The Pissarides Review into the Future of Work and Wellbeing

September 2024

# Firm-level adoption of AI and automation technologies: Case Studies Report

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with Briefing Note on key findings for policymakers by Dr Abigail Gilbert and Anna Thomas

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## Acknowledgements

This paper was prepared for the Pissarides Review into the Future of Work and Wellbeing, a collaboration between the Institute for the Future of Work (IFOW), Imperial College London (ICL) and Warwick Business School.

We gratefully acknowledge financial support from the Nuffield Foundation.

The views expressed herein are those of the authors and do not necessarily reflect the views of the Nuffield Foundation, nor those of the Institute for the Future of Work.

## Citation

H. Y. Liu, R. J. Hayton, *Firm-level adoption of AI and automation technologies: Case Studies Report,* Institute for the Future of Work, September 2024.

DOI: 10.5281/zenodo.12706815

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# Summary of key findings, and implications for policy

These case studies highlight, across different sectors, how the implementation of new technologies changes the way people work and impacts on their experience of work.

The findings from them (expanded in the insights section on page 43) can be summarised into four key areas, each with implications for policymakers:

1. **In our case studies, workers losing their jobs ('worker displacement') was rare relative to workers co-existing alongside new technologies. However, other changes to the nature of work are significant, with divergent impacts on different people, from different demographics, in different roles.**
2. **The impact of having to transition the UK workforce to new types of tasks, requiring new training, is large. However, technology adoption is not reliably or commonly associated with workers being upskilled, or rewarded for developing new skills.**
3. **Poor practices in the design, development and deployment of technology have become barriers to gains in productivity and quality of work.**
4. **The adoption of these new technologies highlights the need for improved governance and regulation.**

These findings suggest some overarching implications for policies that will support the creation and sustaining of good work through this period of technological transformation:

1. **In contrast to many headlines, automation not just *displacing* jobs, and is more often existing *alongside* workers, bringing changes to job quality. This demands a wider lens on the impacts of technology adoption, and tools to understand and prioritise good work impacts through the process of design, development and deployment.**
2. **The large training demand that technology adoption is exacting should be recognised in policies that support firms to be sites of ongoing reskilling.** This suggests that fiscal policies that incentivise investment in people, alongside technology adoption, and regulation that extends rights to access training should be explored.
3. **The nuanced relationship between technology adoption and productivity, and the key factor of managerial support identified in these case studies, points to policies in a new Employment Bill that support high-involvement HR practices.** Supportive management and organisational frameworks are vital if new technologies are to lead to better job quality, and higher productivity, and ongoing conversations are needed between managers, developers and workers to review performance of a technology and how it could be improved.
4. **Changes to work precipitated by new human-machine collaboration support the need for tripartite collaboration across policy development, refinement of workplace governance and regulation, and sharing best practice.**

# Briefing note on technology adoption for policymakers

*Key findings and policy implications from the Case Studies*

## Adoption and deployment

**Work can be positively augmented by new technologies, and the associated efficacy gains and process benefits can lead to increased pride for people in their jobs.** In several cases, good design, development and deployment of systems enables people to secure efficiencies allowing a refocusing of staff time on key activities.

**Those interviewed for these case studies report that good management is essential to the success of implementation and demonstrate enthusiasm about adoption where they feel supported.**

**Adjacent workers can be as significantly impacted - if not more so – than the worker primarily associated with the new technology.** This can be in the form of intensification or routinisation of work, with various routes to reduced job satisfaction leading to a reduced sense of being valued. Further, those who remain involved in a process - but with reduced role significance - can find work less meaningful.

**A focus on displacement of work overlooks the vast range of changes to more granular aspects of job quality.** In a similar way, it is too commonly assumed that acquiring new skills to use a technology will lead to the experience of improved work, or more use of knowledge by workers. More critical interpretations of 'upskilling' are required.

**At the point of adoption, workers are not always aware of the full range of long-run impacts adoption could have on their work, and the work of those around them.** This invites a more relational understanding of automation exposure in aggregate predictions of the impacts of automation. This should also consider the potentially high carbon cost of adopting energy-intensive AI systems.

**Those who find the use of new technologies improves their sense of a job well done can also be more fatigued by the use of new technologies than by previous processes which engaged them more physically.**

**Expectations that adoption will lead to labour-saving outcomes are not reliably realised.** This may be underpinned by poor estimations of how this will be achieved, poor planning of implementation, or a lack of evaluation of job redesign after adoption.

**Adoption is not purely technical but also social.** Relationships between workers, and workplace culture can determine the impact on productivity gains of a new tool. In this sense, poor adoption strategies can lead to reduced productivity.

**Removing 'humans in the loop' can contribute to reduced quality of service provision.** This is particularly true where there are no unified datasets and integrated services.

**Involving employees in the programming of 'cobots' in the workplace can ensure a greater sense of security and control over the presence of a workplace robot.**

**Systems are increasingly used for the gamification of work, and to entrench competition between employees.** This could have negative impacts on work as a site of social connection and relationships.

**In contexts where there is concern about the consequences of adoption, employers have successfully managed this by offering a 20% profit-share with workers from the returns of using robots.**

## Skill use

**Employees are required to acquire skills which allow them to use new systems - but there is limited scrutiny or understanding as to whether this leads to greater overall discretion and skill use or not.** In some cases, those required to 'upskill' to use new technology found reduced overall discretion, creativity and control over their work.

**Moravec's paradox remains relevant for workers conducting manual tasks requiring perception and dexterity.** Contrary to historic expectations, these tasks are very resource-intensive to automate, and so much manual labour may remain insulated from automation.

**People are experiencing highly varied skills transitions.** While for some, costs for reskilling are a barrier to workforce adaptation, others are incentivised by employers to upskill. Workers are less likely to expect financial compensation for learning and acquiring new skills where there is a culture of continued professional development and support for workers to engage in development activities.

**Workers can find themselves 'accidentally' deskilled when systems become capable, but roles are not yet displaced.** Many are actively resisting narratives of 'upskilling' where they are allegedly being augmented, but experiencing reduced demand for their capabilities.

**There is a hollowing out of mid-level skills due to automation, raising concerns about younger workers not coming to learn the basis of mid-level activities/skills.** This creates a risk of reliance on steadily improving automation, as the future generation of leaders will not have secured the same experience to perform the leadership roles being performed today.

## System design and development

**Technology has the potential to support compliance with regulation, reducing complexity and saving time.** However, while regulatory Software-as-a-Service is available, SaaS is not designed to be a substitute for human and professional judgement, and not be compliant with all applicable regulations. Further, businesses lack the regulatory tools and levers to require providers to give them the tools to understand how systems work, or how to adapt them.

**Some ML systems can centralise decision-making in ways which reduces people's discretion about how to complete work.** This can delimit dignity in work by leading to employees at all levels within an organisation experiencing a 'loss of control'.

**Firms are concerned about using Generative AI in ways which could result in proprietary information being accumulated by digital giants and the 'bite back' that this may have on their business.** It also means that businesses are unable to adapt new tools as they need to. This is true for both for business performance and compliance, but also employee satisfaction.

