

# 'Making Things Work'

## Public Opinion of UK Manufacturing 2023

Future of Work - University of Strathclyde

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## Research Programme

**InterAct** (Ref: ES/W007231/1) is funded by **UKRI ESRC** as an investment under the **Made Smarter Innovation (MSI)** challenge. InterAct seeks to “pioneer human insight for industry” and is a call to arms for academics from the social sciences to support the innovation and diffusion of digital technologies that will result in a stronger, more resilient UK manufacturing industry. Working alongside other partners within the wider Made Smarter community, the long-term vision is to build a strong, vibrant, interdisciplinary community to support the digitalisation of UK manufacturing.

The InterAct team is taking a multi-stakeholder approach to understanding industrial challenges that UK manufacturing is facing and developing practical solutions through collaborations and knowledge transfer. As a part of InterAct's core research programme, the **Future of Work** project aims to examine impact of digital technologies in manufacturing on job satisfaction, innovation and productivity.

We hope you find this report insightful and welcome any questions and feedback you may have. You can reach the team at [info@interact-hub.org](mailto:info@interact-hub.org)

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## Executive summary

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The primary aim of this survey is to better understand public perceptions of the UK manufacturing industry and jobs, and what factors shape their views. We hear much about the ongoing 'war for talent', high numbers of unfilled vacancies and skill shortages in UK manufacturing. Previous research raises concerns that the older industrial legacy that surrounds manufacturing may make the sector less desirable to jobseekers. However, new manufacturing digital technologies and the need for greater workforce digital skills may help address some of the negative images associated with the working in the sector and offer better job quality. This should help manufacturers better compete for emerging Gen Z talent and extend their reach into under-represented groups in such as women and minorities.

Our findings show that like previous research in the UK and US, the public still attach a high value to the manufacturing sector, describing it as 'essential' for the supply of goods, innovation, prosperity, industrial reputation, living standards, national security, and as a source of local jobs. While most people feel positive about UK manufacturing, we have identified a weakness in terms of the visibility of the sector: only between a quarter and a third of people saw anything in the media about manufacturing over the past twelve months.

Despite largely positive associations, public understanding of manufacturing work and jobs as an old-fashioned industry provides a strong contrast with the emerging worlds that utilise new digital manufacturing technologies. Negative associations reflect the content of jobs and the deeper industrial legacy of manufacturing work: dominated by perceptions of low pay, job inflexibility, low status jobs and the feeling that manufacturing conveys an old-fashioned industrial image. This suggests that emerging new manufacturing technologies have not yet entered the public awareness sufficiently to counter some of the older industrial legacies associated with the sector. Nearly a fifth of our sample associate manufacturing with poorly paid work.

People's images of the sector feed into their opinions about the quality of manufacturing jobs. Job quality (and why people would choose a new job) is largely driven by pay, wellbeing and flexibility, a desire for clean and safe working environments, contractual security and stability, and employee voice. While these priorities also largely reflect what those currently working in UK manufacturing want from jobs, job quality feels very different for different groups. Under-represented groups in UK manufacturing such as women and Gen Z are more service oriented, and people and value focused. For example, employee voice is the motivator for Gen Z groups, while wellbeing matters more to women than men.

There are reasonable amounts of job quality in manufacturing roles. People recognise the type of work and skills required in UK manufacturing: purposive work with high levels of technical skills. They mostly think that manufacturing jobs come with EDI values and practices, offer career development opportunities, occur in clean and safe working environments, and provide contractual stability and security. However, manufacturing jobs are seen as relatively 'weaker' in terms of pay, employee wellbeing and flexibility, and employee voice. While those currently working in UK manufacturing are more positive about job quality than others, when we compare what people in this group are looking for in jobs and what they think is delivered by the sector, there are some 'gaps' in quality in terms of the above factors.

Nearly two-fifths of our sample would encourage their significant others to uptake jobs/careers in UK manufacturing. Most are uncertain, while just over one in ten would not do so, largely because of the (aforementioned) negative perceptions of manufacturing.

UK manufacturers may need to take positive actions to improve messaging around the quality in jobs and careers. The more people are familiar with manufacturing through direct experience, their social networks, or what they knew about jobs/careers in the sector, the greater their likelihood of feeling positive about the sector, being favourable about job quality and encouraging others to pursue jobs/careers in UK manufacturing. Unfamiliarity (and inaction on creating greater awareness of jobs/careers in the sector) has consequences: women (who are in general less familiar with manufacturing jobs than men), feel less positive about the sector and are more uncertain about job quality in these industries and more apprehensive about encouraging others to uptake manufacturing jobs/careers. Women are a key target group in terms of awareness-raising and getting more positive messaging across about the industry and job quality in UK manufacturing.

Like previous work in the UK and US, the UK public positively think that tomorrow's manufacturing jobs will be more advanced and hi-tech. They think that there will be less environmental waste but are more uncertain that there will be less repetitive (or more creative) work as new manufacturing technologies continue to replace more 'dull, dirty and repetitive' manual tasks. Although people believe that more leadership diversity will lead to more innovation, they don't necessarily think that 'diversity' is just about having more women and minorities in these roles. Just over a third of respondents are sceptical about whether there will be more representation from these groups in leadership positions within the sector going forward. We find that those who are more familiar with manufacturing and those in Gen Z groups are more optimistic about future work and jobs than others.

People familiar with UK manufacturing can identify a range of new manufacturing technologies that will impact future jobs and careers in the sector. However, while people as a whole think that these technologies will have a positive impact on skills and largely make manufacturing jobs more interesting and rewarding for workers, (of concern) just over a quarter think that they will have a destructive impact on the numbers of jobs in the sector. The link between new technologies and their impacts on the numbers of jobs is a divisive issue, with potentially negative or uncertain implications for workers job stability and security unless these are addressed by employers and industry stakeholders through clear communication about their benefits for upskilling workforces and creating new jobs. Our findings mirror recent wider UK public opinion and media speculation on these issues.

Linked to technological developments in advanced manufacturing is the issue of how employers attract more digital talent into the sector, particularly from highly educated younger demographics and from groups such as women and minorities. The largest positive factor for attracting young digital talent concerns the promotion of wellbeing practices. Young people are perceived as less 'threatened' by digital technologies, linked with greater innovation but thought to be less aware of digital careers in manufacturing workspaces. There is also a recognition that manufacturing employers may need to change their practices to attract more women and minorities into jobs. Working practices and environments need to adapt to become more inclusive.

There are several tried and tested pathways into manufacturing careers. The most popular is internships/apprenticeships and directly hearing the views of other young people on their experience of working in manufacturing. Other prominent factors concerned on-campus recruitment, certification and taking new advanced manufacturing technologies on the road and into schools. Both these latter pathways offer the potential to directly reach out and engage with new younger STEM audiences and otherwise harder-to-reach social groups.

Going forward, we want to highlight four key messages for employers and industry stakeholders: keep talking up the value of the manufacturing sector; images of manufacturing work reflect blue-collar jobs and the older industrial legacy of the sector is not that attractive. These images feed into perceptions of jobs quality and employers need to identify and reflect people's job needs in recruitment and retention strategies and continue to tackle perceived deficits in job quality; new technologies are emerging and the digital future looks bright but workforces need to be positively engaged with ongoing changes to skills and jobs; and finally, engage, reach out and develop good people practices that will help to attract under-represented groups and address talent gaps.



## Introduction

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The primary aim of this survey is to better understand UK public perceptions of the manufacturing industry and jobs, and what factors shape these views and opinions. We are interested in a range of issues:

- whether people still value (and how positive they feel about) manufacturing in the post-industrial economy, and their awareness of the sector in the media;
- what people associate with manufacturing work, and what qualities they are looking for from jobs in the current labour market that employers need to provide to attract talent;
- the perceived quality of manufacturing jobs for those currently working in the sector and whether people would encourage others to enter the sector?;
- how new manufacturing technologies are likely to change future jobs and careers in the sector; and
- how can the sector best attract emerging young and 'untapped' talent?

These issues are important for several reasons.

### *UK labour markets, the 'War on Talent' & job quality*

The current UK labour market is characterised by ongoing labour/skill shortages against the backdrop of a decline in the real value of wages since the financial crash of 2008 (TUC 2023) and ageing population demographics. UK manufacturers – like many of their international competitors – are currently engaged in the 'war for talent': generated by the shortages in skills and labour arising from the global Covid-19 pandemic (Allas 2023), and as new digital manufacturing technologies create greater demands for digital skills. Post-pandemic shifts in the labour market include the 'great resignation' as older skilled workers retired earlier or reduced their hours to find better job quality and work-life balance (De Smet et al 2022). Like hospitality and retail, manufacturing – an essential industry during Covid-19 – has been hit particularly hard by the post-pandemic 'great resignation' (Lawson 2023). These factors, coupled with ongoing concerns about Gen Z's lack of commitment to the world of work, mean that manufacturing employers struggle to retain and replace the skills of older workers, and attract those younger workers with skills and interests in digital technologies.

If people's expectations of employers and demands for job quality have changed (in more competitive labour markets) it is important to understand what these expectations currently are alongside their perceptions and views of what manufacturing jobs are offering. This is especially critical for those currently working in UK manufacturing and in younger generations who have recently entered the labour market and are characterised as the first digital 'native' generation acclimatised to the virtual worlds of these new technologies. Gen Z are interesting not just because of their future labour force potential per se but because their 'native' digital lifestyles, interests and skills are consistent with the needs of a manufacturing sector that uses new digital technologies, robotics, and AI to regulate production.

Job quality is also important for women, who comprised 29% of UK manufacturing workforces in 2021 (Make UK 2021). There is a strong gendered division of labour in UK manufacturing. Not only are there fewer women working in the sector, but those that do have proportionally less

influence in the higher levels of company decision-making. This reflects wider issues that affect women in labour markets: 'strong' gender stereotyping and a disproportionate share of domestic caring roles (added to the 'fixed' ways in which manufacturing production cycles are often 'inflexibly' structured). Barriers into UK manufacturing may include not just a lack of encouragement into the sector (even through STEM programmes) but shrinking 'pipeline' opportunities to progress careers because of a lack of non-inclusive workplace cultures, settings and the absence of practices such as flexibility in working patterns that can accommodate the sometimes-fragmented working hours and careers of women with their greater domestic caring roles and responsibilities (Equate Scotland 2023, MSP 2023, Wellner et al 2021).

Our study addresses some of these issues. It offers UK manufacturing industry representatives and stakeholders a means of understanding and tackling some of the conceptions (and misconceptions) of working in UK manufacturing, areas where job quality may be strong and weak, and a route to refocus their efforts on attracting and retaining people for contemporary and future manufacturing careers.

### *New manufacturing technologies & people*

Alongside the transition to environmental sustainability, new advanced technologies in manufacturing are typically seen as offering ways of improving innovation, product quality, production efficiency and reducing waste (Make UK 2023a). There are a relatively wide range of newly emerging manufacturing technologies, many of which are likely to reconfigure jobs, skills, and workforces in some quite fundamental ways in the very near future. As such, through the ongoing elimination of dirty, dull and repetitive manual tasks, and the substitution of mid-level technical skills, new technologies offer new opportunities for manufacturing: to rebrand or 'recast' the manufacturing jobs, tasks, and skillsets needed for the future, moving away from some of the 'dirty work' histories associated with the sector into 'cleaner' technologies and settings; and to better reach (and meet the needs of) new digitally aware audiences such as women and highly educated young people.

