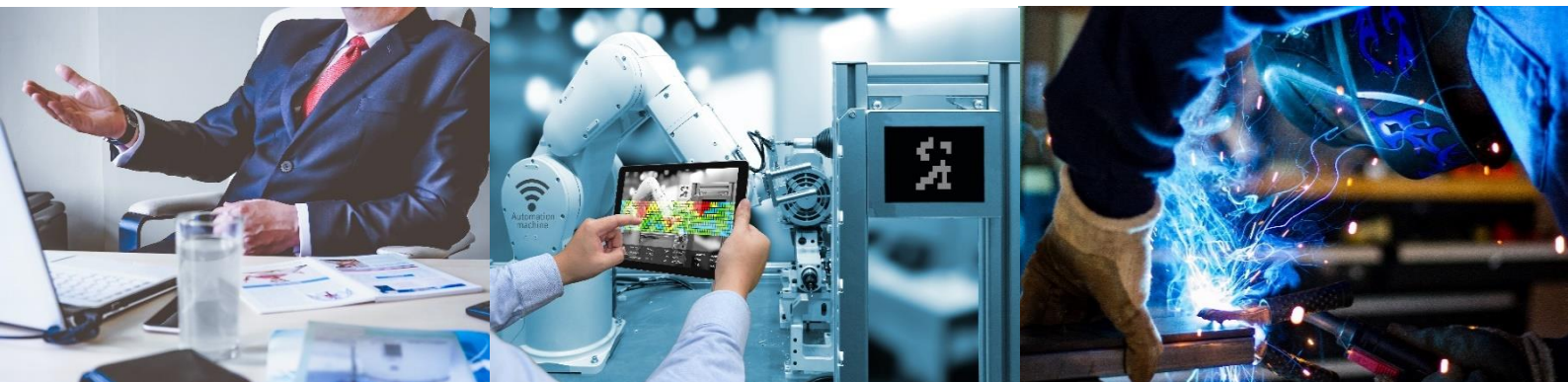




UK Manufacturing Skills Shortages, Leadership and Investment

White Paper by Cranfield University



24th May 2017

National Manufacturing Debate

Supported by;



This white paper provides three key pieces of information:

1. Facts and statistics about skills shortages in the UK's manufacturing sector and their comparison with competitor countries.
2. Leadership and investment for the development and delivery of manufacturing skills in the UK were also identified. Finally
3. An updated well-being profile of UK manufacturing was prepared and compared with the US.

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Part 1: Research Methodology and Data Sources

The study focused on the UK exclusively. The survey included responses from mainly British companies as well as some UK operations of non-British companies.

The manufacturing sector: includes the manufacture of food, beverages and tobacco, textiles and leather products, wood, paper and printing, coke and petroleum, chemical and pharmaceutical products, metal products, computer, electronic and optical, electrical and transport equipment, machinery and equipment, other manufacturing and repair.

(Source: Statistical Industry Classification 2007)

Manufacturing skills: includes skills required for research and development, concept design, engineering design, manufacturing technologies, manufacturing systems, manufacturing operations, manufacturing management, through-life support (including maintenance, repair and overhaul), recycling and remanufacturing.

Manufacturing skills shortage: is defined as the difficulties in recruiting the workforce required for vacancies in a manufacturing company due to the scarcity of skilled people available in the external labour market in the UK for a given salary range.

The subject of this white paper concerns a structured approach and methodology to collect and analyse data relevant to skills requirements in the manufacturing sector. Data was gathered by an historical analysis of articles and citations. To identify specific skills shortages in the sector, a wide range of articles in the British government, organisations and media over the past five years were read and analysed. Moreover, the same documents were used to assess the leadership and investment required for the development and delivery of these skills.

All articles come from government and organisations' websites as well as the Factiva and ABI databases (business information research tools).

In total, 373 reports were selected for the study as follows:

1. **198** reputable reports and articles on manufacturing skills from government and organisations, including:
 - The Foresight Report on the Future of manufacturing (2013)
 - UK Commission for Employment and Skills (UKCES)
 - Office for National Statistics (ONS)
 - Department for Business, Energy and Industrial Strategy
 - EEF reports

2. **175** Media reports on manufacturing skills were selected from credible sources such as:
 - Financial Times
 - The Guardian
 - The Manufacturer
 - The Telegraph
 - BBC

3. NVivo software was used to analyse these published reports. NVivo is a qualitative data analysis software tool.

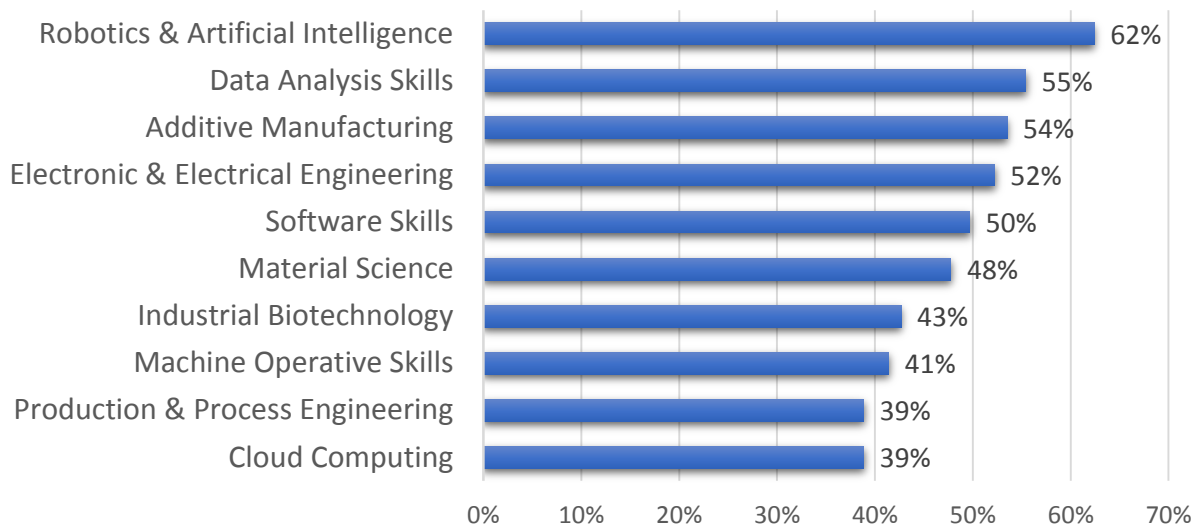
4. Interviews and survey questionnaires were designed to provide insights about skills shortages, and leadership and investment into skills development from industry personnel. The questionnaires were executed as face to face and phone interviews and as an online survey. 24 complete responses were received.
 - Respondents included industry personnel ranging from chairmen and directors to operations managers and skills training heads
 - Most of the respondents were from the aerospace manufacturing industry, working for companies including Boeing, Leonardo and BAE Systems.
 - Employee numbers ranged from 10 employees (Restoration Partners) to 15,000 employees for Siemens UK
 - The average working life experience of the interviewees was 25 years

5. The comparison of competitor countries' skills shortages was made with the help of international reports and documents from organisations including the International Labour Organisation (ILO), International Monetary Fund (IMF), World Bank, The Organisation for Economic Co-operation and Development (OECD) and the US Bureau of Labour Statistics (BLS).