**Employers lack the mechanisms and levers to secure the information they require from providers of systems, to be confident about how their use of them creates reputational, and legal risk.**

## Labour markets

**In keeping with our previous work, we find that local labour supply impacts employer strategies for adoption - not only in terms of the local provision of skills, but also in terms of labour shortages.** Predictions of automation impact should be more attentive to a) local labour market conditions and b) migration.

# Introduction

## Understanding the impact of new technology on work: A case studies approach

In the UK, accelerated by the COVID pandemic and the recent national shortage in skilled labour (House of Commons Library, 2023), there appears to have been an accelerated adoption of various AI and autonomous technologies (Hayton et al., 2023). These include the NHS's AI lab (NHS, n.d.), self-driving vehicles (Stagecoach, 2023), and warehouse robots (Morris, 2023). Alongside this trend, there are growing discussions on how new technologies such as AI, algorithmic management and robotic systems will revolutionise the world of work (techUK, 2023; World Economic Forum, 2023) and the experience and wellbeing of employees (Soffia et. al, 2024).

In general, opinions are divided into two camps. One stream of literature sees AI and other automation technologies increasingly capable of handling physical and cognitive tasks, which suggests that they can - and most likely will - replace many human workers in the labour market in near future. While the concept of "the end of work" has existed for decades (e.g., Rifkin, 1995), in recent years some of these writers made more pictorial predictions about the types and percentage of jobs that would be lost, ranging from a minor fraction to total job displacement (Jung and Desikan, 2024). While, in conventional belief, blue-collar jobs are perceived as one of the biggest losers to technological change, today commentators argue that new technology such as generative AI can have a greater impact on white-collar roles (Pearson, 2023), putting everyone in the labour market at risk.

On the other hand, another line of argument takes a more optimistic view and believes that new technology can - and will - create more jobs and new positions, and augment the work of millions of people (e.g., de Cremer and Kasparov, 2021). Writers advocating for this perspective highlight the unique capacities of human labour, such as flexibility (Liu, 2022), social relations with customers, and as embodied, living knowledge (Karakilic, 2022) – dimensions which are less likely to be effectively substituted by any software or robots. As a result, instead of job displacement, human workers should experience augmentation at work, whereby not only are their skills and productivity magnified and enhanced, but at the same time it is possible to offload repetitive, dull, and even dangerous tasks to AI or robotic systems. Consequently, in this optimistic view, the workforce may gradually reduce working time while maintaining productivity, and enjoy more meaningful, engaging, and healthy working lives (Garcia, Kikuchi and Stronge, 2023).

In truth, both sides of the argument contain some insights about the implications of AI and robotic automation. Both of these outcomes may occur, and the impacts may be unevenly distributed through the population, across occupations, and between demographic groups. However, there remains limited empirical evidence describing how people interact with AI and robotic systems in the workplace prior to, and beyond, potential displacement. To address this knowledge gap, we conducted 11 case studies in the UK across a variety of organisations and economic sectors, involving people working with intelligent machines and advanced robotic systems on a regular basis.

Being descriptive and exploratory in principle, our study aims to provide the following three contributions: (a) to document current practice in the workplace; (b) to provide, inductively, evidence for the contextual and socially constructed meaning and impacts of technology; (c) to document the critical contribution of management practices and employment relations in influencing the impacts of technology on jobs, work organisation and workers. The case study method helps focus attention on understanding the dynamics present within single or multiple organisational settings (Eisenhardt, 1989; Burawoy, 1998). A case study (or studies) is primarily qualitative, and can best reflect the complexities and contradictions of real life over a sustained period of time.

First, our documentation of current adoption practices in the workplace can contribute to a better understanding of how AI and advanced robotic systems affect people's working lives. Our discussions provide real-life examples of how these technologies affect the way people work and their work experience. For each of our case studies, we were able to speak directly to people who use these technologies on a regular basis and observe the organisational context within which they were implemented. This helps us to have an in-depth understanding of what aspects of people's work are affected, as well as how and why these technologies can affect their work experience. We find evidence of both positive and negative aspects of technology adoption; these subjective characteristics do not necessarily contribute to job creation or job loss therefore are relatively difficult to capture in economic statistics, but they are important factors in understanding people's working life and their well-being at work. Understanding workers' subjective experience requires an in-depth understanding of the work context as well as their labour process, which is best achieved through the types of case studies presented in this report.

Second, in line with our previous UK employers' survey (Hayton et al., 2023), we address the call for more empirical studies of the impacts of AI and robotic technology at the organisational level. Instead of seeing these new technologies as an objective, external force inserted in the workplace, which has a determining effect on the organisational aspect of work and can define the characteristics of an industry (e.g., Blauner, 1964), our study is theoretically inspired by studies of the interaction between the social world and the features of technology and context in which it is being deployed (Barley, 2020). Our assumption is that new technology does not deterministically or automatically improve or diminish the experience of work. Indeed, the same technology can have different impacts on different groups of actors within a particular organisational context, all depending on the interaction between actors and the technology in the workplace. This addresses past criticism of scholars who follow a linear diffusion model of technology adoption that ignores the subjective and context-dependent characteristics of technology adoption (Rogers, 2010).

Third, our case studies provide evidence of the significant role played by management philosophy and practice as a determining factor in experiencing the positive and negative impact of technology adoption. We provide multiple examples showcasing that implementing new technology can have both augmenting and diminishing effort in the workplace, and that management philosophy plays an important role in amplifying the positive inference and levelling off the negatives. Many predictions and speculations made over the last decades often see workers merely as receivers of change. However, in our case studies, we demonstrate the relevance of management and other organisational factors in navigating these changes. We hope our case studies can provide an empirical basis to promote positive outcomes and mitigate the negative impacts of technology adoption, helping the workforce to "reclaim" their future from the ideology of technology determinism commonly discussed in public and policy discourses.

# Research design, methodology and data collection

This research project is guided by four key research questions:

1. What motivates the implementation of new technology in the workplace?
2. What are the barriers to adoption and implementation in reality?
3. How does the implementation of new technology change the way people work?
4. How do new technologies impact work as it is experienced?

Addressing these questions can provide new insights into the risks and opportunities in a wider organisational and/or industry context. For example, the organisational risks associated with the implementation of new technology; the creation of new information asymmetries within an organisation that influence power and status; and the possible need for new governance and regulatory frameworks of technology adoption in the workplace.

We began our data collection in 2022, approaching nearly a hundred businesses in the UK, inviting them to take part in this study. We found them through a variety of means, including the data collected from our employers' survey, online resources (e.g., news and industry magazines), attending trade events, and professional networks. Eventually, about 12 per cent of our approaches to companies resulted in case studies.

For each case study, we tailored our interview questions to be more industry-specific, but none of these calibrations were the result of pressure or "pre-scripting" from our research participants. In addition, we allowed our research participants to decide whether or not they wanted their companies and themselves to be named in this study. Where they chose to remain anonymous, pseudonyms have been used to protect their privacy. This enabled our interviewees to express their real concerns or fears that they might have related to the use of the new technology in the workplace.

