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Cambridge Industrial Innovation Policy

Women in manufacturing: the case for a gender-transformative digitalisation

About this policy brief

This work was supported by the UKRI Made Smarter Innovation Challenge and the Economic and Social Research Council via InterAct [Grant Reference ES/W007231/1]. The project Women in digital manufacturing brought together academics and practitioners to raise awareness about the challenges that women face when participating in manufacturing, while highlighting the transformative potential of digital technologies in creating a more diverse and inclusive manufacturing sector.

InterAct is a £4.4 million, Made Smarter Innovation funded, Economic and Social Research Council-led network that aims to bring together economic and social scientists, UK manufacturers, and digital technology providers to address the human issues resulting from the diffusion of new technologies in industry.

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Executive summary

We are at a crossroads, with the opportunity either to progress towards a more equitable manufacturing landscape or to deepen existing gaps. The digitalisation of manufacturing provides a chance to transform the sector into a more inclusive and diverse one. However, if we do not take intentional and proactive steps, this digital transformation could instead reinforce prevailing norms and deepen gender inequalities.

This policy brief aims to inspire and inform gender-transformative initiatives that challenge unequal gender relations and discriminatory norms and practices within the manufacturing sector. It offers insights into the state of women's and men's participation in manufacturing, and through the narratives of accomplished professionals in the field, it unveils the barriers that women face to enter and advance in this sector. The policy brief offers practical recommendations for businesses, industry associations, and research and government organisations to promote gender diversity and inclusion within the UK manufacturing sector.

What is the gender gap in UK manufacturing?

- In 2022 approximately 700,000 women were employed in the UK manufacturing sector, accounting for just 26% of the total workforce.
- Traditional gendered division of labour persists in UK manufacturing. The automotive industry is mostly dominated by men, while the pharmaceuticals, textiles, and apparel industries have a more equal representation of both genders.
- Women working in manufacturing earn 17% less than men.
- Women from non-White backgrounds and women with disabilities are among the least represented population groups in UK manufacturing.
- The representation of women in UK manufacturing witnessed a decline from 29% in 1996 to 23% in 2011. While this trend was eventually reversed in the following decade, women's involvement in manufacturing continues to remain below the levels seen in 1996.
- The decline in women's representation observed between 1996 and 2011, corresponds with a decrease in the contribution of manufacturing to the UK economy. However, since 2012, as the manufacturing value-added shares stabilised, there has been an increase in women's participation in this sector.
- Gender disparities are particularly pronounced and widening among the most industrialised UK regions and countries, such as the North East of England, East and West Midlands and Wales.

What challenges do women face to participate in the UK manufacturing sector?

- We invited stakeholders from the manufacturing sector to participate in an online survey to understand challenges women face to participate in the sector. Survey participants perceive that the prevailing non-inclusive culture, which continues to favour men over women in manufacturing roles, is the primary hurdle for the participation of women in the industry, particularly in leadership positions.

- Other related barriers include limited awareness of job opportunities in the sector, a lack of female role models, limited support for skills development, gendered division of unpaid childcare and household work, rigid working conditions, and gender wage gaps.

What is the business case for bridging the gender gap in manufacturing?

- Research has shown that having a diverse gender representation within an organisation can lead to better financial and environmental performance.
- Increasing the participation of women in UK manufacturing is fundamental to closing skills gaps in the sector. Make UK's estimates indicate that filling current vacancies in the manufacturing sector could contribute to £7 billion extra annually to the UK gross domestic product.

How is digitalisation changing gender diversity in UK manufacturing?

- Over the past two decades, the manufacturing sector has undergone significant changes in the distribution of job roles within its workforce. Despite labour shortages in roles such as process, plant and machine operatives and skilled trades, these positions, which are mostly held by men, have seen a notable decrease in their share of manufacturing employment.
- Administrative and secretarial occupations, which are mostly held by women, have also seen a decline in employment rates, and this trend is likely to continue in the coming years.
- In comparison, there has been a substantial expansion in the shares of professionals and associate professional and technical positions.
- Changes in the skills required by manufacturing businesses are creating opportunities for women to enter the industry. This positive trend is compounded by the interaction of the digital and the environmental sustainability transitions, which are making manufacturing more diverse.
- From 2004 to 2022, there was an increase in gender diversity in several manufacturing jobs. These include professional roles, managers, directors and senior officials, associate professional and technical roles, and skilled trade occupations.

The way forward: How can we improve gender diversity in UK manufacturing?

Businesses, industry associations and research organisations could:

1. **Collect and analyse diversity data**. According to the Make UK ED&I Survey 2021, 47% of manufacturers are not assessing the status of equality, diversity and inclusion.
2. **Promote an inclusive workplace culture** through initiatives such as awareness-raising campaigns, diversity and inclusion training and networking opportunities.
3. **Address gender bias in recruitment and promotion** by using inclusive language in job advertisements, promoting diverse interview panels and candidate pools, and promoting mentoring opportunities.

4. **Support work–life balance** by providing flexible working arrangements, implementing return-to-work policies, promoting the uptake of paternity leave, offering on- or near-site subsidised childcare, among other initiatives.
5. **Share and recognise examples of best practice** by creating spaces for organisations to share their experiences and establishing awards to encourage outstanding practices.

Government organisations could:

1. **Follow a gender-transformative approach in government support programmes**. This includes setting targets for reaching women-owned businesses through support programmes, including women's business organisations in the design of dissemination campaigns, and conducting gender-sensitive evaluations.
2. **Support research on gender equality and gender-disaggregated data collection.** We cannot address what we do not know. A critical gap exists in gender-, ethnic- and disability-disaggregated data, as well as in understanding gender differences in the adoption of digital technologies in manufacturing. Bridging this gap requires both allocating funding to expand survey samples and supporting new research.
3. **Incentivise gender equality in research and innovation teams** by continuing efforts such as Innovate KTN's guidelines for inclusive design and by including gender equality criteria in research and technology fund allocations.
4. **Adopt a lifelong learning approach in training and education programmes** by creating opportunities for women to develop skills at different stages of their lives.
5. **Ensure an enabling environment for improving gender balance in caring responsibilities**. This may involve cross-ministerial coordination and collaboration with industry associations to develop and enforce policies that support flexible working, paternity leave, returning to work, and child and adult social-care provision.

Introduction

Gender norms and stereotypes segregate women and men into different occupations and economic activities. Although women represent almost half of the labour force in the UK, they account for just 26% of all workers in the manufacturing sector.[1] Women working in the manufacturing sector also earn 17% less than their male peers.[2]

Under-representation of women in manufacturing and gender gaps in wages have consequences for women's present and future life standards. However, a lack of diversity also negatively impacts business performance and limits how society benefits from research and innovation.[3]

This policy brief aims to inspire and inform gender-transformative initiatives that challenge unequal gender relations and discriminatory norms and practices within the manufacturing sector. It offers insights into the state of women's and men's participation in manufacturing; and, through the narratives of accomplished professionals in the field, it unveils the barriers that women face in entering, and advancing in, this sector. The policy brief concludes by presenting practical recommendations for businesses, industry associations and government organisations to foster gender diversity and inclusion within the UK manufacturing landscape.

The analysis presented in this document is based on five main sources of evidence: (i) national and industry association statistics; (ii) national and international publications on gender gaps in manufacturing and digital technologies; (iii) a discussion panel on 'women in manufacturing' conducted during Digital Manufacturing Week, Liverpool, UK, in November 2022; (iv) an online survey with 63 participants; and (v) the review of national and international practices addressing gender gaps in the workplace.

The policy brief is organised into five sections addressing the following questions:

1. What is the gender gap in UK manufacturing?
2. What challenges do women face to participate in the UK manufacturing sector?
3. What is the business case for bridging the gender gap in manufacturing?
4. How is digitalisation changing gender diversity in UK manufacturing?
5. How can we improve gender diversity in UK manufacturing?

This policy brief is a part of the InterAct-funded project *Women in digital manufacturing [Grant Reference ES/W007231/1],* and it contributes to the work of the Women in Manufacturing Initiative, a network of academics, practitioners and professionals working in the field of manufacturing with a shared interest in raising the profile of women in manufacturing.

1. What is the gender gap in UK manufacturing?

Women represent 26% of the manufacturing workforce.