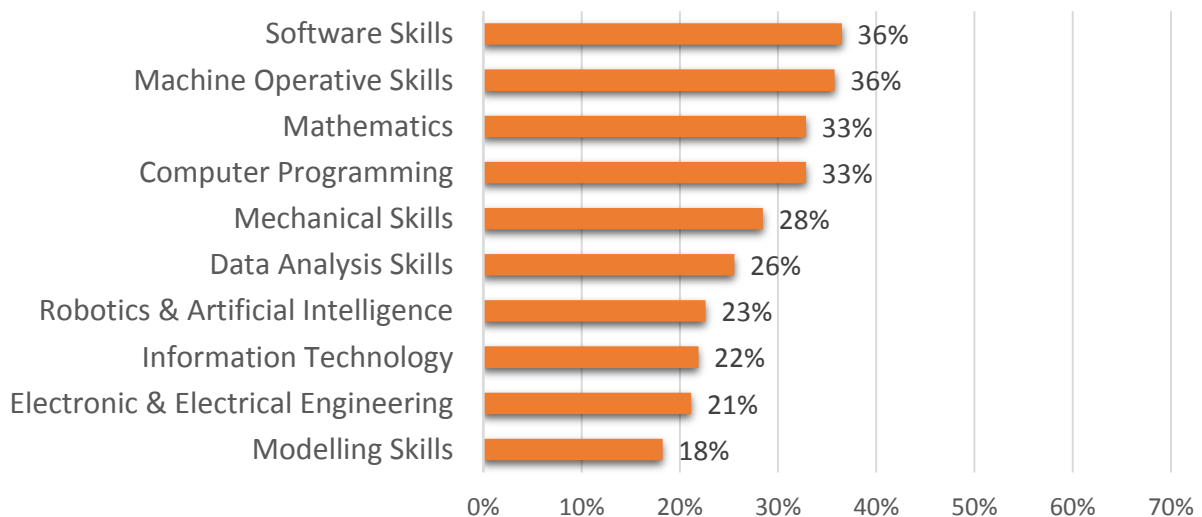
Part 2: Analysis of History

Top 10 UK Manufacturing Technical Skills Shortages

Source: Government & Organisations



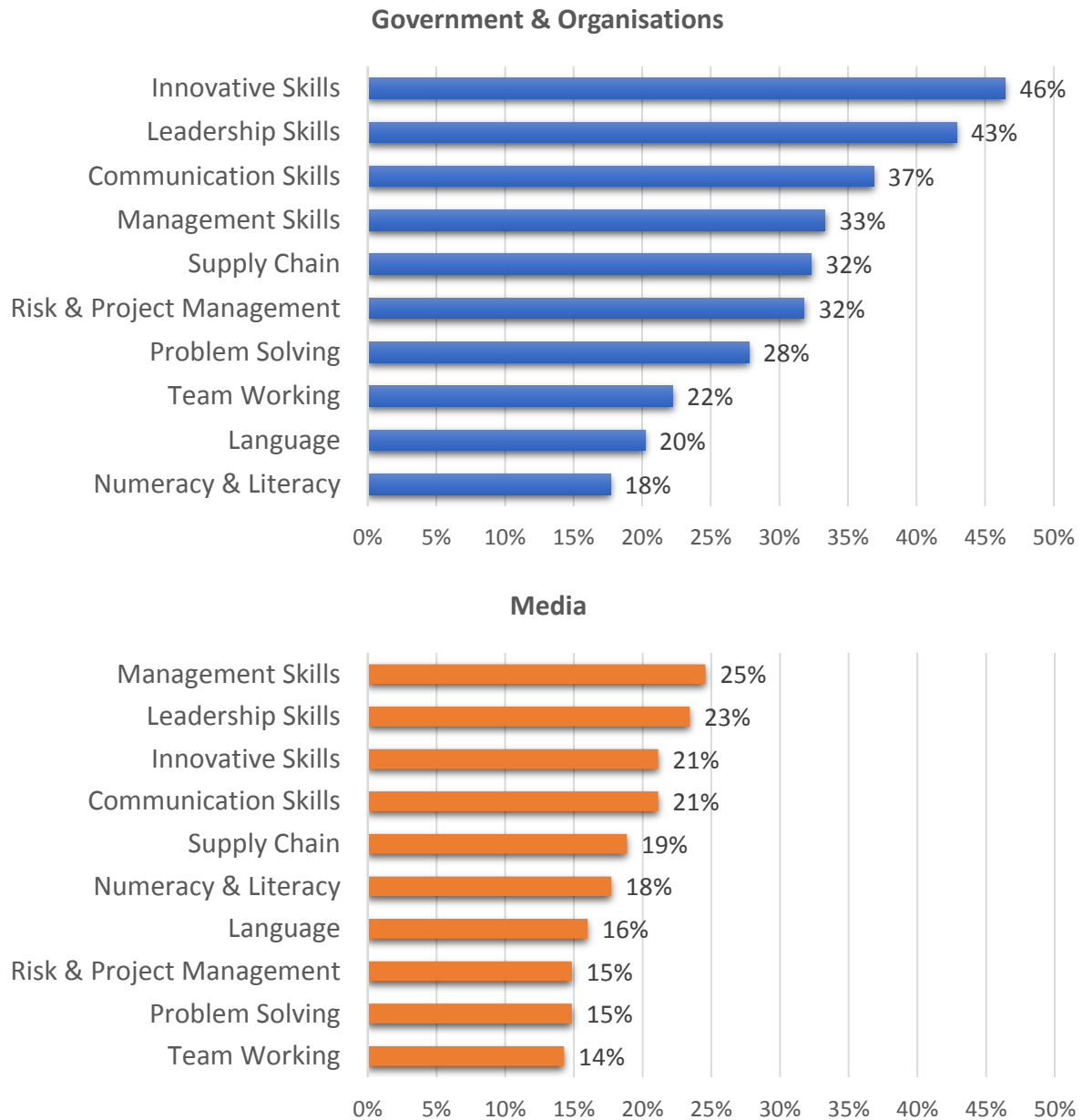
Media



As shown above, shortages in **robotics & artificial intelligence, data analysis skills, electronic & electrical engineering, software skills and machine operative skills** were among the top 10 manufacturing technical skills shortage identified by both government & organisations' articles as well as media articles. The similarity in the frequency of these skills