In all of our 11 case studies, we interviewed at least some employees in the company who were working with AI or advanced robotic technology on a regular basis as part of their jobs. Our aim was to interview at least one person in each case study who had some hands-on experience using the new technology in the workplace. However, in most cases, we were able to interview other stakeholders involved in the implementation of the new technology, including: (1) executives or senior decision-makers who decided to adopt the new system; (2) technology officers or developers of the system; (3) mid-level managers or supervisors of the employees. We also contacted unions and workers' representatives in some selected industries, yet there was no response from them. These interviews took place in-person and online, and were recorded and stored according to Warwick Business School's protocol for handling participants' personal data.

To strengthen the validity and reliability of our data, we have used multiple sources of evidence to triangulate our findings. For instance, we collected documentation related to the technology purchase process, attended team meetings, and conducted workplace observations to understand how these systems were set up in these workplaces and how

workers interact with them on a day-to-day basis. These visits also provided opportunities for us to have informal conversations with the participants about their everyday work experiences and struggles. The purpose of our case studies is to understand the real experience of how AI and advanced robotic systems change the way people work, and how workers experience these changes in reality.

We purposely attempted to recruit participants from across some of the most important economic sectors in the UK, including manufacturing, logistics, healthcare, and public sectors. Through talking to people directly involved in technology adoption, we are able to learn about the nuances in the workplace that affect people's work experiences and their well-being, as well as special circumstances that cannot be captured by other statistics or surveys. For statistical analysis of the adoption of AI and robotic technology in the UK, we recommend readers consult our previous publications published by the Institute for the Future of Work. https://www.ifow.org/resources/publications.

In the next section, we present 11 case studies of the implementation of AI and advanced robotic systems in the workplace (see Table 1). In some of these case studies, pseudonyms are used to protect the organisations' and interviewees' identities. Each case study ends with a summary of key learnings from the narrative, discussed according to one or more themes addressing our research questions. In order to avoid repetition, we shift away from describing some general properties of the technologies and focus more on insights that are more specific to the organisational or industrial context which a particular case was situated in.

***Table 1. Summary of Case Studies***

| Case Study (CS) | Technology | Organisation(s) |
|---|---|---|
| CS1 | Surgical robot (da Vinci system) | An NHS Hospital |
| CS2 | Digital Dictation System | An NHS Trust |
| CS3 | Algorithmic automation: MS Power Automate | A marketing research agency |
| CS4 | Generative AI (ChatGPT) | A tech solution company |
| CS5 | Logistic management software (SmartLogistic) | A charity shop network |
| CS6 | Collaborative Welding Robot | A vehicle safety equipment manufacturer |
| CS7 | Collaborative Welding Robot | A machine shop |
| CS8 | Collaborative Welding Robot | A construction steel manufacturer |
| CS9 | Robotic Process Automation (automation software) | A police force |
| CS10 | Agricultural robots (Antobot) | Growers and an agricultural robot developer |
| CS11 | Service robots | A service robot provider |

# Case Study 1: Surgical Robot - NHS Hospital

A shortage of skilled labour has long been an issue for the NHS, and the situation has worsened after Brexit (Nuffield Trust, 2022). Since 2019, the COVID pandemic has also created enormous pressures for healthcare systems globally, and England is no exception. The waiting list for hospital treatment in England almost doubled from 4 million in 2020 to a record 7.8 million in September 2023. While the NHS promises that the maximum waiting time for non-urgent, consultant-led treatments is 18 weeks from the day a patient booked his/her appointment, this target has not been met since 2016. Official statistics revealed that in 2023, more than 13,000 patients had to wait for more than 78 weeks for hospital care, with 282 extreme cases waiting more than 104 weeks.

In February 2022, NHS England set out a recovery plan to address the backlogs built up during the COVID pandemic, and one of its priorities is to reduce the time patients spend waiting for elective surgery. The target is that by 2025 no patient in England should wait longer than a year to receive their operation. According to Sajid Javid, the Health and Social Care Secretary at that time, an extra £700 million scheme will be invested in this plan to 'harness innovative technology to free up staff time so they can care for more people up and down the country and can get the treatment they need'. This emphasis on technology as a way out of the NHS care crisis was more recently echoed by Jeremy Hunt, Chancellor until July 2024. Against this background, the NHS trust in this case study seized the opportunity to invest in a da Vinci surgical robot, which is expected to increase capacity to deliver procedures and consequently shorten patient wait times. The da Vinci system was installed in May 2022 and the first robotic surgery on a patient was conducted in June 2022.

On a regular busy Monday in June, at 9:00 a.m. in the morning, the colo-rectal surgeon was briefing his (in this case the surgeon is male) surgical team about the procedure of the following operation inside the main operation theatre in an NHS hospital. Everyone was paying extra attention because it was their second robotic surgery on a living patient. The surgical team includes six key members: a lead surgeon, a surgical first assistant (usually a junior doctor), an anaesthetist, an operating department practitioner (ODP), a scrub nurse, and a circulating nurse. In addition, for this operation there were student nurses observing the operation process, wondering what a robot can do differently compared with a traditional open or laparoscopic surgery.

During an open or laparoscopic surgery, the surgical first assistant and the theatre nurses work alongside the surgeon, who stands next to the patient. However, it was not the case for this robotic surgery, as the surgeon was sitting behind a console at the corner of the operating theatre and had his head fully immersed into the system. Under the surgeon's control, the operation is mainly conducted by the robotic arms. However, the rest of the team remains next to the patient providing their assistance. During the operation, they see the live image of the endoscope displayed on the vision unit, and communicate with the surgeon through the microphone built-in to the surgeon's console. As we observed in multiple visits, a robotic surgery could take four to six hours, depending on its complexity, not dissimilar to complicated laparoscopic surgeries.

In recent years, robot surgery has become increasingly popular in the UK, especially for colo-rectal and gynaecologic operations. Surgical robots are not autonomous, but are manipulated by a surgeon who is able to operate at a console that provides a greater range of movement and dexterity that would not be possible in laparoscopic or open surgery. In this sense, they are augmenting the skills and capacities of the surgeons. Robotic surgery can also bring a lot of benefits to patients and the healthcare workforce.