Advanced manufacturing technologies offer opportunities to reshape interest in the sector as a career of 'choice' with future skills likely to be based on cognitive, social, emotional, and technological skills (Bughin et al 2018) around AI and machine learning, project management and business development (World Economic Forum 2023). There is a strong link between diversity and innovation, and new technologies should help create more opportunities for women to enter the sector (IfM 2020). However, without meaningful changes by more employers towards more inclusive and flexible working settings and practices, the talent pipeline for under-represented groups will probably continue to 'leak' (Wellner et al 2021, Field et al 2023). We also know that good people engagement and wellbeing practices often distinguish more productive employers from others (Oswald et al 2015). Very simply, where people feel connected to their work and they are valued and supported, they tend to perform better, invest more discretionary effort, and stay with companies (Findlay et al 2017).

There are a relatively wide range of newly emerging manufacturing technologies and how they will shape future workforces is (as yet) emerging and unclear. We have already seen moves towards the development of high-value Industry 4.0 SMART factories in Europe and elsewhere and there is an active post-pandemic debate around 'reshoring' to make supply-chains more resilient to cycles of consumer demands.

What is apparent, however, is that SMART factories will likely employ significantly fewer people in manual and frontline production jobs/tasks compared to traditional manufacturing enterprises: most probably, adversely affecting those in less qualified groups who in the past were able to find 'easy' job opportunities in manufacturing industries (Economist 2023).

While manufacturers will still need people to complement the technologies in areas that are difficult or too 'risky' to automate or synthesise through generative AI, they will probably change the career opportunities for those currently working in UK manufacturing. This can be mitigated by upskilling people and tasks into new roles, or by moving across into more manual work in other sectors such as hospitality, retail or health and social care. Despite the historical lessons of previous technological changes showing that new technologies augment skills and create more jobs than they eliminate (Lund & Manyika 2017), we've witnessed significant Government and media attention being directed towards the wider threat to jobs and skills posed by automation, robotics, and generative AI. Do fears about new digital technologies resonate with the UK public and how does this influence what people think future manufacturing jobs and careers will be like as advanced manufacturing becomes more the norm?

### *Previous research & opinions of manufacturing work*

Finally, this study is topical and relevant because of the relative absence of data on public perceptions of working in UK manufacturing work. A major survey of UK public opinion on manufacturing was conducted by the Institute of Manufacturing (IfM) over a decade ago (Livesey 2012). This detailed the change in UK government policy concerns as successive governments witnessed a decline in manufacturing jobs (offshoring) and the GDP-share of the sector in the early 2000's - the rise of the 'post-industrial' economy dominated by the service sector. However, since the financial crash of 2008, successive governments placed a greater value on manufacturing being an essential part of rebalancing the UK economy as a key driver of innovation and growth.

There are a few main messages for the sector outlined by Livesey (2012) who provides a detailed summary of previous academic and 'grey' literature, research, and commentary on UK public opinion and Government policy. On the positive side, the UK public appear to value the sector and think of it as highly technical and skilled but have concerns about levels of pay and job security. The 2012 survey documents issues that are as relevant today as they were over a decade ago: namely that there is an established policy narrative amongst UK industry stakeholders that there is an image problem with UK and US manufacturing that needs to be 'fixed' (Livesey 2013). This is driven by concerns in the UK (and the US) about negative public perceptions of the sector: especially among young people) and what this means for attracting and retaining skilled workers, sustaining industrial productivity, and generating future growth. Manufacturing industries come with some powerful industrial images and historical legacies about the types of work that is done in the sector. Despite the present-day focus on innovation and new advanced manufacturing technologies, US studies highlight the persistence of images of dirty, boring, dead-end factory jobs, alongside 'insecure' work created by the offshoring of jobs into economies with cheaper labour costs. In this study, we explore these images of UK manufacturing jobs and work.

One potential impact of negative images of working in the UK manufacturing sector is that fewer young people are interested in working in these industries. This applies especially to

those in more highly educated groups with high-level digital skills who may instead be more attracted to work in software, financial services or in other areas of the economy with better (perceived) working conditions and job quality than manufacturing.

In the 2012 survey, however, (and through recent iterations such as Make UK's 2018 and 2023 studies) there is very little asked about the attraction of manufacturing jobs and careers. Nor is there much insight about emerging (some post-pandemic) labour market issues such as health and wellbeing (and flexibility), workforce diversity (and the relative absence of women and those from ethnic minorities in leadership positions), sustainability and moves towards 'net zero', or the perceived threat posed by new advanced technologies to jobs in the sector. In modern labour markets there are significant indications of the importance to women and younger age groups of an employer's image, brand, reputation, prestige, mission, vision, and values. These factors matter in recruitment and retention, and an employer's values may be critically important in competitive labour markets with restrictions on the supply of talent. Potential recruits and employees want to know about an employer's identity and values: and how these resonate through their products, people, practices, and culture.

While earlier UK public opinion on manufacturing largely mirrors similar work in the US, by contrast, the US Manufacturing Institute (NMI) has conducted a regular series of public opinion surveys on US manufacturing - in association with Deloitte - since 2017 (Giffi et al 2017, Wellner et al 2022). These US surveys offer a more wide-ranging job and career-focused insight into public perceptions of manufacturing as these industries try to move forward, 'recast', and refresh their image as a sector of choice for jobseekers. These surveys benchmark changes in US public perceptions: using some standard questions but recent work has also looked at public awareness of new manufacturing technologies. The quality of the US survey work and our desire to offer a current picture of opinion on UK manufacturing jobs was a major factor in approaching this survey in a way that way that draws more similarities with US studies than previous work in the UK.



## Method

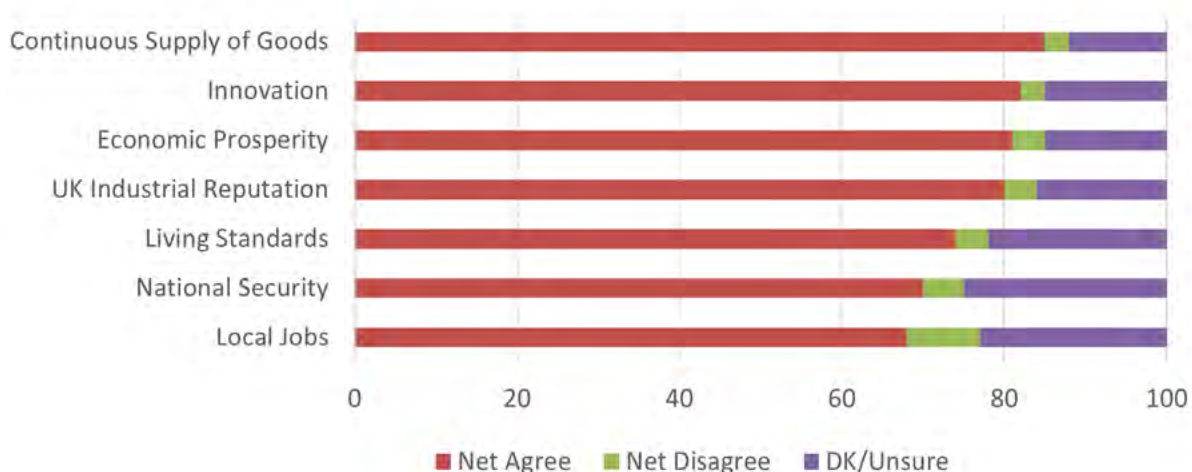
Our study is based on the results of a nationally representative online survey of 2107 people across the UK conducted in March 2023. Our target sample for the survey is the working and economically active population aged 18-55 years of age. By 'economically active' we mean all those who are currently working (full or part-time) and who, if they are not directly in jobs, intend to return to labour market in the next few years. This ensured that we captured the views of those in full-time education and people (mostly women) in domestic caring roles. We did not want to focus on the 'retired' because their views are less directly relevant to the issues we explored in our study. Although 'retirement' in the UK isn't age-related, and many over-55's are also economically active, for the purposes of this study, our attention was solely focused on those in early, mid and later career groups, and what they think about jobs and working in the sector.

In our reporting, where we use the term 'public opinion', this should be understood in terms of the sample parameters outlined above.

In our reporting we selectively draw on previous UK and US studies. We report sub-group variations where appropriate and relevant in terms of national/regional differences across the UK, gender and age. We also look at variations in terms of people's familiarity with the sector and with manufacturing jobs/careers. Previous US studies show that there were important differences of opinion in terms of people's familiarity with working in manufacturing (e.g. Giffi et al 2017, Wellner et al 2022). This measure usually refers to their proximity to manufacturing through their own direct experience of working in the sector and/or their social network contacts with others who do so. However, it should be apparent that people's social networks may not capture all that is familiar to them about manufacturing. Consequently, we also used a measure of how knowledgeable they thought they were with jobs and careers in the sector.

These sub-group differences were important factors in shaping public attitudes towards the sector, the quality of jobs in the sector, and how people look at the future.

Figure 3.1: Net Importance of UK manufacturing (%)



## The importance of UK manufacturing

Like previous UK surveys (and comparable with US), the UK public recognises the importance and value of manufacturing to national and local economies.

As a sector, UK manufacturing is overwhelmingly seen by the UK public as important across several key areas: the supply of goods - workers were classed as 'essential' during the Covid-19 pandemic - innovation, prosperity, industrial reputation, and then, living standards, and national security. Opinions were particularly strong about the 'essential' aspect of UK manufacturing but weaker around the sector's contribution to local jobs.

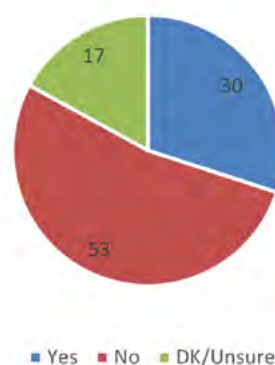
Figure 3.2: Net Importance by Age (%)



The clearest sub-group variations (as we may expect) are in terms of age (Figure 3.2). Except for the UK manufacturing as 'essential', those in the youngest (Gen Z) age groups are consistently weaker in identifying the importance of UK manufacturing across all categories. Age is likely to act as a proxy for people's wider labour market knowledge and experience, as opposed to, their familiarity per se with the manufacturing sector.

## Public awareness of manufacturing

Figure 3.3: Read or Seen Something on UK Manufacturing in Past 12 Months



There are moderate-low levels of awareness among the public of the UK manufacturing sector in media: just under a third told us that they had read or seen something about the sector in the past twelve months (Figure 3.3).

### Public views of the Sector

Unsurprisingly, over two-thirds of our sample told us that they have positive views of UK manufacturing as a sector (Figure 3.4).

While sector value is driven by age, positive views of manufacturing are largely shaped by familiarity. While men have slightly more positive views of the sector compared to women, differences are sharpest in terms of familiarity, especially among those familiar with manufacturing jobs/careers (Figure 3.5). While less than half of those unfamiliar with manufacturing jobs/careers were positive, the more familiar you are, the more likely you are to feel positive about the sector. This suggests there may be considerable work to be done to raise awareness among those unfamiliar with manufacturing jobs/careers about the value of the sector.

Our data suggests that the more intensely industry and policy stakeholders engage in raising awareness of the profile and value of UK manufacturing, the more likely this will sustain the reputation of the sector among the wider UK public.