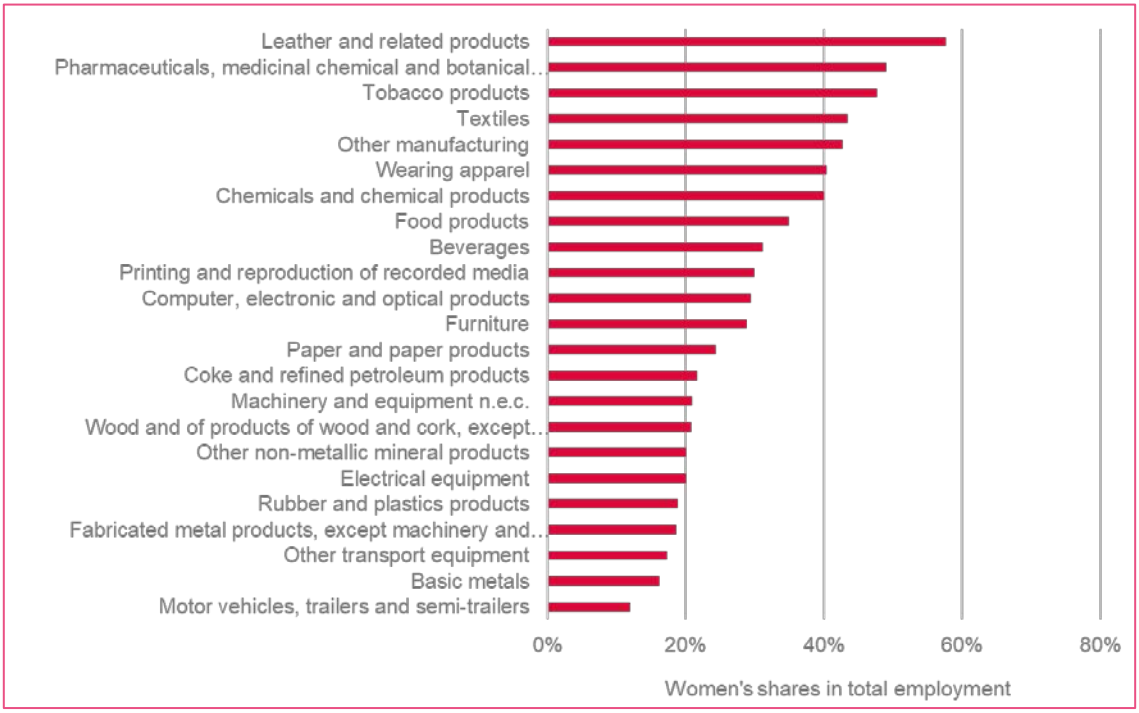
In 2022 approximately 700,000 women were employed in the UK manufacturing sector, accounting for just 26% of the total workforce. This is in stark contrast to sectors such as education, human health and social-work activities, where women's participation exceeds 60%.[4]

Representation of women in UK manufacturing is markedly lower in skilled trade occupations (9%); process, plant and machine operatives (23%); and managers and senior officials (23%). In comparison, women's representation is larger in administrative and secretarial occupations (70%), personal services (55%); and sales and customer service (49%).[5]

Traditional gendered division of labour persists in UK manufacturing. Industries such as automotive are predominantly male-dominated, while pharmaceuticals, textiles and apparel show a more gender-balanced participation.

Among manufacturing industries, and based on 2019 data, the lowest representation of women is found in: motor vehicles (12%), basic metals (16%), other transport equipment (17%), fabricated metal products, excluding machinery and equipment (19%), and rubber and plastic products (19%). In contrast, industries with near-equal gender participation include: leather and related products (58%), pharmaceuticals (49%), tobacco products (48%), textiles (43%) and other manufacturing (43%) (Figure 1).[6]

FIGURE 1. WOMEN'S EMPLOYMENT SHARES IN MANUFACTURING INDUSTRY AND GENDER, 2019



Source: ILOSTAT. Employees by sex and economic activity – ISIC level 2.

FIGURE 2. THE GENDER GAP IN UK MANUFACTURING

How many women work in UK manufacturing?

700,000 women work in manufacturing in the UK

They represent **26%** of the manufacturing workforce

Women from non-White backgrounds and women with disabilities are among the least represented population groups.

88% White women **12%** Women from other ethnic groups

Women with disabilities represent **1%** of the manufacturing workforce

What types of occupations do women perform?

Women represent:

In administrative and secretarial occupations

In sales and customer services

But only:

In skilled trades

In process, plant and machine operatives; and as managers and senior officials

In which industries do women work?

Industries with **near-equal gender participation** include:

58% Leather and related products
49% Pharmaceuticals

48% Tobacco products
43% Textiles

Industries with **the lowest representation of women** include:

12% Motor vehicles
16% Basic metals

17% Other transport equipment
19% Rubber and plastic products

Women are less likely than men to own a business.

Only **15%** of manufacturing SMEs are owned by women

Unpaid childcare and household work disproportionately affect women's participation in manufacturing

Women spend **1.7 more time** a day in **unpaid childcare** than men

23% of the **women** in manufacturing **work part-time**

5% of the **men** in manufacturing **work part-time**

Women working in manufacturing **earn 17%** less than **men**

Source: Author, based on ILOSTAT. Employees by sex and economic activity – ISIC level 2; Office for National Statistics (2022). Workforce jobs by industry (SIC 2007) and sex via Nomis; Office for National Statistics, Social Survey Division. (2023). Annual Population Survey, January–December, 2022.

Women from non-White backgrounds and women with disabilities are among the least represented population groups in UK manufacturing.

According to 2022 data, women from non-White backgrounds account for 15% of the workforce, while they represent just 3% of manufacturing employees.[7] Of the 700,000 women working in manufacturing, less than 12% are from an ethnic minority group: Indian (3%), mixed ethnicity (2.1%), other ethnic group (1.8%), Black, African or Caribbean (1.4%), other Asian background (1.4%), Chinese (1.1%), Pakistani (0.7%) and Bangladeshi (0.3%) (Figure 3).

In 2022 women with disabilities, as defined in the Equality Act 2010, represented 9% of the people in employment; however, they made up for less than 5% of the manufacturing workforce.[8]

FIGURE 3. WOMEN IN MANUFACTURING BY ETHNIC GROUP, 2022

Source: Office for National Statistics, Social Survey Division (2023). *Annual Population Survey, January–December 2022* [data collection]. UK Data Service. SN: 9069, DOI: http://doi.org/10.5255/UKDA-SN-9069-1

Women face persistent barriers that hinder their advancement to leadership positions.

Women are significantly under-represented in senior manufacturing roles, such as managers and senior officials. According to the Make UK equality, diversity and inclusion (ED&I) Survey 2021, only around 11% of manufacturers have women in C-Suite-level roles.[9]

Women are also less likely to own a business, and their start-ups receive less funding.[10] In the UK only 15% of manufacturing small- and medium-sized enterprises are owned by women.[11]

Gendered division of unpaid childcare and household work constraints the participation of women in manufacturing.

Women in the UK spend 1.7 more time a day in unpaid childcare than men and 1.4 more time in household work.[12] This traditional gender-based division of unpaid work means that women face larger burdens to participate in paid work, particularly in positions with little flexibility or involving uncertain shifts and locations.

Because of this situation, women are more likely to work part-time than men. In 2022, 23% of the women working in manufacturing were working part-time, while only 5% of men were working part-time.[13]

Women working in manufacturing earn 17% less than men.

Barriers to the participation and progression of women in manufacturing have impacts on their present and future living standards, including their income. In 2022 women in the UK earned 15%[14] less than men, while those working in manufacturing earned 17% less than men. Manufacturing industries with the largest gender pay gaps include: the manufacture of computer, electronic and optical products (32%); the repair and installation of machinery and equipment (28%); the manufacture of chemicals (19%); the manufacture of textiles (17%); and the manufacture of electrical equipment (17%).[15]

By occupation, the largest gender pay gaps are observed in: skilled trade occupations (20.6%); business and public service associate professionals (20.1%); and science, engineering and technology associate professionals (17.6%).[16]

Gender diversity in UK manufacturing worsened between 1996 and 2011.

Between 1996 and 2011, women's participation in manufacturing dropped from 29% to 23%. Although this trend reversed in the subsequent decade, women's participation in manufacturing remained at 26% in 2022, which is still lower than the 1996 figure of 29%.

The decrease in female representation within manufacturing coincides with a decrease in the magnitude of the manufacturing sector in the UK.

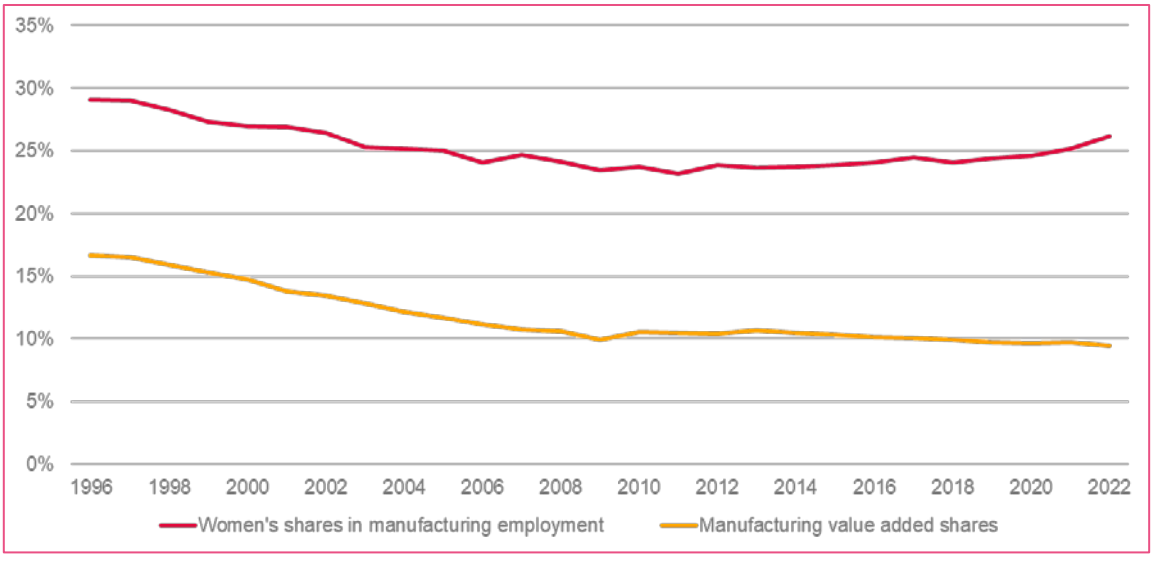
Figure 4 illustrates a parallel trend between women's participation and the shares of manufacturing in value added, especially between 1996 and 2011. During this period, both women's shares in employment and manufacturing value added experienced a decline of 6 percentage points. Conversely, as the shares of manufacturing stabilised in 2012, and the adoption of digital technologies intensified,[17] the participation of women in this sector increased by 3 percentage points between 2012 and 2022.