Firstly, as the lead surgeon shared his years of experience with us:

> *Doing laparoscopic surgery is really uncomfortable. It is not ergonomically sensible… there is a significant rate of occupational injury and long-term illness associated with surgeons' necks and backs and shoulders, and hopefully operating on a robot where you can sit comfortably and you know it is all ergonomically set up should avoid that.*

Commenting on the benefits for patients, he said:

> *[the advantage of using a robot is] it is all held very still. This means less abdominal wall pain because you [the surgeon] are not pulling on the ports that go through the patient's tummy wall, […] the recoveries are meant to be quicker from that point of view, even than standard laparoscopic surgery.*

Seeing patients recover better has a very positive impact on healthcare professionals' sense of achievement, as theatre nurse Meranda described what she sees in the ward:

> *When you do an open surgery, the patient stays in bed for days; for laparoscopic surgery, they can sit up the next day; and for robotic surgery, you can see them walking the day after. […] You know that the theatre practises are very driven by the fact that patients are getting safe, good*

> *operations with really good outcomes. And so that comes with its own set of mental well-being benefits, doesn't it?*

Another benefit to the healthcare workforce related to introducing a new technology at work is receiving new training and, consequently, the opportunities for upskilling. In particular, for the safety of the patient, and to ensure their knowledge is up-to-date, healthcare professionals have constantly received on-the-job training provided by the NHS as part of their Continuing Professional Development. The opportunities to learn and apply new skills are generally considered a favourable job characteristic.

To help surgeons better prepare for robotic surgery, the hospital management came up with a policy that allows them to be more flexible in taking shifts and other theatre duties. The surgeons we interviewed agreed that good management support is essential to the success of the implementation.

As the lead surgeon told us:

> *We are lucky in that we have got the support of the department in being able to do it, once we have got the proper green lights for the first case is to happen that week, then I am going to be negotiating with our manager, which sessions I cannot do, so I can do the simulation training and that kind of thing.*

However, while the surgeons we interviewed felt they were well-supported by the hospital to participate in the training programme, some theatre nurses shared their opinion that they only received 'minimal amount of training'. One reason for this appears be the significant shortage of theatre staff in the hospital. Commenting on the difficulties of sending theatre nurses to attend training for robotic surgery, the General Manager told us, "our trust has 25 whole-time equivalent vacancies for trained staff… So there is a significant stress on the manpower and staffing in theatres as well." The implication of this is that theatre nurses who were not receiving robotic training were shouldering more workload when others underwent training before the robot was put into clinical use.

This workplace arrangement has upset some of their colleagues, as one nurse said:

> *So just at the time when you want your surgeons to be doing as many long waiting cases, …, we are deciding that we are going to undertake robotic training, […which] ties up two of our surgeons for one patient all day and a whole team. …They are a scarce resource, and we are focusing our time on their training and development as opposed to the routine of keeping the wheels of the bus.*

Moreover, there are also some unpredicted negative impacts on healthcare professionals' work experiences, namely due to the pressure of doing new, unfamiliar operation procedures using the robot. In the first month after the robot was installed, when we asked the surgeons to comment on their performance doing robotic surgery, Henry told us:

> *I am quite good at doing keyhole surgery via laparoscopy, and I have not been able to do robotic surgery properly for a while. So I am feeling unconfident and concerned and probably irritated about why I am doing this more difficult [robotic] operation when I could do a less difficult*

> *[laparoscopic] operation. […] And I know that that concern will obviously run through all of the theatre practitioners, and they are all worried about learning new skills and changing current ways of working.*

In a similar vein, when the surgeons were asked if he felt less fatigue when doing robotic operations compared with doing a laparoscopic surgery, he replied:

> *Physically, yes, it is more comfortable to do robotic surgery, but mentally, it is more draining. I spent my whole night rehearsing the procedures in my head last night and when it was done, I went straight to bed for six hours.*

In addition to the anxiety, from our interviews, we found that the new operation procedure introduced by robotic technology also has a negative effect on theatre nurses' work satisfaction. This is because the robot has taken over their roles in the operation theatre: once the robotic arms are attached to the patient, the scrub nurse is no longer involved in the operation procedures, yet they have to stay in the operation room for hours as an insurance policy in case the surgeon decide to switch to laparoscopic or open surgery in the operation rooms. All scrub nurses that we interviewed felt the robot was devaluing them in the operation theatre; many used 'boring' to describe their feelings when assisting with the operation. As one theatre nurse described, 'it is tiring to stay focused during the operation, it is even more tiring when you have nothing to do, and you cannot help but think about when is this going to end and when can I get my coffee.'

Lastly, we spoke to the scrub nurses who felt their work had been devalued by the robot and asked if they would consider taking up further development opportunities to shift their roles in the operation theatre, for example, to become a surgical first assistant. This is a specialised position of assisting the lead surgeon in the operating room during a surgical procedure, replacing the role normally filled by a junior doctor but without being a doctor. All of them have heard of this career option, but none shows any interest. One senior nurse said her age is a barrier to continual education and suggested speaking to the junior nurses. A scrub nurse explained:

> *The course takes six months, it is an intensive programme and you have to do essays [...] I have to pay £700, and I have to take fewer shifts for my studies, which is another economic cost. This is not something I can afford to do now.*

Every year, this hospital undertakes about 250 bowel operations. By the time this article is written, the colo-rectal surgical team has conducted about 50 major robotic operations and about another 50 more minor robotic procedures such as hernias, gallbladders and hysterectomies. It is expected more operations will be conducted by robotic methods in the future.

In this case study, the implementation of the da Vinci surgical robot has three major benefits: (1) improved occupational health of surgeons, (2) improved morale due to better patient outcomes, and (3) upskilling. However, these impacts are shared unevenly among the workforce; while surgeons feel more supported during the adoption process, other members of the surgical team, such as scrub nurses, feel less satisfied with their jobs because the robot takes away some interesting aspects of their jobs and they are left

with some comparatively boring tasks that they did not have to do before, and they see themselves as being less invested by the organisation.

Also, some nurses we interviewed think that the adoption of the surgical robot makes their role less important and valued. While these nurses are aware of the opportunity to be trained up as surgical first assistants, many of them struggle to take these training programmes due to financial or personal reasons. Past studies suggest that surgical assistants can play a vital role in the effectiveness of robotic surgery (Nayyar R et al., 2016), we believe that providing more support to nurses facilitating their career transition can contribute to better overall surgical capacity and surgical safety in the NHS.

# Case Study 2: Digital Dictation System - NHS Hospital

Ramji, a paediatric consultant at an NHS network, has clinical sessions every Tuesday, Wednesday, and Friday in a week. His consultation hours begin at 10am in the morning, but he always arrives two hours early on Friday to his office to write up the consultation letters that have accumulated throughout the week. Instead of using a pen and paper or typing on his laptop, Ramji uses a digital dictation software that is specifically designed to transcribe medical terms. Since 2020, NHS England has implemented various digital dictation and speech recognition systems as one of their digital workplace solutions. According to the NHS England's website, they believe that this software can bring a lot of benefits to the workforce and NHS operations, including a reduction of document turnaround time, saving valuable time for staff, streamlining the document management process, and improving staff productivity by allowing secretaries better visibility of staff workloads. In this case study, the research team focuses on the digital dictation system (hereafter, DDS) used by consultants within one NHS network.

The DDS software is currently being used on many occasions, for example: at the weekly multi-disciplinary team meetings (MDT meetings), where physicians have to discuss 50 to 60 patients in an hour. Before the software was implemented, physicians and their medical secretaries would write everything down on paper themselves, and it was the secretaries' job to document everything during the meeting into an official record. This record was then sent back to the physicians for their editing and final approval.