Figure 3.4: Views on UK Manufacturing (%)

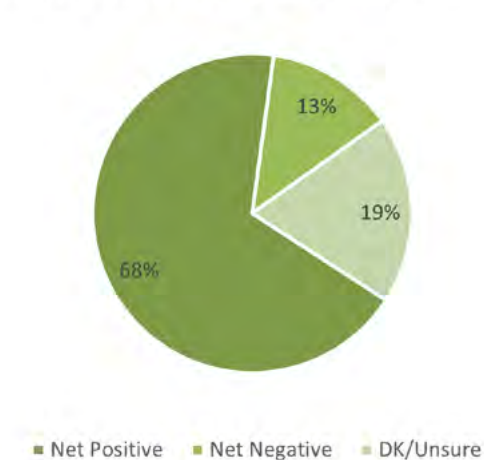
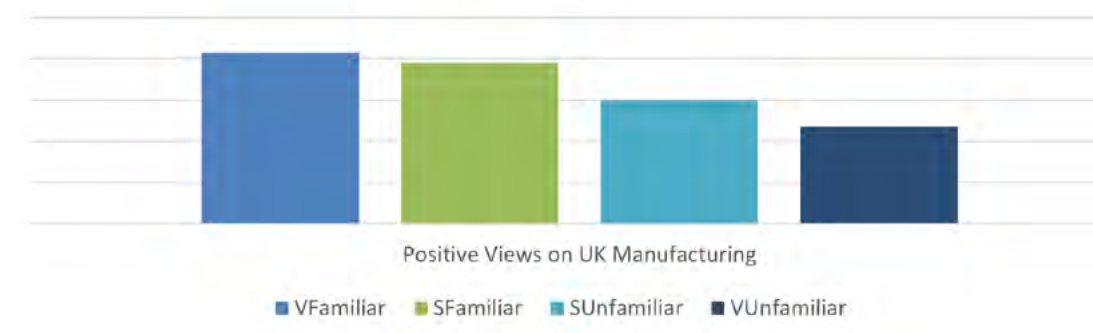


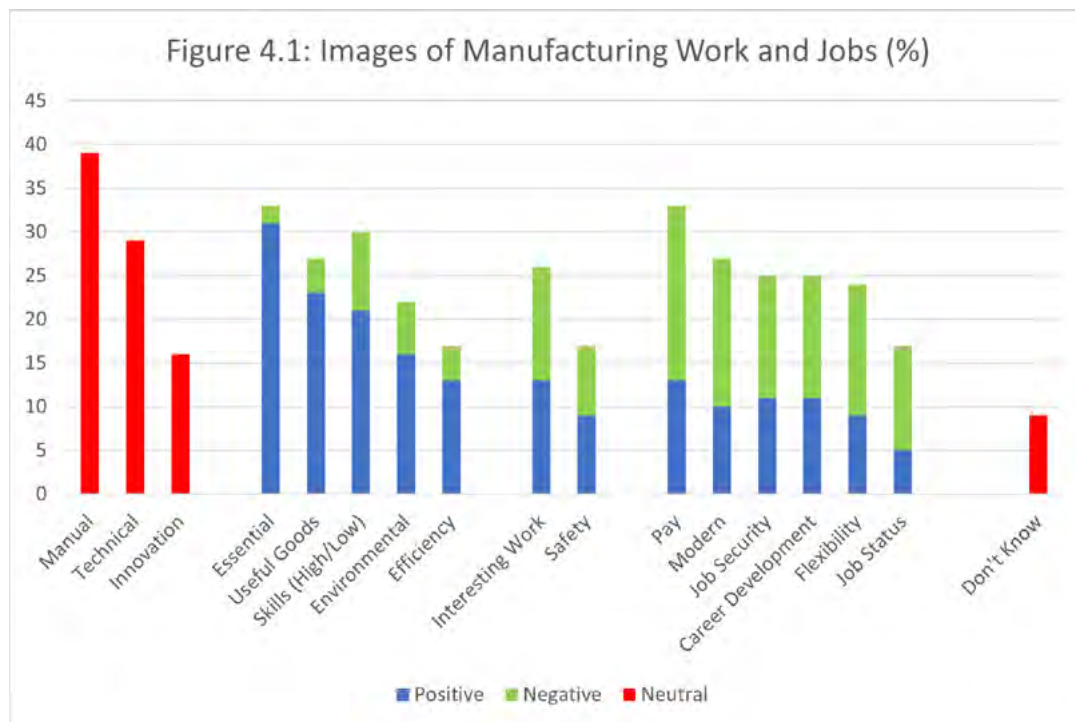
Figure 3.5: Positivity and Familiarity with Manufacturing Jobs/Careers (%)



So, we know that UK manufacturing is largely positively valued but what about the images of the sector and the quality of jobs/careers in manufacturing?

## Images of UK manufacturing work & jobs

We spoke earlier about the image 'problems' around manufacturing work and jobs, and how previous research typically characterises the sector with several positive and negative images. We explored this in more detail with our sample. We gave people the opportunity - before we asked any detailed questions about work and jobs in the sector - to tell us what words or phrases they associate with the manufacturing sector, work, and jobs (Figure 4.1).



The profile of their selected words describes the *type* of work, the *content* of jobs and the wider *images* of the sector. The profile describes manufacturing as 'creative blue-collar': involving manual and technical work but also innovation.

Where associations are largely positive, these speak to skills and sector characteristics - purpose-driven work (i.e., making useful goods), making a positive environmental impact (i.e., moving towards net zero) and an 'essential' industry (e.g., supplying goods throughout the period of the Covid-19 pandemic).

Where associations are largely neutral or negative, these speak more to job content and the deeper industrial *legacy* of manufacturing factory work. Negative associations are dominated by stereotypical perceptions of poor pay, less career development, the lack of job flexibility, low status work and that manufacturing conveys an old-fashioned industrial legacy image.

In terms of pay, nearly a fifth of our sample associated UK manufacturing with poor pay (19%) compared to one in eight who describe jobs as having 'good pay' (12%).

Images of manufacturing as an old-fashioned industry provide a strong contrast with the emerging worlds of new SMART manufacturing technologies. They suggest that the adoption and use of these new manufacturing technologies has not yet strongly countered the older industrial legacies associated with the sector.

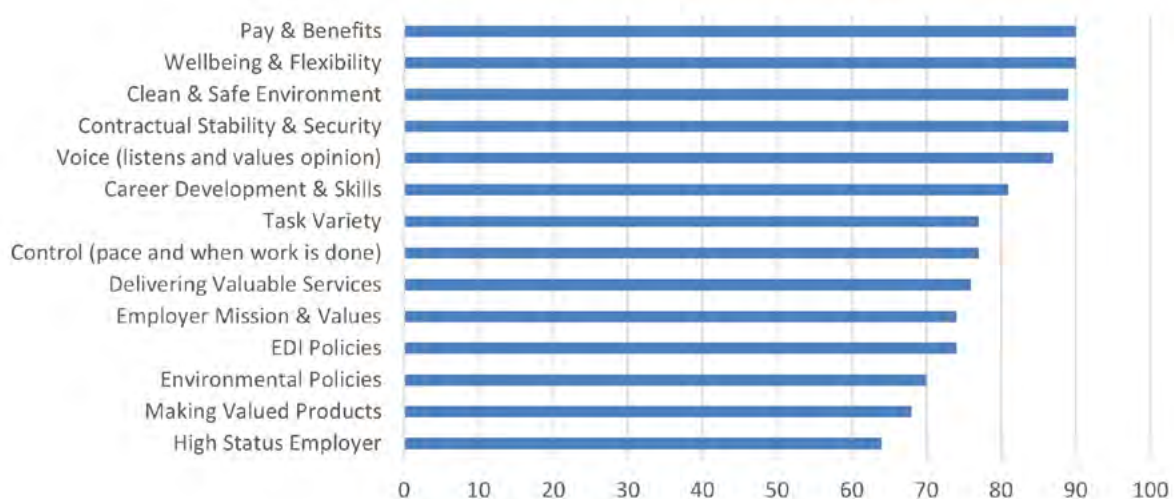
There are, however, some (usually negative) stereotypes of jobs in the sector that are evenly contested: whether jobs are interesting or boring and if they are safe. While it's reassuring that these associations are not negative, they are still areas that may need to be strongly addressed in sector recruitment and branding.

Images of manufacturing work and jobs are important as they set the context for how people look at job quality in the sector. They matter. As we see in the next section, they feed into people's opinions of manufacturing jobs and some of the negative perceptions around low pay, job security and safety are strong disincentives to encourage people into jobs/careers in UK manufacturing.

### *Job quality in the UK*

We know that manufacturing is highly valued by the UK public, but what do they think about job quality in the sector, and would they encourage members of their family and social networks to pursue careers in UK manufacturing? Before looking at this issue it's useful to ask about what the UK public are looking for in terms of job quality (Figure 5.1). This allows us to compare and contrast the overall picture with their views of jobs in UK manufacturing and focus on what factors are important for the recruitment and retention of 'talent' in the wider UK labour market.

Figure 5.1: Job Selection Net Importance (%)



While most (unsurprisingly) largely focus on instrumental pay and benefits, these are equally valued alongside wellbeing and flexibility. Other important job selection factors concern working in clean and safe environments, contractual stability and security, and employee voice (employers who listen to, and value, people's views, and opinions).

Interestingly, for UK manufacturing, just over two-thirds to three quarters would choose jobs that offer purposive [work around making valued products and/or delivering services. It is particularly striking that nearly two-thirds of our sample selected 'making valued products' as a job-selection factor. This shows the value of marketing manufacturing jobs around 'purposive' work.

Conversely, task variety and autonomy also strongly feature in job-selection: a potential problem for manufacturing jobs without strong people engagement practices, autonomy and distributed leadership, or repetitive production jobs without task variety or job rotation.

### *Job choice: manufacturing workers, gender & Gen Z*

In terms of these job selection criteria, there are three key groups that are of particular interest to UK manufacturing employers for recruitment and retention: those who currently work in UK manufacturing industries, women, and young people. In constricted labour markets with people and skills shortages, understanding the employment needs and choices of these groups is critical for effective recruitment and retention strategies.

Firstly, those who currently work in UK manufacturing display a job choice profile that is not substantively different to that of the main sample. In other words, if manufacturing employers want to understand what those employed in manufacturing want and need from their jobs, Figure 4.1 provides a useful indicative guide about what they are looking for and value. Like the main sample, those working in UK manufacturing are not simply just looking for instrumental rewards from work, they value wellbeing and flexibility, clean and safe working environments, contractual stability and security, and employee voice.

Our survey highlighted some interesting variations to the overall job selection profile for women and Gen Z (Figures 5.2 and 5.3).

While male job selection criteria are mainly instrumental and relatively close to the main sample profile (with a slightly greater emphasis on contractual security), women, are significantly more service oriented and people and value focused. Having active people engagement practices that support policies and practices, and employer values around wellbeing (and flexibility), work-life balance, equality, diversity, and inclusion (EDI) and employee voice appears to be especially important for this demographic. The importance of knowing who an employer is in terms of their 'story', values, and practices will be critical for manufacturing employers who want to support gender diversity.

Similarly, people engagement and values are important for those in early career Gen Z groups: employee voice was the largest job selection factor for those aged 18-25, who also place far more emphasis (than older cohorts) on EDI and environmental policies and practices in the workplace. For Gen Z, these differences may represent an important aspect of workplace entry and socialisation: a desire to positively engage with employers who listen, value their input, and reflect some of their own personal values in the workspace.

