



UK COMMISSION FOR
EMPLOYMENT AND SKILLS

The Labour Market Story: Skills For the Future

Briefing Paper
July 2014

The Labour Market Story: Skills for the Future

Briefing Paper

July 2014



Table of Contents

Executive Summary	v
1 Future skills demand.....	1
2 Drivers of demand	2
2.1 Technical change.....	3
2.2 Competition and globalisation	4
2.3 Demographic change	5
2.4 Corporate strategic choice	5
2.5 Impact of drivers of change.....	6
3 Demand for skills in 2022.....	8
3.1 Service sector expansion	9
3.2 Changes in demand for skills.....	11
3.3 Replacement demand.....	13
3.4 Future UK skills performance.....	16
4 Disruptive factors	18
5 Future skills and jobs.....	23
5.1 Emerging skills needs.....	23
5.2 What type of jobs do we want?	25
6 Policy implications	26
Bibliography	30

Tables and figures

Figure 2.1: Drivers of skill demand in the workplace	2
Figure 3.1: Trends in gross value added and forecast growth to 2022 (year-on-year percentage growth)	8
Figure 3.2: Population, Unemployment and Labour Force Profiles, 1981-2022 in the UK (000s)	9
Figure 3.4: Changes in Skill Demand in the UK: Occupational structure in 2012 and 2022..	12
Figure 3.5: Replacement and expansion demands 2012 to 2022 (000s).....	13
Figure 3.6: Replacement and expansion demands to 2022 (000s).....	14
Figure 3.7: Changing patterns of qualification in the UK's working age population (%)	15
Figure 4.1: Trends driving the future of UK jobs and skills	18

The Labour Market Story is based on research undertaken by the Institute of Employment Studies, the Warwick Institute for Employment Research, Cambridge Econometrics and UKCES. We would also like to acknowledge the assistance of expert reviewers who provided comments on early drafts.

Executive Summary

- Future skills demand will depend on the types of jobs that the economy creates. Growth is projected in high level occupations (managers, professionals, and associate professionals) and some lower skilled occupations (in caring, hospitality and leisure).
- The share of employment in services is projected to increase to 2020, and the share of employment in manufacturing and utilities to decrease. There is also likely to be polarisation by location, with higher skilled jobs increasingly concentrated in London and the South East.
- The projected demand for skills indicates a continued polarisation of the labour market, with growth in relatively high and low skilled jobs. This has implications for career progression: without middle-level occupations, individuals may find it more difficult to progress from low to high skilled jobs.
- Future skills demand will be shaped by technical change, trade liberalisation and demographic change. Information and communication technologies will make it increasingly easy for employers to engage in complex supply chains which cross national boundaries. The UK's skills base will need to form a substantial part of its competitive advantage, enabling the nation to capture high value segments of the global market. This underlines the importance of an adequate supply of skills for innovation.
- However, technology alone will not drive growth: organisational change will be needed to optimise the gains from technology. This emphasises the important role of high performance working in bringing about future economic growth in the UK.
- People with hybrid skillsets, such as technology and project management skills, are likely to be in demand and workers will need to continue training to develop new skills throughout their careers.
- Demographic change as well as changes to the state pension age will increase labour supply. Individuals will compete on the basis of their skills, and older workers will need to continue learning and updating their skills. Employers will need to consider succession planning as people leave the labour force.
- The future remains uncertain: sudden, radical shifts in technology or new trade barriers could impact on skills demand. Meeting future challenges will require a more flexible and responsive skills system which better meets current and future economic needs.

1 Future skills demand

Future skills demand will be dependent upon macroeconomic developments in the domestic and global economies. Following the economic crisis in 2008/9 and the subsequent period of turbulence, greater stability is beginning to emerge. In early 2014 the global economy, especially in some European countries and the USA, has achieved a degree of stability (IMF, 2014). The Office of Budget Responsibility's (OBR) latest (March 2014) forecasts suggest GDP growth of 2.7 per cent in 2014 and 2.3 per cent in 2015. This is lower than growth rates before 2008/9 but points to the return of a medium-term positive trend.

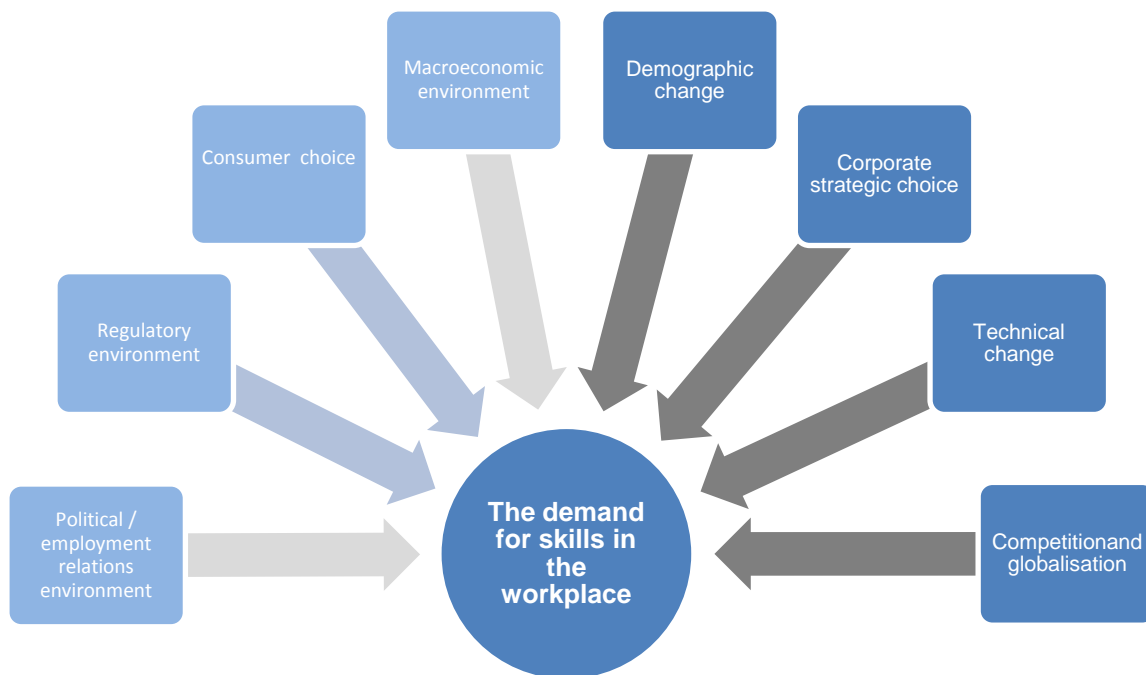
It is important to understand what the implications of the economic future are for the UK and: (a) whether current skills development activities are sufficient to enable firms to compete successfully; and (b) how policy can best support them. This includes addressing risks posed by failure to change and adapt the skills system to meet new and emerging economic needs. Developing a structured view about the future enables labour market actors to make informed decisions about the skills investments they may need to make, especially in achieving outcomes which are optimal for society as well as for the economy.

These predictions may be affected by unforeseen changes and uncertainties that may influence the shape and direction of economic recovery and growth. However, thinking through the challenges they raise helps ensure that we develop better responses to skills issues and are proactive in how we address change. This paper explores the implications of economic projections for the UK labour market over the next decade, taking into consideration qualitative foresight studies as well as quantitative skill projections. It considers key drivers of skills demand and likely impacts on employer demand for skills; and what employer demand for skills will look like in 2022. It then draws out policy challenges and implications.

2 Drivers of demand

The demand for skills is a derived demand: skills demand is dependent on the types of products and services produced, and so affected by an organisation's product market strategy, future plans for growth and wider economic conditions. The future demand for labour and skills will be shaped by a number of factors (see Figure 2.1).¹

Figure 2.1: Drivers of skill demand in the workplace



Economic and political factors will have a major influence on the level and profile of product and service demand and thereby future skills demand in the workplace. This section considers these drivers and their likely impacts. It assumes continued economic growth of around two per cent per year, broad political stability and similar levels of labour market regulation, and therefore focuses on the following drivers:

1. technical change
2. competition and globalisation
3. demographic change
4. corporate strategic choice (i.e. firms' product market strategies and strategic choices).

¹ Figure 1 is based on a summary of a number of reports on skills demand. Skills in England was published annually by the Learning and Skills Council between 2002 and 2007 and regularly reviewed the drivers of skill demand – see, for example, http://readingroom.lsc.gov.uk/lsc/national/SiE_Volume1final_12Sept07.pdf

2.1 Technical change

Innovation leads to the development of new products, services, and production processes, including automation of production systems that were previously labour intensive. The pace of technical change is substantial, and it is expected to continue with the development of key enabling technologies (KETs), including nanotechnologies, nano-electronics and biotechnology (European Commission, 2011; Dickens *et al.*, 2013). Technological innovations inspired by the need to mitigate or respond to environmental change also have the capacity to create new demands for product and services. Renewable technologies are an example, with potential increased demand for new products (e.g. off-shore wind turbines) and services (e.g. marketing services) for green energy (UKCES/PWC and Garrett, 2010). Technical change also has the capacity to give rise to new sectors of activity. The creative sector, for instance, has been transformed by the introduction of digital technologies with a shift into the development of multi-media computer games and apps (UKCES/Williams *et al.*, 2012).

Foresight studies reveal a number of key trends driven by technology innovation, including on-demand manufacturing incorporating the production of personalised products, the emergence of regenerative medicines, and the use of new materials (BIS, 2010b; BIS, 2013a; EIU, 2006). Realising the economic potential of technological breakthroughs will rely on creating an infrastructure to move innovations from initial ideas into the marketplace. This includes further development of the links between industry, including small businesses, and research institutions including universities (Wilson, 2012). This is not always easy to achieve, as the Lambert (2003) and Wilson (2012) reviews on the links between industry and higher education have shown. The higher education sector's capabilities, in particular, will need to be harnessed in business-led research and innovation. In the future, the skills sets associated with idea generation and exploitation to develop future products and services will be increasingly important (BIS, 2010b; UKCES, 2009; UKCES, 2010).