The DDS software is also being used at clinics to help physicians write complex letters. In the past, physicians used a recorder to record their diagnosis, and this was then passed to their

secretaries for writing up into a complete medical letter. The physicians had to verify the letter and make revisions if needed. This turnaround usually took at least three days before the letter was sent out to the patients or other NHS service providers (e.g., a pharmacy). In some cases, physicians we interviewed reported that it took up to two weeks for them to finish these letters.

With the new DDS, physicians can dictate their letters during or after the consultation. The software can recognise their voice and transcribe the letters as they speak. Physicians then proofread and edit their letters and then send them out to the patients. Without any delay, the patients can receive their diagnosis letter and medical secretaries no longer have to be involved in this process. It is also believed that the DDS will, in the near future, connect with the NHS' Electronic Patient Records system, so that other GPs or pharmacists will be able to access these letters more easily.

At first glance, DDS software can take over the writing up process and shorten document turnaround times, making physicians more efficient at work. However, it also impacts on the physicians' work experience in other, perhaps unanticipated ways. Firstly, as physicians now are responsible for drafting and editing their own letters, some report that they have to reduce the number of patients they can see in a clinic session due to the extra time needed to create, edit, and send out these letters. Although there is a function for the physicians to dictate their letters and then send them to their secretaries for editing, all ten physicians we interviewed hesitated to involve their secretaries in this process because they believe that the purpose of implementing the DDS is to reduce the workload of the secretaries. As Ramji said:

> *I think if we had more admin resources it would help with some of the frustrations with the current system [DDS]. It would get rid of all of it, … I am more than happy to do the dictation bit, [but] it is the tidying up and making the format and the addresses doesn't really need a consultant.*

Moreover, the software is designed specifically for medical professionals, therefore it is very good at recognising complicated medical terminology. However, because these letters are sent directly to the patients, the hospital encourages physicians to use simple, everyday language so that the patients can understand their diagnosis better. This is a problem because the software is comparatively not good at recognising simple, everyday conversational language.

Mr Taylor, a urology consultant gave us some vivid examples: in one case, 'you must have been a lot' was recognised as 'you masturbate a lot', or in another case, 'you're in pain' was recognised as 'urine pain' - both 'masturbate' and 'urine' are very common medical terms in urology, but can cause serious misunderstanding when they are being used under the wrong circumstances.

For this reason, physicians have to pay additional attention to their letters to avoid miscommunication, and some physicians we interviewed find it stressful as they think it is difficult to spot their own mistakes and edit their own letters. As a result, some of them, including Ramji, prefer leaving their clinic letters until the end of the week and proofreading them all at once, which slows down the delivery of letters to the patients. A few physicians think that editing and correcting their own letters is not the best use of their clinical hours,

but there is little support to help them with the process. This is particularly the case for physicians who write complex diagnosis letters rather than standardised letters. Thus, a form of resistance is created as a result of adaptations by those using the system, and this unanticipated resistance has partly undermined the expected productivity benefits.

For medical secretaries, although the DDS helps relieve some of their workload, at the same time it cuts them out of the communication chain, so it becomes more difficult to follow up physicians' work than before. One example was given by medical secretary Esther, who said:

> *In the past, when I was writing letters for a patient, I learnt that this particular patient needed to book a blood test or needed other follow-up actions. But now since the letters are not sent to me by default, very often physicians might miss arranging follow-up actions and nobody is aware of this.*

Every physician interviewed believed they should not bring their secretaries back for these letters because they understand that their secretaries are overworked, so eventually this could turn into a no-win situation when physicians struggle with their letters and hesitate to seek help, and their secretaries struggle to step in and offer their help to the physicians. Because physicians and their secretaries were not involved in the decision to adopt this DDS, some of them find this situation particularly difficult as they were not prepared for all of the potential drawbacks.

In some interviews, physicians mentioned the functionality problems of the software, which they cannot fix at the user's end. While the DDS claimed to be AI-powered, a few physicians pointed out that the software failed to learn terms that were regularly used by them. For instance: in their letters, the name 'University Hospital' is always used in upper case, but the software will always use lower case and there is no way to change this other than manually.

Physicians who are not satisfied with the software mentioned that they have reported these issues to the hospital's IT department, but since the DDS is a third-party software, there is little they can do to help with improving functionality. A few physicians said they feel their voices are not valued by the management, because as end users they were not consulted when implementing the technology, and they were seen as 'failed to keep up with technology' by the management when pointing out their concerns.

In summary, opinions on the DDS software are very divided. Those physicians who are happy with the software agree that the DDS can help increase productivity and deliver better healthcare service. However, other physicians and medical secretaries think that the software brings more challenges to their everyday work. Although the software could help them deliver the letters sooner, it also has a negative impact on their work experience as they feel they lack support and their voices are not being valued in this digital transformation process.

In this case study, once again we see that the benefits of technology adoption are unevenly distributed within healthcare professionals. However, this is not only due to their occupation roles or demographics, but also the tasks they are dealing with every day at work. Physicians who write comparatively more standardised letters tend to be more satisfied with the software than those who write more complicated letters. To help maximise the benefits of technology adoption, consultation with workers, as users before, during, and after the implementation process is essential, so that adjustments can be made according to the

needs of different practices. For instance, some physicians suggested that having two different software packages installed could give them the flexibility they needed to handle different writing tasks.

# Case Study 3: Algorithmic Automation - Market research firm

Business marketing today often involves collecting, storing, and analysing customers' data. In the UK, these activities are currently regulated by the General Data Protection Regulation (GDPR), which companies must comply with. Any infringement could risk damaging a company's reputation, a temporary or definitive ban on business, or a maximum fine of £17.5 million or 4 per cent of annual global turnover - whichever is greater. For multinational companies, there is usually a legal team dedicated to overseeing how customers' data is handled. However, for small and medium-sized enterprises (SMEs), the GDPR can create a series of challenges for their business operation, as they have fewer compliance resources.

Juliet, who is a market insight analyst, works for a marketing research company that involves handling and processing customers' personal data on an everyday basis. It is a London-based SME, with the majority of employees working as market researchers and a small operations team to support the business, handling IT and legal tasks. The company conducts surveys and focus groups across a range of industries, including healthcare, telecoms, and gaming. For the healthcare research in particular, there are increasingly complicated legal requirements to protect participants' privacy, including what personal data the company can collect and store, and for how long. During the COVID pandemic, this company moved its business operation into 'the cloud' and at the same time introduced Microsoft (MS) Power Automate as a tool for streamlining projects and to improve collaborative working. MS Power Automate is an algorithmic automation software which has a built-in AI builder to help develop models tailored to a business' operational needs. In this case, the software also helps reduce the risk of human errors when dealing with the GDPR requirements.