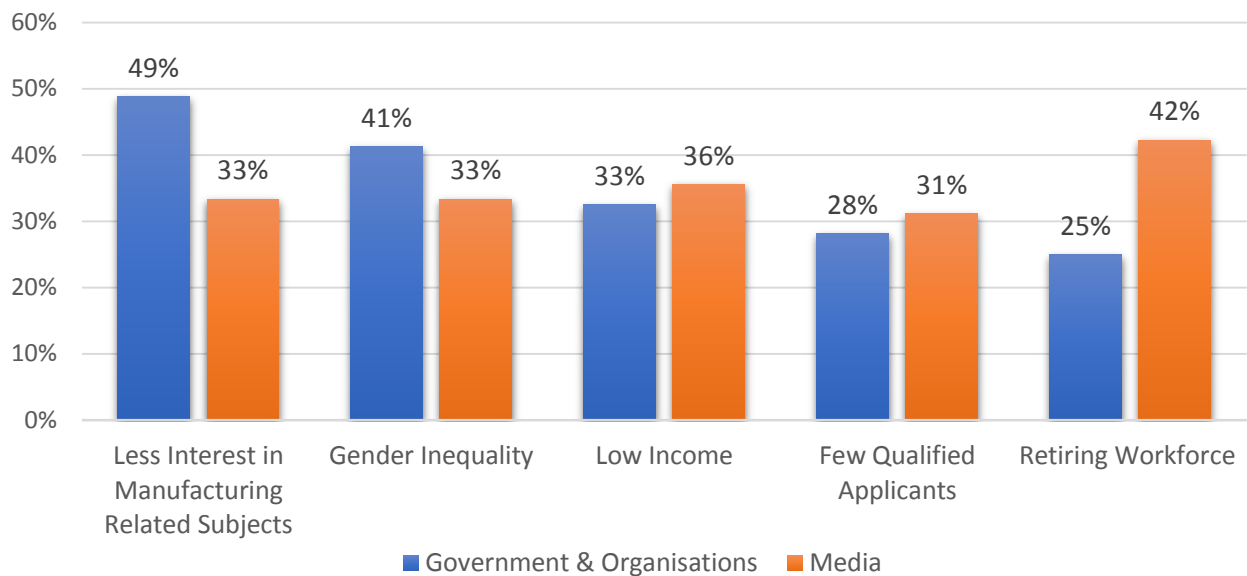
in both article sources indicates the prime importance of these skills to manufacturing.

Top 10 UK Manufacturing Non-Technical Skills Shortages



The top 10 non-technical skills in the manufacturing sector in short supply from government and organisations and media documents were found to be similar. Therefore, it is clear there is an acute shortage of these skills in the sector, particularly in **innovative skills, leadership skills, communication skills, management skills and supply chain**.

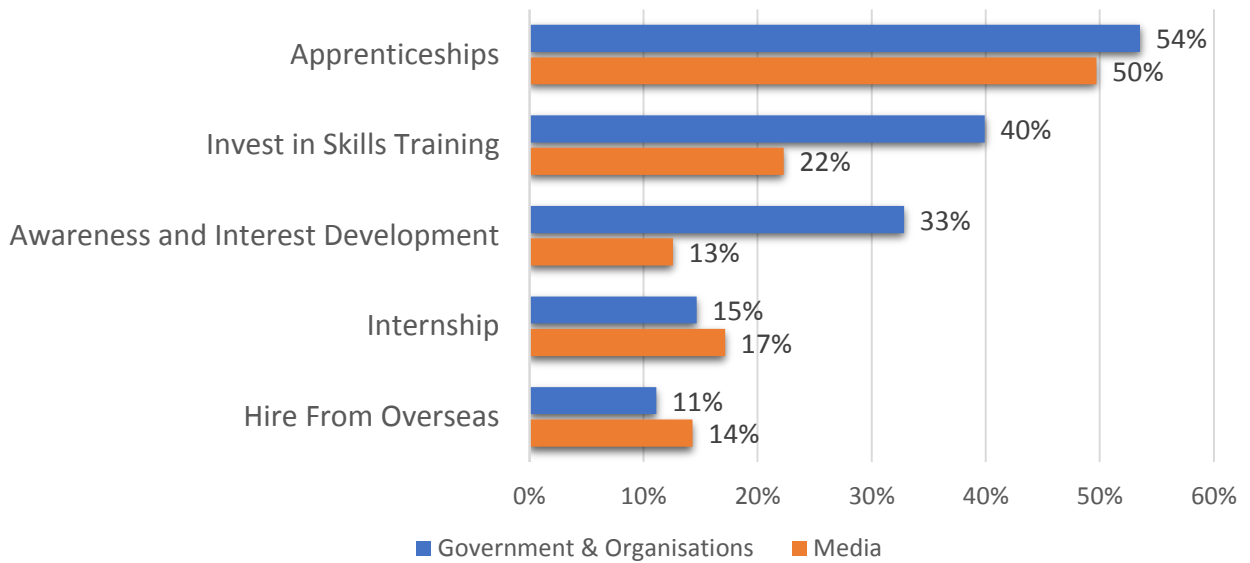
Root Causes of Skills Shortages in UK Manufacturing



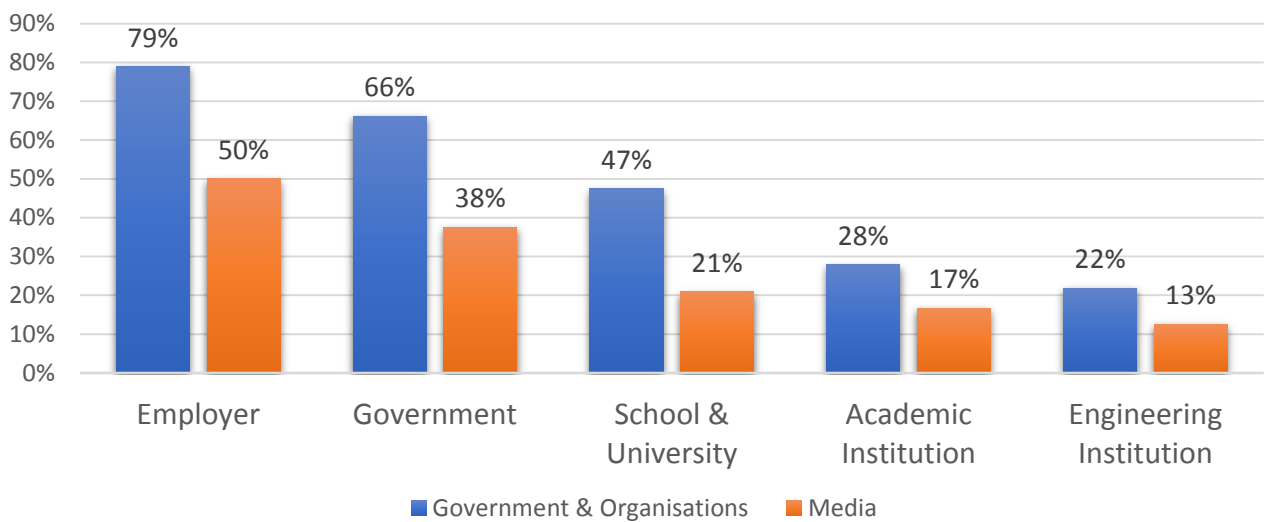
Five main underlying causes were identified from the study of both sets of articles:

