	AT	DE	SE	UK
Any	9	19	12	10	9
Rent to paying guest (e.g. Airbnb)	8	16	11	8	8
Sell/re-sell on own website	13	18	12	12	10
Sell self-made products (e.g. Etsy)	9	21	12	10	10
Resell products on online marketplace (e.g. Amazon)	25	45	32	13	31
Sell own possessions (e.g. eBay)	62	66	55	59	54

Source: Huws, Spencer and Joyce (2016).

5.3 Other forms of flexible working arrangements

Being able to match the supply of labour to its demand is dependent, at least in part, on having working time arrangements that provide the employer with the flexibility that will allow this to take place. In Europe, Eurofound’s Company Survey asks employers – in the management questionnaire – a range of questions relating to working-time:

Approximately what percentage of employees have the possibility to adapt – within certain limits - the time when they begin or finish their daily work according to their personal needs or wishes?

Is it possible for employees to use accumulated overtime for days off? This can be full or half days

Yes, it is possible for all employees

Yes, it is possible for some employees

No

Don't know / No answer

This provides a relatively limited insight into the extent of any flexibility in working-time arrangements. The 2011 Workplace Employment Relations Survey (2014) asks a more detailed set of questions, though the terms used may be UK-specific in some cases. The main questions include:

Flexible working arrangements available to at least some employees:

Home-based working

Compressed hours

Job share

Reduced hours

Flexitime

Term time working

Constraints on flexible working provision

No constraints on provision of flexible working

Workplace size constrains provision of flexible working

Nature of work/operating hours constrains flexible working

Pressure on employees/managers constrains flexible working

Cost constrains provision of flexible working

Lack of demand constrains provision of flexible working

Availability of reduced hours

Is flexitime available to employees with statutory rights or other employees?

Is reduced hours available to employees with statutory rights or other employees?

Managers constrains flexible working

No constraints on provision of flexible working

A further survey worth considering is the UK's Work-Life Balance Survey. The approach it takes to working time arrangements is to ask whether various flexible forms are available, whether anyone has made use of them over the past 12 months, and the characteristics of the workers who make use of them (2013). The survey contains several questions of interest that relate to flexible working time (see below).

Thinking about the days your establishment operates, does your establishment operate...

seven days a week?

six days a week?

Monday-Friday?

five and a half days a week (e.g. Monday – Friday plus Saturday morning)?

or is it usually open some other working pattern?

And do ANY employees on the payroll at this establishment.

have days where they only work part of the day (e.g. just the morning or just the afternoon)?

work nights?

work shifts? i.e. a pattern of working whereby different groups of employees work over different periods of the day or week?

work on zero-hours contracts? A zero-hours contract does not guarantee the employee a fixed number of hours per week and the employee is only paid for the hours that they work.

work part-time? i.e. less than 30 hours a week.

And can you tell me if ANYONE on the payroll at this establishment currently, or in the past 12 months has...

job shared?

worked flexitime? READ OUT: The employee chooses when to start and end work (within agreed limits) but works certain 'core hours', e.g. 10am to 4pm every day 2.

worked a compressed week? READ OUT: This is where an employee works full-time hours over fewer days in their working week. For example, working a 40 hour week over four days, or working a nine-day fortnight.

worked reduced hours for a limited period?

worked from home on a regular basis rather than an ad hoc basis?

worked during school term time only?

worked annualised hours? READ OUT: This is where the number of hours staff have to work is calculated over a full year rather than a week or month.

None of these

In the UK the Work-Life Balance Survey provides an indication of the percentage of employers that make use of flexible working contracts (see Figure 5.3).

Figure 5.3: Availability of flexible working practices in establishments (% of establishments)



Source: BIS Fourth Work-Life Balance Survey (2013).

6. A long-list of questions for on-demand labour and other flexible forms of working arrangement

6.1 Potential on-demand labour questions

One the basis of the questions outlined above, the following questions are suggested to ask about on-demand labour and other flexible forms of labour.

1. Does this workplace [or employer] employ people on contracts where there is no guarantee that any hours will be worked? These are sometimes called a zero-hours contract do not guarantee the employee a fixed number of hours per week and the employee is only paid for the hours that they work.