In the past, in order to create a job request to the operation team, Juliet had to write down her request on a shared Excel spreadsheet, then someone in the operations team would follow up, and they communicated face to face or through exchanging emails. Now, using MS Power Automate, Juliet submits her job request to the software and the pre-set algorithm will create a "project" on the company's MS Teams channel with a unique job number assigned to the project. The algorithm will also copy a certain set of files into that project and send out emails to inform other team members that a new task has been commissioned. The algorithm is also connected with other MS products that the company is using, such as MS Power BI to create a system of automation from requesting a job and communicating with colleagues, to extracting and visualising data.

With new technology comes new needs and opportunities for upskilling. Following up job requests and doing administrative tasks used to be a vital part of the on-the-job training for new employees to help them understand more about the company's business operations. With the new automated system, these in-house training activities are even more important. As algorithmic software was new for Juliet and her colleagues, her company organised a series of training activities. They ran an intensive graduate training programme for newcomers, as well as quarterly team training days and some ad-hoc 'how-and-why' demonstrations to keep employees updated about what resources are available to them. Debby, an Insight Consultant, told us how important these training activities were to herself and her colleagues:

> *There are a lot of people just not aware of the functions available. Actually when you start looking at it there are a lot of functions available, and unless someone shows it to you and you see the benefits in it, you just don't know about it. So maybe [they] know about it, but they are too confused about how it works, so if someone is feeling time pressure, they don't really want to look out for something that they are not familiar with, they will just go for their normal habit, because they know how long it takes for them to get the result, whereas using new functions can make you feel it takes longer as you are not familiar with it.*

These training sessions were usually done by a more experienced colleague, who walked through the software's functions with the rest of a team. These sessions were recorded and then shared with other colleagues. Those who participated in the sessions were given a token or a prize at the end to encourage participation.

According to our interviewees, there are at least three advantages to adopting this automation software: the first is the standardisation of work and the elimination of personal errors. In this case, when Juliet creates a new project, her MS Team's channel will always have standardised information about the client, providing all the files they need (e.g., cost forms, service agreements, policies, etc.). Without using the software, each of her colleagues had their own way of extracting data and organising files, which could cause discrepancy and confusion. This standardisation is especially important for the company's newcomers or colleagues who are newly assigned to the research team. Moreover, no matter how conscientious, people make mistakes and are sometimes forgetful. As Steven, the Head of operation said,

> *[The shift to automation] means you don't have to just email people and tell people things… It takes some of the natural forgetfulness out of things because there are many.*

The second advantage is speeding up and streamlining the process, and having more control over their business. Before Power Automate was implemented, a job request was written on a shared Excel spreadsheet in any format and handled differently according to individuals' practices. It also took time for a colleague to hand over and follow up a job request manually. With the automation algorithm, when a project is finished, it will automatically advise the company's accountants that it's been delivered so that they can start preparing the invoice. The algorithm also automates the archiving and sets restrictions, so that employees without access rights cannot amend the data once the project is completed.

Commenting on the impact on his colleagues' work experience, Steven believes that:

> *We allow the people that are actually dealing with clients and bringing in the money, we allow them to focus on the things that actually add value. Rather than the administrative stuff and the legal stuff, and that, you know, someone still needs to do them, but if they're going to do it, we want to make it easy for them as they can.*

Automation can help to manage the risk related to GDPR regulations if it is designed to do so. Within six months of personal data being collected, the company has to ensure that there is no personal information left in its database. In this case, the algorithm is set to create a reminder six months after a project is created, and will advise the project manager that the data needs to be cleaned and if any follow-up is needed. Also, this standardised process can ensure all customers' data is handled according to the legal requirements, in the event of data auditing by the authority. As Steven said:

With increasing legal requirements, there are so many forms you have to complete, particularly when we are doing healthcare work. So, this basically reminds people that they need to do these things and it can check if they have already done them. When we do our job, for example, it has records of whether some of these things have been completed. So, we can, if a project reaches a certain stage and this hasn't been done, then you can sort of flag up in a big red warning that you should have done this now.

When talking about the challenges of implementing algorithmic automation in this company, and how well it is perceived by his colleagues, Steven said:

> *For many younger, more junior people in the business, it is almost completely natural [...] OK, that is how it works, we have a robot sending us emails, it is not a shock to people. But we have some more experienced people joining the business and saying "I have never seen anything like this in other businesses." [...] But I think it is just about how we communicate. I am approaching 50, and I've been doing market research for lots of years and using the Internet, working in the cloud was just crazy. That was science fiction. [...] but it doesn't take long [for his more experienced colleagues] to adapt.*

However, despite being more adaptive, Steven also expressed concerns about his junior colleagues:

> *More of the younger, the new workers take these things for granted. [...] My fear is they would go to a new company, which might not have a system like this, and they wouldn't think to do*

*the steps that were previously automated. Because for them they went from A-Z, whereas there were actually steps in between.*

In this case study, the implementation of MS Power Automate affects everybody's work, especially for tasks dealing with personal data. It can be said that all of them can benefit from the standardisation of work, as well as the productivity gain from using the software. Our interviewees are more satisfied at work because the software can free them from tedious tasks and provide them with more free time at work. However, while junior people in this company are very good at adapting to the technology, they can also be seen as the most vulnerable, because many tasks that used to be assigned to junior people are now given to the software. In this regard, on-the-job training provided to both junior and experienced workers becomes ever more important to ensure they are equipped with the right skill sets and knowledge to contribute to the business operation.

During the research period, we did not see any workers being substituted by the software, yet it is believed by the management that using the software can reduce the need for hiring as there are fewer tasks needed to be done by human labour.

# Case Study 4: Generative AI - Technology solutions firm


Catherine is an account manager working for a small software development company in England. She and her colleagues develop applications and digital solutions for businesses, charities, and social enterprises across the UK. About six months ago, Catherine adopted generative AI (i.e., ChatGPT) to assist her with her work. She shared how she is using generative AI in her workflow.

Catherine is currently building a website for a plumbing and heating firm. The website contains pages of information specific to every town and village across the local region. Her previous practice was to ask the client to prepare the copy, which could be a problem because the clients might not have good writing skills. In some cases, Catherine had to draft some examples of content for them or outsource this task to an external professional copywriter. Now this is done by ChatGPT to generate the required content.

Catherine also uses ChatGPT to create social media posts for a client who produces foundation screws for buildings. She prompted ChatGPT to produce a humorous post, including at least one joke and a pun based on the business idea (i.e., using these two-meter screws into the ground to anchor a building, instead of putting in concrete foundations). ChatGPT then came up with phrases like “don’t get screwed over by using expensive concrete” and other puns that are ready to be posted on social media. She also asked ChatGPT to tailor for the different platforms such as Facebook, LinkedIn and Instagram.