1. Young people in the UK have less interest in manufacturing related subjects
2. Female employment in manufacturing is far less than male employment
3. The perception that employees have low income in the manufacturing sector
4. The lack of applicants with the right skills to fill open posts
5. UK manufacturing has an aging workforce which needs replacements quickly

Major Actions Taken to Deal with Skills Shortages in Manufacturing



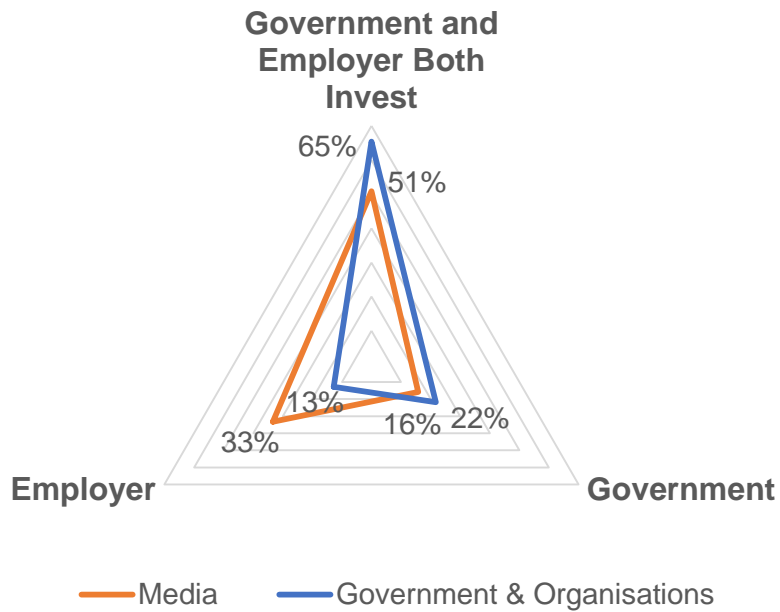
Leadership and the Contributors to Skills Development



The graph above illustrates both government, organisations and media articles show that people believe employers should lead on and be accountable for skills development.

Other organisations such as government, schools & universities, academic and engineering institutions should also make some contributions to skills development.

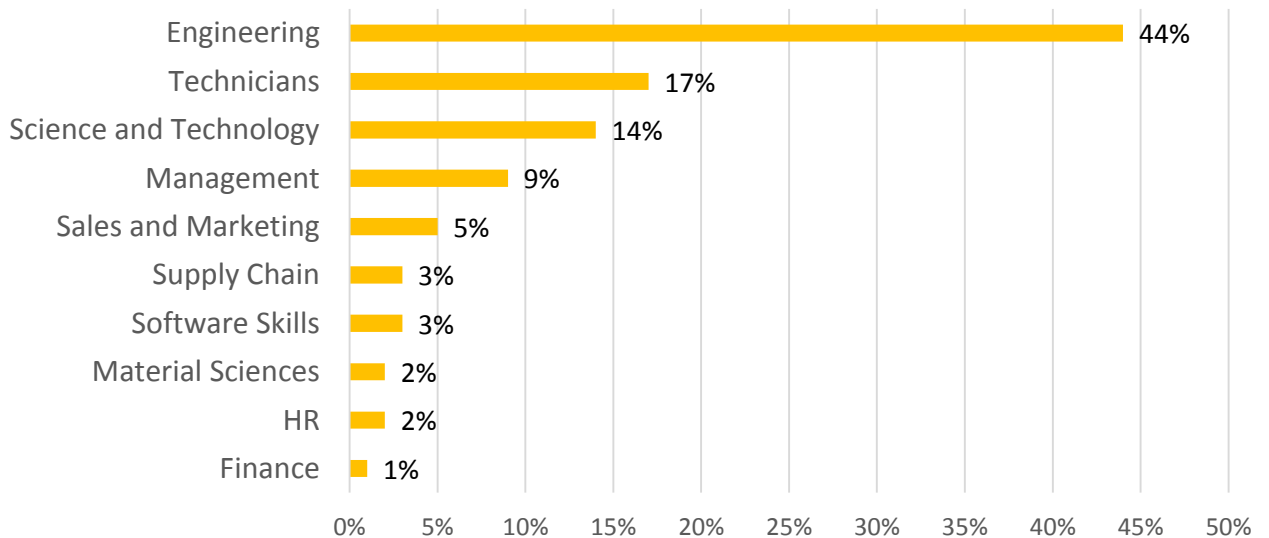
Investment of Skills Development – Whose Responsibility?



Part 3: Analysis of Current View - Interview and Survey

Skills Shortages in UK manufacturing

The top ten skills in short supply, which were identified by the respondents are listed as follows;



The above graph shows that technical skills forms the biggest part of the skills shortage in the United Kingdom, dominated by engineering qualifications, while non-technical skills like

management and sales and marketing skills will also be important requirements.

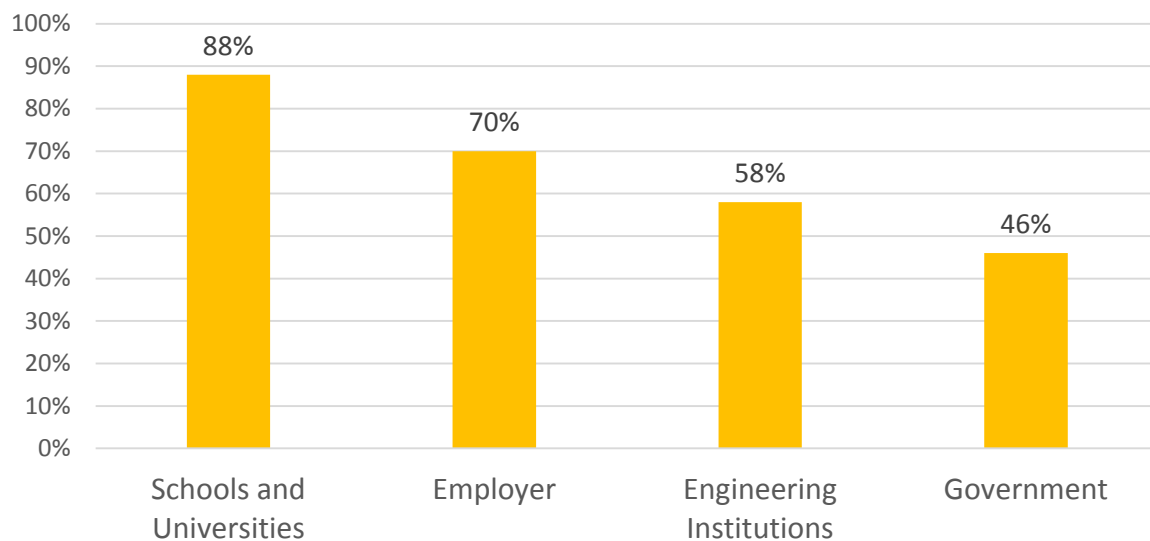
Main Skills Shortages - Engineering sub-categories