The reduction in the size of the manufacturing sector between 1996 and 2011 meant that job opportunities in manufacturing were reduced for both men and women. However, women were the most impacted by these changes.

Although this is an underexplored topic in the literature, studies across different contexts have found a negative relationship between women's participation in manufacturing and technological upgrading.[18] Factors explaining this negative relationship include gender bias in recruitment and promotion and higher barriers for women to develop new skills.[19] However, there is mixed evidence about the ongoing impact of the digital transformation on gender diversity in manufacturing (see Section 4).

The digitalisation of manufacturing offers a unique window of opportunity to address diversity gaps. According to the 2023 World Economic Forum (WEF) *Future of Jobs Report*, within manufacturing the demand for roles such as administrative and executive secretaries is expected to decline in the coming years.[20] As discussed in Section 1, women are disproportionally represented in these positions, accounting for 70% of employees in these roles, which places them at higher risk of being negatively impacted. Providing upskilling opportunities and having in place gender-sensitive safety nets would help to mitigate negative impacts and facilitate the integration of women into emerging roles.

FIGURE 4. THE GENDER DIMENSION OF DEINDUSTRIALISATION



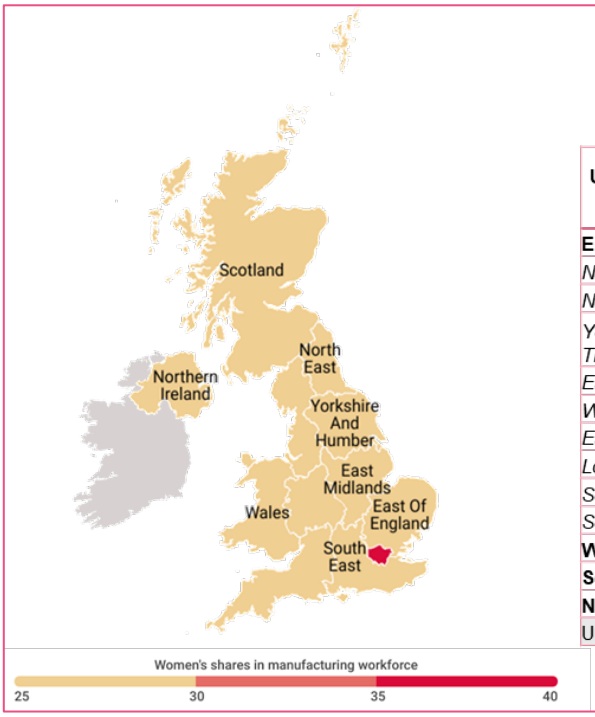
Note: Data for women's shares in manufacturing employment refers to March of each year.

Source: Office for National Statistics. Workforce jobs by industry (SIC 2007) and sex via Nomis.

Gender disparities are particularly pronounced and widening among the most industrialised UK regions and countries.

Women represent less than a third of the manufacturing labour force across UK regions and countries. The only exception is London, where women accounted for 41% of the manufacturing workforce in 2022. However, manufacturing contributes to less than 2% of London's economy. Gender disparities are particularly pronounced and widening among the most industrialised UK regions and countries, such as the North East of England, East and West Midlands and Wales, where manufacturing comprises over 14% of their respective economies (Figure 5).

FIGURE 5. WOMEN'S PARTICIPATION IN MANUFACTURING BY UK REGIONS AND COUNTRIES



Women's participation in manufacturing is lower and decreasing in the most industrialised UK regions

UK regions and countries	Women's shares in 2022	Change in women shares 1996–2022	Manufacturing value added shares
England			
North East	21%	-7.2	15%
North West	25%	-3.1	14%
Yorkshire and The Humber	25%	-4.5	15%
East Midlands	26%	-10.3	17%
West Midlands	23%	-5.2	16%
East	26%	-0.1	11%
London	41%	17.8	2%
South East	27%	1.3	9%
South West	26%	-1.2	11%
Wales	24%	-6.4	17%
Scotland	27%	-5.4	10%
Northern Ireland	23%	-9.2	14%
United Kingdom	26%	-2.9	9%

Source: Office for National Statistics. Workforce jobs by industry (SIC 2007), region and sex via Nomis.

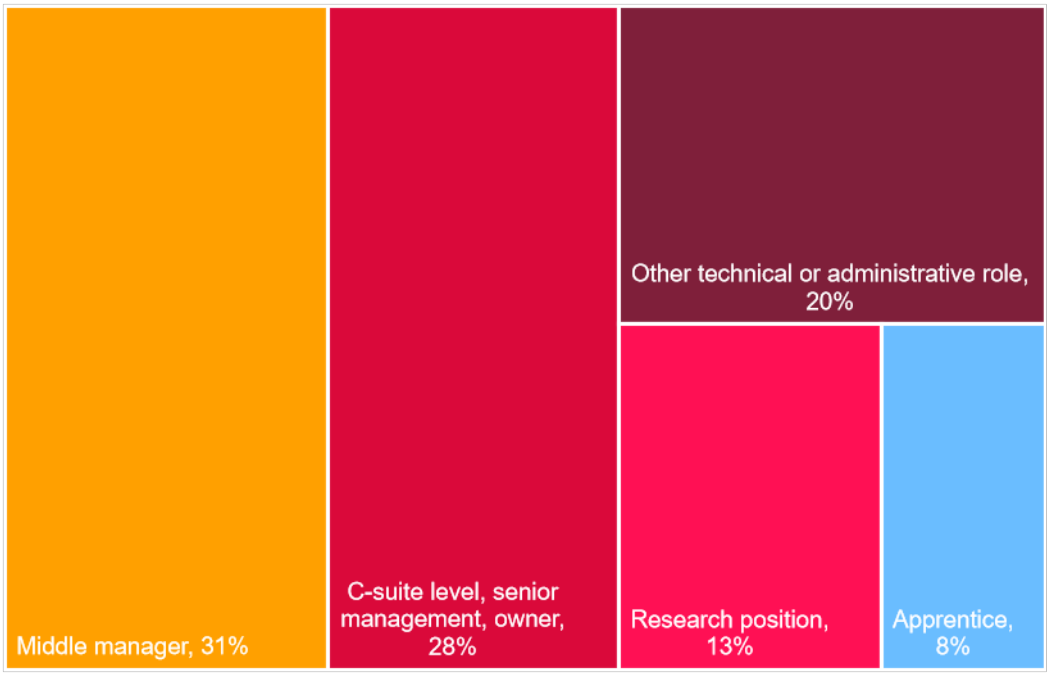
2. What challenges do women face to participate in the UK manufacturing sector?

In November 2022, as part of the Digital Manufacturing Week held in Liverpool, stakeholders from the manufacturing sector were invited to participate in an online survey. The survey aimed to gather insights on the key challenges hindering gender diversity in UK manufacturing and potential solutions. Promotion of the survey was done during the panel discussion and subsequent outreach through social media.

We received 63 responses from stakeholders representing various sectors, including private companies and research and technology organisations. Although participants were not explicitly asked to disclose their gender, a majority of respondents had names that are typically associated with women.

Figure 6 provides an overview of the survey respondents' roles within their respective organisations. More than half of the respondents hold managerial positions, while 20% are engaged in other technical or administrative roles, 13% of respondents occupy research positions, and 8% are apprentices.

FIGURE 6. ROLES OF SURVEY RESPONDENTS WITHIN THEIR ORGANISATIONS



Note: Number or respondents = 61. The sum of the percentages exceeds 100% because respondents had the option to select more than one choice. Two participants did not disclose their role.

Source: Women in Manufacturing survey.

Figure 7 shows the main challenges that survey participants perceive regarding the equitable participation of women in manufacturing. The prevailing non-inclusive culture, which continues to favour men over women in manufacturing roles, is perceived as the primary hurdle for the participation of women in the industry (68%). This is followed by barriers in promotion and leadership (59%), a lack of awareness and visibility of job opportunities (54%), a lack of skills and training support (33%) and work–life balance (19%).

'Challenging culture and microaggressions should not be the responsibility of the woman but of the whole team around her to support the change.'