Yes CONTINUE

No

Don't Know

2. Approximately how many or what percentage of all employees are employed on these types of contract?

_____ number, or _____ %, or Don't know

3. [IF DO NOT KNOW AT Q 2] Would you say it was? [READ OUT OR SHOW CARD]

	N	%
1	1-5	Less than 5% but greater than %
2	6-10	Between 5% and 10%
3	10-24	More than 10% but less than 25%
4	25-49	More than 25% but less than 50%

5	50-99	More than 50% but less than 75%
6	100+	More than 75%
7.	Don't know	Don't know

4. What are the main types of job in which you employ people on zero-hour contracts?
[READ OUT OR SHOW CARD]

1	Managers	
2	Professionals	
3	Technicians and associate professionals	
4	Clerks	
5	Service workers and shop and market sales workers	
6	Skilled agricultural and fishery workers	
7.	Craft and related trades workers	
8.	Plant and machine operatives and assemblers	
9.	Elementary workers	

5. What are the main reasons for employing people in this way?

Reduce production costs

Difficulties finding skilled labour

Avoids recruiting people as employees

Other (please specify)

6. Thinking about those employees with employment contracts that do not guarantee a set number of hours work. Do these contracts include any obligations/restrictions around working for other employers?

Yes

No

Don't know

7. Do you have an employees who have no fixed times for starting or finishing work, but who are expected to work a certain number of hours a week?

Yes

No

Don't know

8. Who is mainly responsible for determining when the hours are worked?

Management at this workplace

The employee

Both equally

Don't know

With regard to on-demand labour it may be that this is supplied by the informal sector or by unregistered firms if the formal sector is relatively inflexible with regard to, for instance, on-demand labour. Therefore, one may approach this issue indirectly. In the World Bank Enterprise Survey (2010) respondents are asked whether the establishment competes against unregistered or informal firms: Does this establishment compete against unregistered or informal firms? This might be adapted so that respondents are asked:

1. Does this establishment subcontract work to unregistered or informal firms?

Yes	1 CONTINUE
No	2 GO TO X
Don't know	3 GO TO X

If there is an interest in knowing in what work is subcontracted out to unregistered or informal firms, then the following question might be asked.

2. [IF YES]What activities are subcontracted?

Catering	1
Transport and logistics	2
Other general manual work	3
Other general non-manual work	4
Other (please specify)	5
Don't know	6

6.2 Potential questions on crowd sourcing

Questions relating to crowd work or crowd sourcing might be developed along the following lines.

I would now like to ask you some questions about crowd sourcing. This refers to paid work that is organised by an online platform. You access the crowd sourcing online platform and are put in contact with people who have the skills you are looking for to carry out a particular task. The emphasis is on carrying out a particular task.

1. Over the past 12 months, have you used online sites or platforms that put you in contact with people who can undertake certain tasks for you at short notice?

Yes CONTINUE

No

Don't know

2. Did the people you commission ...

do all the work for you remotely, online?

come into this workplace to do the work?

Both

Don't know

3. Will these people be classed as your employees whilst they do the work for you?

Yes

No

Don't know

4. Over the past 12 months, how many people have you taken on through crowd sourcing?

5. [IF DO NOT KNOW AT Q 4] Would you say it was? [READ OUT OR SHOW CARD]

	N
1	1-5
2	6-10
3	10-24
4	25-49
5	50-99
6	100+
7.	Don't know

6. What are the main reasons for employing people in this way?

Reduce production costs

Difficulties finding skilled labour

Avoids recruiting people as employees

Work is easily done online

Other (please specify)

7. What skills have you been looking for taken people on through crowd sourcing?

1	IT / digital skills
2	Finance
3	Design / R&D
4	Other (please specify)

6.3 Potential questions on flexible working arrangements

1. Do any employees at this workplace [or company]...
 - have days where they only work part of the day (e.g. just the morning or just the afternoon)?
 - work nights?
 - work shifts i.e. a pattern of working whereby different groups of employees work over different periods of the day or week?
2. And can you tell me if any employees at this workplace [or company] currently, or in the past 12 months has...
 - job shared?
 - worked flexitime? READ OUT: The employee chooses when to start and end work (within agreed limits) but works certain 'core hours', e.g. 10am to 4pm every day 2.
 - worked a compressed week? READ OUT: This is where an employee works full-time hours over fewer days in their working week. For example, working a 40 hour week over four days, or working a nine-day fortnight.
 - worked reduced hours for a limited period?
 - worked from home on a regular basis rather than an ad hoc basis?
 - worked during school term time only?
 - worked annualised hours? READ OUT: This is where the number of hours staff have to work is calculated over a full year rather than a week or month.
 - None of these

6.4 Conclusion

The above has provided a long list of potential questions. In the next section a shorter list of questions is suggested for inclusion in IDB's Skills at Work in LAC survey.