Technology alone will not drive growth. Technical and organisational change need to take place hand-in-hand if the gains from technology are to be optimised. This emphasises the important role of high performance working in bringing about future economic growth in the UK.

2.2 Competition and globalisation

The gains from information and communications technologies (ICTs) need to be seen in the context of globalisation and the removal of trade barriers between countries (Friedman, 2007). Globalisation is a second driver of change and in a global economy which has seen many trade barriers lowered, if not removed, firms have increased choice regarding the location of production. With the development of ICT it is increasingly possible for products and services to be produced anywhere in the world and exported. ICT enables the creation of complex supply chains which can benefit from the relative economic advantages possessed by a particular country. The choice of location for various elements of the production process, such as research and development (R&D), product design, assembly, sales and marketing, is affected by a range of factors, including the regulatory environment, as well as labour and skills supply.

Comparative international studies conclude that the UK's competitive advantage lies in its capability to engage in the production of relatively high value added goods and services (CBI, 2009; EIU, 2006; BIS, 2013a). This is linked to the creation of a knowledge-based economy where the relative strength of the economy is based on the invention and design of products. However, other countries are looking to capture this segment of the global market too. South Korea, India and China have invested heavily in the skills of their populations over recent decades which has increased their capacity to produce medium- to high-value added goods and services, but at lower prices than in Western economies.

The UK Government has tried to create a regulatory environment which is attractive to foreign direct investors and entrepreneurs setting up new businesses. This includes protecting intellectual property which can affect company decisions about country of location. This is important because the ability of the UK to position itself as a leading knowledge-based economy is increasingly dependent upon having the skills required to support knowledge based products and services.

2.3 Demographic change

The third main driver of change is demographic change. In particular, an ageing population potentially gives rise to increased demand for health and social care products and services. For example, in medical technologies use of self-diagnostic kits is growing (e.g. blood pressure machines which would previously have been prohibitively expensive) and telemedicine involving remote imaging and diagnosis is expanding. These are just examples of the types of product and services which an ageing population may demand. In addition, an ageing population will increase the demand for people to work in medical/caring jobs. This has implications for sectoral labour demands by creating a need for people to work in the medical technologies sector, though there is strong international competition to produce these goods (Hogarth *et al.*, 2010), and for people to work in the care sector. Additionally, some sectors have ageing workforces and will need to consider succession planning and how best to transfer skills and knowledge to younger workers who will remain in the labour force.

2.4 Corporate strategic choice

A key question which will affect skills needs is what type of goods and services will be produced in the UK or imported from elsewhere in the world, and the type and volume of high value added outputs requiring high skills which will be produced in the UK. This is the fourth main driver of change: corporate strategic choice. Employers will choose where to locate different elements of the production process. If a company wants to develop its products in a given market it is likely to locate at least some of the more high value-added elements of the production process there, as a sign of its willingness to invest in that country (UKCES/Hogarth *et al.*, 2010).

With trade liberalisation comes the prospect of greater competition from elsewhere in the world. To date, Europe, the USA, and Japan have been able to dominate the production of high value goods which depend upon highly skilled workers. This is why policy makers in these countries have placed such a premium upon the innovation process and having a strong supply of people qualified in science, technology, engineering and mathematics (STEM). The UK is not forecast to have skill shortages for higher level STEM skills (UKCES/Bosworth *et al.*, 2013) but supply and demand are often finely balanced so there would be little capacity to meet a sharp increase in demand for STEM skills. In addition, people with STEM qualifications are not necessarily interchangeable and may need significant retraining if moving to a new sector.

Skills supply is a strong factor which will help determine where goods and services are developed and eventually produced. A shortage of skilled labour is potentially a major constraint on a firm's productive capacity. This is particularly important in sectors at the cutting edge of technological developments including advanced manufacturing, but also in service sectors such as those related to digital and creative industries, health, and financial services.

2.5 Impact of drivers of change

In summary, the combination of trade liberalisation (or globalisation) and the development of new technologies which facilitate the creation of complex, international supply chains is perhaps the greatest driver of change for the future. There will, inevitably, be a range of products and services which need to be produced and consumed locally, but increasingly high value goods and services produced within complex, international supply chains will drive growth in the economy (UKCES/Mason and Constable, 2011; Mason, 2004). The challenge for the future is to ensure that the UK has the skills base which will enable it to capture a sizable market share. As noted earlier, the skills base in locations such as urban China, India and Singapore is also developing rapidly and threatens to overtake the UK's competitive position. The UK also needs firms to make optimal use of available workforce skills.

These drivers are likely to bring about changes in the demand for skills through task-biased technological change (TBTC) and off-shoring. Technological change can replace jobs which do not require workers to make decisions in response to changing needs of the job or customers (Autor *et al.*, 2003, 2009; McIntosh, 2013). This affects skilled production jobs and routine administrative ones (Goos and Manning, 2007). Higher level skilled jobs which require workers to use cognitive skills are less readily substituted by automation. Equally, some lower skilled jobs in caring, leisure and hospitality occupations require worker/customer interaction and are less easy to automate.

In addition, tasks which require a highly qualified and skilled professional to perform them can be substituted by self-service type activities, off-shoring and/or automation. For instance, in legal services, it is now possible to purchase kits which enable people to write their own will or complete legal forms for house purchases. Similarly, some medical procedures can be automated, which may reduce the number of skilled clinicians and medical staff required to carry them out. It is possible that technical change will affect the demand for high skilled employees too, but new jobs are often created during waves of automation, and these may have equal or greater skills demands.

Globalisation has resulted in many jobs being transferred to countries with lower labour costs (Goos *et al.*, 2011; McIntosh, 2013). Many skilled manual production jobs have been transferred to cheaper Asian countries, whereas workers employed in managerial and professional jobs making strategic decisions about developing new products and markets remain in EU countries. However, even high skilled jobs can be transferred offshore, given the investments countries such as India and China have made in their education systems. Jobs which have been considered prestigious, high-skill, high-wage ones may come under increased price competition from developing countries over the medium term (Brown *et al.*, 2008).

3 Demand for skills in 2022

Future skill demand will depend on overall levels of economic demand, but is also affected by much longer-term employment trends which shape the demand for, and supply of, skills. This is where the Working Futures series of skill projections provide valuable insights.

Working Futures provides a detailed assessment of the future medium-term demand for skills in the UK based on a macroeconomic forecast for the UK economy which provides an indication of the future employment levels across industrial sectors (UKCES/Wilson *et al.*, 2014a, 2014b). Defining skill is tricky because of the different kinds of measures that can be used (Green, 2011); in Working Futures occupational classification and qualification attainment are used as widely accepted proxy measures of skill.

The forecasts on which Working Futures are based suggest modest economic growth over the next decade. Over the period 2014 to 2017 a slight increase in business investment and modest growth in household consumer spending will be partly offset by falling government consumption and investment (see Figure 3.1).

Figure 3.1: Trends in gross value added and forecast growth to 2022 (year-on-year percentage growth)



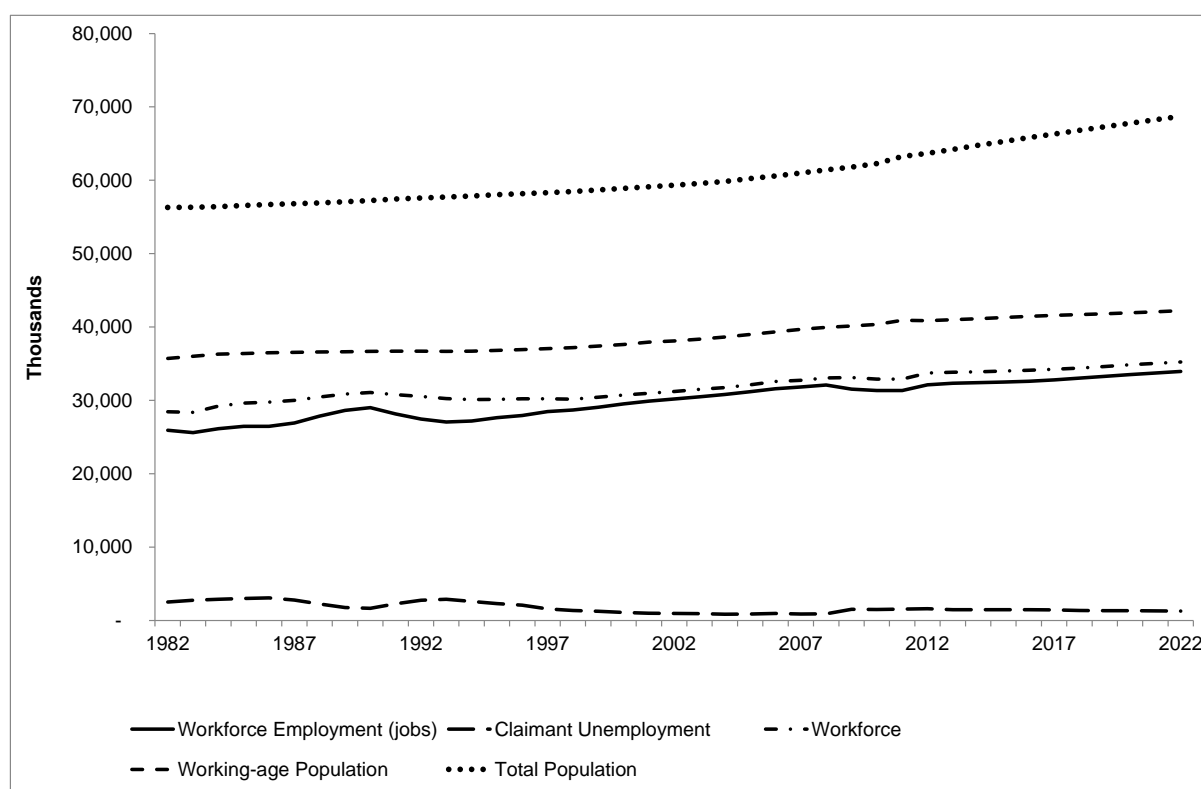
Source: Cambridge Econometrics, MDM revision 12015

The level of demand for and supply of skills depends on demographic factors as well. Over the forecast period (2012-22), the UK population is expected to grow by 0.8 per cent a year and experience a slightly larger increase (7.9 per cent) compared with 2002-12 (7.3 per cent). The UK labour force is also expected to grow between 2012 and 2022 (by 2.2m or 7.1 per cent) but at a somewhat less rapid rate than in the previous decade, when it grew by 2.8m (9.5 per cent).