Survey respondent

FIGURE 7. WHAT ARE SOME OF THE CHALLENGES PREVENTING EQUITABLE OPPORTUNITIES AND REWARDING CAREERS FOR WOMEN IN MANUFACTURING?

Note: Number or respondents = 63. The sum of the percentages exceeds 100% because respondents had the option to select more than one choice.

Source: Women in Manufacturing survey.

Conscious and unconscious bias in recruitment and promotion is perceived as an inhibitor of the participation of women in manufacturing, particularly in leadership positions. This is compounded by ethnicity and disability-based bias. This intersectionality is widely recognised in critical race studies.[21]

'I have attended (name of the event) and other events many times and felt very isolated when they fail to see the absent minorities.'

Survey respondent

Glass ceiling

Since gender and other types of bias are usually embedded in organisations' culture but not explicit in corporate policies, this barrier is commonly referred to as a 'glass ceiling', a metaphor for the invisible – and often not acknowledged – barriers that prevent women from progressing in their careers.

This glass ceiling, manifested as the under-representation of women in leadership and the related barriers, was considered to be one of the main challenges for the participation of women in manufacturing by more than half of the survey participants.

Factors contributing to this disparity include conscious and unconscious biases, gender stereotypes and traditional gender-based distribution of care and domestic responsibilities, which make it more difficult for women than men to progress in their careers.[22]

Women represent less than a third of the engineering, manufacturing and construction graduates.[23] However, survey participants emphasised that this gap is a result of the barriers mentioned above and that a lack of skills is less of a challenge than other factors, such as the lack of awareness and visibility of opportunities in the sector. This challenge was raised by more than half of the respondents.

> *'I don't think the issue is with women lacking technical, leadership or communication training. There are so many talented women that have a lot more higher qualifications, experience and skills than their male peers. Yet it's the male peers that get promoted to higher positions and having higher salaries at the same levels. The issue is with the organisations and how this is allowed to happen. Initiatives should be focused on changing the mindset of organisations to change how they work, not by just ticking the box in order to show acceptable metrics but to genuinely bring equity across employees.'*
>
> *Survey respondent*

A lack of role models

The overall low participation of women in manufacturing and of women from ethnic minority backgrounds means that girls lack role models that could inspire and guide them to participate in the industry.[24] Survey participants highlighted how a lack of representation of women also contributes to reinforcing gender stereotypes and to making it more difficult for women working in manufacturing to progress in their careers.

Box 1 presents the inspiring journey of Michelle Quinn, who shattered the glass ceiling in 2020, becoming the first female managing director of Almond Engineering.

BOX 1. MICHELLE QUINN: INSPIRING THE NEXT GENERATION OF MANUFACTURERS

One day, while conversing with the managing director, Michelle remarked: *'Imagine if I were the first female managing director after you retire, how amazing would that be?'* Little did she know that 15 years later, her words would become a reality as she became the first female managing director.

Michelle Quinn's journey began when she joined Almond Engineering in Livingston, Scotland, immediately after finishing school. Initially intended to be a temporary position to cover administrative duties for 3 weeks, Michelle's enthusiasm and dedication led her to request an extension, eventually turning it into a long-term commitment. As of 2023, she has been an integral part of the company for 18 years.

Michelle Quinn, Managing Director, Almond Engineering

Her continuous growth and passion for the company can be attributed to the opportunities she seized to explore different aspects of the business. Michelle fondly recalls: *'I think the longer I was there, the more I learned about the company, and the more interested I became (...) they were saying, well, actually, this extra pair of hands is really helpful.'*

Working at a small company gave Michelle the opportunity to learn from various facets of the business, fostering her career progression alongside the company's expansion.

'I was really thankful for the opportunity to learn about all aspects of the business. I would spend time on the shop floor, speak to the guys there and learn how they went through the full process of manufacturing parts. I also spent time with the designers and sought to learn about the finance side of the business.'

Passionate about manufacturing and diversity

Michelle's passion for manufacturing grew as she observed the diverse sectors and projects that Almond engaged in, and she marvelled at how they were able to come up with creative solutions to the problems their clients were facing.

'It's so varied across so many different industries, and it's nice to constantly see different processes being used and reviewed, different materials, different manufacturing methods. But I think the main thing is actually being able to see components and products being manufactured.'

Her journey at Almond was not without challenges, especially as a young woman in a male-dominated industry. Yet, Michelle persevered and acknowledges the support she received from her colleagues and the management team, particularly the mentorship she received from Willie Scott, former Managing Director of Almond.

'You know everyone that I worked with, no matter what their role was, they helped me, guided me, taught me different things. The managing director was a mentor who took me under his wing and really wanted me to succeed.'

(continued on the next page)

Despite facing initial resistance and gender stereotypes, both within and outside the company, Michelle has witnessed a notable positive shift in gender diversity and inclusion within the industry. She highlights how male colleagues appreciate changes in the work environment brought about by diversity in leadership.

An advocate of apprenticeships

Michelle is passionate about promoting career opportunities in the manufacturing sector, especially among young girls. Having faced limited information about such prospects herself, she now actively collaborates with organisations such as Edeta, a charity dedicated to apprentice training, serves as a Regional Board Member for Developing Young Workforce West Lothian, and also volunteers her time as a mentor for the Career Ready programme. Her goal is to empower and guide young individuals towards fulfilling and rewarding careers in manufacturing.

'It's not just about college or university or further education, it's also about apprenticeships and work experience and connecting everyone.'

Looking to the future, Michelle is determined to pave the way for the next generation. She acknowledges: *'I won't be here forever, and I need younger people to come through the company like I did. I want the apprentices to become future managing directors.'*

Michelle Quinn's inspiring journey at Almond Engineering exemplifies the power of determination, hard work and mentorship in shaping successful careers and driving positive change in the workplace.

Source: Interview with Michelle Quinn, July 2023; Almond Engineering (2020). New Executive Team.

Gendered division of unpaid childcare and household work

Gendered division of care and household tasks means that, overall, women spend more time than men performing care activities. The survey participants highlighted how a lack of work flexibility, work–life balance and affordable childcare act as barriers for women to participate in manufacturing jobs while raising a family.

> *'Difficult working hours and a lack of flexibility make childcare difficult.'*
>
> *Survey respondent*

'It is important for manufacturing business to offer the same parental leave entitlements to all staff, regardless of gender. Without this, companies will worry about losing women's time to maternity leave. If all staff are treated equally, this concern will apply to all staff during their child-rearing years.'

Survey respondent

3. What is the business case for bridging the gender gap in manufacturing?

Gender equality is a human right; however, there is also evidence of the economic benefits of increasing gender diversity. Globally, enterprises with more diverse leadership tend to report better business outcomes, such as turnover, profits and productivity, they are better able to attract and retain talent, and they have greater innovation activity.[25,26] There is also evidence of the positive feedback between gender diversity and the environmental performance of start-ups and established firms.[27]

Studies in the UK context have found a positive relationship between gender diversity on boards and financial business performance.[28] Addressing the factors that inhibit the participation of women in UK manufacturing is fundamental to closing the skills gaps that UK manufacturers have faced over the last decade. Make UK's estimates indicate that filling current vacancies in the manufacturing sector could contribute £7 billion extra annually to the UK gross domestic product.[29]

4. How is digitalisation changing gender diversity in UK manufacturing?

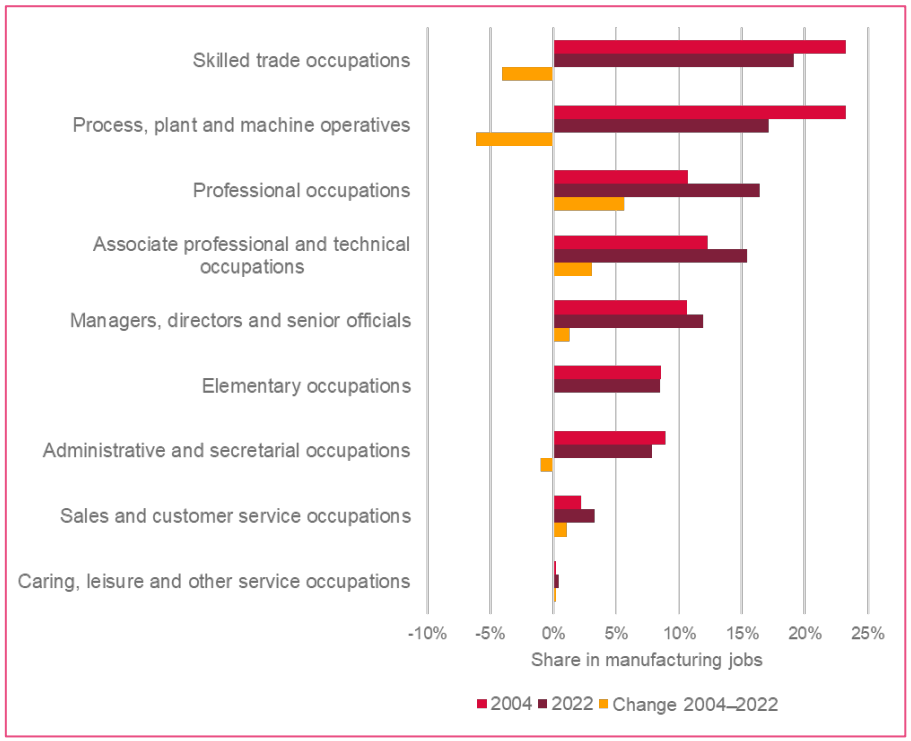
With the right policy mix and contextual enablers in place, digital technologies have the potential to contribute to narrowing gender inequalities. By bringing financial services and markets closer to women, while also fostering greater work flexibility, digital technologies have contributed to financial inclusion and created opportunities for women to enter the labour market and to establish their own businesses.[30,31]

The digital transformation is having mixed effects in gender diversity in the manufacturing landscape. Over the past two decades, the manufacturing sector has undergone significant changes in the distribution of job roles within its workforce. Positions such as process, plant and machine operatives, as well as skilled trade occupations, have witnessed a considerable decline. In comparison, there has been a substantial expansion in the number of professionals and associate professional and technical positions.