7. A suggested final set of questions for inclusion in the IDB Skills at Work Survey

7.1 Ensuring questions on automation and AI are asked only of those to whom they are relevant

The representativeness of the enterprise surveys that ask about the introduction of automation / AI is far from clear. These surveys tend to have a small number of observations with little information about the population from which the enterprises were sampled or how they were sampled. Given the nature of the organisations which conduct the surveys – such as Narrative Science – there may be a suspicion that the participant enterprises are relatively hi-tech ones. Accordingly, a suite of questions on automation / AI may lack relevance to respondents in enterprises / workplaces that are not hi-tech ones. It may also lead to the over-reporting of the introduction of automation / AI if respondents felt that a failure to state that they were, at the very least, considering the introduction of automated systems reflected poorly on their workplace. The introduction of filtering, such that only workplaces to which such questions were relevant were asked them, can solve this problem. There are several options available:

1. Ask the questions only of those workplaces with, say, 50 or more employees or which belong to a larger organisation. The rationale here is that it is only in larger workplaces that automated systems are applicable or affordable;
2. Exclude sectors where there is likely to be little demand for automation, such as agriculture, restaurants, etc. The problem here is that AI tends to be a pervasive technology that has the capacity to affect nearly all sectors;
3. Introduce a filtering question along the lines of:⁴ “Is this establishment one where automated production systems are or could be used?” Alternatively, respondents could be asked to describe the workplace with respect to the use of technology: “How would describe the use of new technologies at this establishment? [READ OUT] We use state-of-the-art technologies / we use relatively advanced technologies / we use standard technologies / there is limited technology use.” All those using ‘state-of-the-art’ and ‘relatively advanced technologies’ could then be asked to respond to the automation / AI / robotics questions.
4. Introduce a filter that is based on a combination of all of the above (i.e. only companies with more than 50 employees excluding agriculture and restaurants and which self-select themselves for inclusion).

One balance, it might be best to use the filtering question given that automated systems and AI are so pervasive, though there may still be merit in also limiting respondents to those workplaces with 50 or more employees or are part of a larger organisation. So the filtering would be as follows.

IF EMPLOYEES AT WORKPLACE \geq 50 OR PART OF A LARGE ORGANISATION CONTINUE; ELSE GO TO SECTION X

I would now like to ask you some questions about the use in this establishment of automated systems including those that use artificial intelligence and robots. Just to check: is this establishment one where automated production systems are, or could be, used?

- Yes CONTINUE
 No GO TO SECTION X
 Don't know GO TO SECTION X

This would then ensure as far as possible that only respondents to which the following questions were relevant would be asked them.

7.2 Questions on AI/automation/robotics

Listed below are a suggested set of question on new technologies. The list of technologies listed could be reduced just to include AI /robotics/3D printing.

1. To what extent are each of the following technologies in place in your workplace?
[SHOW CARD]

	Yes, very much so	Yes, a little	No	Don't know
--	-------------------	---------------	----	------------

⁴ In the original questionnaire designed for Peru there was a question on the complexity of production processes – question E2: “A score of 1 indicates that compared with others in your industry, this establishment provides a highly complex product or service, and a score of 5 indicates that you provide a simple service or product?” All with a score of three and under could be asked the suite of questions on the use of automation / AI / robotics.

Nanotechnologies				
New materials				
The Cloud - software as a Service delivered over the Internet				
Mobile devices and applications				
Marketing platforms (digital media, advertising platforms)				
Social media (social networking and collaboration platforms)				
Artificial intelligence (smart software systems)				
Digital payments and currency (e.g., mobile payment systems, etc.)				
Robotics (physical systems of automation, including driverless cars)				
3D printers				
Big data				
None of the above				

2. Over the next three years, which technologies is it likely that you will be investing in...
[SHOW CARD]

	Yes, very likely	Yes, probably	No	Don't know
Nanotechnologies				
New materials				
The Cloud - software as a Service delivered over the Internet				
Mobile devices and applications				
Marketing platforms (digital media, advertising platforms)				
Social media (social networking and collaboration platforms)				
Artificial intelligence (smart software systems)				
Digital payments and currency (e.g., mobile payment systems, etc.)				
Robotics (physical systems of automation, including driverless cars)				
3D printers				
Big data				
None of the above				

3. [ASK ALL WHO ANSWERED NOT 'None of the above' at Q1 or Q2] Why have you / why will you introduce the new technologies? [READ OUT OR SHOW CARD / TICK ALL THAT APPLY]

Need to increase productivity / efficiency with which we produce goods and services

Need to keep up to date with the way we produce our goods and services

Instructed to do so by head office

Improving quality of goods and services

Reduce overall costs

Because of difficulties recruitment people in general

Because of difficulties recruiting the specific skills we need

In order to reduce personnel costs

Recruit better staff

Other (please specify) _____

[GO TO Q5]

4. [ASK ALL WHO ANSWERED 'None of the above' at Q1 or Q2] Why have you not introduced the new technologies just mentioned?