1. Systems Engineering
2. Production Engineering
3. Software/IT Engineering
4. Control and Instrumentation Engineering
5. Electrical Engineering

Others

- Mechanical Engineering
- Process Engineering
- Quality Engineering
- Maintenance
- Civil Engineering

Leaders and Contributors to the Delivery of Manufacturing Skills



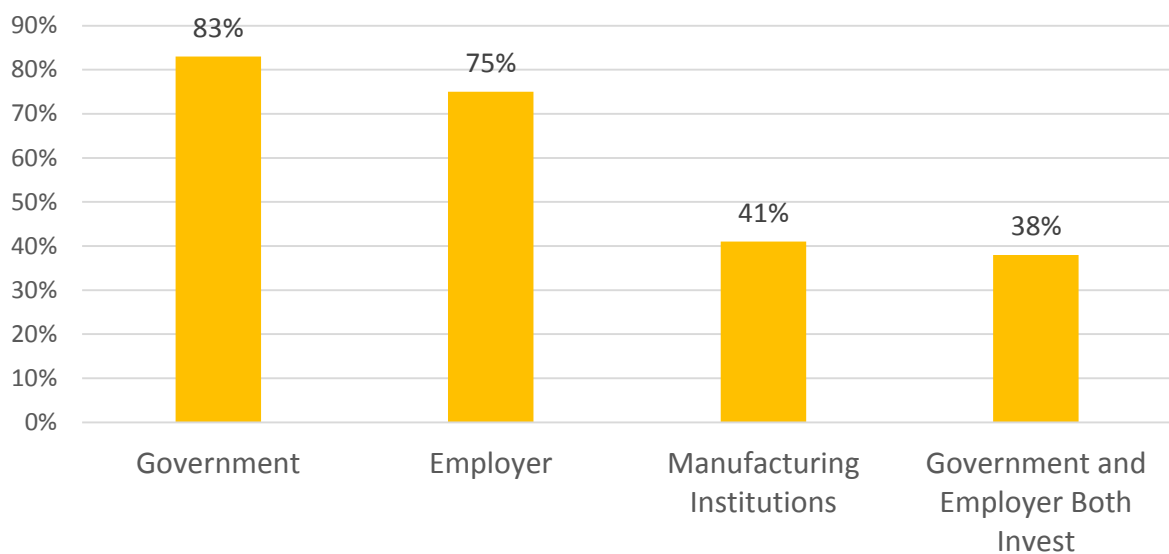
The biggest proportion, 88%, of the survey identified schools and universities as the leaders for skills delivery. Employers, engineering institutions and then government should be the next most active contributors of training the workforce in manufacturing skills.

Actions taken by employers to deal with skills shortages

In order to overcome these skills shortages, the main actions taken by employers were:

- Educating students about careers in manufacturing
- Internal training of the workforce
- Apprenticeship and internship schemes
- External recruitment from job centres
- Improved government involvement with respect to encouraging manufacturing

Skills Training Investment Responsibility

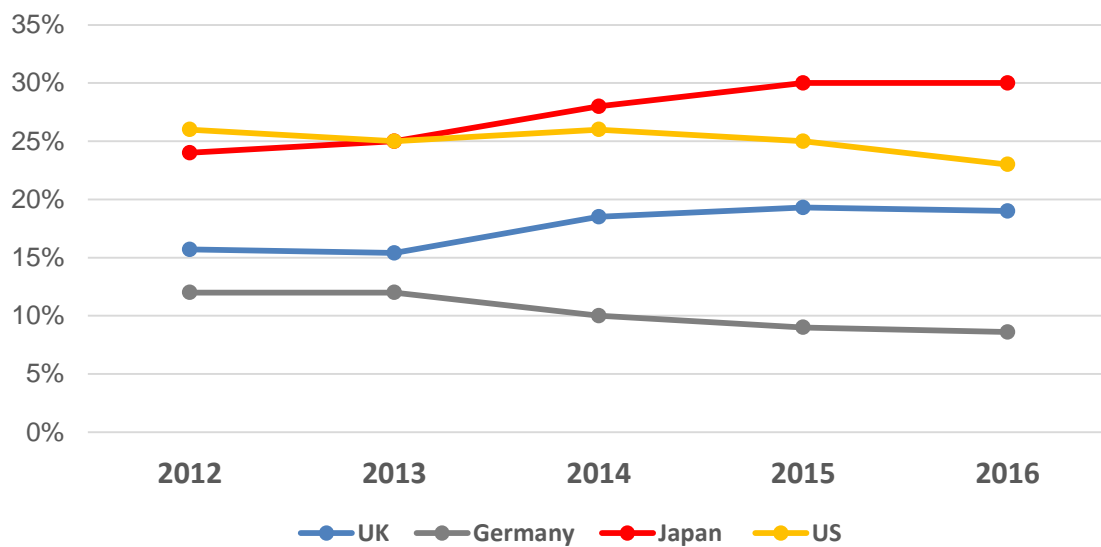


From industry’s point of view, government should be more responsible than any group for training investment. However, employers also ranked highly (75%), and manufacturing institutions should also invest more in training to develop their current and future workforce. Several interviewees commented that government and employers should work together when investing in skills training.

Part 4: Comparison with other competitor countries

Density of Skills Shortage Vacancies (SSVs) in Manufacturing

SSVs is defined by UKCES as the “number of manufacturing skills shortage vacancies as a proportion of total manufacturing employment”.



Sources: UKCES, OECD, Manufacturing Institute (Deloitte 2015 US Manufacturing Report), Japanese Statistics Bureau, Destatis – German Statistics Department

The density of skills shortage vacancies in the UK and Japan continues to grow, while countries with improved manufacturing working infrastructure like Germany and the United States have been able to reduce the number of skills shortage vacancies.

Root Causes for Skills Shortages

Although manufacturing in some competitor countries has shown improvement and growth, shortages in various types of skills are still observed in the current workforce and expected in the future. Some of the root causes are stated below.