In 2004, process, plant and machine operatives, along with skilled trade occupations, jointly accounted for 46% of manufacturing jobs, whereas professional, associate professional and technician occupations represented only 23% of the jobs. However, by 2022 the gap between these two groups of occupations had considerably narrowed to just 4 percentage points, with them making up 36% and 32% of the manufacturing workforce, respectively.

Administrative and secretarial occupations, which, as discussed before, are predominantly held by women, have also experienced reductions in their participation in manufacturing employment, although to a lesser extent than the aforementioned occupations (Figure 8).[32]

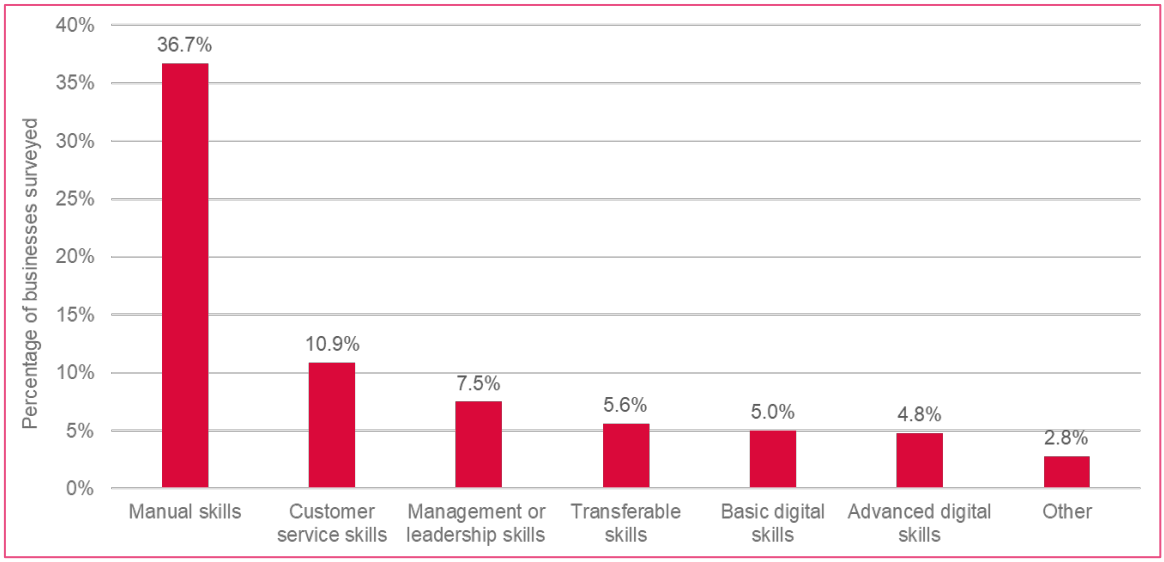
FIGURE 8. CHANGES IN MANUFACTURING OCCUPATIONS, 2004 AND 2022 (TOTAL)



Source: Nomis. Annual Population Survey – Workplace analysis

Despite the decline in the shares of process, plant and machine operatives and skilled trade occupations, manual skills are among the main shortages faced by UK manufacturers. As of July 2023, 37% of the manufacturing business that participated in the ONS Business Insights and Conditions Survey mentioned manual skills as an area of high demand in the last 12 months. Other skills in high demand include: customer service; management and leadership; transferable skills; and basic and advanced digital skills (Figure 9).

FIGURE 9. SKILLS IN HIGH DEMAND, 2023



Source: ONS (2023). Business Insights and Conditions Survey, Wave 87, July 2023.

Changes in the skills required by manufacturing businesses are creating opportunities for women to enter the industry. Skills such as data analysis, forward-thinking and innovation are becoming more relevant, and a growing number of women from different backgrounds have these skills.[33]

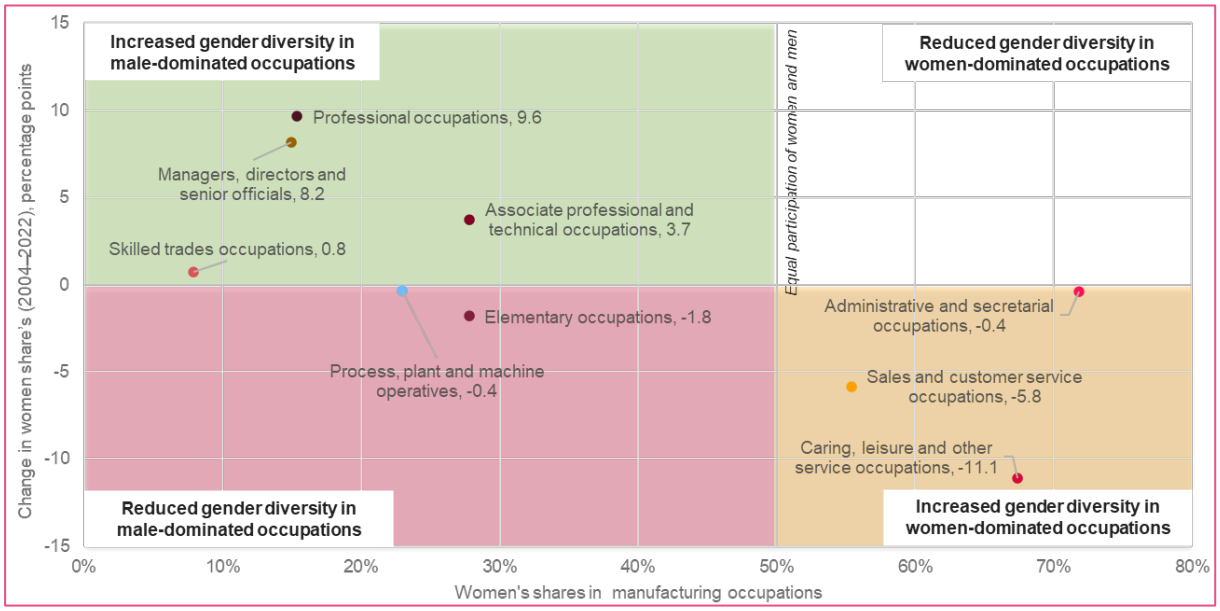
Globally, according to the World Economic Forum *Future of Jobs Report 2023*, manufacturing roles that are expected to experience a net growth in the next 5 years include: AI and machine-learning specialists, project managers, business development professionals, technical specialists, mechanics and machinery repairs, and industrial and production engineers.[34] Box 2 presents examples of career opportunities in digital manufacturing, based on information from the National Careers Service.

This positive trend is compounded by the interaction of the digital and the environmental sustainability transitions, which are making manufacturing more appealing to women. Research has shown that women are more inclined to participate in green industries than in conventional ones. This is driven by environmental concerns, a desire to contribute positively, and a perception of there being greater avenues for women's advancement within green industries.[35]

Table 1 and Figure 10 present shifts in women's participation in UK manufacturing occupations between 2004 and 2022. Progress in gender diversity was found in seven of the nine occupations. Four of these are roles where women are under-represented (change in women's shares is in brackets): professional occupations (9.6 percentage points, pp.); managers, directors and senior officials (8.2 pp.); associate professional and technical occupations (3.7 pp.); and skilled trade occupations (0.8 pp.). The other three are near-to-equal representation occupations or roles where men are under-represented (change in women's shares is in brackets): caring, leisure and other service occupations (-11.1 pp.); sales and customer-service occupations (-5.8 pp.); and administrative and secretarial occupations (-0.4 pp.) (Figure 10). However, a slight widening of gender gaps was observed in two male-dominated occupations: process, plant and machine

operatives (-0.4 pp.); and elementary occupations (-1.8 pp.). For detailed definitions of the nine occupational categories, please refer to Appendix A.

FIGURE 10. CHANGES IN GENDER DIVERSITY IN MANUFACTURING OCCUPATIONS, 2004–2022



Source: Author, based on Nomis. Annual Population Survey – Workplace analysis. For detailed definitions of the nine occupational categories, please refer to Appendix A.