Catherine also uses ChatGPT to support email communications between account managers and clients. As she said:

> *Some of the most awkward of the emails, you know, tricky customer communications - maybe they're not happy about something, maybe there are unexpected costs that they have come up and that you need to talk to them about - I used to find that it would take a very long time to craft those emails really well, but I've got ChatGPT to give the bullet points. An email that would have normally taken a long time because you've got to get the tone right. It gives me the first draught and then I can just tweak it and it'll probably save half an hour to 45 minutes.*

In addition, we also interviewed Catherine's colleagues who are software developers in this company. ChatGPT is now used to support software development. ChatGPT can correct mistakes in the code and even suggest the next five or six lines of code in programming. In a similar vein, it can be used by Alice, the UX designer, to create user personas in a project. It was a time-intensive task with a lot of research and writing (from 30 minutes to an hour for each one). Based on a template with some small input, ChatGPT will create a whole story around a user with minimal editing to simulate targeted users' experience in a few minutes. Alice added:

> *It just kind of frees up time for the things that I should really be focusing more time on anyway, puts more time into the design, the creative side of it, rather than having to do too much into thinking it through and the research type of thing.*

When we discussed the value of human labour in their business, all interviewees in this case study believed that they would not be replaced by generative AI easily. As Peter, the company director said:

> *I've been doing what I've been doing for 20 years now, and 20 years ago you could not build your own website. You needed people to learn the code to use the tools to do it. But for today, I would say even with Squarespace and Wix [websites for DIY web design] and all that, people can't do a good job at creating websites. You still need that craftsmanship to do it.*
>
> *I would always go back to the argument that everyone can fit their own bathroom if they want to. You can go to B&Q, you can buy all of the parts, you can do all that. But if you flood your house, only you're to blame. However, if you bring in a professional to do it. They're going to use the same parts you can go buy at B&Q. They're going to use them in the same way, but they're going to know how to do it and what to do if it goes wrong. And that's what the skill you're paying for. You pay for the plumber to come and do that because they have the skill and knowledge to do it.*

In this company, humans are gatekeepers for the content generated by AI and they have to watch out for hallucinations. AI models like ChatGPT are trained on data, and they learn to make predictions by finding patterns in the data. However, if the training data is incomplete or biased, the AI model may learn incorrect patterns. This can lead to the AI model making incorrect predictions, which is hallucination. In general, the hallucination rate of AI models varied from 2.5 to 22.4 per cent (GitHub, 2024).

Our interviewees are aware of the fact that ChatGPT is capable of making some very convincing but incorrect arguments (i.e., hallucinations). Therefore, human expertise remains important to the business operation.

As developer Benny shared,

> *We asked one client to supply the content for his new website and he came back within about half an hour with, you know, about 50 pages of content and. I have my doubts as to how well that could have been fact-checked. And I find that it absolutely needs to be checked, reviewed, to fit the requirements. But if it wasn't thoroughly checked, there's potential for having incorrect information put online."*

When Benny was asked whether the need for fact-checking gives him more workload, he replied:

> *It's definitely saving time rather than creating time because there's not that many facts, it's more just like persuasive writing, which is, basically, if you read it and it feels right, and it feels easy to read and understand, then it's doing the job. So, there's not as much checking required.*

Although the overall experience of using ChatGPT in this company is generally positive, the interviewees also mentioned some concerns related to the potential risk associated with the technology. The primary concern is data privacy and the potential of leakage.

When talking about what data they input to Chat GPT, Peter described how he had to be extra cautious:

> *At the moment, we haven't used it for anything where we're giving it proprietary information. The closest we've come to that is using it in source code generation, where it's learning from the project we're in. However, it would be learning from that same source code anyway, because we're submitting it to repositories, which we know submits off to these engines anyway.*
>
> *And so actually at that point, we're kind of feeding it regardless of how we interact with GitHub or GitLab or whatever, because that information will be used to train those models. So, we're not giving it anything it wouldn't already have access to. And in the case of anything we're doing with clients, we're not feeding any information that isn't already publicly available anyway. [...] when we get to the point of starting to maybe identify individuals and actually starting to use it to process data, there are data privacy concerns around that, [...] anything that actually involves client information, we'll have to think about how we sandbox that and how we make sure that it does not form part of a wider knowledge bank, and we're not training AI based on that information.*

In this case study, our interviewees shared with us how useful generative AI (large language models, LLM) could be to their business operations. Overall, despite the fact that the technology is not yet faultless, it helps improve their work experience, by supporting their code writing and their communication with clients. The increased variety of tasks at work can also be considered as another positive impact. However, there is a loser in this case study: the copywriter who used to write content for this company has now been replaced by ChatGPT.

In addition, our interviewees also told us that the precondition for such successful adoption is technology literacy (i.e., writing the right prompts). In order to keep themselves and their clients up-to-date, Peter started multiple WhatsApp groups to share news and techniques of how to use ChatGPT with his co-workers and his clients. Our interviewees also mentioned how the company encourages them to explore the AI system

to gain some hands-on experience with the software. At the same time, however, our interviewees are well aware of the limits, which is not to share proprietary data with the software to prevent data misuse or data leakage. By the time this report is written, there have been many debates on generative AI and intellectual rights (e.g., Reed, 2024). These concerns must be addressed before a wider application of generative AI in our economics and should involve not only legal experts, but users and stakeholders in society.

# Case Study 5: Logistics management software - Charity shop network

David is a van driver who works for one of the largest charity retail networks in the UK. This charity network has over 200 charity shops across the country, employing over a thousand staff and volunteers working from accepting donations to transportation and storage, shopfront retailing and customer service.

For many years, this operation had always been a paper-based, manual process: first, a customer contacted a local charity shop describing what they wanted to donate. A member of staff then asked for the size and condition of the donation and scheduled a date for picking it up from the customer. All of the information about this order was written down on paper, which was then passed down to David - or one of the other van drivers - who were responsible for collecting all the donations. During this trip, David also needed to deliver what other customers had ordered online or at the shop, and he had to devise his own route to complete multiple pick-up and delivery orders in a day. At the end of the day, David was paid according to the orders he had completed in a day; however, occasionally, a store manager would pay him some extra money if the task he did was particularly difficult (e.g., helping collect/deliver heavy furniture to a higher floor apartment), as an additional payment to the driver's extra effort in the collection/delivery process.

In 2023, the charity's retail network implemented a new intelligent system – SmartLogistic - to digitise this process. During the initial phase, a few shops were selected across the country to use the new system for processing customers' bookings and managing van drivers. Instead of filling out a paper form, a staff member now submits the donation details to an online, centralised management system, which can calculate and suggest

the most efficient route for a van driver to pick up donations and deliver goods during the day. A tablet is given to David and his colleagues in the fleet, which shows them their tasks of the day and suggests the route they should follow.

SmartLogistic works according to a points-based logic. For example, the maximum capacity of a van is 20 points, where picking up a piece of large-size furniture gives the van 5 points, and delivering a medium sofa to a customer takes away 3 points. From a management perspective, SmartLogistic can provide the most efficient solution when scheduling drivers' daily tasks and managing their vans' space. Another feature of the software is that it can track a driver's location. When a driver accepts a task on his/her tablet and heads to the pick-up location, a text message will be sent to notify the customer that the driver is on their way. This helps facilitate communication between store staff, drivers, and customers.