Figure 5.2: Net Importance of Job Selection Criteria by Gender (%)

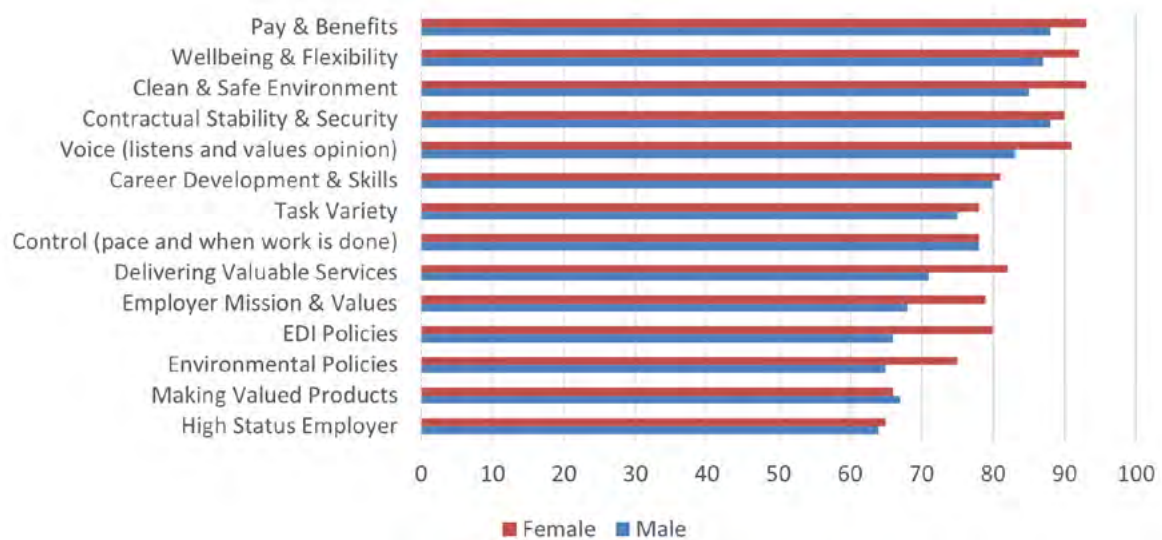
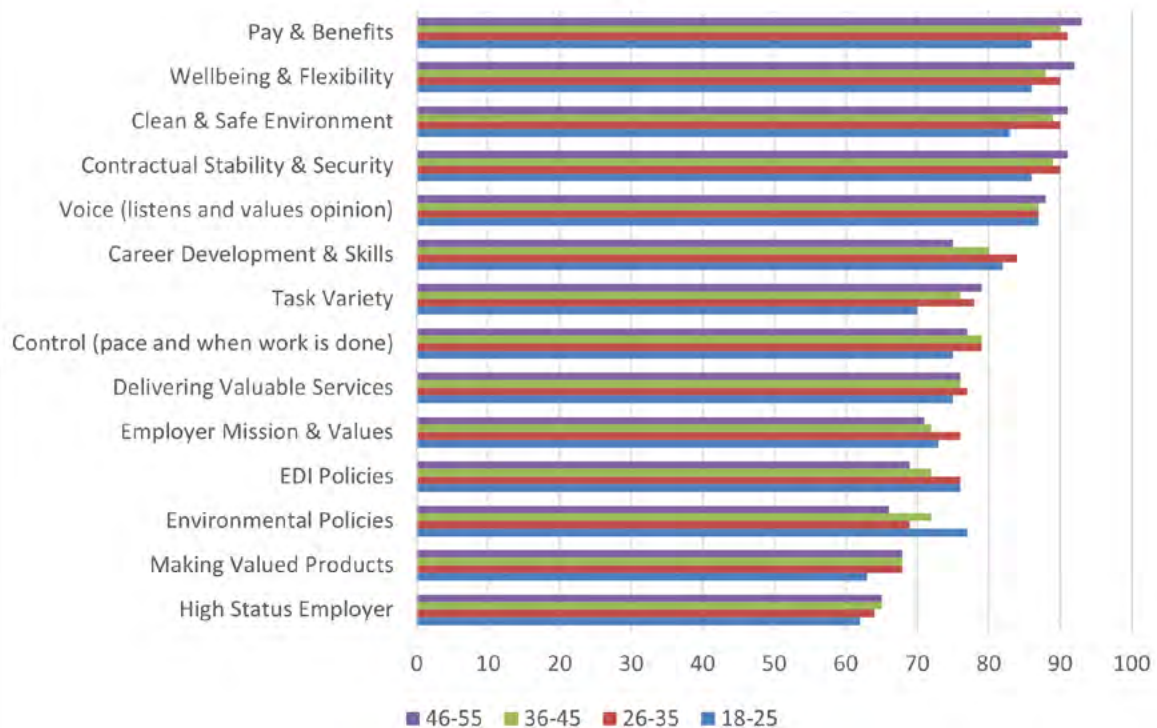


Figure 5.3: Net Importance of Job Selection Criteria by Age (%)



So, what does job quality in manufacturing look like – particularly for those currently working in the sector – and would people encourage members of their family and social networks to pursue careers in UK manufacturing?

### *Job Quality in UK Manufacturing*

In contrast to the high value attached to UK manufacturing as a sector, people have very mixed views on the quality of jobs in the sector. There are relatively high levels of uncertainty in people's perceptions about the quality of jobs and careers delivered by the sector and a possible mismatch, inconsistency, or 'gap' between what some want in jobs and what they think is delivered by UK manufacturers (Figure 6.1). UK public opinion on the quality of manufacturing jobs offers a sharp contrast to how the public views the importance of the sector.

On the positive side, people in the UK certainly recognise the type of work and skills required in UK manufacturing: delivering purposive work with high levels of skills. They also mostly think that manufacturing jobs come with EDI values and practices, offer career development opportunities, occur in clean and safe working environments, and largely provide contractual stability and security. Conversely, there is a strong association with repetitive working/low autonomy and that manufacturing jobs are perceived as 'weaker' in terms of pay, employee wellbeing and flexibility, and employee voice. Given the strength of these latter three factors in what people look for in jobs (particularly for women and Gen Z groups), these may be critical areas of weaknesses for marketing manufacturing jobs, especially among those unfamiliar with jobs in the sector.

Figure 6.1: Opinions on UK Manufacturing Jobs/Careers (%)

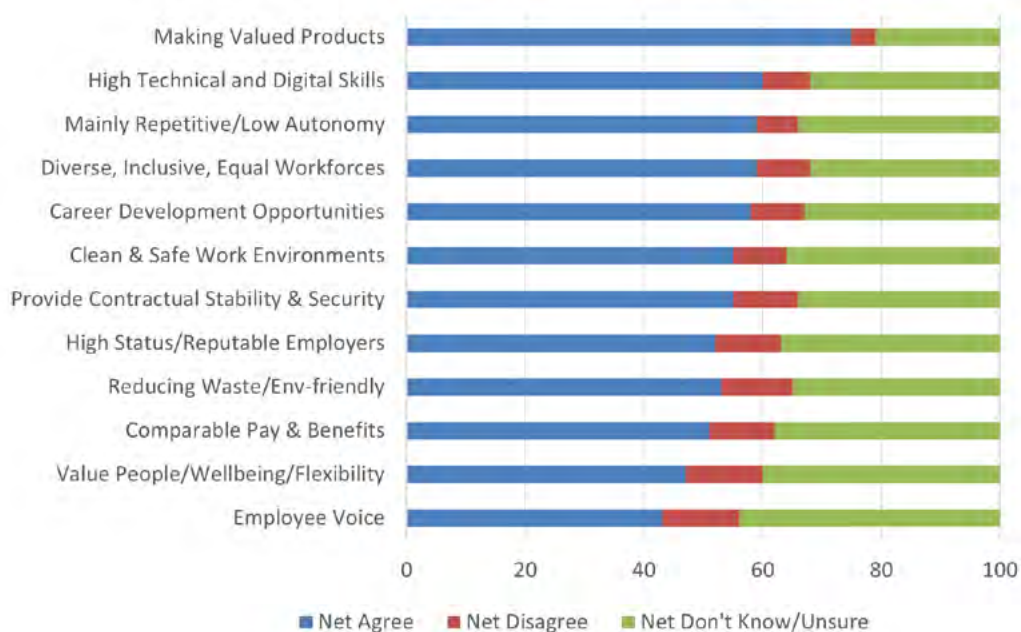
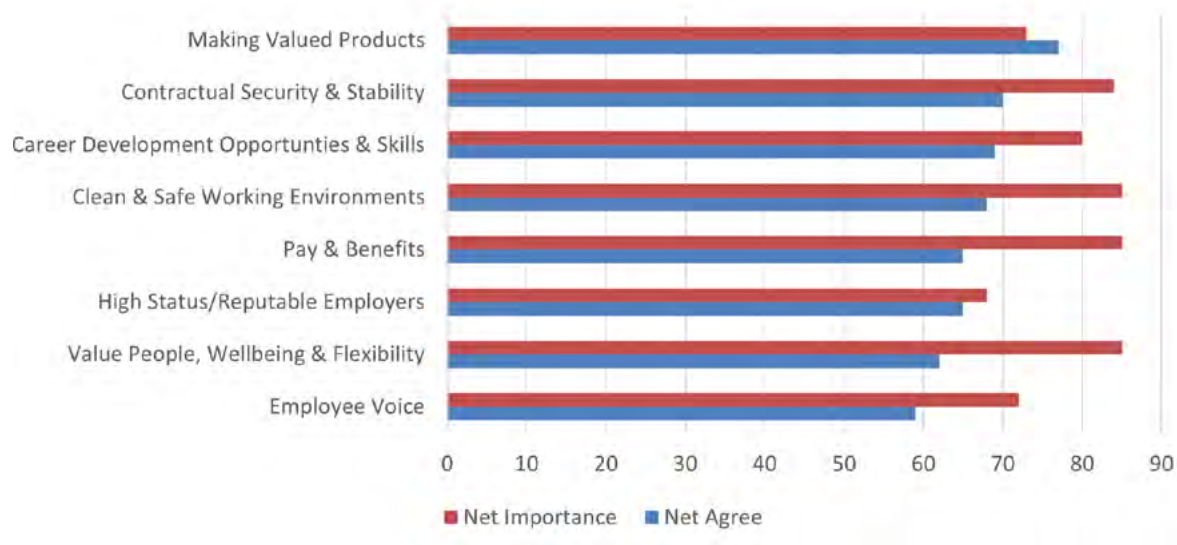


Figure 6.3: Manufacturing Workers Net Agreement on Jobs vs Net Importance (%)



While we may think that there are reasonable levels of job quality among workers in manufacturing, there are some important 'quality gaps' between what workers tell us is delivered in manufacturing jobs, and what they themselves want from a new job (Figure 6.3). These figures tell us there are some 'quality gaps' between what is delivered and desired from manufacturing jobs from these workers in the sector. The most important of these gaps concern: contractual stability/security, the provision of clean and safe working environments, pay and benefits, wellbeing (and flexibility) and employee voice. In all these cases, there are significantly more workers who want these features in new job, than tell us they are delivered by current manufacturing work. This is potentially indicative of job quality 'gaps' for these workers in manufacturing.

### *Encouragement to enter UK manufacturing jobs and careers*

Would people encourage their family, friends, and others they know to pursue jobs and careers in UK manufacturing (Figure 6.4)? Although there is a high degree of uncertainty in nearly half the sample, nearly two-fifths would encourage members of their family, friends, and others to work in UK manufacturing. This compares closely with other recent UK work by Make UK (Make UK 2018, 2023b).