This increase in labour supply has two implications. First, if people remain in the labour force for longer, demand for retraining and continuing education is likely to increase. Secondly, if people work until they are older than in previous generations, this may reduce short-term opportunities for young people to enter the labour market. However, this will be mitigated by growth in the number of jobs available.

The overall trends in population and employment presented in Working Futures are outlined below in Figure 3.2.

Figure 2.2: Population, Unemployment and Labour Force Profiles, 1981-2022 in the UK (000s)



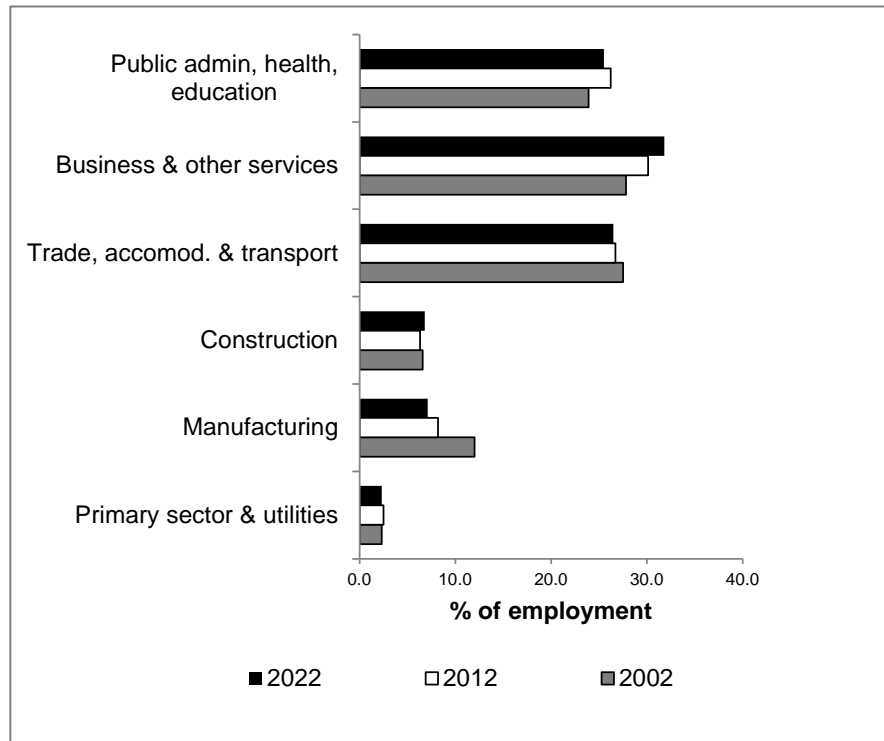
Source: Cambridge Econometrics, MDM revision 12015

3.1 Service sector expansion

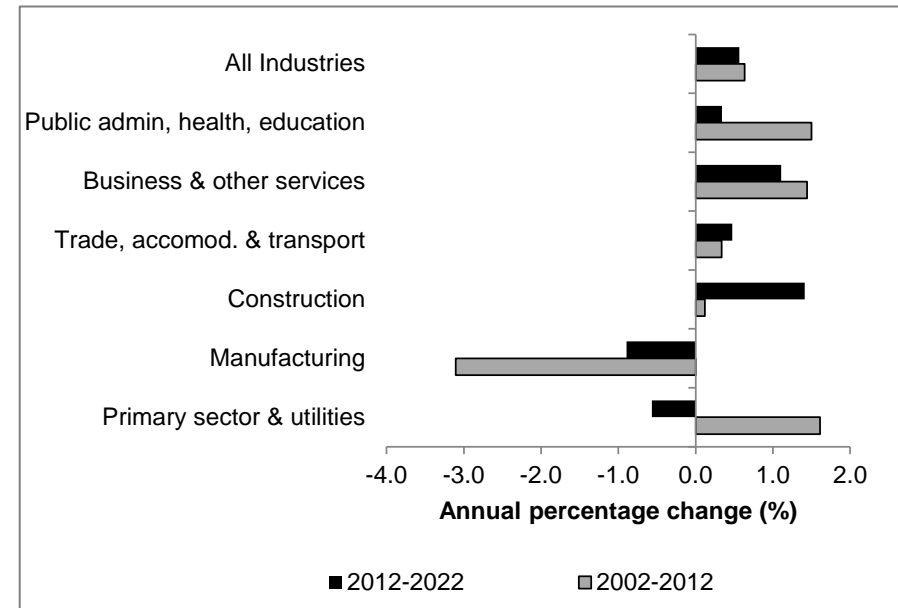
Skill demand in Working Futures projections is influenced by the changing occupational structure of employment, as well as shifts in the industrial structure of employment. The broad pattern of sectoral change to 2022 shows a continuing long-term trend of increasing employment in private sector services, particularly in business & other services (Figure 3.3).

Figure 3.3: Employment by Broad Sector in the UK, 2012-2022

(a) Change in share of employment



(b) Annual percentage growth



Source: UKCES/Wilson et al., 2014a

Source: UKCES/Wilson et al., 2014a

In general, the share of employment in the primary & utilities and manufacturing sectors is projected to fall. Productivity growth and increased specialisation in key industries will lead to a further fall in manufacturing employment. In contrast, construction is expected to increase its share of employment, partly as a result of government investment in public infrastructure projects. In trade, accommodation & transport, employment growth from 2012-2022 is expected to be greater than from 2000-2012. Growth in the business services sector will be higher than in trade, accommodation & transport, but lower than levels experienced from 2000-2012, which partly reflects the legacy of the economic crisis in financial services. Overall, this sector will remain highly important for employment over the medium-term. The non-marketed services sector (composed of public administration, education, health, residential care and social work) will continue to grow to 2022, but at a lower rate than between 2000 and 2012, mainly as a result of Government's plans to reduce public sector employment levels. The overall share of public sector employment will fall.

These results need to be placed in a wider perspective. Manufacturing, for instance, accounts for around 10 per cent of employment and output. Given productivity changes, manufacturing will employ fewer people in the future, but a large share of service sector employment is dependent upon the manufacturing sector (Wilson and Hogarth, 2013).² Over the period to 2022, employment levels overall will, to a large extent, depend on the manufacturing sector's demand for a range of business services. The business services sector provides support to other sectors of the economy and is dependent on their growth.

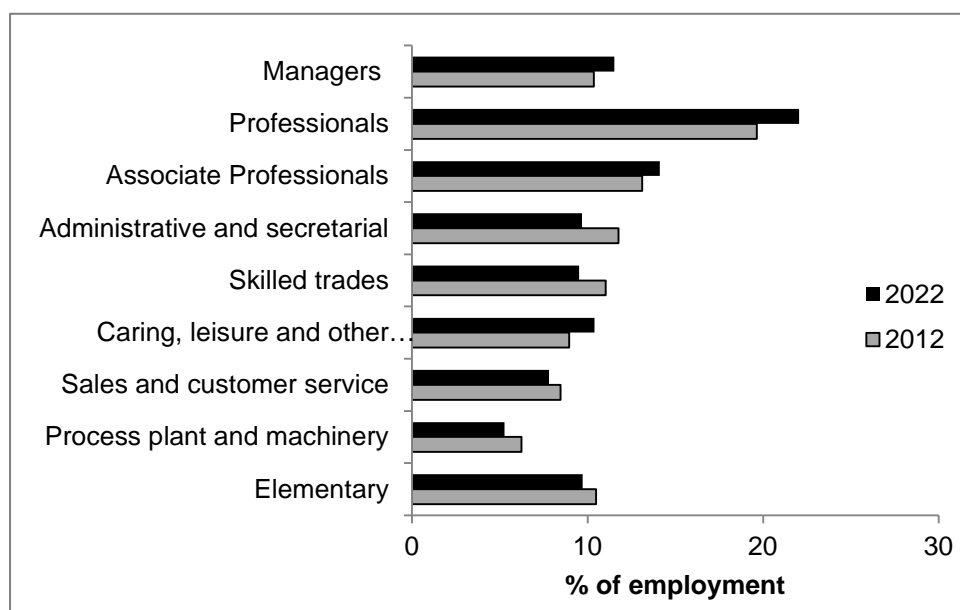
3.2 Changes in demand for skills

Figure 3.4 shows how the demand for skills, as reflected in the occupational profile of employment, is likely to change over the period to 2022. Demand for skills is likely to be concentrated in the high level occupations of managers, professionals, and associate professionals and in relatively lower skilled jobs among caring and leisure occupations. This is consistent with interpretations of polarisation in the UK's skills structure, with increased demand for high and low level skills but net decline in employment for some occupations that require intermediate skills. This is not unique to the UK; projections of future skill demand for many European Union member states reveal the same outlook (Wilson *et al.*, 2013).