- No demand for it in business
- Not skills in business to introduce it
- Not sure what it is or what it can do
- A shortage of investment capital
- Don't know

[GO TO NEXT SECTION]

5. In what tasks are the new technologies engaged?

- Assembly
- Tasks that require high levels of dexterity and precision
- Materials handling/packaging
- Performing highly dangerous/onerous tasks
- Telephonic systems
- Customer service
- Other (please specify)

6. What do you think the impact will be of introducing the new technologies on overall employment at this workplace?

	Employment will increase a great deal	Employment will increase a little	Employment will stay same	Employment will fall a little	Employment will fall a great deal	Don't know
Nanotechnologies						
New materials						
The Cloud - software as a Service delivered over the Internet						
Mobile devices and applications						
Marketing platforms (digital media, advertising platforms)						

Social media (social networking and collaboration platforms)						
Artificial intelligence (smart software systems)						
Digital payments and currency (e.g., mobile payment systems, etc.)						
Robotics (physical systems of automation, including driverless cars)						
3D printers						
Big data						

7. [ASK ALL AT Q1 WHO DO NOT ANSWER 'None of the above'] Will the introduction of new technologies lead to:

- A. recruitment of staff with new skills to replace existing staff?
- B. recruitment of staff with new skills in addition to existing staff?
- C. bringing in outside experts to transfer skills to employees?
- D. outsourcing of some business functions?
- E. the recruitment of new staff expert in these new technologies?
- F. None of the above

8. [ASK ALL If the introduction of new technologies required you to recruit people with technology relevant skills, how easy would it be for you to recruit people with those skills

Very easy

Easy

Difficult

Very Difficult

9. Don't know [IF A B OR E @ Q7] What skills do you expect to be difficult to recruit?

10. [IF A B OR E @ Q7] Will your search for recruits be from ...[TICK ALL THAT APPLY]

the local labour market?

the national labour market?

the international labour market?

Don't know

11. [ASK ALL AT Q1 WHO DO NOT ANSWER 'None of the above'] Will the introduction of the new technologies lead to training of existing employees?

Yes CONTINUE

No

Don't know

12. [IF YES @ Q11] Will this be delivered through:

off-the-job training?

on-the-job- training?

Don't know

13. [IF YES @ Q11]Do you expect any difficulties in being able to supply the training needed?

Yes, very much so

Yes, some difficulty

No

Don't know

7.3 Questions to be included in WEF enterprise survey on AI/automation/robotics

If it were possible to include questions in the WEF questionnaire for LAC, then the following might suffice. It is suggested that the filtering specified in Section 7.1 above be used to ensure that the questions are asked only of those respondents to whom they are likely to be relevant.

The following questions ask about **new technologies** that might affect the way you carry out your business.

1. **Are you currently using any of the following in the processes you use to produce your goods or services? [READ OUT]**

READ OUT	Yes, to a great extent	Yes to a moderate extent	No	Don't know
A Artificial Intelligence and Machine Learning				
B Advanced robotics and autonomous transport				
C Advanced manufacturing and 3D printing				

2. **In the next three years, how likely is it that you will introduce more artificial intelligence into your production systems? [READ OUT]**

	Very likely	Likely	Not likely	Not at all likely	Don't know
A Artificial Intelligence and Machine Learning					
B Advanced robotics and autonomous transport					
C Advanced manufacturing and 3D printing					

3. [ASK ALL AT Q1 WHO ANSWER NO @ A B OR C] OR [ANY AT Q2 WHO ANSWER NOT LIKELY OR NOT AT ALL LIKELY AT A B OR C] **Why have you not introduced \ will not introduce [ITEM MENTIONED AT Q1 as NO OR AT Q2 AS NOT LIKELY OR NOT AT ALL LIKELY]?**

No demand for it in business

No skills in business to introduce it

No skills available in the labour market that would allow us to introduce it

Not sure what it is or what it can do

A shortage of investment capital

Other (specify)

4. [ASK ALL AT Q1 WHO ANSWER YES @ A B OR C] OR [ANY AT Q2 WHO ANSWER LIKELY OR VERY LIKELY AT A B OR C] **What do you think the net impact will be**

of [ITEM MENTIONED AT Q2 AS VERY LIKELY OR LIKELY] on overall employment at this workplace?