BOX 2. CAREER OPPORTUNITIES IN DIGITAL MANUFACTURING

The National Careers Service provides information about careers in manufacturing. Examples of these include:

3D printing technician. 3D printing technicians make different products, such as medical implants, car parts, aircraft parts or fashion accessories.
Average salary (a year) £19,000 Starter, £38,000 Experienced
Typical hours (a week) 37 to 42

Automotive engineer. Automotive engineers design, develop, test and build cars and motorbikes.
Average salary (a year) £20,000 Starter, £45,000 Experienced
Typical hours (a week) 39 to 41

CAD technician. Computer-aided design (CAD) technicians use software to design structures, machinery, goods and components.
Average salary (a year) £17,000 Starter, £35,000 Experienced
Typical hours (a week) 39 to 41

Design and development engineer. Design engineers improve product performance and efficiency while researching and developing new manufacturing ideas and systems.
Average salary (a year) £24,000 Starter, £50,000 Experienced
Typical hours (a week) 38 to 40

Electronics engineer. Electronics engineers design and develop systems for industry, from mobile communications to manufacturing and aerospace.
Average salary (a year) £26,000 Starter, £60,000 Experienced
Typical hours (a week) 42 to 44

Garment technologist. Garment technologists choose the right fabrics and designs for manufacturers to make clothes at a set cost.
Average salary (a year) £20,000 Starter, £35,000 Experienced
Typical hours (a week) 38 to 40

Product designer. Product designers create new products and improve existing ones.
Average salary (a year) £22,000 Starter, £45,000 Experienced
Typical hours (a week) 40 to 42

Production manager. Production managers make sure manufacturing processes run smoothly and cost-effectively, and deliver products on time.
Average salary (a year) £24,000 Starter, £65,000 Experienced
Typical hours (a week) 38 to 40

Source: National Careers Service. Explore Careers. Manufacturing.

As Table 1 shows, the financial crisis of 2008 represented a setback in gender diversity across various occupations. Nonetheless, this trend reverted during the post-crisis period, both in men-dominated jobs – such as professional occupations, managers, directors and senior officials, and elementary occupations – and in women-dominated roles – such as sales and customer service and administrative and secretarial positions.

The COVID-19 pandemic saw a further surge in women's participation in professional occupations, while women's representation also increased in skilled trades and associate professional and technical occupations. However, a setback in gender balance was also observed in some occupations, affecting both men-dominated jobs – particularly managers, directors and senior official roles, and elementary occupations – and women-dominated jobs – particularly sales and customer-service roles.

TABLE 1. CHANGES IN WOMEN'S SHARES IN MANUFACTURING OCCUPATIONS, 2004–2022 (PERCENTAGE POINTS)

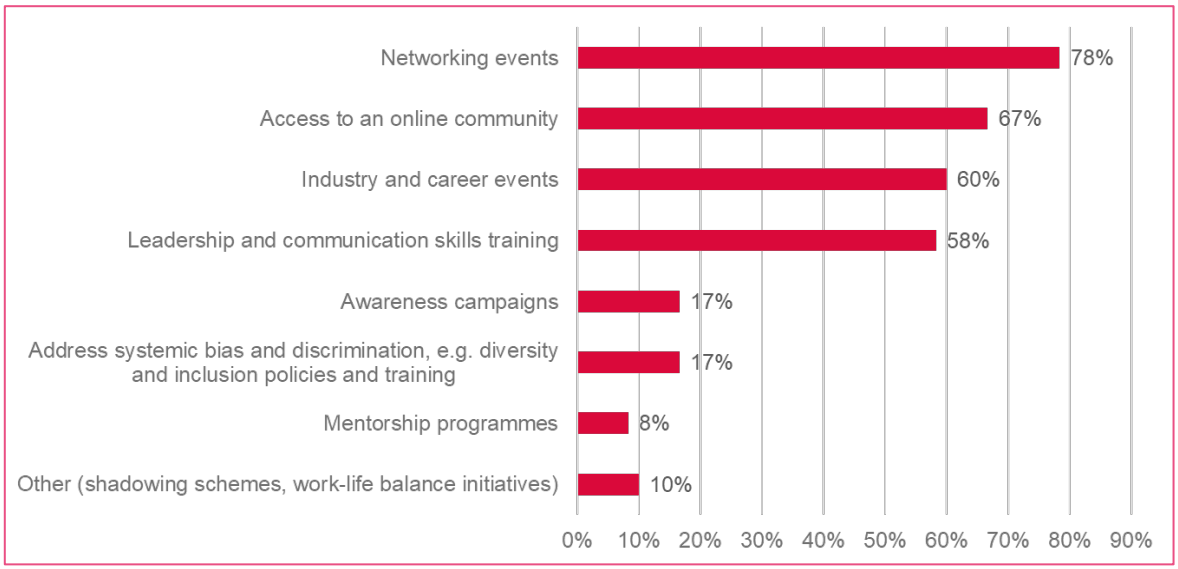
Occupation	Pre-financial crisis	Financial crisis	Post-financial crisis	COVID-19 pandemic	Whole period
	2004–2008	*2008–2010*	*2010–2019*	*2019–2022*	*2004–2022*
Professional occupations	2.6	-2.4	4.4	5.1	9.6
Managers, directors and senior officials	1.0	2.1	5.9	-0.8	8.2
Associate professional and technical occupations	2.5	-1.9	2.2	0.9	3.7
Skilled trade occupations	-1.2	1.2	-1.2	2.0	0.8
Process, plant and machine operatives	0.2	-1.7	1.2	-0.1	-0.4
Administrative and secretarial occupations	4.2	-2.6	-2.1	0.1	-0.4
Elementary occupations	0.6	-0.8	4.8	-6.4	-1.8
Sales and customer-service occupations	-3.3	0.8	-7.2	3.9	-5.8
Caring, leisure and other service occupations	4.7	-16.1	6.1	-5.8	-11.1

Source: Nomis. Annual Population Survey – Workplace analysis. Appendix A presents definitions of these occupations.

5. The way forward: How can we improve gender diversity in UK manufacturing?

The consultations for this project supported the relevance of fostering a community where women can actively engage in exchanging experiences, accessing job opportunities, establishing relationships, and promoting awareness of the benefits of a diverse talent pool (Figure 11). This aligns with the core objective of the Women in Manufacturing initiative, which, together with the online community 'Inspiring Women in Manufacturing', seeks to promote diversity and inclusion within the manufacturing sector.

FIGURE 11. WHAT COULD ORGANISATIONS DO TO INCREASE WOMEN'S PARTICIPATION IN MANUFACTURING?



Note: Number or respondents = 63. The sum of the percentages exceeds 100% because respondents could select more than one choice.

Source: Women in Manufacturing survey.

Drawing upon established practices to promote gender equality in the workplace, 10 practical recommendations are provided for UK organisations to cultivate a more diverse and inclusive manufacturing sector (Figure 12).

FIGURE 12. RECOMMENDATIONS FOR UK BUSINESSES AND GOVERNMENT ORGANISATIONS

Source: Author, based on UNIDO (2023), the European Union (2021), Himmelweit, S. and De Henau, J. (2022), ILO (2020) and Make UK (2021).

Recommendations for businesses, industry associations and research organisations include:

i. *Collect and analyse diversity data*. According to the Make UK ED&I Survey 2021, 47% of manufacturers are not assessing the status of equality, diversity and inclusion (ED&I). In order to address this gap, businesses need to start collecting diversity data and handling it following GDPR requirements.[36]

ii. *Promote an inclusive workplace culture.* Creating inclusive workplaces requires an integral approach, from organising awareness-raising campaigns, to providing diversity and inclusion training, facilitating networking and knowledge-sharing opportunities for under-represented groups, and establishing comprehensive ED&I policies that provide guidance and encourage inclusive behaviours and attitudes. Box 3 presents Siemens' comprehensive approach to promoting gender equity.

iii. *Address gender bias in recruitment and promotion.* Attracting and retaining women in the manufacturing sector involves addressing conscious and unconscious bias in recruitment and promotion. Measures in this direction include the use of inclusive language in job advertisements, diverse interview panels and candidate pools, and mentoring opportunities.[37]

For example, drawing from her experience in law, another male-dominated field, Lucy Pringle recommends setting diversity targets (e.g. 30%) for candidate pools. She explains: 'There is no obligation to select a female candidate for the job, but by simply ensuring that your candidate pools include women, you challenge yourselves to start with the best pool of talent and, in turn, help [to] expose women to opportunities and help [to] build their internal profile and CV.'[38]

BOX 3. SIEMENS: A COMPREHENSIVE APPROACH TO GENDER EQUITY

'Gender equity isn't a women's issue, it's a business issue. We need a cultural shift, and we need systemic change. And we need to do it together. Everyone. In partnership.'

Siemens, Advancing gender equity

Siemens acknowledges the pressing issue of gender under-representation and has adopted a comprehensive approach to advancing gender equity. In 2020 the company made a commitment to achieve a minimum of 30% of women in top management and gender parity in entry-level positions by the end of fiscal year 2025.

Their diversity and inclusion activities range from increasing the visibility of female role models, conscious inclusion training, networking opportunities, a women's leadership programme and flexible working. Below we present some examples:

Inspiring the next generation

The #BeingSeen video series features remarkable female role models within Siemens, nurturing a sense of belonging, purpose and inspiration for the next generation of women. Siemens is also part of the UK Apprenticeship Diversity Champions Network (ADCN), which champions apprenticeships and encourages people from diverse backgrounds to consider apprenticeship opportunities.