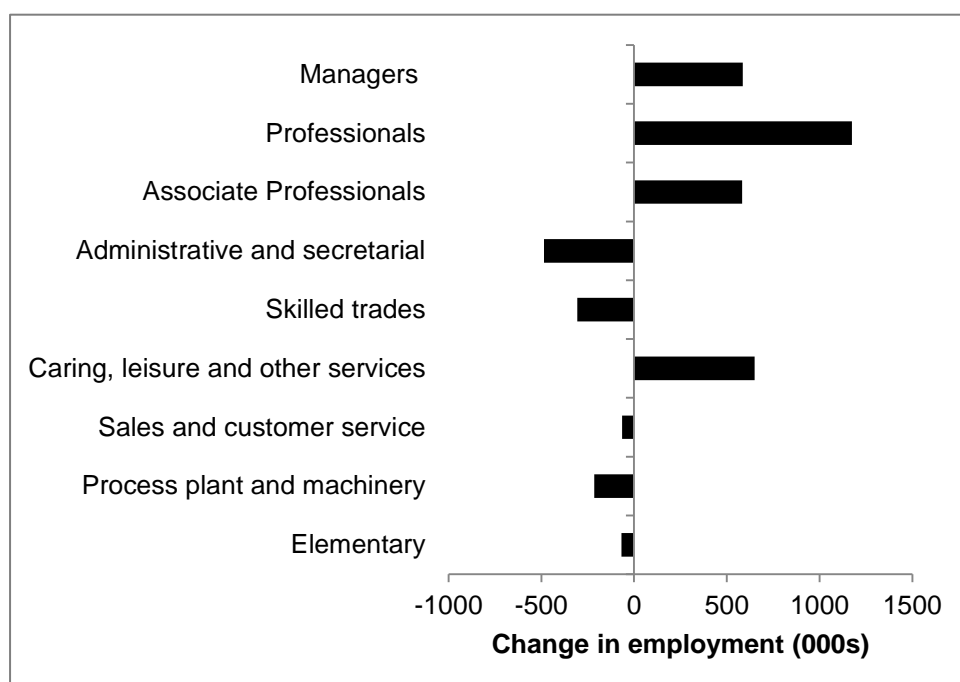
² Wilson and Hogarth (2013) report: "Manufacturing provides important inputs to other sectors of the economy because it satisfies a range of final and intermediate demands. The OECD illustrates this by examining the share of manufacturing in overall total demand (intermediate and final demand). Data from the mid-1990s for the UK suggest that this was around 35 per cent which is much higher than indicators such as employment or value-added would suggest (OECD, 2006)." (p.1).

Figure 3.4: Changes in Skill Demand in the UK: Occupational structure in 2012 and 2022

(a) Share of employment accounted for by each occupation



(b) Change in employment levels



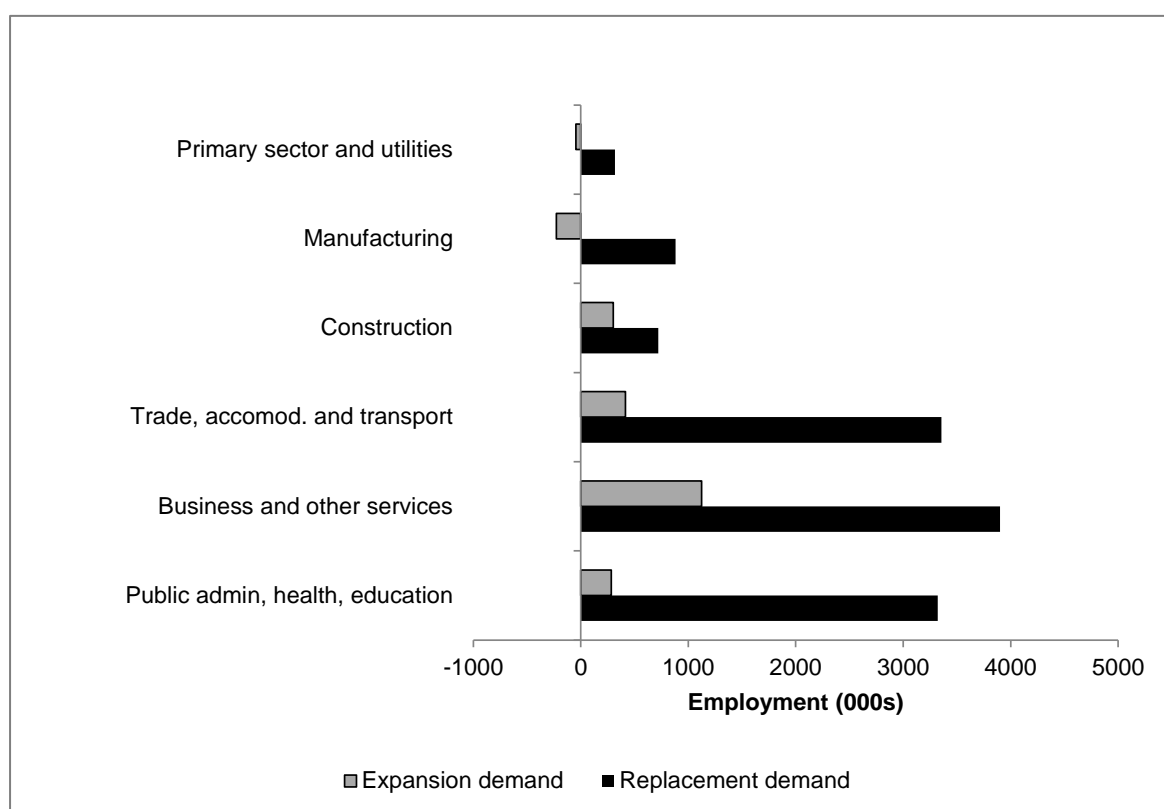
Source: UKCES/Wilson et al., 2014a

3.3 Replacement demand

The projections provided above of occupational employment are based on expansion demand (the net increase in the level of jobs expected between 2012 to 2022). In addition there will be significant replacement demands for people required to do the jobs of individuals who leave the labour market e.g. through death or retirement.³

Figure 3.5 shows that, even in sectors projected to decline in employment levels from 2012 to 2022, notably the primary & utilities and manufacturing sectors, there will be significant replacement demands. In sectors with projected increases in overall employment the replacement demands are much greater than the expansion demands.

Figure 3.5: Replacement and expansion demands 2012 to 2022 (000s)

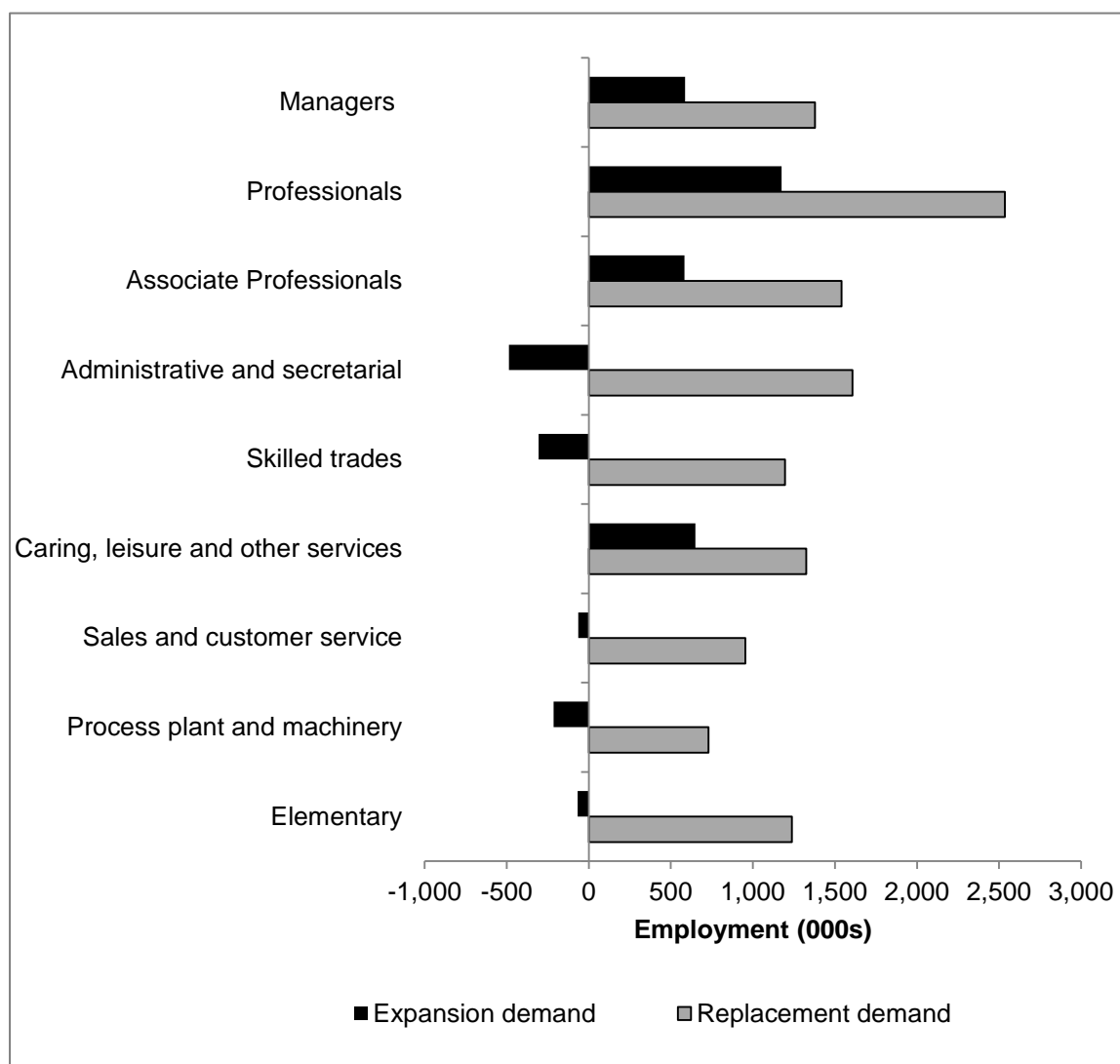


Source: Wilson et al., 2014a

³ Working Futures produces projections of future replacement demand which refers to the total number of people in an occupation who will need to be replaced as workers leave the labour force, as a result of retirement, mortality and to start a family etc. The total net requirement is expansion demand plus replacement demand.