Japan

1. Declining and aging population (low fertility rate)
2. University curriculums do not meet the emerging needs of its industries

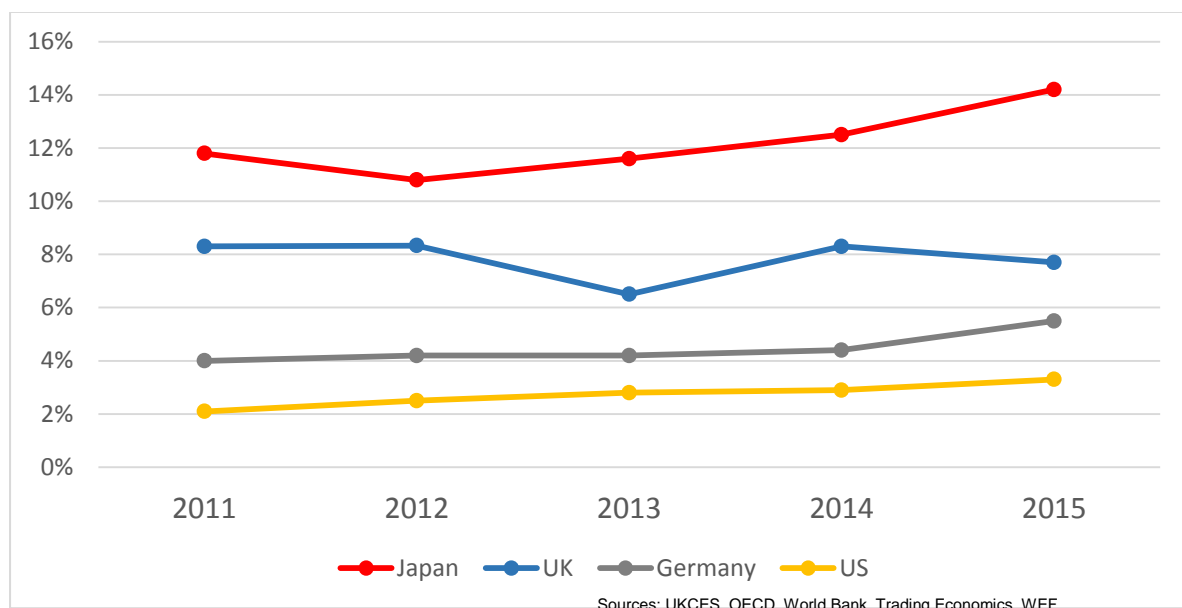
Germany

1. German adult population shows high levels of under skilled labour
2. Reduction in enrollment in dual education system
3. Retirement of baby boomer generation

United States

1. Downsizing and offshoring of companies
2. Lack of adequate training and education pipeline for talented new entrants

Percentage of Investment for Skills Development in Manufacturing GDP



The above graph shows that Germany and the United States spend a lower percentage of their manufacturing GDP on skills development, compared with Japan and the UK. The United Kingdom has seen fluctuations in the amount of investment in manufacturing skills development, with recent trends showing a decline in these investments.

Actions taken to deal with skills shortages

In order to overcome skills shortages, these countries have taken the following actions:

Germany

1. Dual vocational training programmes and on-the-job training and work experience
2. Co-Determination, which ensures the right of workers to participate in the management of the companies they work for

Japan

1. Adopting higher international standards for education
2. Nurturing local talent and casting a wider recruitment net to include more women
3. Partnerships and exchanges with foreign companies for two-way transfer of knowledge and management practices

United States

1. Collaborating with colleges and universities to review, and update, the curriculum
2. Setting up open access training programmes and remote skills training for manufacturing to assist manufacturing companies in building skills that culminate in a certified skill level

Part 5: Updated Well-being Profile for 2017

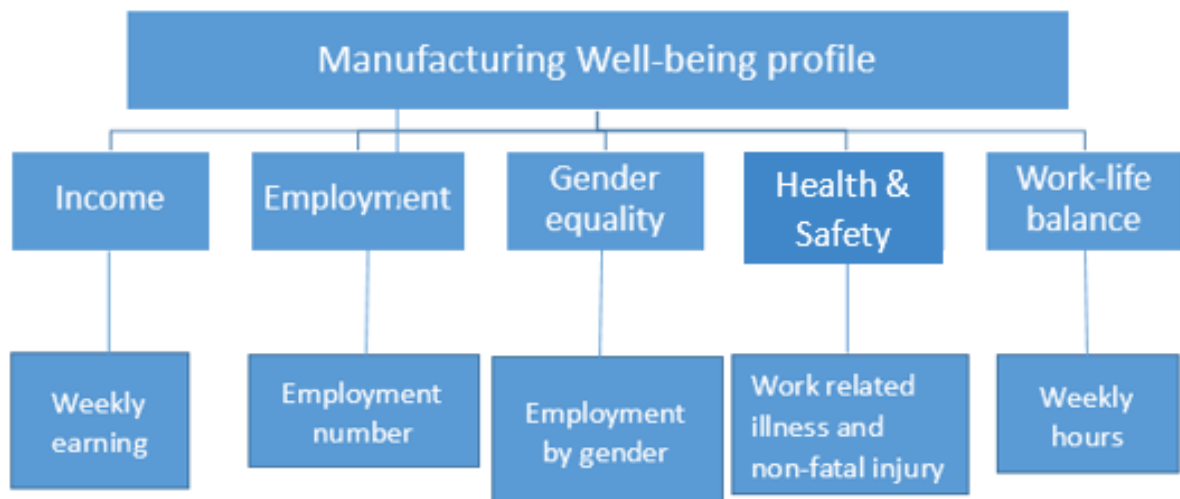
The manufacturing sector not only plays a major role in the economic development of a country but also impacts the well-being of the people. For creating a well-being profile, framework ONS and OECD well-being indices were referenced. A new framework was made by selecting five key indicators, which are:

Income, work-life balance, health and safety, gender equality and employment

...used for the simplified profile calculation. For comparison, a well-being profile for the US was also created.

All data for the UK was collected from the ONS except health and safety, which was obtained from the Health & Safety Executive. For the US, all statistics were obtained from the Bureau of Labour Statistics.