(continued on the next page)

Measuring progress

Siemens has developed an Equality, Diversity, and Inclusion (ED&I) Standard that places as much importance on ED&I as it does on other business priorities. This involves formulating a strategy and setting targets. Through peer-review assessments of its business units, Siemens obtains independent and objective perspectives on their baseline and progress, enabling each unit to develop a roadmap of actions for further advancement.

Addressing unconscious bias

Their Conscious Inclusion programme equips individuals with crucial skills such as speaking up, active listening, and providing and receiving constructive feedback. This 12-week programme encourages ongoing behaviour change through a 12-week series of inclusion nudges.

Fostering networking

Launched in 2020, Siemens' women's network serves as a virtual space for female employees to share experiences and provide peer support. Regular meetings explore a variety of topics, with sessions hosted by experts within the company, making the events engaging and thought-provoking.

Breaking the glass ceiling

The Women into Leadership programme offers group and one-on-one coaching, tailored events and mentorship from senior individuals across a 6-month period. This initiative aims to overcome common barriers to women's career progress. In addition to coaching each individual, the programme also focuses on the role of their line manager in career progression and provides support for the corresponding managers. In 2022 Siemens also started advertising all manager roles as being available part-time to encourage a wider diversity of candidates to apply.

By implementing these initiatives and fostering a culture of inclusivity, Siemens is at the forefront of driving meaningful change and paving the way for gender equity in a traditionally male-dominated industry sector.

Source: Siemens (2017). Engineering a progressive future for women at Siemens; Siemens. Advancing gender equity; Siemens. Gender Pay Gap Report 2022; Siemens. Women's Network.

iv. *Support work–life balance*. Providing flexible working arrangements, such as adjusting working hours or working from home, and actively encouraging all employees to make use of these arrangements, are key elements of fostering work–life balance. Box 4 features the case of Almond Engineering and how it embarked upon the journey of flexible working.

Drawing upon the work done by Flexibility Works, a consultancy firm that supports employers to develop more flexible workplaces, Box 5 explains what flexible working is, its benefits and five practical tips for manufacturers interested in creating more flexible forms of working.

Organisations can also support work–life balance through the implementation of return-to-work policies, promoting the uptake of paternity leave, establishing care-related leave for adult dependents, facilitating breastfeeding support in the workplace, offering on- or near-site subsidised childcare, and providing dedicated spaces for employees with caregiving responsibilities to connect and share experiences.[39,40]

v. *Share and recognise examples of best practice.* Creating spaces for organisations to share effective practices that address gender gaps and recognising outstanding achievements through awards are also essential steps towards promoting gender equality in manufacturing. This may also include engaging with suppliers that have demonstrated outstanding practices.

BOX 4. ALMOND ENGINEERING: LEADING THE WAY IN FLEXIBLE WORKING

Located in Livingston, Scotland, Almond Engineering has a broad offering, including design, precision machining, repairs, fabrication and welding, catering to both one-off prototypes and small-to-medium-volume batch work. Originally established in 1979 as a mould-maker, the company gradually expanded its expertise to encompass a wider array of solutions.

In January 2020 Almond Engineering embarked on its journey into flexible working, shortly before the onset of the COVID-19 pandemic. The primary objective was to create an optimal work environment and adaptable arrangements for its staff. The changing work patterns of its customers also acted as a driving force behind embracing flexible working practices, especially with companies finishing earlier on Fridays.

In its search for flexible working examples in the industry, it could not find any. But that did not stop Almond, which decided to go ahead and explore different options. Finally, the company settled on a flexi-time arrangement: employees would work their core hours from 9:00 to 15:00 between Monday and Thursday, and until 12:30 on Fridays, completing a total of 39 hours per week. This lets employees start anytime between 7:00 and 9:00 AM and finish between 3:00 and 5:00 PM, giving them more flexibility in their schedules.

The transition involved modifying organisational rules, and, although there was some initial resistance, the results after a year were overwhelmingly positive. Michelle Quinn, Managing Director of Almond Engineering, explains: *'It worked really well; now everyone utilises it in some way, and it has only improved over the years.'* The introduction of flexible working positively impacted the work–life balance among staff.

'We have lots of people who want to get an early start, so they'll be here working at seven, and we have others who prefer to drop their kids off at school and arrive at nine. Some need to pick up their children after school or manage their commutes, so they leave at three. We even have golfers who enjoy the sunny days, finish early, and head out for a game.'

Almond Engineering's experience with flexible working has been so successful that it eagerly shares its story with others in the industry. Michelle Quinn confidently states: *'People who believe that flexible working does not work in manufacturing, we have tried it for the past three years and it has worked great.'*

To hear first-hand experiences from Michelle Quinn, Managing Director, and Darren Jamieson, CNC Five Axis Miller, about their journey with flexible working hours, watch the video prepared by Flexibility Works.

Almond Engineering is a remarkable model of how flexi-time can attract talented people and foster a more enjoyable work environment in the manufacturing sector.

Source: Interview with Michelle Quinn, July 2023; Almond Engineering. About; Flexibility Works (2023). Employer Case Study: Almond Engineering.

BOX 5. FLEXIBLE WORKING IS THE FUTURE OF WORK

Flexible working is here to stay and will continue to change working places in the future as digital technologies enable remote work and the automation of tasks. Previously, it was believed that flexible working was incompatible with jobs involving machine operatives and production lines. However, manufacturing environments are undergoing transformative changes, offering greater flexibility to workers. This change is contributing to improved work environments and enhancing the ability to attract and retain talented individuals.

The COVID-19 pandemic acted as a catalyst for positive change in flexible working practices. While some employees may currently experience reduced flexibility compared to the pandemic period, overall there has been an upswing in the adoption of flexible working arrangements. According to the *Flex for Life 2023* report, a survey analysis of flexible working in Scotland, 82% of Scottish adults have, or want to have, flexible working, compared to 73% before the pandemic. In addition, most Scottish employers (70%) expect to maintain or increase flexible working opportunities in the next 12 months.

What is flexible working?

Flexible working looks different depending on the person (and their life stage), their role and the organisation where they work. However, overall, it involves providing employees with some **choice and control over where, when or how much** someone works. For example: being able to choose to work from home or some other location than your employer's premises, varying the length of your working day within the week or month, varying start or finish times, taking breaks for personal reasons during working hours without needing to ask permission or using your employer's hybrid working policy.

For shift workers or frontline, on-site or customer-facing roles, this might include: the ability to swap shifts, self-rostering, the ability to adjust hours occasionally, and making small adjustments to start and finish times. It might also include having predictable shifts and input into shift patterns.

It can be informal or formal (in a contract), or a mix of both, and **it does not include things like zero-hours contracts, over which you have no control.**

What are the benefits of flexible working?

According to research conducted by Flexibility Works in Scotland, the benefits of flexible working **for employers include: employee retention, increased diversity, productivity growth, improved employee engagement, reduced sickness absence, and attraction of a wider pool of talent.**

Flexible working is the second most important factor in a job search, after salary. In Scotland, four in ten people who are thinking about changing jobs consider work–life balance to be important.

(continued on the next page)

For employees, the benefits of flexible working include: a **better work–life balance, improved wellbeing (mental and physical), reduced costs in care services and transportation, increased opportunities to participate in the labour market, and the ability to progress in their careers.**

Flexible working has a significant impact on certain population groups who would otherwise face the choice of leaving work or accepting precarious arrangements. This is particularly true for individuals with disabilities or long-term health conditions, as well as mothers, single parents and couples raising children.

In Scotland, being a father increases the desire of men for greater flexibility around location. Fathers are more likely to prefer working from home and hybrid working. Mothers, in comparison, are more likely to seek part-time hours, flexible start and finish times, and term-time working. However, for women, opting for reduced hours is often influenced by gendered divisions of care and domestic work. This suggests that women encounter greater trade-offs between family obligations and career advancement compared to men.

Five practical tips for manufacturers

Flexibility Works, a consultancy firm that supports employers to develop more flexible workplaces, has five practical tips for manufacturers to create more flexible ways of working:

1. **Advance notice, reliable and predictable shifts.** If you can plan ahead and give people more notice of their shifts, including specifics about location if this varies, and have some regular patterns, it gives employees more control over the rest of their life. They can book medical appointments, arrange childcare or just know when they can go for swim or take the dog for a walk.
2. **Direct rota input for employees, including swaps**. Make it simple for people to select and change shifts. There are good apps that can help teams to communicate clearly, view rotas and swap shifts quickly, as well as email and group messaging.
3. **Flexible hours and locations**. By offering flexibility in working hours and locations, you create opportunities for a wider range of individuals to participate, including parents, caregivers and people with disabilities. Flexible arrangements may involve part-time roles, compressed hours (doing fewer, longer days) or a twilight shift, among others. Even a small amount of remote work, where feasible, can greatly benefit individuals with busy schedules.
4. **Know your team.** Take the time to understand the personal circumstances of your team members. This knowledge allows you to create shift patterns that align better with their needs, even if it might not be possible to accommodate everyone's preferences all of the time. By considering individual circumstances, you demonstrate a commitment to supporting your team members in achieving a healthy work–life balance.
5. **Communicate effectively and empathetically.** Ensure that employees are aware of the support and benefits available to them within the company. Encourage and facilitate the use of leave entitlements and provide clear information on available resources. Managers who communicate effectively and empathetically with their teams foster a positive work environment and encourage open dialogue.