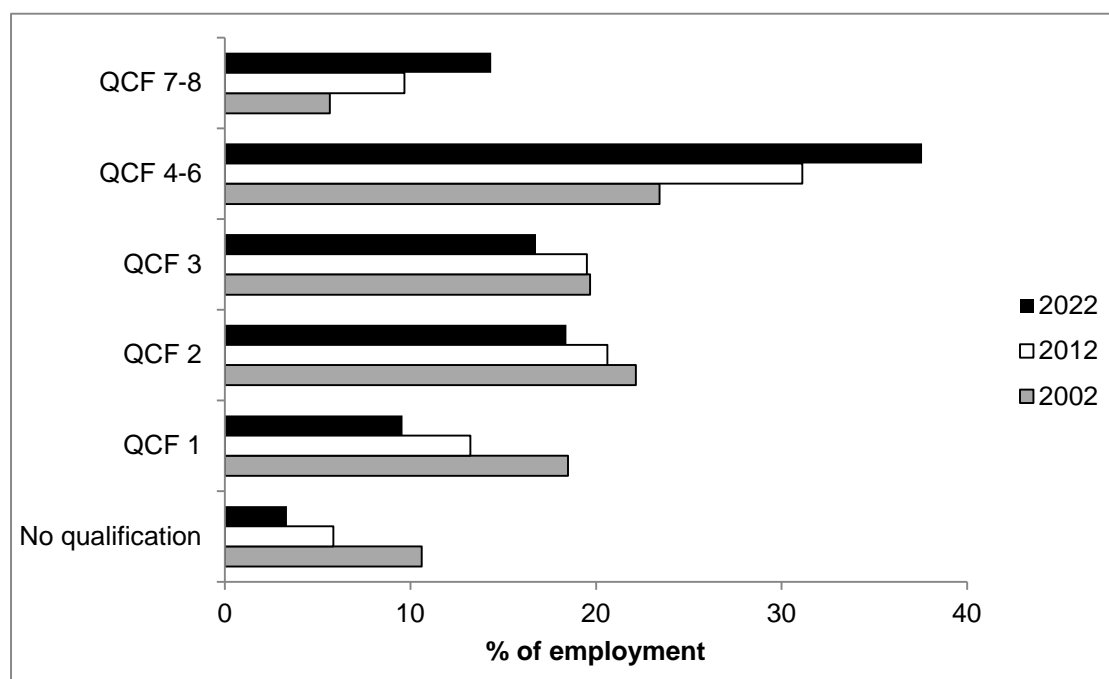
Figure 3.6 provides an indication of the level of replacement demand and the overall net requirement, which results from the need to replace people plus net job growth / decline resulting from expansion demand. There is a positive net requirement across all occupational groups, including those where overall employment decline is projected, such as skilled trades jobs and administrative and secretarial.

Figure 3.6: Replacement and expansion demands to 2022 (000s)



Source: Wilson et al., 2014a

The predicted high volume of higher skilled jobs suggests that demand for people with high level skills will continue to grow. Figure 3.7 shows expected growth in employment to 2022 for people with different levels of qualifications.

Figure 3.7: Changing patterns of qualification in the UK's working age population (%)

Source: *Working Futures 2012-2022*

By 2022 it is projected that a near majority of workers will be qualified at QCF Level 4⁴ or above. The key issue is whether the skills people acquire in attaining qualifications are those the economy needs. If a higher share of the labour force obtains relatively high level qualifications, the penalty for people not obtaining such qualifications could worsen. The projected unemployment rate for those with no qualifications in 2022 is around 20 per cent (17 per cent in 2012) compared with around five per cent (four per cent in 2012) for those qualified at QCF levels 4, 5 and 6.

Data from ONS shows a steady increase in the number of graduates in the labour market and a rise in the percentage of graduates working in non-graduate jobs: 37 per cent in 2001 compared to 47 per cent in 2013 (ONS, 2013). This may mean that skills produced by the education and skills system are not fully used in the workplace (as discussed in 'The Labour Market Story: Skills Use at Work'). Ongoing reform of the UK's training system may improve the match between the supply and demand in the future (Richard, 2012; UKCES; 2013). It will be important to assess progress on this over time.

⁴ Equivalent to a Certificate of Higher Education, or the first year of a degree

3.4 Future UK skills performance

Since the quality of the UK's supply of skills will be an important determinant of its future competitiveness in world markets, it is also useful to consider its performance on skills attainment in an international context.

Analysis of the current international skills position and the latest projections to 2020 for 25-64 year olds paint a mixed picture of the UK's international ranking relative to 33 other member countries of the OECD (UKCES, forthcoming). Skills attainment is classified according to three levels: *Low skills* (Below Upper Secondary), *Intermediate skills* (Upper Secondary) and *Higher skills* (Tertiary)⁵.

For *Low skills* (Below Upper Secondary level) the UK is currently ranked 19th (i.e. there are 18 out of the 33 other countries with lower proportions); this places it below the averages of both the OECD and EU. The UK is not expected to see an improvement in its poor relative performance in the period to 2020, based on current trends. Although the proportion qualified below upper secondary level is projected to fall from 26 per cent to 18 per cent, this would leave the UK three places lower in the rankings because of more rapid improvement by other nations.

Four in ten (37 per cent) of the UK's adult population are currently qualified at *Intermediate* level (Upper Secondary), giving a ranking of 24th out of 33 OECD nations. The proportion qualified at this level is projected to decline slightly (to 34 per cent) in the period to 2020, resulting in a decline in the UK's ranking to 28th. Conversely, the proportion of the UK's adult population qualified at a *Higher* (Tertiary) level is projected to increase significantly, from 38 per cent to 48 per cent in the period to 2020, elevating the UK's international ranking slightly, from 11th to 7th. This points towards a strengthening of the UK's position on high level skills but it is important to bear in mind that the projected position of the UK in 2020 is based on a continuation of existing trends. It seems highly likely that at least some nations will see an improvement in the "trajectory" of their performance as a result of policy intervention and / or other factors, such as increased demand for higher level skills within their national labour markets.

⁵ These levels correspond broadly with below QCF level 2 (*Low*), QCF levels 2-3 (*Intermediate*) and QCF4 and above (*High*)⁵.

From this analysis it could be argued that the most pressing priority is to reduce the size of the long 'tail' of the low skilled in the UK population; both by supporting the progression of those already in the labour force and helping them to move up into the intermediate band, as well as by minimising the proportion of new entrants to the labour market who lack qualifications at upper secondary level.

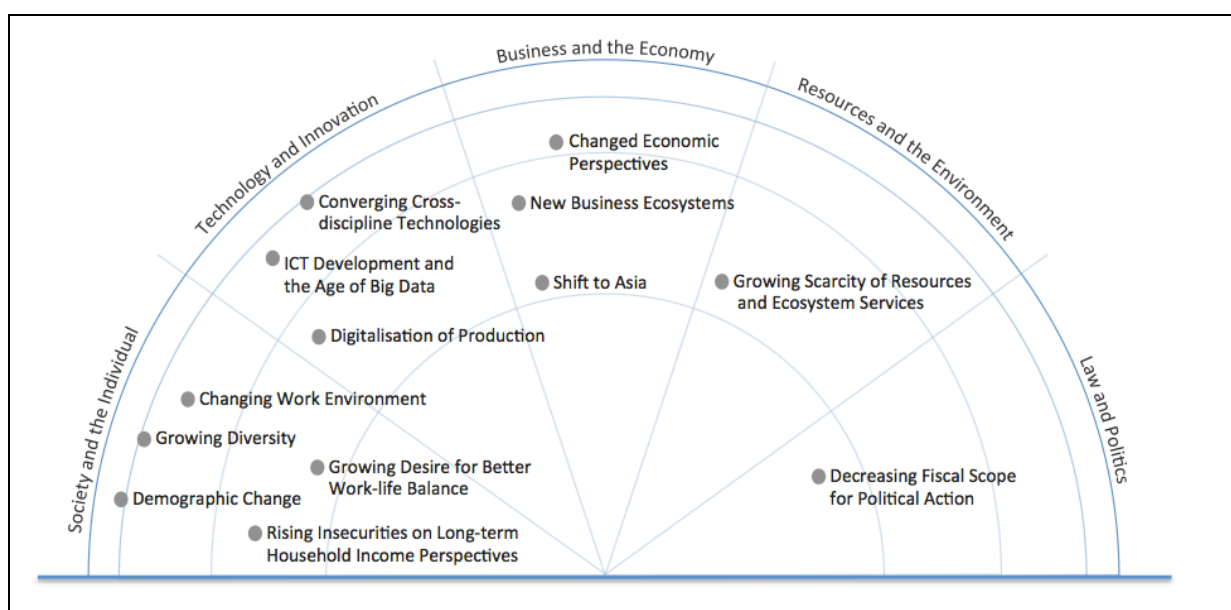
Clearly, the level of skills available in the economy is only one consideration; the relevance of those skills to business and the ability of organisations to utilise them effectively are also key. Quantitative projections provide an assessment of the skills levels that may be required in the future, if current trends continue. However, they do not cover likely changes to the nature and type of skills needed, or the impacts of potential disruptions. The next section of this paper draws on qualitative foresight work to identify how the nature of skills needed are likely to change in the future labour market.

4 Disruptive factors

Underlying the Working Futures projections is a key assumption that the patterns of performance and behaviour in the UK economy and labour market will reflect past trends and that there will be no major disruptions to the UK economy continuing its gradual recovery. But a number of factors have the potential to reduce the pace of medium-term recovery. For instance, economic conditions in the Eurozone remain uncertain, and the western economy may have entered a period of prolonged stagnation⁶ and which would limit future UK employment growth.

Recent qualitative foresight research (UKCES/Daheim *et al.*, 2014) has identified a set of trends which are driving the long-term future of UK jobs and skills (see Figure 4.1). Trends are defined as a continuation of the current direction of travel and are expected to follow a clear course; they include social, technological, economic, ecological and political factors.