	Employment will increase a great deal	Employment will increase a little	Employment will stay same	Employment will fall a little	Employment will fall a great deal	Don't know
A Artificial Intelligence and Machine Learning						
B Advanced robotics and autonomous transport						
C Advanced manufacturing and 3D printing						

5. [ASK ALL AT Q1 WHO ANSWER YES @ A B OR C] OR [ANY AT Q2 WHO ANSWER LIKELY OR VERY LIKELY AT A B OR C] **Will the introduction of new technologies lead to**

- A. recruitment of staff with new skills to replace existing staff?
- B. recruitment of staff with new skills in addition to existing staff?
- C. bringing in outside experts to transfer skills to employees?
- D. training of existing employees?
- E. outsourcing of some business functions?
- F. None of the above

6. [IF A B OR E @ Q5] **Do you expect to experience recruitment difficulties in taking on new staff?**

- Yes
- No
- Don't know

7. [IF A B OR E @ Q5] **Will your search for recruits be from...** [TICK ALL THAT APPLY]

- the local labour market?
- the national labour market?
- the international labour market?
- Don't know

8. [IF mentioned D @ Q5] **Will this be delivered through:**

off-the-job training, in public training centres?

off the job training, in private training centres?

on-the-job-training?

Don't know

9. **Do you expect any difficulties in being able to supply the training needed?**

Yes, very much so, because of the low quality of training available \ low relevance of content

Yes, very much so, because of other reasons

Yes, some difficulty

No

Don't know

7.4 Questions to ask about on-demand labour

1. [ASK ALL] Does this establishment subcontract work to unregistered or informal firms?

Yes	1 CONTINUE
No	2 GO TO X
Don't know	3 GO TO X

If there is an interest in knowing in what work is subcontracted out to unregistered or informal firms, then the following question might be asked.

2. [IF YES] What activities are subcontracted?

2. Catering	1
Transport and logistics	2
Other general manual work	3
Other general non-manual work	4
Other (please specify)	5
Don't know	6

7.5 Question to ask about crowd sourcing

1. Over the past 12 months, have you used online sites or platforms that put you in contact with people who can undertake certain tasks for you at short notice?

Yes CONTINUE

No

Don't know

2. Did the people you commission ...
- do all the work for you remotely, online?
 - come into this workplace to do the work?
 - Both
 - Don't know

8. Conclusion

Most of the large scale surveys relating to technology tend to ask about computer use by companies or the introduction of new products and processes. In the EU there are several surveys that address these issues, especially the introduction of new products and processes (e.g. the Eurofound Company Survey). Where information is collected about AI/automation/robotics – which tend to be grouped under the heading of disruptive technologies – it is from relatively small-scale, non-representative surveys of senior executives sometimes with a responsibility for IT / technology within their firms. These surveys have sought to categorise disruptive technologies. This provides a useful resource in being to isolate and describe specific technologies (e.g. such as the surveys reported by Narrative Science on AI). But they tend to have a limited interest in which groups of employees or which skills are likely to be affected by the introduction of specific technologies. Accordingly, it has proved difficult to find questions which can be replicated for use in the LAC Employer Survey given the latter survey's interest in understanding the demand for, and supply of, particular types of skill. It has, however, been possible to use the disruptive technology surveys as a basis for producing a classification of technologies that could be used in the IDB's Skills at Work in LAC survey if there is an interest in specific (disruptive) technologies.

In relation to on-demand labour, surveys in the UK have sought to estimate how many employers make use of zero-hour contracts. Some of the questions used in the UK have been suggested for use in the IDB's Skills at Work in LAC survey. It is recognised that in countries with a substantial informal sector that there may be no need to make use of on-demand labour if supply is readily available from unregistered firms or those in the informal sector who might not be subject to employment regulations. Accordingly, there has been an attempt to include a question which asks whether use is made of labour supply by firms from unregistered firms or those in the informal sector. This may therefore provide a proxy measure of on-demand labour.

Finding questions that can be replicated in the IDB's Skills at Work in LAC survey has proved difficult. The questions which are suggested for use are, for the most part, new ones. Construction of the questions has been informed by other survey questionnaires that have tackled these issues though from a different perspective. Accordingly many of the questions are new - which limits the scope for benchmarking – because the issue of the skill needs for the workforce as whole arising from the introduction of AI / robotics is a relatively new one.