For those who wouldn't offer any encouragement, it's important to understand their reasons for not doing so (Figure 6.5). The main reasons cited by those who would not encourage others to pursue careers in UK manufacturing concern some of the 'usual suspects' (from our earlier section on images of manufacturing): low pay, poor job security, low status work, limited career development opportunities and a feeling that (on balance) there are better labour market choices elsewhere in other sectors such as services. There were often associations between these factors: low pay was sometimes set in the context of the effort involved in hard manual work or working long hours, while poor security was associated with feelings that UK manufacturing is 'old-fashioned' industry in longer-term decline with jobs at higher risk of being offshored or eliminated by advances in automation, robotics, and AI.

Figure 6.4: Would Encourage Family, Friends & Others in UK Manufacturing Jobs/Careers (%)

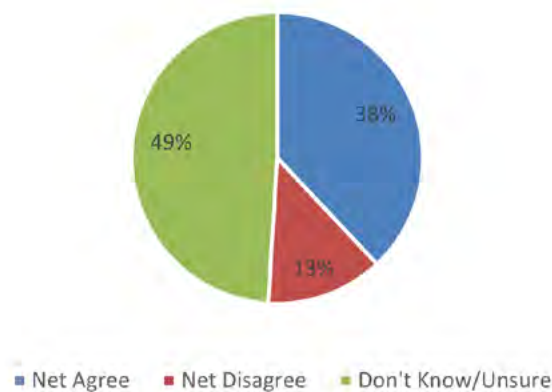
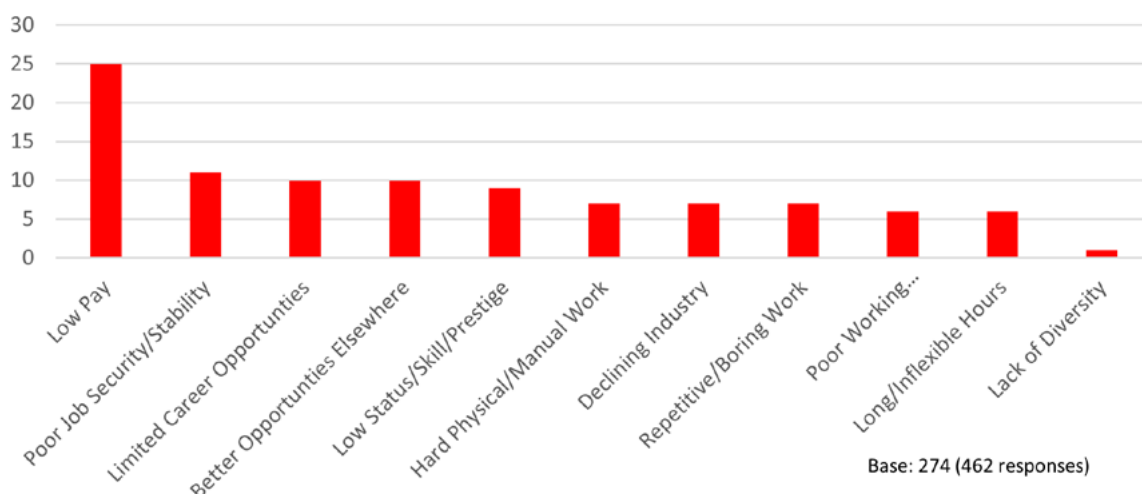


Figure 3.6: Reasons for not Encouraging Others into jobs in UK Manufacturing (%)



### *Drivers of manufacturing jobs: familiarity & gender*

The most powerful driver of people's views on manufacturing jobs and whether they would encourage friends, family, and others to pursue careers in UK manufacturing is familiarity. Both of our familiarity measures were the most effective discriminators of public opinion about the quality of jobs in the sector.

In terms of networks, people were significantly more likely to have more favourable opinions of manufacturing jobs/careers especially if they currently work in UK manufacturing. Direct experience and greater social network familiarity also means that people are significantly more likely to encourage others to pursue jobs/careers in UK manufacturing (Figure 6.6).

Similarly, the more people knew about and were familiar with UK manufacturing jobs/careers, the more they were likely to have more favourable opinions of jobs/careers in the sector (Figure 6.7). The more people know about jobs/careers in UK manufacturing, the more they are more likely to encourage others to pursue jobs/careers in UK manufacturing.

In terms of social network and job/career familiarity, those who know manufacturing the best were also those who rated job quality in the sector the highest. In other words, the closer people are to manufacturing in terms of their networks and the more they know about jobs/careers in the sector, the more positive they are about job quality in these industries and encouraging others to take up manufacturing jobs/careers.

However, unfamiliarity with manufacturing jobs/careers has consequences for the attraction of jobs and advocacy of the sector as a career destination of choice. Women (in general) are less familiar with manufacturing jobs and careers than men, they are simply less positive (not negative but more uncertain) about job quality in these industries and encouraging others to uptake manufacturing jobs/careers (Figure 6.8). From our data, in future efforts by industry stakeholders to tackle 'unfamiliarity' with manufacturing work, women are the key target group in terms of getting more positive messages across about the quality of jobs in UK manufacturing.

Figure 6.6: Impact of Social Networks on Manufacturing Jobs  
(Net Agree %)

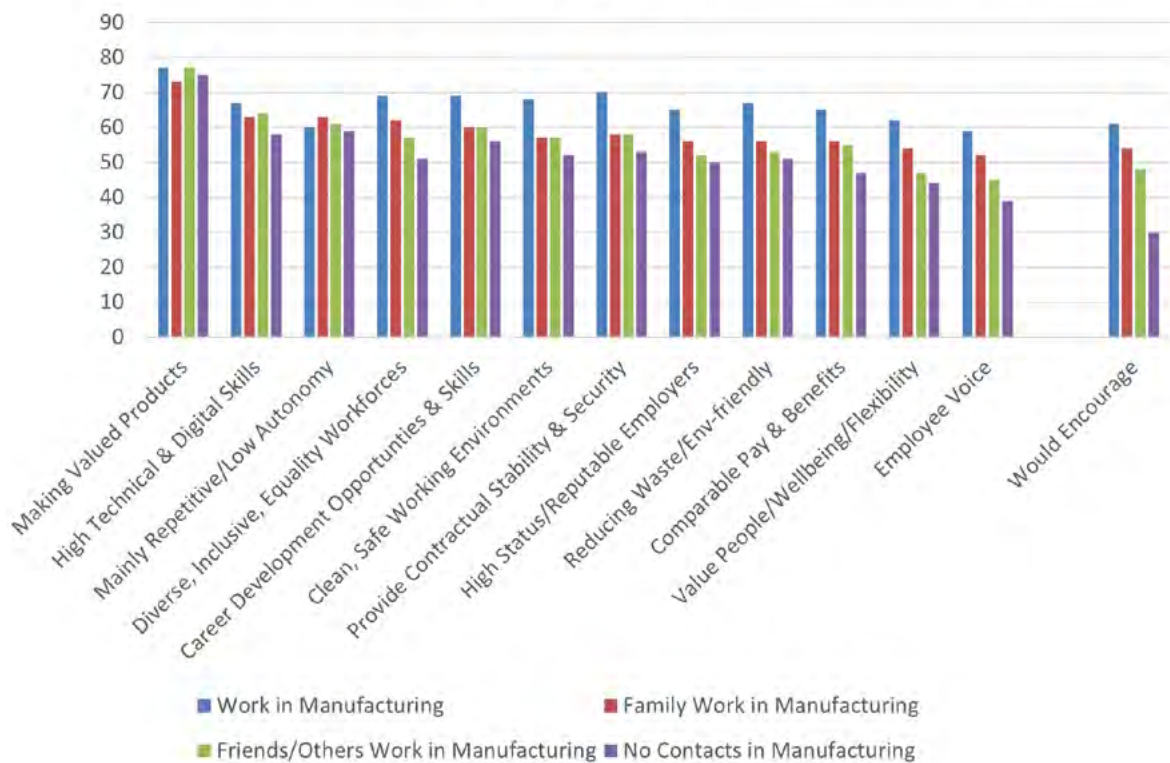


Figure 6.7: Familiarity and Opinions on with Manufacturing Jobs/Careers (Net Agree %)

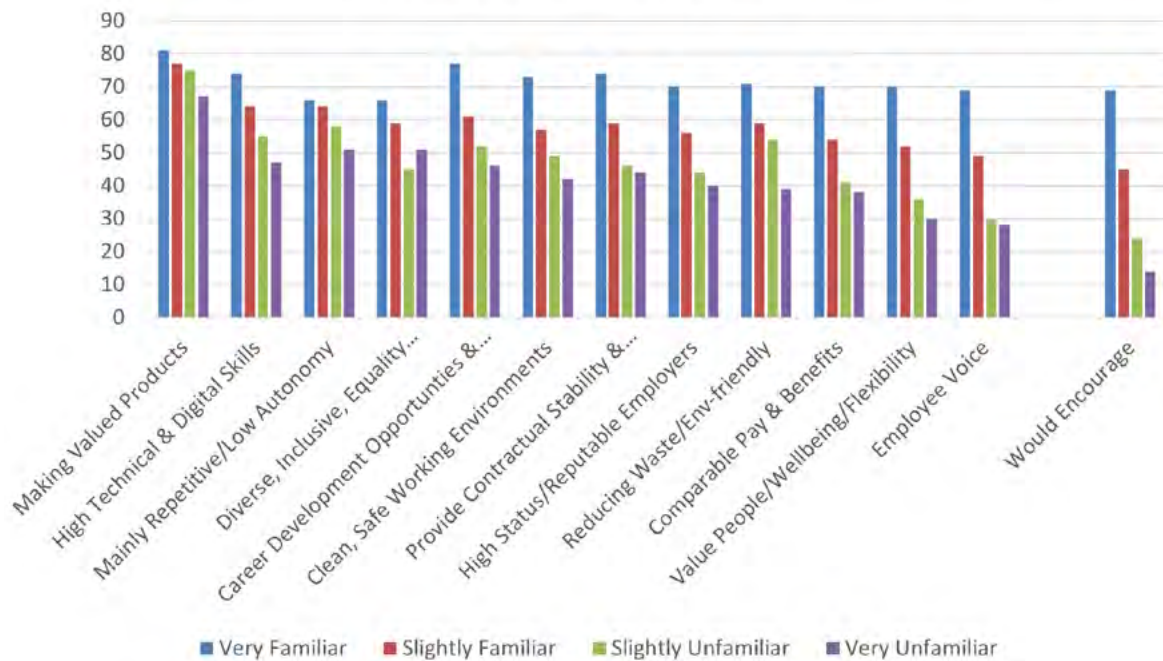
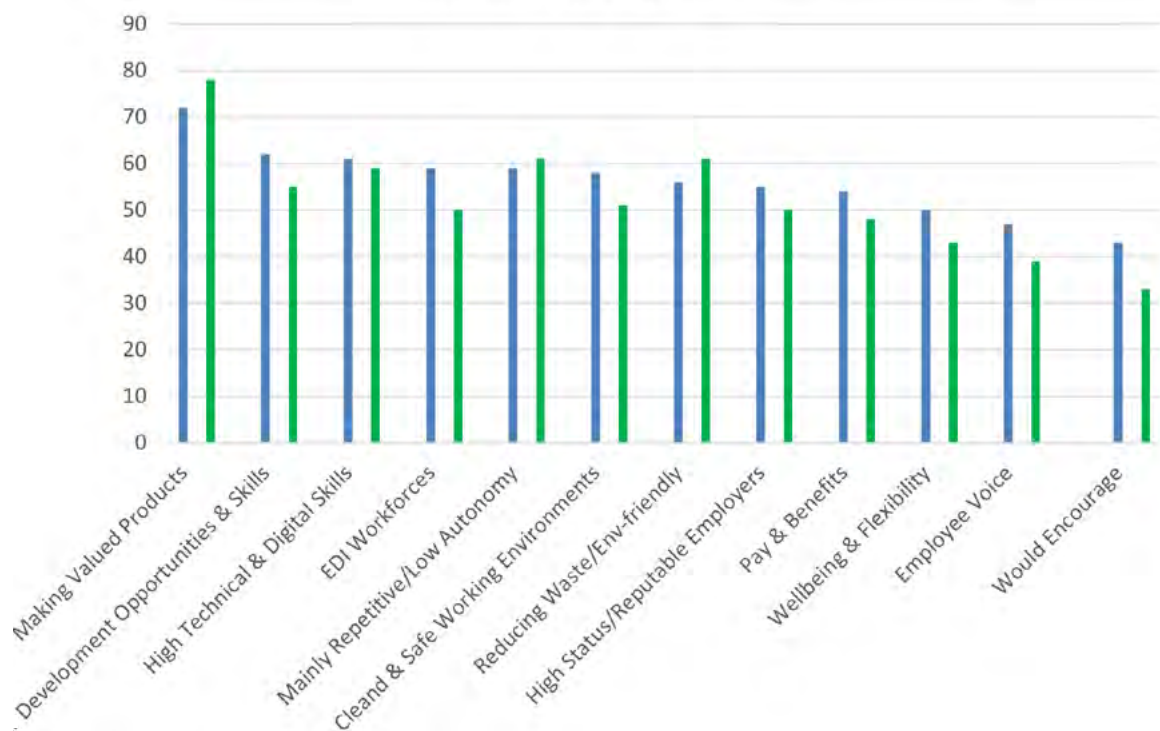