Figure 4.1: Trends driving the future of UK jobs and skills



Source: UKCES/Daheim *et al.*, 2014

⁶ <http://equitablegrowth.org/2013/11/16/759/this-mornings-must-watch-larry-summers-on-the-danger-of-a-japan-like-generation-of-secular-stagnation-here-in-the-north-atlantic>

The report (UKCES/Daheim *et al.*, 2014) also identifies a number of disruptive factors, potential events that represent a sharp deviation from business-as-usual, which have the potential to affect skills demand and supply. These include:

- Reverse migration: including immigrants in developed economies moving back to their country of origin due to more attractive labour market prospects.
- Employees' changing values: workers choosing their employer on the basis of shared personal and organisational values.
- Fragmented zero-hour contracts and more flexible forms of employment.
- Anywhere, anytime skills delivery: new models of delivery of learning and skills facilitated through online and distance learning.
- Artificial intelligence and robots: further advances in these areas enabling radical and far-reaching automation of processes and services.
- De-globalisation: adoption of protectionist and nationalist policies in reaction to continuing economic difficulty may counteract international cooperation and trade.
- Alternative geographic centres of excellence: further development of emerging economies creates a new wave of cities leading in specific business fields, such as financial services, on which the UK has a strong reliance.
- Disruptive internet developments: heightening corporatisation and privacy concerns could affect the 'smooth' development of the Internet.

These potential disruptions have implications for demand for and supply of goods and services as well as for labour and skills. Reduced mobility of workers could limit labour supply. Reverse migration, de-globalisation, and alternative geographic centres of excellence could all result in a reduced potential workforce in the UK as people choose not to enter the country due to regulatory barriers or more appealing prospects elsewhere. People may also leave the UK due to regulatory changes or in pursuit of better job opportunities. Many highly skilled workers operate in international labour markets where there is strong competition between countries for their skills, so this could have the potential to damage the UK's competitive advantage in a number of high value markets. Reduced access to international labour sources would challenge sectors with high use of migrant labour (e.g. construction, health and social care), so the risk of skill mismatches emerging could be substantial.

Technical change is a vital component of jobs growth, but history shows it causes sectoral employment shifts within and across industries. Technological changes, including advances in artificial intelligence (AI), robotics and ensuing automation have far reaching consequences for the labour market and the demand for and supply of skills. More sophisticated robots could automate an increasing number of processes, not only in manufacturing but also in a number of service sectors (for example, voice recognition and artificial intelligence software on telephone help-lines). Advances may also result in more highly skilled processes being automated e.g. in medicine. These changes will lead to a decrease in demand for workers performing these roles but a growth in skills used to implement and maintain automated and robotic processes.

Increased international trade is a key driver of global economic growth. Reverse globalisation would cause significant changes for the UK economy and labour market. A decrease in access to foreign markets would lead to employment decline in a number of sectors, including service sectors with a relatively large foreign customer base such as higher education, which has a large number of foreign students. If reversed globalisation leads to manufacturing for domestic customers locating entirely within the UK, then increased employment and skills needs may develop in the short-term. But de-globalisation would have an adverse impact on overall levels of demand, which would subsequently reduce output and employment levels across the global economy. Partial fragmentation of the EU would have similar consequences, with an impact on exports if the UK no longer had a free-trade agreement with the EU.

Increased use of more flexible forms of employment, including zero-hours contracts, also has implications for labour and skills. Employers may make increasing use of such contracts to enable efficient matching of labour supply to demand. Potential implications of wider adoption of these contracts include a reduction in productivity due to employees being less engaged with their employers' processes and cultures, and high labour turnover. It may also result in a disincentive to training because employers would be unwilling to invest in employees with a loose relationship to the firm, and employees may be unwilling to invest in skills for jobs without sufficient income security. Lower disposable incomes may result where people are working very short working hours, so demand for goods and services in the UK market could fall which would further reduce labour demand. If employees face uncertainty about their income levels, they may also increase their savings, which would also reduce the demand for goods and services.

It is not possible to predict which, if any, of these disruptions will occur. What is important is that the skills and employment system in the UK is able to respond to such disruptions, taking advantage of opportunities offered and minimising negative impacts. In a report for UKCES, Daheim *et al.* (2014) develop four different scenarios of what the labour market might look like in 2030, and identified implications for individuals, employers, education and training providers, and policy makers.

They suggest that the UK workforce of 2030 will be multi-generational, older, and more highly polarised. Businesses are likely to retain a smaller core staff, with people moving across organisations and projects, with the lower-skilled experiencing ‘increasing insecurity of employment and income’. People are more likely to develop portfolio careers around hybrid skills. Collaborative business models become more important, and businesses demand people with excellent project and risk management skills. Key aspects of the 2030 labour market include:

- Technological growth and expansion: resulting in changing skills needs across all sectors. For example, new construction technologies will require people with specialised building and maintenance skills.
- Interconnectivity and collaboration: work will become increasingly virtual and collaborative, requiring excellent people and project management skills.
- Convergence of innovation: innovative breakthroughs will result from cross-disciplinary working and the exploitation of novel materials and technologies. Businesses will increasingly seek people with hybrid skillsets, such as project management and nanotechnology.
- Increased individual responsibility for skills development.
- Increased polarisation in the labour force, with a high-skilled minority retaining significant bargaining power, and people with lower-level skills increasingly marginalised.
- The four-generational workplace: as people stay in work longer, the workplace will become increasingly multi-generational, and skills for managing staff of different ages and levels of seniority will become more important.

The implications of these changes are wide-ranging:

- Employers will need to take ownership of skills in their sectors and rise to the challenge of international competition; develop career routes and progression pathways for young people and those with lower skills in particular; and collaborate with education and training providers to ensure learning provision meets employer needs.
- Individuals will need to adapt to a changing labour market and patterns of work; take responsibility for investing in and developing their skills; develop both job-specific and soft skills, including collaboration and communication; and develop the skills required by employers, including enterprise and management skills.
- Education and training providers will need to collaborate with employers to ensure that their offer meets employer needs; invest in new modes of learning and continually update content; develop content which reflects the role of technology and an increasingly interdisciplinary approach to work; and provide more flexible opportunities for learning.
- Policy makers will need to maximise the public and private markets for skills, ensuring that public investment supports provision that meets employer needs; encourage employers to take ownership of skills and develop training solutions; support those with lower-level skills to reskill and take opportunities in a changing labour market; and mitigate local, regional and demographic disparities in access to jobs and skills.

The next section of this paper considers some of the types of skills that are likely to be in increasing demand in the labour market of the future.

5 Future skills and jobs

5.1 Emerging skills needs

In addition to the broad levels of skills and qualifications predicted by Wilson *et al.* (2014a), the types of skills which will be in future demand may evolve (UKCES/Daheim *et al.*, 2014). Existing trends suggest that a range of generic skills are likely to be particularly important. Skills related to communication, problem solving, team working and ICT skills are increasingly valued by employers (Felstead *et al.*, 2013a, Felstead *et al.*, 2007). In some respects these are the key employability skills which employers demand and which are needed to supplement the technical skills individuals possess alongside their creative capabilities. The latest data shows that between 2006 and 2012 the generic skills which have increased in importance were computing skills and 'influence' skills (Felstead *et al.*, 2013a). Influence skills are defined as a group of highly correlated activities associated with communicating, analysing and persuading. Computing skills which have grown in importance are relatively lower level ones (e.g. data input) and not necessarily those obtained through formal education. Long-term trends suggest therefore that hybrid technical and generic skills are likely to increase in importance.

Recent research for the UK Commission for Employment and Skills explored how technological developments impacted on skills needs in the aerospace and automotive sectors. Both sectors are expected to experience significant global growth, and the UK is well-positioned to take advantage of this growth. The research focused on three technologies experiencing rapid innovation: Additive Manufacturing (often referred to as 3D printing), Advanced Composites and Plastic Electronics. It found that existing recruitment pressures are likely to increase, to the extent that 'skill shortages pose significant threats to future UK employment growth if not tackled' (UKCES/Feloy *et al.*, 2013, p91). The authors argue that companies will increasingly be seeking people with hybrid technical and business development skills. For example, in Additive Manufacturing, Design Engineers with experience of the technology are likely to be in demand; and in composites, the development of new products will require business development managers who understand the technological innovations.

Similarly, in the off-site construction industry, there is expected to be a shift from 'silo-based' approaches to increased collaborative working and the development of hybrid roles (UKCES/Vokes *et al.*, 2013). This is likely to result in increased requirements for people with high level skills in project management, marketing and planning.

In the digital industry, emerging technologies including cyber security, mobile technologies, green IT and cloud computing may affect the nature of future skills required (UKCES/Hollingworth *et al.*, 2013). These are likely to include: knowledge of security issues; risk analysis, management and communication skills; technical pre-sales, sales, marketing and understanding of customers' industries; energy management expertise; data collection and analytics; high level maths skills; and commercial awareness. In particular, employers noted that, in addition to a core of technical and computing skills, project management and communication skills are of increasing importance. Employees are also increasingly expected to bring sector expertise. In a report for UKCES, Hollingworth *et al* (2013) argue that, in addition to technology skills, 'technology specialists ... increasingly need to have better business skills and awareness to promote the application of technology to their customers' (p71).

In addition to generic skills, technical and occupation specific skills are likely to be in high demand in the future. The UK Commission's Employer Skills Survey consistently finds skill shortages for occupation-specific skills and in STEM skills linked to innovation. Projections of skills supply suggest that there are unlikely to be substantial skill shortages for people qualified in STEM subjects in the period to 2020 (UKCES/Bosworth *et al.*, 2013) which is consistent with other studies (DTI, 2006). But the demand for, and supply of, people with STEM skills at an intermediate level is often finely balanced, mostly because of the cost to the employer of producing these skills (McCaig *et al.*, 2014). A marked increase in demand for people with these skills resulting from investment in improving national infrastructure would lead to skill shortages. Policies which seek to address the fall in the UK's competitiveness over recent years, as indicated in the BIS Competitiveness Report (BIS, 2013b), may well need to stimulate growth in STEM skills simultaneously with any other policy changes.

'The Labour Market Story: The State of UK Skills' highlighted that employers under-use the skills of a substantial share of workers. This could be a transitional issue due to a lag in employer responses to availability of higher level skills, but it could also reflect structural problems of limited employer ambition and therefore demand for advanced skills, and/or failure of the skills system to supply skills needed by firms. Underusing skills is a waste of investment, limits productivity and can lead to disengaged employees.