For more information about Flexibility Works, please visit: flexibilityworks.org

Source: Flexibility Works (2023). Flex for Life 2023. Gallagher, L. (2023). Why flexible working is part of the 'future of work' for manufacturers. InterAct Blog.

Recommendations for government organisations include:

i. *Follow a gender-transformative approach in government support programmes.* This may involve: (i) setting targets for the share of businesses supported and owned by under-represented groups, including women; (ii) including women business organisations in the design of campaigns for disseminating government programmes; (iii) understanding the specific challenges that women face and the barriers to accessing support; and (iv) collecting gender- and ethnic-disaggregated data on participants of government programmes. Box 5 presents examples of how organisations are following gender-transformative approaches in digital manufacturing.

ii. *Support research on gender equality and gender-disaggregated data collection*. We cannot address what we do not know. A critical gap exists in gender-, ethnic- and disability-disaggregated data, hindering comprehensive analysis and targeted interventions. Bridging this gap requires providing guidance to businesses on data collection[41] and allocating funding to expand survey samples and encourage the analysis of available and emerging data. Supporting new research is equally important. Several key knowledge gaps remain, such as understanding gender differences in the adoption of digital technologies in manufacturing and how the digital transformation is changing the gender balance in the industry.

iii. *Incentivise gender equality in research and innovation teams.* Promoting diversity and inclusion in research and design is crucial to ensure that everyone can benefit from innovations, such as digital technologies. For example, to promote institutional change, the European Union has included having a gender equality plan as an eligibility criterion to gain access to Horizon Europe. Gender balance among researchers involved in projects is also included as an assessment criterion for awarding funding.[42]

   Innovate UK KTN is working to promote diversity and inclusion innovation. Its efforts include guidelines for inclusive design; its Women in Innovation Programme to increase access to capital and mentoring to women innovators and promote new role models; and an 'inspiring diversity manufacturing speaker list'. By completing a form on its website, speakers from diverse backgrounds who associate themselves with manufacturing innovation can register as guest speakers.[43]

iv. *Adopt a lifelong learning approach in training and education programmes.* Because of gender stereotypes and gendered division of unpaid care work, women are less likely than men to follow a linear path in their careers. Women are more likely to opt for female-dominated fields early in their careers and to take career breaks to support their families with caring duties. Thus, creating opportunities for women to develop skills that are relevant to manufacturing businesses, at different stages of their lives, will contribute to increasing their participation in the manufacturing sector.[44]

v. *Ensure an enabling environment for improving gender balance in caring responsibilities.* This may involve cross-ministerial coordination and collaboration with industry associations to develop and enforce policies that support flexible working, paternity leave, returning to work, and child and adult social-care provision.[45,46]

BOX 6. A GENDER-TRANSFORMATIVE APPROACH IN SMES DIGITALISATION

The challenge

In the UK women own only 15% of manufacturing SMEs, and this gender gap is not being systematically addressed in business support services, in the UK or elsewhere. Several entrepreneurship programmes have emerged to address gender gaps in tech sectors; however, gender-sensitive or gender-transformative approaches are often absent in digital manufacturing programmes.

What can be done?

Preferential access to digital skills training. The European Institute of Innovation & Technology (EIT) Manufacturing provides preferential rates for women to participate in training courses in digital manufacturing.

Gender-balance targets and inclusive campaigns. The Inter-American Development Bank recently implemented a gender-sensitive approach in a loan to assist Caribbean MSMEs. The bank set targets for the percentage of women-owned businesses to be supported through loans and advisory services. Additionally, it provided funding for campaigns aimed at reaching out to businesses operated or owned by women.

Inclusive digital technology. Vinnova, the Swedish Innovation Agency, has launched a call for projects to develop tools and methods to ensure gender equality in the digital transformation of the Swedish industry. This may include: frameworks for analysis, new methods for risk analysis, and new methods and tools for promoting gender equality in recruitment, among others.

Source: BEIS (2021). Longitudinal Small Business Survey 2021; EIT (2023). Online Short Course: Digital Manufacturing; Inter-American Development Bank (2022). Caribbean Development Bank will promote Eastern Caribbean MSMEs with IDB support; Vinnova (2023). New tools and methods for gender equality in the digital technology development.

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Appendix A

Occupation	Description
Managers, directors and senior officials	This major group covers occupations whose tasks consist of planning, directing and coordinating resources to achieve the efficient functioning of organisations and businesses. Working proprietors in small businesses are included, although allocated to separate minor groups within the major group. Most occupations in this major group will require a significant amount of knowledge and experience of the production processes, administrative procedures or service requirements associated with the efficient functioning of organisations and businesses.
Professional occupations	This major group covers occupations whose main tasks require a high level of knowledge and experience in the natural sciences, engineering, life sciences, social sciences, humanities and related fields. The main tasks consist of the practical application of an extensive body of theoretical knowledge, increasing the stock of knowledge by means of research and communicating such knowledge by teaching methods and other means. Most occupations in this major group will require a degree or equivalent qualification, with some occupations requiring postgraduate qualifications and/or a formal period of experience-related training.
Associate professional occupations	This major group covers occupations whose main tasks require experience and knowledge of principles and practices necessary to assume operational responsibility and to give technical support to Professionals and to Managers, Directors and Senior Officials. The main tasks involve the operation and maintenance of complex equipment; legal, business, financial and design services; the provision of information technology services; providing skilled support to health and social care professionals; and serving in protective service occupations. Culture, media and sports occupations are also included in this major group. Most occupations in this major group will have an associated high-level vocational qualification, often involving a substantial period of full-time training or further study. Some additional task-related training is usually provided through a formal period of induction.
Administrative and secretarial occupations	Occupations within this major group undertake general administrative, clerical and secretarial work, and perform a variety of specialist client-orientated administrative duties. The main tasks involve retrieving, updating, classifying and distributing documents, correspondence and other records held electronically and in storage files; typing, word-processing and otherwise preparing documents; operating other office and business machinery; receiving and directing telephone calls to an organisation; and routing information through organisations. Most job holders in this major group will require a good standard of general education. Certain occupations will require further additional vocational training or professional occupations to a well-defined standard.
Skilled trades occupations	This major group covers occupations whose tasks involve the performance of complex physical duties that normally require a degree of initiative, manual dexterity and other practical skills. The main tasks of these occupations require experience with, and understanding of, the work situation, the materials worked with and the requirements of the structures, machinery and other items produced. Most occupations in this major group have a level of skill commensurate with a substantial period of training, often provided by means of a work-based training programme.
Caring, leisure and other service occupations	This major group covers occupations whose tasks involve the provision of a service to customers, whether in a public protective or personal care capacity. The main tasks associated with these occupations involve the care of the sick, the elderly and infirm; the care and supervision of children; the care of animals; and the provision of travel, personal care and hygiene services. Most occupations in this major group require a good standard of general education and vocational training. To ensure high levels of integrity, some occupations require professional qualifications or registration with professional bodies or relevant background checks.
Sales and customer service occupations	This major group covers occupations whose tasks require the knowledge and experience necessary to sell goods and services, accept payment in respect of sales, replenish stocks of goods in stores, provide information to potential clients and additional services to customers after the point of sale. The main tasks involve knowledge of sales techniques, a degree of knowledge regarding the product or service being sold, familiarity with cash and credit handling procedures and a certain amount of record keeping associated with those tasks.

Occupation	Description
	Most occupations in this major group require a general education and skills in interpersonal communication. Some occupations will require a degree of specific knowledge regarding the product or service being sold but are included in this major group because the primary task involves selling.
Process, plant and machine operatives	This major group covers occupations whose main tasks require the knowledge and experience necessary to operate and monitor industrial plant and equipment; to assemble products from component parts according to strict rules and procedures and to subject assembled parts to routine tests; and to drive and assist in the operation of various transport vehicles and other mobile machinery. Most occupations in this major group do not specify that a particular standard of education should have been achieved but will usually have a period of formal experience-related training. Some occupations require licences issued by statutory or professional bodies.
Elementary occupations	This major group covers occupations which require the knowledge and experience necessary to perform mostly routine tasks, often involving the use of simple hand-held tools and, in some cases, requiring a degree of physical effort. Most occupations in this major group do not require formal educational qualifications but will usually have an associated short period of formal experience-related training.

Source: UK Standard Occupational Classification (SOC) 2020.

About us

Cambridge Industrial Innovation Policy (CIIP) is a global, not-for-profit policy group based at the Institute for Manufacturing (IfM), University of Cambridge. CIIP works with governments and global organisations to promote industrial competitiveness and technological innovation. CIIP offers new evidence, insights and tools based on the latest academic thinking and international best practices. This report was delivered through IfM Engage, the knowledge transfer arm of the Institute for Manufacturing (IfM), University of Cambridge.

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