Figure 6.8: Opinions on Manufacturing Jobs/Careers by Gender (Net Agree %)



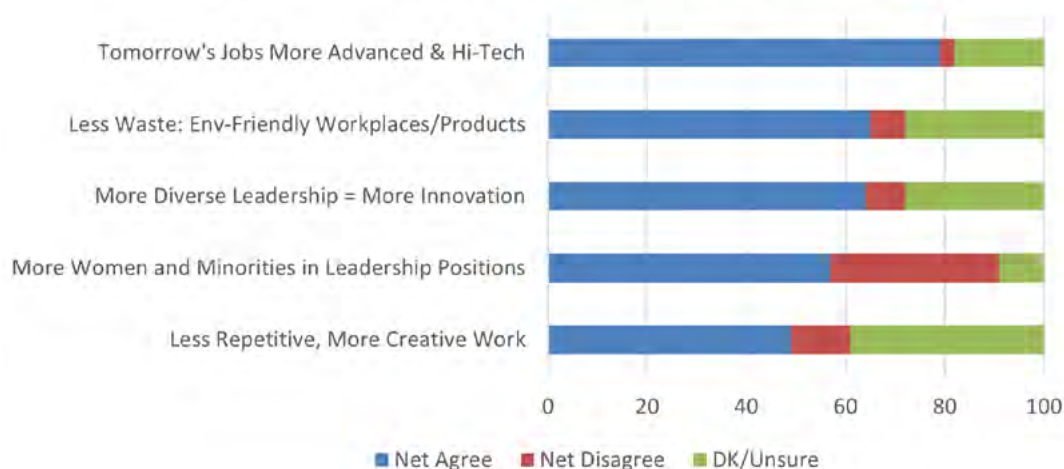
## Future work in UK manufacturing

How do the UK public think that manufacturing will change in the future and what roles will new manufacturing technologies play in shaping jobs in the sector?

There are a number of strong 'future of work' themes around UK manufacturing: the development of higher technical skills alongside advances in digital technologies; moves towards Net Zero which means that jobs, workspaces and products should be 'cleaner' and generate less waste; the need for more young digital talent and diversity in the sector (because of people talent/skill shortages), particularly in leadership roles; and the link between diversity and innovation (e.g. in goods, services, marketing strategies, research and development, etc).

As with previous work in the UK and US, the UK public positively think that tomorrow's manufacturing jobs will be more advanced and hi-tech. They also think that there will be less waste because of more environmentally friendly workplaces and sustainable products. However, they are far more uncertain that there will be less repetitive (and more creative) work as new manufacturing technologies continue to replace more 'dull, dirty and repetitive' manual tasks. Although they largely believe that more leadership diversity will lead to more innovation, they don't necessarily think that 'diversity' is just about having more women and minorities in these roles (Figure 7.1). Just over a third are sceptical about whether there will be more representation from these groups in leadership positions in UK manufacturing.

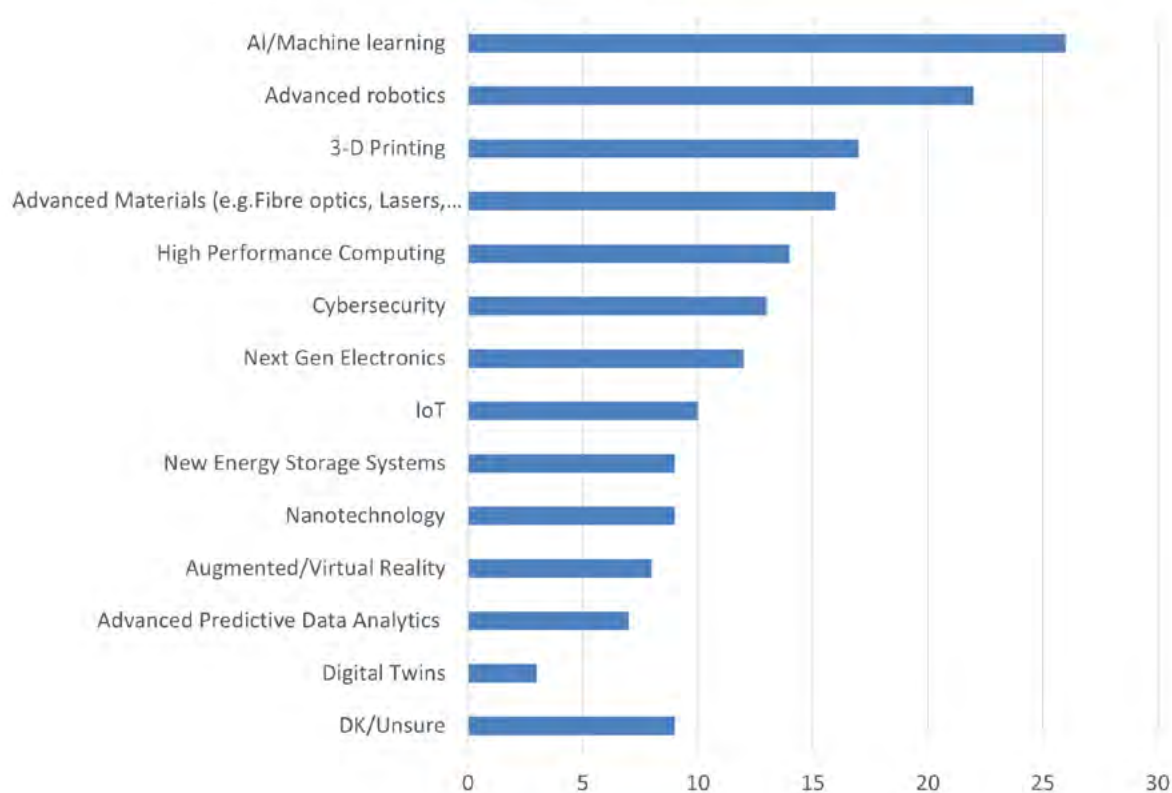
Figure 7.1: Opinions on Manufacturing Futures (%)



## New technologies & future manufacturing jobs

The advance of new manufacturing technologies will have an important role in shaping tomorrow's labour markets as they change future roles, tasks, and jobs. Many of those most familiar with UK manufacturing jobs are aware of these technologies: a number of these were identified as (potentially) having the most impact on future jobs/careers in the sector (Figure 7.2).

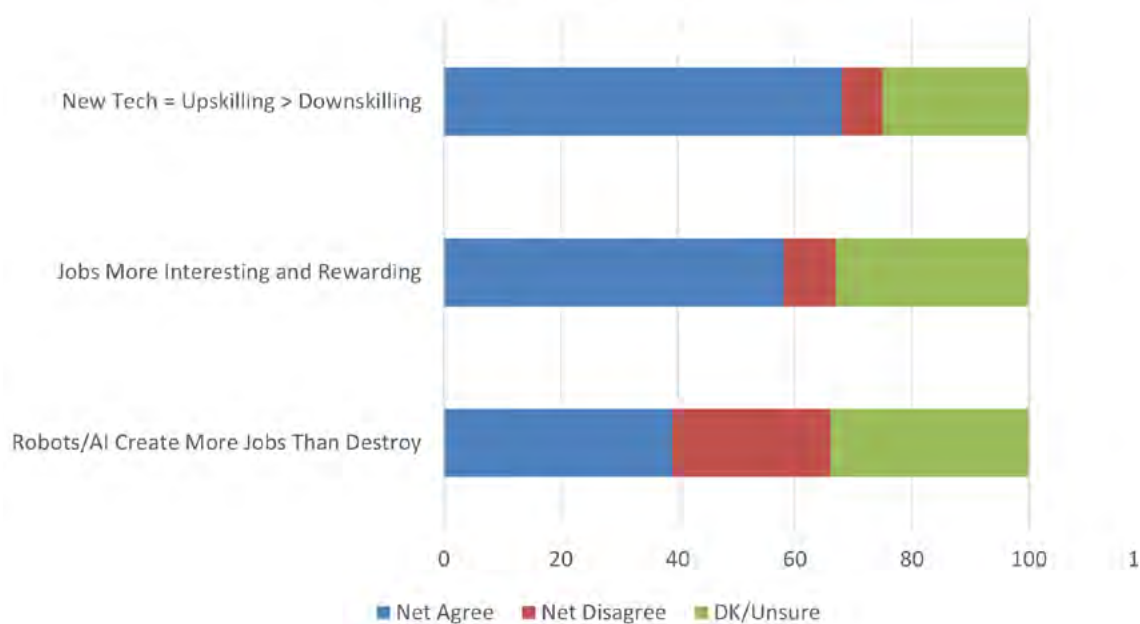
Figure 7.2: Most Impact of New Manufacturing Technologies on Future Jobs (%) Base: 703



For those most familiar with manufacturing, the biggest impacts on future jobs/careers will arise from AI/Machine learning, advanced robotics, and 3-D printing. Although our survey was conducted before a lot of the recent UK media attention on the potentially significant impacts that could be made on jobs by AI and robotics, these findings indicate a high level of awareness of their potential impact on manufacturing workforces in the present and future. Do the UK public think that new manufacturing technologies will impact on jobs in the sector in a positive or a negative way (Figure 7.3)? Our figures show that people think that these technologies will have a positive impact on skills and largely make manufacturing jobs more interesting and rewarding for workers. However, just over a quarter think that they will have a destructive impact on the numbers of jobs in the sector.

The link between new technologies and their impacts on the number of jobs is one of the most contested issues in our survey, with potentially negative or uncertain implications for workers job stability and security unless addressed by upskilling workforces, creating new jobs and proactive workforce engagement. Our findings mirror the divisions and ambiguity over the future impacts of AI in recent wider UK public opinion surveys and media speculation on these issues (e.g. Sleight 2023, YouGov 2023).