5.2 What type of jobs do we want?

The meaning of work to people and what type of work they will be willing to accept in the future is important to national well-being and productivity. There is little consensus on likely future job quality and limited discussion in current policy debates. In part it depends upon the state of the labour market and the power workers will have to exercise their preferences (Hogarth and Bosworth, 2008). Technical change will influence the future state of the economy and the structure of the jobs market, but competitive gains will depend on how work is organised around new technologies, increased efficiency in work and adoption of High Performance Working.

As the economy recovers and the demand for labour increases there may be scope for job quality to improve into the 2020s, particularly for those with higher-level skills. The trend in the changing occupational structure, which has seen an increasing divide in the skills structure between high and low skilled jobs, may mean that those in less skilled occupations have less opportunity to access high quality employment. The use of modern IT systems may well increase the degree of employer control over work by, for instance, restricting workers' autonomy over how they do their job and controlling the pace at which work is undertaken. Some authors are pessimistic about future jobs prospects in this regard. Brown *et al.* (2008) present a vision of the future where a knowledge-based economy providing meaningful and well paid work for all may be a mirage. In this scenario well paid knowledge based jobs may constitute a minority of employment.

6 Policy implications

Future projections suggest relatively modest economic growth for the UK, limiting the likelihood of large scale unanticipated skills needs. However, underlying projected trends in the demand for skills, more profound changes are taking place. Job content is changing, new types of job are likely to emerge as a consequence of technical change, and the UK faces increasing competition from emerging economies. If the global market grows sufficiently rapidly this should not pose a problem. But if global economic growth is sluggish or stalls, then this could intensify competition between countries for high value added segments of the world market.

Capturing the high value segments of the global market depends on a number of drivers, including investment, competitiveness and skills supply. Adequate skills supply depends on substantial investments by individuals, employers and the state in initial and continuing vocational education and training. The UK faces economic uncertainty, primarily due to combined trade liberalisation and technical change, so the skills system needs to be adaptable. Some countries have sought to 'pick winners' by investing in industries with substantial growth potential and gearing the vocational education and training system towards supporting the chosen sectors. This is exceedingly difficult to achieve, and is only possible when the state has a high level of control over the economy. An alternative is to develop a skills system where the government acts as a co-ordinator and enabler, with a view to helping the markets for labour and skills to operate more effectively. This more flexible approach is more suitable for an uncertain world and future economic growth patterns are hard to predict.

In this context, the UK skills system has arguably been too supply side oriented and has not always met employers' skills needs fully. However, over the past twenty years, considerable effort and public expenditure has focused on increasing employer participation levels in vocational training, including Apprenticeships, to offer school leavers a range of options to pursue a vocational education pathway through further education (FE). A more recent challenge is ensuring vocational training content is responsive to employer signals about the skills the economy needs. Increasingly this has needed to take account of (un)employed adults' retraining needs as well as those of young people making the transition from school to work (Leitch, 2006; Wolf, 2011). Recent policy changes have included granting more autonomy to further education colleges and plans to implement the recommendations for greater employer involvement in the design of Apprenticeships, contained in the Richard Review of Apprenticeships.

The introduction of the Employer Ownership of Skills pilots marks a substantial break with past practice, with employers taking the responsibility for setting out how they will invest to improve the skills of their current and future workforces (Hogarth *et al.*, 2014). Employers will identify and articulate their training needs and develop appropriate and high quality solutions (UKCES, 2013), encompassing the skills produced in higher education (HE) as well as in further education and the vocational skills system. If much future skills demand is for high level skills, as Working Futures projections suggest, then the HE system needs to be responsive to emerging skill needs, as noted in a number of reviews (Wilson 2012; Lambert, 2003). Education and training providers will need to be responsive and highly adaptable in meeting future employer and individual demand for skills. This will include changes to the delivery of learning, for example through online provision, more tailored short courses, and employer-specific training. It will also include changes to the content of provision, with courses encompassing hybrid skillsets and crossing disciplinary boundaries.

Employer ownership can be seen as part of a longer-term trend to encourage individuals and employers to co-invest in skills required for future economic growth, supported by labour market information which can assist labour market actors to make informed decisions. By providing employers with the influence to obtain the education and training they need in order to meet and anticipate changes in their product markets, it should ensure that solutions in which the state co-invests meet current and future skill needs. This will support the development of an economy that it is better able to adapt to emerging challenges and opportunities.

There are several risks and potential future skills challenges for the UK. The first set of problems relate to growth in the economy. It is possible that international growth and demand for high level skills remain low, and that UK firms will continue to under-invest in skills. This carries risks because skills levels in the UK are failing to keep pace with those in international competitors, and the UK is falling further behind on the share of people with intermediate level skills. This means that without dedicating some effort to catching up, the UK may become less attractive to internationally mobile firms requiring high and intermediate skilled labour. It is possible that even with a slow but steady recovery, skills investment remains patchy and skills deficits remain unaddressed.

'The Labour Market Story: The State of UK Skills' shows that there are already skills shortages for skilled trades and technical professions. An exacerbation of this situation may hinder the UK's capability to capture a sufficient share of the high value added product markets which will be increasingly important to our future economic competitiveness. Skills gaps in occupations which are critical to service delivery in leisure, entertainment, retailing

and hospitality sectors may lead to global tourists and UK citizens choosing to spend disposable income outside the UK. The strategies selected to plug these deficits will depend on a combination of influences, all of which are subject to considerable uncertainty. Recruiting and retaining staff in front line and support jobs within service industries could be possible through inward economic migration from EU member states and further afield, but this will depend on public and political acceptance of this labour supply strategy.

Alternatively, employers may seek to redesign these kinds of roles and/or to review the management practices they adopt to improve job quality, address skills gaps and staff turnover. Changes to work organisation may also raise demand for individuals with hybrid skills who can apply their knowledge effectively across a range of sectors. Increasing labour market polarisation will also require labour market institutions (education, employment and training) to adapt and provide high quality progression pathways to high skilled jobs.

Related to this challenge is the question of how attractive the future labour market looks for those entering it. More attractive living standards and better prospects in more successful economies may encourage higher skilled mobile workers to go overseas. Those without such prospects may face a long working life requiring a number of job transitions, and the challenge is to make their quality of work motivating, satisfying and financially sustaining. Arguably these kinds of issues have received too little policy attention in recent years, but now we are emerging from recession they are beginning to regain visibility.

The second set of challenges relate to the ongoing practical challenges in aligning the skills system with employer priorities. Until recently, the process of purchasing training and accessing support for skills investment has been heavily stacked against some SMEs. Redesign of the skills system, relying on much greater employer leadership and collaboration, may take five to 10 years for the full benefits to be realised and for financial sustainability to be achieved (UKCES/Beaver *et al*, 2013). There is also increasing attention being given to coordinating problems and channelling investment at a local level, including through Local Enterprise Partnerships, the Regional Growth Fund, and City Deals. It will take time to reap the returns on investment in new collaborative partnerships in learning delivery. This requires prolonged commitment of a kind that is rarely seen in short-term political perspectives. The challenge for policy makers will be to hold their nerve.

The third set of challenges is arguably the most important. As other papers in the Labour Market Story series have shown, the key influences on choice of products and services offered, the levels of skills sought from the workforce, and the management practices used, are business owners and managers. Yet one of the UK's biggest primary skills challenges is

dealing with under-utilisation of highly skilled and qualified people who are working in jobs where they do not have the opportunity to use their skills. This contributes to the UK's relatively poor productivity performance in global terms. Stimulating managers to raise their game in terms of developing high value-added products and services, which in turn are more likely to demand high skill levels, is not an easy task. It will require a stable business and economic environment which inspires business and consumer confidence, a greater focus in business and education policy on supporting entrepreneurship and innovation and companies which compete on the basis of premium goods and services. It also requires a more sophisticated approach to human capital measurement and recognition of the importance of people management and management education to ensure that individuals entering management roles are adequately equipped to make the most of workforce talent.

Bibliography

- Autor, D. and Dorn, D. (2009) *The Growth of Low Skill Service Jobs and the Polarization of the U.S. Labor Market*. National Bureau of Economic Research Working Paper 15150. National Bureau of Economic Research, Cambridge, MA.
- Autor, D., Levy, F. and Murnane, R. (2003) 'The skill content of recent technological change: an experimental exploration', in *Quarterly Journal of Economics*, Vol. 118, No. 4, pp. 1279-1333.
- BIS (2010a) *Skills for Sustainable Growth: Strategy Document*. Department for Business, Innovation and Skills, London.
- BIS (2010b) *Technology and Innovation Futures: UK Growth Opportunities for the 2020s*. Department for Business, Innovation and Skills, London.
- BIS (2012) *Following up the Wilson Review of Business University Collaboration: Next Steps for universities, business, and Government*. Department for Business, Innovation and Skills, London.
- BIS (2013a) *Future of Manufacturing: Synthesis Report*. Department for Business, Innovation and Skills, London.
- BIS (2013b) *Benchmarking UK Competitiveness in the Global Economy*. Department for Business, Innovation and Skills, London.
- Brown, P., Ashton, D., Lauder, H., and Tholen, G. (2008) *Towards a High-Skilled, Low-Waged Workforce? A Review of Global Trends in Education, Employment and the Labour Market*. Skills, Knowledge and Organisational Performance, Cardiff and Oxford Universities, Cardiff.
- Cambridge Econometrics (2013) *Industry and the British Economy*. Cambridge Econometrics, Cambridge.
- CBI (2009) *Jobs for the Future*. Confederation of British Industries, London.
- Cedefop (2012) *Skill Mismatch: the role of the enterprise*. Cedefop Research Paper No.21. Commission of the European Communities, Luxembourg.
- Daniel, W.W. and McIntosh N. (1971) *The Right to Manage*. Macdonald, London.