The simplified framework for well-being profile is shown below:



Normalization

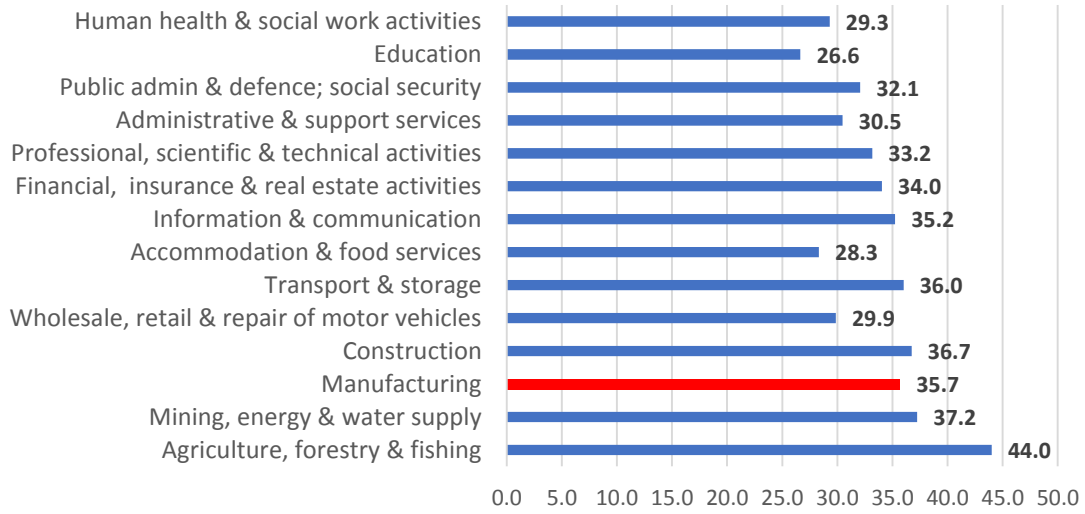
Indicators for well-being are represented in different units like hours, pounds, etc. To eliminate the unit differences these values are normalized for comparison of the manufacturing sector with other sectors in the UK economy.

$$\text{Normalized Value for Manufacturing} = \frac{V_{\text{manufacturing}} - V_{\text{min}}}{V_{\text{max}} - V_{\text{min}}} \times 100$$

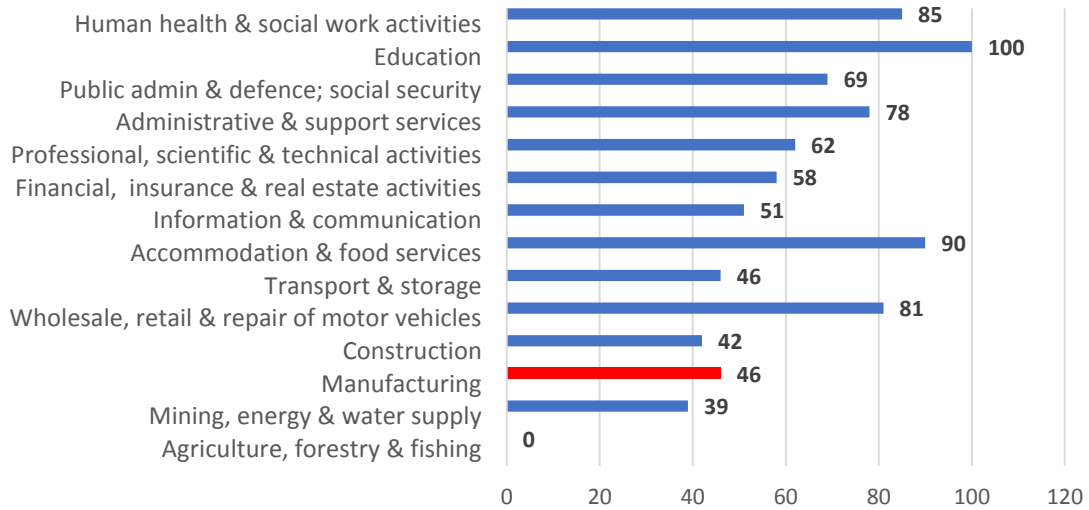
For average weekly hours, workplace illness and non-fatal injury, which are considered as negative indicators, the following formula is used:

$$\text{Normalized Value for Manufacturing} = 100 - \frac{V_{\text{manufacturing}} - V_{\text{min}}}{V_{\text{max}} - V_{\text{min}}} \times 100$$