Figure 7.3: How Will New Manufacturing Technologies Change/Impact Jobs (%)

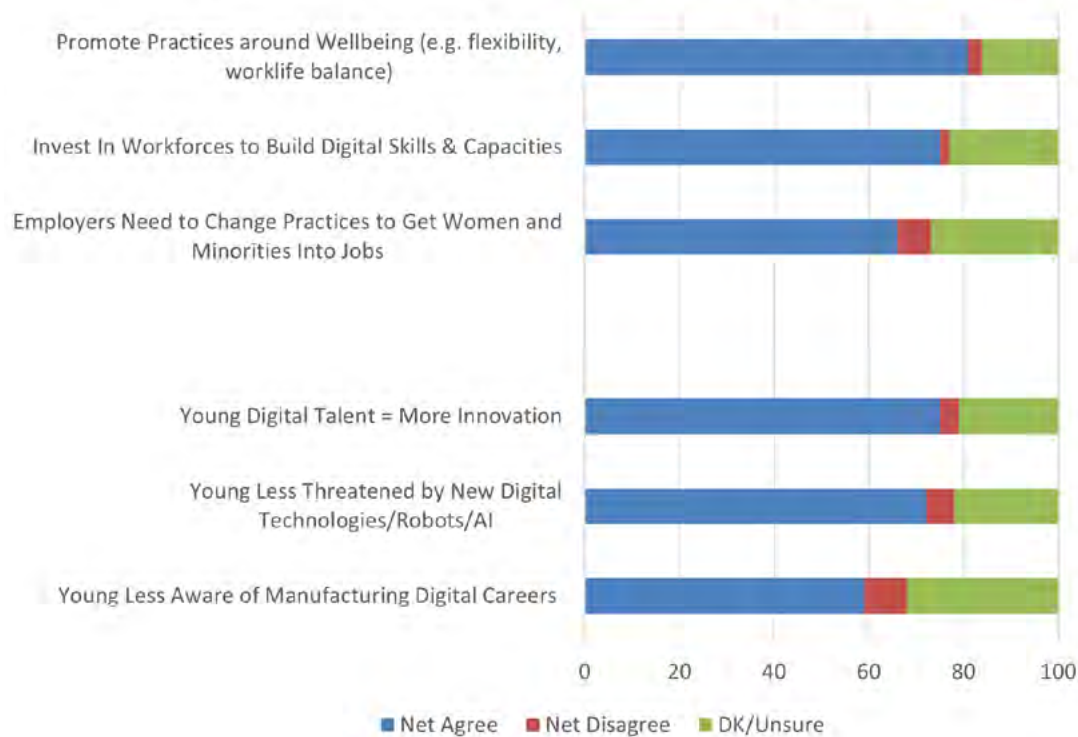


### Attracting digital talent: Gen Z & Alpha

Linked to technological developments in advanced manufacturing is the problem of how employers attract more digital talent into the sector, particularly from more highly digitally educated younger people, including those from harder-to-reach groups such as women and minorities, and whether any innovation benefits would arise from these inputs. In addition, employers can also focus on upskilling and developing their existing internal talent (Figure 7.4).

The largest factor for attracting young digital talent concerned the promotion of practices around wellbeing. Our figures suggest that (going forward) this is and will continue to be a key issue in recruitment and retention for UK manufacturers and one which may be problematic for many of them. Why? If we take 'flexibility' as one topical example of a wellbeing initiative, we already know that this can be 'messy', complex, and 'unevenly' spread across and within manufacturing businesses. While relatively unproblematic to implement with knowledge workers, doing the same with skilled frontline workers in multi-site manufacturing operations with 'fixed' production shifts and some 24/7 cycles, poses some significant structural challenges for flexible working. Although we know that there isn't a 'one-size fits all' approach to flexibility, the key for recruitment and retention in manufacturing will be trying to ensure that as many workers as possible can benefit from a least a degree of flexibility. The more employers offer and accommodate workforce flexibility, the more successful they are likely to be in attracting and retaining key staff in current and future labour markets, especially among groups that value this, such as young people and women.

Figure 7.4: Attracting &amp; Building Young Digital Talent (%)



Other factors that are seen as important for attracting digital talent concern upskilling and investing in internal talent. Young people are a key group, seen as less 'threatened' by digital technologies, linked with greater innovation because they are potentially more familiar with these technologies but thought to be less aware of digital careers in manufacturing workspaces.

Finally, there is a recognition that manufacturing employers may need to change their practices to attract more women and minorities into jobs (for reasons we outlined earlier). This may point to a demand and need to ensure that working environments are inclusive.

In terms of manufacturing futures, new technologies and attracting more digital talent, people were more positive about these aspects if they were...



### **Manufacturing workers and familiarity with jobs & careers**

The more familiar people are with manufacturing jobs and careers the more likely they were to think more positively about future jobs in the sector.

They also think more positively about the future impact of new manufacturing technologies on work: upskilling, more job creation and more interesting and rewarding work.

They are more supportive of encouraging diversity initiatives, skills investment by employers, that young digital talent is linked with more innovation and that young people are less aware of digital careers in UK manufacturing.

### **Gen Z**

Gen Z are optimistic and think more positively about future manufacturing jobs.

They are optimistic about the future impact of new manufacturing technologies on work: more job creation and more interesting and rewarding work.

They are more supportive of the link between diversity and innovation but think that young people are less aware of digital careers in UK manufacturing.

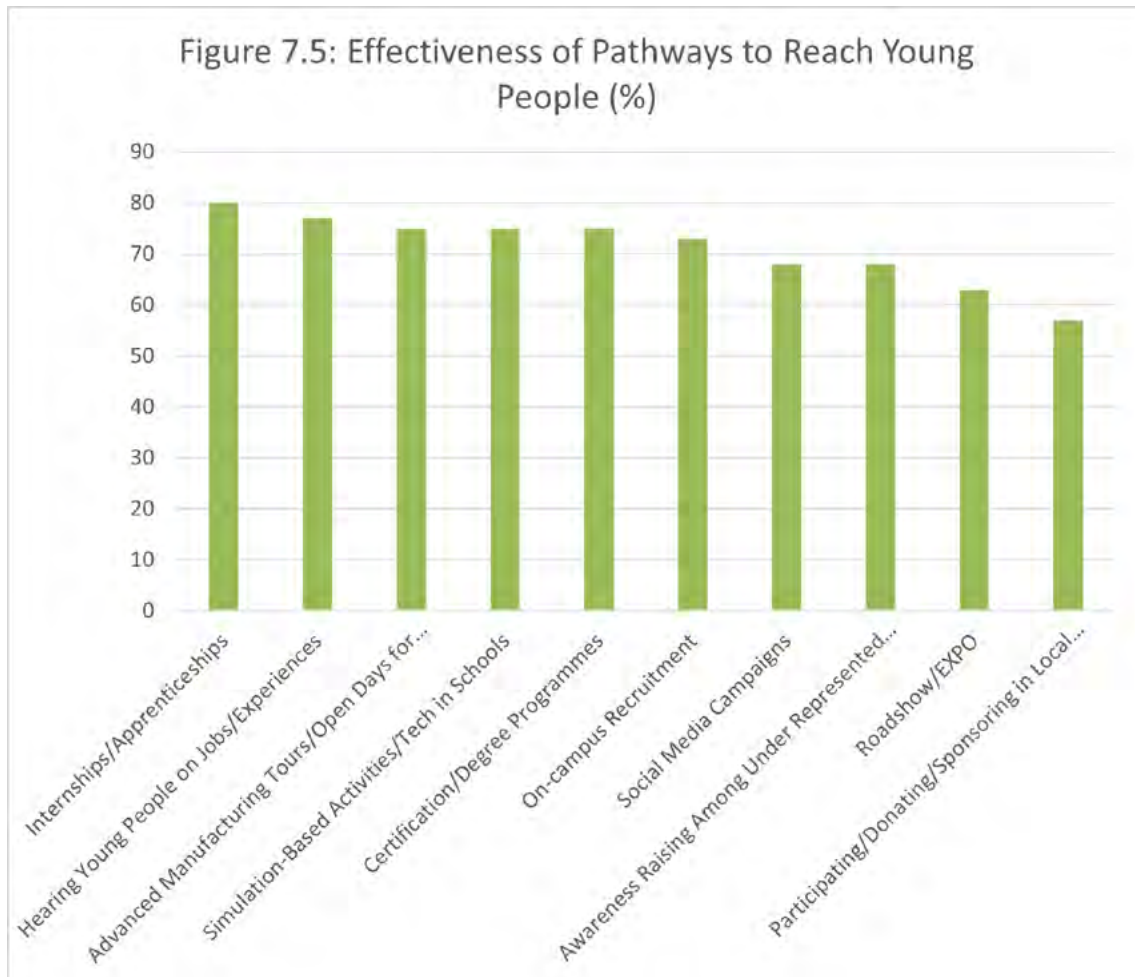
### **Women**

Women are more pessimistic about future jobs and about the impact of new manufacturing technologies on work: less job creation and less interesting and rewarding work.

They are more supportive of the link between diversity and innovation. They think that there has to be a change in employer practices to bring more women into manufacturing and by having more wellbeing practices at work

## Reaching out to Gen Z & Alpha

Finally, what did people think would be the most effective pathways to increasing interest in manufacturing jobs among young people (Figure 7.5)?



There are several tried and tested pathways into manufacturing for young people. The most popular concerned traditional skill-based apprenticeships and internships. Other popular pathways included hearing the views of other young people already working in manufacturing about their experiences, taking new advanced manufacturing technologies on-the-road as part of open days and trying to take the technology into schools. Alongside, having a social media presence, these latter pathways offer the potential to directly reach out and engage with new younger STEM audiences, and otherwise harder-to-reach social groups.

## Summary & conclusions

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The results present an interesting picture of public opinion on UK manufacturing: the value of the sector, people's images of work and jobs, the quality of jobs/careers and a window on the future with advances in new technologies. Clearly, the good news for employers and industry stakeholders is that manufacturing (as an industrial sector and shown in previous work in the UK and US) still matters for many people in many very fundamental ways: as an essential industry that is important for the continuous supply of useful goods, for innovation, economic prosperity, living standards, national defence, and local jobs.

However, appreciating the value of the manufacturing sector is distinct from what people think about job quality in the sector. UK manufacturing is associated with imagery that largely paints the sector as creative, highly skilled 'blue-collar' technical and manual work. For some, such as Gen Z and women, this means that working in the sector still tends to be heavily tinged with images of older industry: low paid jobs and inflexible working. An old-fashioned industrial image still resonates with many in our sample. These are very different to those 'blue sky' pictures presented by many advanced manufacturing workplaces and settings. These negative associations of working in the sector are important because they feed into people's opinions about job quality in UK manufacturing. For example, relatively few people would actively encourage members of their family, friends, and others to pursue jobs/careers in the sector.

Despite this there is significant quality in manufacturing work and jobs for those who currently work in the sector, most of whom rate job quality highly in terms of pay, security, safety, and career development. Nevertheless, if we take a closer look at what people working in manufacturing want from jobs compared to what they think is delivered by manufacturing employers, there are some notable gaps in 'quality': particularly in relation to delivering on pay, wellbeing and flexibility, and voice.