- Dickens, P., Kelly, P. and Williams, J.R. (2013) *What are the significant trends shaping technologies relevant to manufacturing?*. Future of Manufacturing Project, Evidence Report No. 6. Foresight, Government Office of Science, London.
- DTI (2006) *Science, Engineering and Technology Skills in the UK*. DTI economic Paper No. 16. Department for Trade and Industry, London.
- Economist Intelligence Unit (2006) *Foresight 2020: Economic, Industry and Corporate Trends*. Economic Intelligence Unit, Cisco Systems, London.
- European Commission (2011) *High Level Expert Group on Key Enabling Technologies, Final Report*. European Commission, Brussels.
- European Commission (2013) *European Economic Forecasts Autumn 2013*. Commission of the European Communities, Luxembourg.
- Felstead, A., Gallie, D., Green, F. and Inanc, H. (2013) *Skills At Work In Britain: First Findings from the Skills and Employment Survey 2012*. Centre for Learning and Life Chances in Knowledge Economies and Societies, Institute of Education, London.
- Felstead, A., Gallie, D., Green, F. and Inanc, H. (2013b) *Work Intensification in Britain: First Findings from the Skills and Employment Survey, 2012*. Centre for Learning and Life Chances in Knowledge Economies and Societies, Institute of Education, London.
- Felstead, A., Gallie, D., Green, F. and Inanc, H. (2013c) *Job Control in Britain: First Findings from the Skills and Employment Survey, 2012*. Centre for Learning and Life Chances in Knowledge Economies and Societies, Institute of Education, London.
- Felstead, A., Gallie, D., Green, F. and Zhou, Y (2007) *Skills at Work in Britain, 1986 to 2006*, ESRC Centre on Skills, Knowledge and Organisational Performance, Oxford.
- Friedman, T. (2007) *The World Is Flat: A Brief History of the Twenty-first Century*. Farrar, Straus and Girou, Auburn, WA.
- Gambin, L. (2014) *The Returns to Further Education and Higher Education Qualifications: A Review of the Evidence*. Department for Business Innovation and Skills, London.
- Goos, M. and Manning, A. (2007) "Lousy and lovely jobs. The rising polarization of work in Britain", in *The Review of Economics and Statistics*, Vol. 89, No. 1, pp. 118-133.
- Goos, M., Manning, A. and Salomons, A. (2009). "Job polarization in Europe", in *American Economic Review: Papers and Proceedings*, Vol. 99. No. 2, pp. 58-63.

- Goos, M., Manning, A. and Salomons, A. (2011) *Explaining Job Polarization: the Roles of Technology, Offshoring and Institutions*. Center for Economic Studies Discussion Paper 11.34. University of Leuven, Leuven.
- Green, F (2011) *What is Skill? An Inter-Disciplinary Synthesis*. Centre for Learning and Life Chances in Knowledge Economies and Societies, London.
- Herzberg, F., Mausner B. and Snyderman B.B, (1959) *The Motivation to Work*. Wiley and Sons, New York
- Hogarth, T., Adams, L., Gambin, L., Garnett, G. and Winterbotham, M. (2014) *Employer Routed Funding: Employer Responses to Funding Reform*. BIS Research Paper No. 161. Department for Business Innovation and Skills, London.
- Hogarth, T. and Bosworth, D.L. (2008) *Future Horizons for Work-life Balance*. DfES / Futurelab Beyond Current Horizons, Warwick.
- IMF (2014) *World Economic Outlook Update: Is the tide rising?* International Monetary Fund, Washington DC.
- Lambert, R. (2003) *The Lambert Review of University Business Collaboration*. HM Treasury, London.
- Leitch, S. (2006) *Leitch Review of Skills: Prosperity for All – World Class Skills*. Stationery Office, London.
- McCaig, C., Hogarth, T. Gambin, L, and Clague, L. (2014). *The Demand for STEM Apprenticeships*. Department for Business Innovation and Skills, London.
- McIntosh, S. (2013) *Hollowing-out and the Future of the Labour Market*. BIS Research Paper No.134. Department for Business Innovation and Skills, London.
- Mason, G. (2004) *Enterprise Product Strategies and Employer Demand for Skills in Britain: Evidence from the Employers Skill Survey*. SKOPE Research Paper No.50. National Institute of Economic and Social Research, London.
- Moffat, J. (2013) *What are the recent micro- economic trends and what do they tell us about the future?* Future of Manufacturing Project, Evidence Report No. 23. Foresight / Government Office of Science, London.
- OECD (2013a) *OECD Skills Outlook 2013: First Results from the Survey of Adult Skills*. OECD, Paris.

OECD (2013b) *PISA 2012 Results in Focus: What 15-year-olds know and what they can do with what they know*. OECD, Paris.

OBR (2013) *Forecasts for UK Economy*. Office of Budget Responsibility, London.

ONS (2013) *Graduates in the Labour Market*. Office of National Statistics, Newport.

Pink, D. (2007) *A Whole New Mind: Moving from the Information Age to the Conceptual Age*. Riverhead Books, New York.

Richard, D. (2012) *Richard Review of Apprenticeships*. Department for Business Innovation and Skills, London.

UKCES (2009) *Towards Ambition 2020: Skills, jobs, growth*. UK Commission for Employment and Skills, Wath-upon-Deane

UKCES (2010) *Skills for Jobs: Today and Tomorrow - The National Strategic Skills Audit for England 2010 - Volume 1: Key Findings*. UK Commission for Employment and Skills, Wath-upon-Deane

UKCES (2013) *Employer Ownership of Skills: Building the Momentum*. UK Commission for Employment and Skills, Wath-upon-Deane

UKCES (forthcoming) *UK Skill Levels and International Competitiveness: an update*. UK Commission for Employment and Skills, Wath-upon-Deane.

UKCES / Beaver, K., Hale, C., Colahan, M., Hart, M., Thompson, A. and Willis, T. (2013) *UKCES Investments Beneficiary Survey: Feasibility Study*. UKCES Briefing Paper. UK Commission for Employment and Skills, Wath-upon-Deane.

UKCES / Bosworth, D.L., Lyonnette, C., Wilson, R.A., Bayliss, M. and Fathers, S. (2013) *Supply of and demand for High-Level STEM skills*. UKCES Evidence Paper 77. UK Commission for Employment and Skills, Wath-upon-Deane

UKCES / Daheim, C., Störmer, E., Patscha, C., Prendergast, J., Rhisiart, M., Glover, P., Beck, H. and Manson, K. (2014) *The Future of UK Jobs and Skills: Qualitative Foresight: Trends and Disruptions Report*. UK Commission for Employment and Skills, Wath-upon-Deane

UKCES / Feloy, M., Dsouza, R., Jones, R. and Bayliss, M. (2013) *Technology and Skills in the Aerospace and Automotive Industries*. Evidence Report 76. UK Commission for Employment and Skills, Wath-upon-Deane.

- UKCES / Hogarth, T., Davis, C., Bosworth, D.L., Price, S. and Garrett, R. (2010) *Strategic Skills Needs in the Bio-medical Sector*. Evidence Paper No.10. UK Commission for Employment and Skills, Wath-upon-Deane.
- UKCES / Hollingworth, L., Harvey-Price, A., Bayliss, M. and Pinto, R. (2013) *Technology and Skills in the Digital Industries*. Evidence Report 73. UK Commission for Employment and Skills, Wath-upon-Deane.
- UKCES / Mason, G. and Constable, S. (2011). *Product strategies, skills shortages and skill updating needs in England: New evidence from the National Employer Skills Survey, 2009*. Evidence Report 30. UK Commission for Employment and Skills, Wath-upon-Deane.
- UKCES / PWC / Garrett, R. (2010) *Strategic Skill Needs in the Low Carbon Energy Generation Sector*. Evidence Report No. 16. UK Commission for Employment and Skills, Wath-upon-Deane
- UKCES / Vokes, C., Brennan, J., Bayliss, M. and Beck, H. (2013) *Technology and Skills in the Construction Industry*. Evidence Report 74. UK Commission for Employment and Skills, Wath-upon-Deane
- UKCES / Williams, M., Hillage, J., Pinto, R. and Garrett, R. (2012) *Sector Skills Insights: Digital and Creative*. Evidence Report No.49. UK Commission for Employment and Skills, Wath-upon-Deane.
- UKCES / Wilson, R.A., Beaven, R., May-Gillings, M., Hay, G. and Stevens, J. (2014a) *Working Futures 2012–2022*. Evidence Report 83. UK Commission for Employment and Skills, Wath-upon-Deane.
- UKCES / Wilson, R., Beaven, R. and May-Gillings, M (2014b) *Working Futures Technical Report*. UK Commission for Employment and Skills, Wath-upon-Deane.
- Van Wanoory, B., Bewley, H., Bryson, A., Forth, J., Freeth, S., Stokes, L., and Wood, S. (2012) *2011 Workplace Employment Relations Survey First Findings*. Department for Business Innovation and Skills, London.
- Wilson, R.A. and Hogarth, T. (2013) *The Workforce of the Future in the Manufacturing Sector*. Future of Manufacturing Project, Evidence Report No. 36. Foresight / Government Office of Science, London.
- Wilson, R.A. (2008) *Beyond Current Horizons: the future of work*. DfES / Futurelab Beyond Current Horizons, London

Wilson, R.A. et al (2013) *Future skills supply and demand in Europe: Forecast 2012*. Cedefop Research Paper No. 26. Publications Office of the European Union, Luxembourg.

Wilson, T. (2012) *A Review of Business–University Collaboration*. HM Treasury, Department for Business, Innovation and Skills, London.

Wolf, A. (2011) *Review of Vocational Education - The Wolf Report*. Department for Education, London.

The UK Commission for Employment and Skills is a social partnership, led by Commissioners from large and small employers, trade unions and the voluntary sector. Our mission is to raise skill levels to help drive enterprise, create more and better jobs and economic growth.

UKCES
Renaissance House
Adwick Park
Wath-upon-Deane
Rotherham
S63 5NB
T +44 (0)1709 774 800
F +44 (0)1709 774 801

UKCES
Sanctuary Buildings
Great Smith St.
Westminster
London
SW1P 3BT
T +44 (0)20 7227 7800

© UKCES 1st Ed/07.14