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Appendix 1: Questionnaire surveys with questions about new technologies, on-demand labour, crowd work and flexible working time

SURVEY	ORGANISATION	LINK	COMMENTS
New technologies			
Community Innovation Survey	Eurostat on behalf of the European Commission	General information: http://ec.europa.eu/eurostat/web/microdata/community-innovation-survey Questionnaire: http://ec.europa.eu/eurostat/documents/203647/203701/Harmonised+survey+questionnaire+2012/164dfdfd-7f97-4b98-b7b5-80d4e32e73ee	Tend to focus on innovation rather than specific technologies
European Company Survey	Eurofound on behalf of the European Commission	General information: https://www.eurofound.europa.eu/surveys/european-company-surveys Questionnaire: https://www.eurofound.europa.eu/surveys/european-company-surveys/european-company-survey-2013/ecs-2013-questionnaire	Focus is upon introduction of new processes and products
ICT Usage and E-commerce in Enterprises	Eurostat on behalf of the European Commission	General information: http://ec.europa.eu/eurostat/cache/metadata/en/isoc_e_esms.htm Data: http://ec.europa.eu/eurostat/web/digital-economy-and-society/data/database [file - isoc_ci_eu_en2]	Enterprise information about e-commerce, connections to internet, use of social media, cloud computing, etc.
EU Survey on Nanotechnologies, New Materials New Production	European Commission	General information: https://cordis.europa.eu/nmp/whatis.htm	Range of questions on nanotechnologies and new material use

Processes and Devices (NMP)			
Survey of disruptive technologies	KPMG International	Report: https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2016/11/disruptive-technologies-barometer-tech-report.pdf	Detailed information on take-up by enterprises of specific technologies including AI/automation/robotics
Survey on digitisation	Manpower	Report: http://www.manpowergroup.com/wps/wcm/connect/5943478f-69d4-4512-83d8-36bfa6308f1b/MG_Skills_Revolution_lores.pdf?MOD=AJPERES&CACHEID=5943478f-69d4-4512-83d8-36bfa6308f1b	Detailed information on take-up of digitisation by enterprises in 43 countries
Survey of AI	Narrative Science	Report: http://www.datascienceassn.org/sites/default/files/Outlook%20on%20Artificial%20Intelligence%20in%20the%20Enterprise%202016.pdf	Contains information on AI take up by enterprises. Data collected annually
Survey of robotics use	PWC	Report: https://www.pwc.com/us/en/industrial-products/assets/industrial-robot-trends-in-manufacturing-report.pdf Chart-pack https://www.pwc.com/us/en/industrial-products/assets/robotics-chart-pack.pdf	Information on current and future take up of robotics
Future of Jobs Survey	World Economic Forum	Questionnaire: https://eu.qualtrics.com/SE/?SID=SV_4IQMSqaKVNGcaA5&Q_JFE=0&Preview=Survey See also: http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf	Asks about detailed list of technologies including AI/robotics/3-D printing

On-demand, labour crowd sourcing and flexible working time arrangements			
Annual Business Survey	Office of National Statistics UK	Report: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/articles/contractswithnoquaranteedhours/2015-09-02	Provides an estimate of the number of enterprises and people working on zero-hour contracts
Crowd work in Europe Survey	Hertfordshire University (UK)	Report: http://www.feps-europe.eu/assets/39aad271-85ff-457c-8b23-b30d82bb808f/crowd-work-in-europe-draft-report-last-versionpdf.pdf	A survey of individuals not firms – questions placed in an existing omnibus survey
European Company Survey	Eurofound on behalf of the European Commission	General information: https://www.eurofound.europa.eu/surveys/european-company-surveys Questionnaire: https://www.eurofound.europa.eu/surveys/european-company-surveys/european-company-survey-2013/ecs-2013-questionnaire	Questions about use of flexible working time arrangements
Workplace Industrial Relations Survey	UK Government	Report and questionnaires available from: https://www.gov.uk/government/publications/the-2011-workplace-employment-relations-study-wers	Questions on flexible working time arrangements
Work-Life Balance Survey	UK Government	Report: https://www.gov.uk/government/publications/fourth-work-life-balance-employer-survey-2013	Questions on flexible working time arrangements
Enterprise Survey	World Bank	Questionnaires available from: http://www.enterprisesurveys.org/methodology	Questions on informal economy