There are several key moderating factors of people's opinions of the sector and job quality. Familiarity - either through direct experience of manufacturing work, social networks and/or what they know of manufacturing jobs/careers - is a major influence. Arguably, those who are the closest to the sector and know manufacturing the best, are typically those who are also the most positive about the sector, the most likely to talk up job quality, and the most likely to encourage their significant others to take up jobs and careers in the sector. To encourage future talent, some work will of necessity have to be done to engage those 'unfamiliar' population segments (particularly women): to encourage, inform, challenge, or counter their largely 'uncertain' views about the importance of the sector and working in UK manufacturing.

Although there is some uncertainty and negativity about current job quality in manufacturing, the future offers a positive picture. People anticipate that tomorrow's jobs will be more advanced, highly skilled, and high-tech but not necessarily more creative (and less repetitive). This latter issue highlights the value of manufacturers strategically building task variety and introducing more autonomy into jobs, which may increase their relative attraction and help challenge those perceptions around the 'dull repetitive factory nature of working'. We can make a similar point around the importance to employers of having policies and practices around inclusive working environments that support wellbeing (and flexibility) and employee voice to improve the attraction and reach of manufacturing jobs among women and Gen Z.

While the advent of new advanced technologies may help dispel some of the sector's negative imagery and perceptions and help attract young highly educated groups into the sector, industry stakeholders need to be aware that while these technologies are thought to have a positive impact on skills, they are very likely to be highly divisive on jobs and people's underlying perceptions of job stability and security unless these are addressed by upskilling and job creation.

Equally, there may be more to do in terms of developing and ensuring that approaches to diversity and reaching out to under-represented groups resonate with their target groups, such as women and Gen Z. In some ways the key issue for these groups will be tackling the complexities around providing inclusive workplace settings that offer flexibility and see the value in diversity. Wellbeing is high on the list of what many people are looking for in jobs. It is (along with diversity) what people anticipate as part of the future of manufacturing work. Quite simply, manufacturers need to be creative about how they extend and build out flexible working, particularly for frontline production workers. They also need to ensure that their 'inclusive' policies and practices around diversity are reflected in their recruitment practices and workspaces.

Going forward, there are several practical steps that manufacturing employers and industry stakeholders need to consider.

**Talk it up: tell people why the industry matters, its value and USP:**

People readily identify why manufacturing is important. As an 'essential' sector, industry stakeholders need to recognise and capitalise on their strengths. Manufacturers and policymakers should clearly and consistently tell people what these strengths are, and why working in the industry matters. Providing purposive work' makes manufacturing different to many other economic sectors. Manufacturing offers purposive work that industry stakeholders can link to wider UK innovation, prosperity, security national brands and reputations.

This also provides some leverage into how industries should start to engage with under-represented and hard-to-reach groups such as women who only make up 29% of UK manufacturing workforces.

**Images of manufacturing work and jobs are not that attractive and employers need to reflect people's job and career priorities, and tackle perceived weaknesses in quality:**

UK manufacturing already provides much of what people look for in jobs and careers, especially for those currently working in the sector but it is a tight jobs market. Employers therefore need to ensure that what they can also compete with comparable work elsewhere.

There are strong perceptions of jobs in the sector being repetitive and having low autonomy. There may be similar weaknesses around wellbeing and flexibility. While having active employee engagement practices can counterbalance these perceptions, it's important to recognise that these are not always easy practical steps to take, particularly for medium and smaller employers. However, they are essential – and are likely to be increasingly so – if the industry wants to attract and retain good staff whilst being better able to tap into under-represented and hard-to-reach groups.

Examining the websites of many manufacturers based in the UK will tell you much about their backstory as a business, how this informs what they value as employers and how they really

engage with the views and wellbeing of their employees. However, the 'quality gaps' identified from those currently working in manufacturing may point to the need to better deliver on this through more effective outreach, public relations, recruitment, and marketing materials. From those currently working in manufacturing may point to the need to better deliver on this through more effective outreach, public relations, recruitment, and marketing materials.

### **Digital futures look bright but hold on the shades for now:**

Advanced manufacturing offers much technological promise and has very clear messaging around the production and efficiency benefits for companies. New technologies also represent new opportunities for employers to augment worker skills, realign and restructure workforces, invest in workforce capabilities and /or recruit new digital talent. To get the productivity benefits from these new technologies, the key challenge for employers will be to align people and augment their skills.

It is important to recognise that for workforces, much of the economic messaging around new technologies will inevitably trigger fears about the security of their skills and jobs. As we have seen in this survey, while most people are very upbeat on the upskilling benefits that are likely to arise from the adoption of new digital technologies, they are much more cautious and divided about whether they will create more jobs.

Manufacturers and industry stakeholders need to be proactive with engaging workforces on the subject of new technologies and their likely impact in the workplace. Having early planning and consistent employee engagement practices will help remove some of fears that can arise about job security and let workforces understand how skills and jobs can change in positive and meaningful ways. Manufacturers need to emphasise upskilling not downskilling, enabling more interesting and rewarding work, and demonstrate real job creation as opposed to destruction.

### **Engage with good people practices:**

The advent of new manufacturing technologies also represents an opportunity to make industry outsiders and jobseekers look at manufacturing in a very different way. This offers the opportunity to rebrand from an 'old-fashioned' technical, manual, and mechanistic sector with 'low status' jobs to higher status, more creative and flexible work in modern technological settings with state-of-the-art equipment where innovation matters and happens.

Reaching out to under-represented groups can help address existing and future talent gaps and there is more to do to build diversity and ensure that UK manufacturing better matches the workplace priorities of women and Gen Z. Inclusive workspaces, building in levels and pathways for employee voice and having active wellbeing and flexibility practices will be critical going forward. We know that good people engagement practices often distinguish more productive employers from others. People management is a key foundation of innovation, greater efficiency, and better business performance. In short, in organisations where people feel valued and supported, they tend to perform better. Understanding that people anticipate greater and better people engagement practices as part of the future of work in manufacturing will only help recruitment and the retention of skilled workers. Manufacturers need to ensure that their people policies positively reflect their values and practices in their workspaces. Best people practices allow manufacturers to better capitalise on the value attached to purposeful work.

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## Endnotes

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<sup>i</sup> Brinkley (2023) however, in analysis of CIPD Good Work Index survey data argues that claims around the 'great resignation' are contested and over-stated, and that the UK labour market has largely returned to pre-pandemic norms.

<sup>ii</sup> Job quality refers to the extent to which a set of job attributes contributes to, or detracts from, workers' well-being (Muñoz de Bustillo et al 2011). Job quality is multidimensional and overlaps with related concepts such as 'good' or 'decent' jobs and 'fair work' (e.g. Findlay 2016, Findlay et al 2017). Although there is no commonly accepted definition of job quality, Warhurst et al (2017) list six key dimensions: pay and rewards; intrinsic objective (e.g. skills, autonomy and control) and subjective (e.g. effort, fulfilment) characteristics; terms of employment (e.g. contractual security, career development); health and safety; work-life balance (e.g. flexibility); and representation and voice. While our survey measures what people value in choosing a new job which tell us something about the qualities that they value and would be looking for, they are not detailed nor comprehensive measures of the dimensions and depth of 'job quality', or 'good' jobs or fair work.

<sup>iii</sup> In terms of UK manufacturing industries, women are under-represented in the automotive, metals, fabrication, transport and rubber and plastic product sectors but industries with near-equal gender representation include leather, textiles pharmaceuticals and tobacco products. In terms of roles, women are over-represented in administrative, secretarial, sales and customer service roles but under-represented in skilled trades, in process and, plant and machine operatives, and as managers and in junior and senior leadership roles. Women working in manufacturing typically earn 17% less than men (Castaneda-Navarrete (2023))

<sup>iv</sup> UK opinion surveys of 'job quality' tell us that there have been no significant improvements in this over the past four years and that there has been a decline into 'mediocrity' (Brinkley 2023).

<sup>v</sup> For example, see Forbes 2011, Ruiz-Jimenez and Fuentes-Fuentes (2015).

<sup>vi</sup> The top three reasons cited by the 1 in 4 women considering exiting US manufacturing jobs in a Diversity, Equality and Inclusion (DEI) survey by the US National Manufacturers Association and the Manufacturing Institute were low pay, a lack of flexible schedule options and more work-life balance (Giffi et al 2017).

<sup>vii</sup> 'Smart' factories are digitised manufacturing facilities that combine artificial intelligence (AI), robotics and machine learning in a network of interconnected machines, communications, and cloud computing to analyse data and independently drive automated processes (Coussins 2023).

<sup>viii</sup> In the following sections all the figures use this sample base unless stated otherwise.

<sup>ix</sup> In this sample we use Gen Z to capture the opinions of all those who listed their age as between 18-25 years. While at the time of the survey, Gen Z would cover all respondents aged 18-26 years, to sharpen our analysis we used a narrower data capture to exclude those at the upper limit of this age range aged 26 years. This provides a more reliable measure of those in Gen Z age groups because it excluded an unknown number of respondents who were 26 at the time they completed the survey but who were just about to turn 27.

<sup>x</sup> Brinkley (2023) in a longitudinal analysis of successive waves of UK survey data from workers tells us that there is an increasing focus on transactional employment and that 43% of workers are simply working for pay and benefits. Pay is a major factor in job change: people are most likely cite pay and conditions, job dissatisfaction and the lack of work-life balance as the most important reasons for thinking about quitting their jobs and for those who left their employer in the past year.

<sup>xi</sup> Voice is typically listed as a key driver of workplace change for recruitment and retention. Workers who lack any or little means of expressing their views or feel these are or would not be valued are unlikely to be happy in their jobs. In 2023 in the UK, 20% of workers tell us that they lack any voice channels (e.g. face-to-face or team meetings, or employee surveys) to express their opinions at work (Brinkley 2023).

<sup>xii</sup> Average salaries in manufacturing jobs are 10% higher than those in the economy overall and in the service sector: £36,488 (Make UK 2023b and Make UKc)

<sup>xiii</sup> Those currently working in UK manufacturing are a sub-sample of our wider economically active population. We are not claiming that this sub-sample is a representative sample of workers in UK manufacturing, only that they are broadly indicative of the opinions of workers in the sector. However, our sample exhibits many of the characteristics associated with the wider workforce: mainly white males in older age groups above 46 years in a variety of production and non-production roles, and in junior and senior management positions. The sample is 30% female which is reasonably close to the figure of 29% for the UK manufacturing workforce in 2021.

<sup>xiv</sup> In the UK more companies are moving to the evolution stage of digital adoption: implementing changes to their processes, marketing, product design, finance, and manufacturing systems (Make UK 2022).

<sup>xv</sup> According to Make UK, the UK is set to see a surge in the use of AI and machine learning: over half of the companies they surveyed in 2023 are increasing their investment in these technologies, with nearly three-quarters spending on automation across a range of technologies and functions, from manufacturing processes to product design and development (Make UK 2023a).

<sup>xvi</sup> Make UK (2023a) list a number of significant barriers to the adoption of these technologies: the lack of existing technical skills, high costs and critically, negative workplace cultures.

<sup>xvii</sup> There is a wider literature on workplace resistance to technological change, contested views of task automation and the 'neglected' roles of workers in innovation and organisational learning (e.g. Pfeiffer 2016). Authors also point to the link between new technologies and post-pandemic work intensification and performance management surveillance (e.g. Hodder 2020). They also highlight the benefits of applying human-centred principles in work design around new technologies (e.g. Parker and Grote 2019). Along with communication and early planning for change, worker involvement in the design and application of new technologies is typically cited as key means of countering resistance as technologies are developed and implemented in workspaces (e.g. Stadler et al 2021).

<sup>xviii</sup> For example, see Huttley (2021), Bloomberg (2023) and Fife Gingerbread (2023)

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