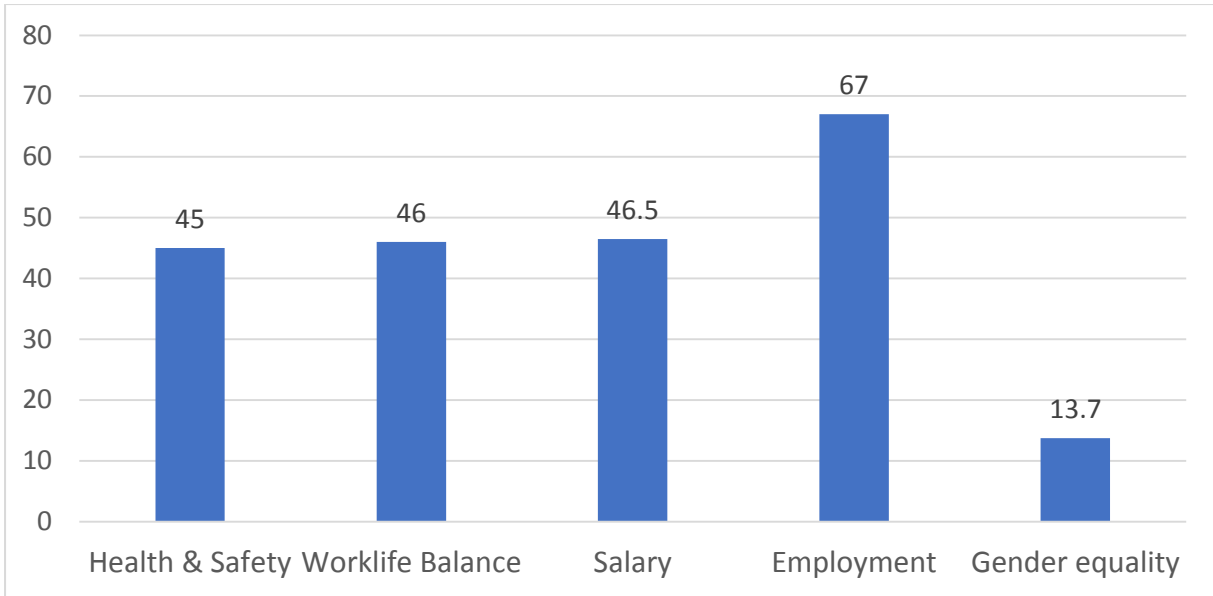
Weekly Working Hour UK



Weekly Working Hour UK - Normalized

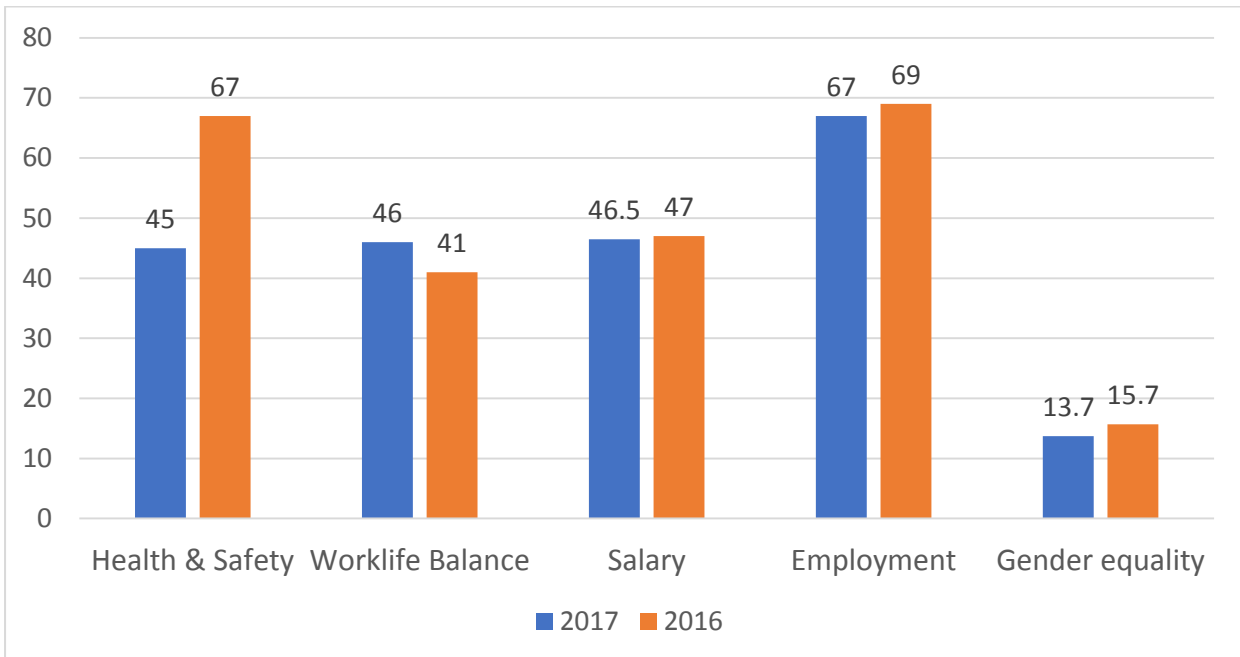


UK Manufacturing Well-being Profile 2017



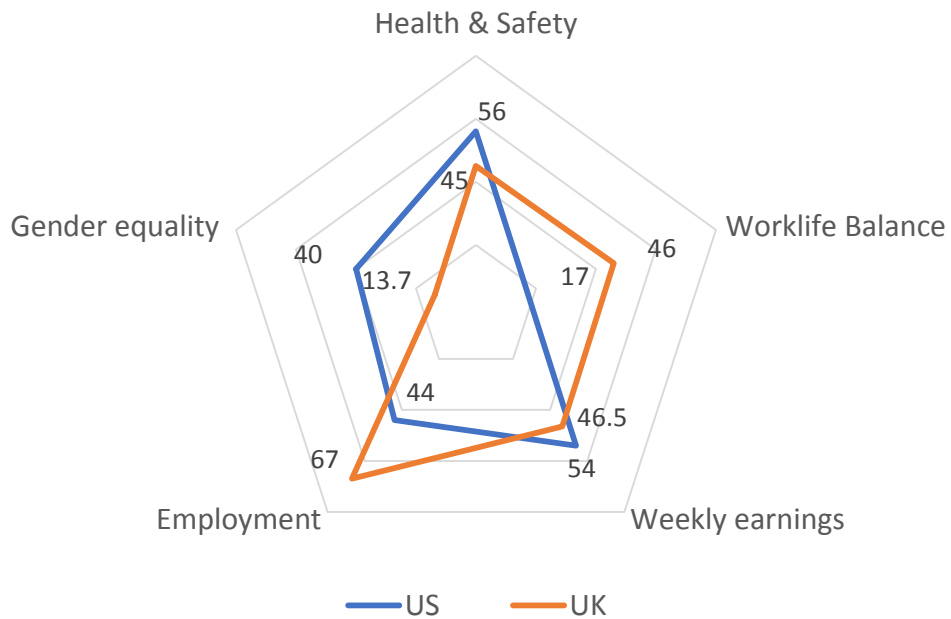
Employment showed the best performance, while the other indicators were below average. On comparing with other sectors, female participation was low resulting in poor performance for gender equality.

UK Manufacturing Well-being Profile 2017 vs 2016



On comparison with the 2016 well-being profile, all the indicator performance were more or less the same except for health & safety. Increase in work related illness and non-fatal injury lead to the decrease in health and safety performance.

Manufacturing Well-being Profile of United Kingdom vs United States



From the above diagram, it is evident that UK performed better in terms of work-life balance and employment. Weekly earnings, gender equality and health & safety were found to be higher for US manufacturing. Unlike UK, Manufacturing is seen as an attractive career choice by females in US resulting in their higher participation.

Part 6: Conclusion and Recommendations

Conclusion

- Technical skills required for manufacturing were in shorter supply than non-technical skills measured by all articles, interviews and the survey.
- Robotics & artificial intelligence, data analysis skills, electronic & electrical engineering, software skills and machine operative skills were the most frequent manufacturing technical skills in short supply, according to historical analysis.
- Innovative skills, leadership skills, communication skills, management skills and supply chain skills were the biggest skills shortages in the non-technical category according to historical data.
- Interviews and survey: Recruitment of engineering skills is the biggest skill set deficit from the employer's experience, while people with management skills are also difficult to recruit among non-technical skills.
- Skills development leaders: Government & organisations' sources and media sources, both say that employers should lead skills training development*. Industry expects schools and universities to be responsible for the delivery of skills.
- Skills investors: Government & organisations and media articles suggest that employers and government should both invest in skills training, whereas the view from industry believes that government should be contributing more.

Recommendations

- Employers should work more closely with schools and universities in designing the curriculum to ensure that the skills industry needs are delivered.
- Government should increase investment in skills training and develop supporting policies.
- Educational institutions and engineering institutions should raise awareness of manufacturing career opportunities for the students.
- Skills training, such as apprenticeships and internships, should improve the quality as well as the quantity of the qualified workforce.
- Although this will have challenges in the current political environment, strategic overseas recruitment could be a way to deal with manufacturing skills shortages in the short term.
- All stakeholders of manufacturing should work together and invest in the development of skills.



National Manufacturing Debate

Vincent Building, Cranfield University, 24th May 2017

Theme: Leadership and Investment for Manufacturing Skills

Now in its eighth successful year, the National Manufacturing Debate hosted by Cranfield University brings together manufacturing professionals from a range of sectors to discuss and debate current challenges in the industry. This event is designed to encourage networking and collaboration across the sector to enable continued and long-term growth.

This white paper and collected data are available from:

www.national-manufacturing-debate.org.uk

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