While the SmartLogistic system is deliberately designed in a way that is easy to use, some drawbacks are found during the implementation process, mainly concerning the loss of control in daily operations. For instance, while in principle, the charity network could never reject any donations from the local community, in reality, a shop manager had the discretion to turn down a donation if there were many similar items in storage; or to delay the pick-up to weeks later to allow freeing up more storage space. This is not possible with the SmartLogistic system because once it receives an order, it will schedule a pick-up automatically that cannot be amended by either the shop manager or the van driver.

Moreover, sometimes David felt frustrated following the route suggested by SmartLogistic, because he believes he has much better knowledge of local traffic and knows when to avoid certain routes during busy hours. In some cases, SmartLogistic would suggest David collect one donation before delivering another, which might work according to the points-based logic but is very difficult in reality. As David is well aware of the surveillance and geo-tracking by his tablet, he feels he has no choice but to comply with the instructions suggested by the system, despite not necessarily agreeing with it. Moreover, David no longer receives additional payment for the difficult tasks as he used to, because the payment is now made fully automated by SmartLogistic once a task is completed; shop managers are no longer involved.

In summary, from the van drivers' perspective, the implementation of the SmartLogistic system has a negative impact on their work experience, as now their autonomy and ability to take the initiative at work are much reduced. One of the principles of good work is to promote workers' autonomy and their ability to take part in determining their work conditions (see Institute for the Future of Work, 2018), and this algorithmic management seems to be restricting rather than augmenting this.

Meanwhile, from the charity's perspective, the implementation of the SmartLogistic system has successfully lowered logistics costs and made these processes more transparent to managers. The key factor in this case study is how much the cost saved through the implementation of the software is then invested in improving other aspects of van drivers' work - for instance, providing them better pay or more job protection, further training, or other career development opportunities. It is expected that the charity network will continue to involve more of their shops to participate in this digital transformation. In the long run, the demand for human workers such as telephonists is expected to be lowered, and shop staff could shift their roles to provide better customer service.

# Case Study 6: Collaborative Welding Robot - Hope Technical, a vehicle safety firm

Chris and Will Hope run a family-owned SME called Hope Technical, located in Littlehampton, West Sussex. It is one of the leading manufacturers of vehicle safety equipment and accessories for vans and trucks in the UK. Hope Technical sells its products directly to customers online, but its main source of income comes from taking large quantity orders from its business customers, who operate some of the largest courier fleets in the country.

To fulfil these large orders, from time to time Hope Technical needs to employ a number of skilled welders. However, the Hope brothers found recruiting skilled welders very difficult in the local area. Indeed, there has been a national shortage of experienced welders for more than a decade. According to one estimate, the total number of welders in the UK has fallen by a quarter in five years and half of the nation's welders are expected to retire by 2027. Those welders who are currently working for Hope Technical are ageed from mid-40s to 71. Therefore, in 2023, they decided to invest in a collaborative welding robot – 'cobot' - in one of its workshops in Littlehampton to automate some of its welding work.

Once programmed and set up correctly, a cobot can weld two to three pieces of a product in a single run - an increase in efficiency and productivity compared with manual welding. Removing the human factors of manual welding, the cobot also offers greater weld consistency and quality for large-volume production. A perceived advantage of cobots is that, compared to full-scale industrial robots, the set-up is easier and can be done by an experienced welder or a welding engineer with some basic programming knowledge. In

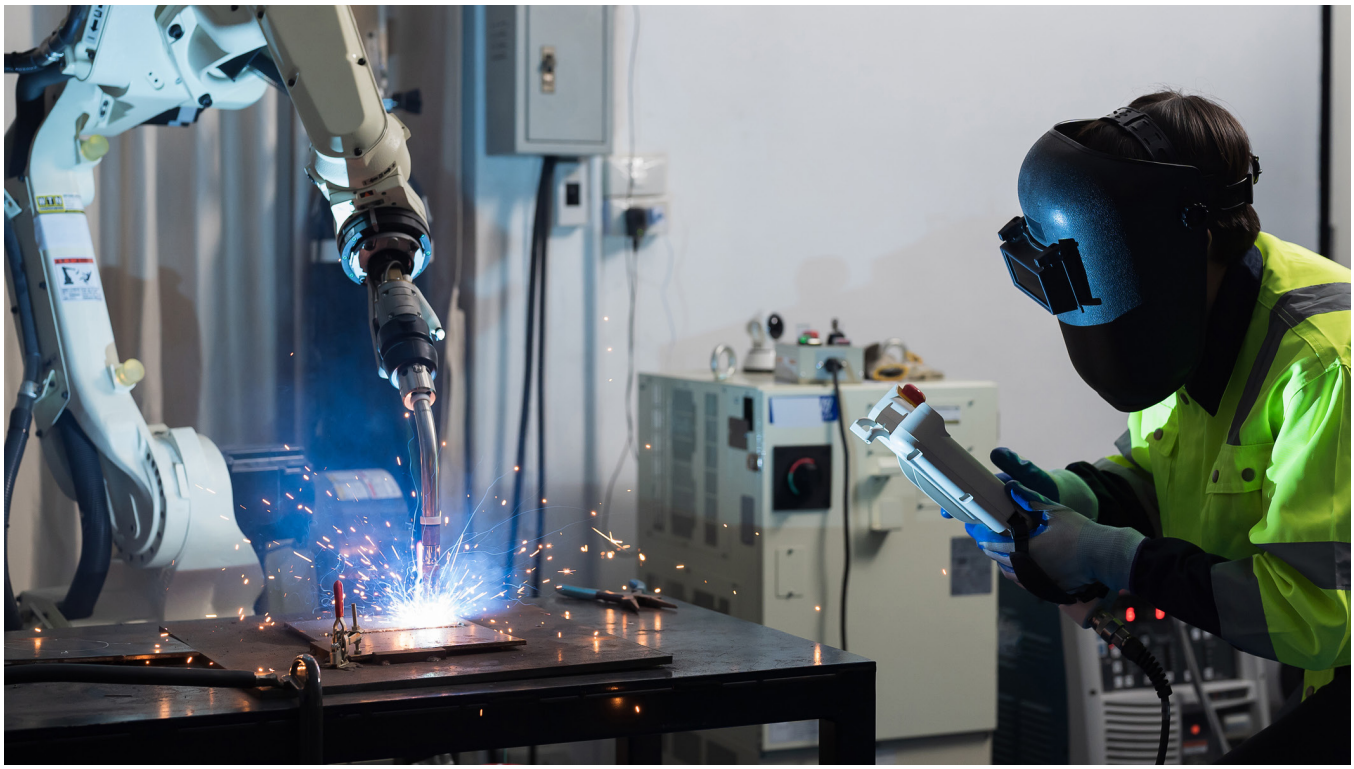
reality, not every welder has the technological literacy to do this set-up work.

From a management perspective, a benefit of implementing a cobot is that it can lower the demand for manual labour in the production process. As a result, the Hope brothers can have more flexibility in managing their welders and honouring their requests for annual leave. They also believe that the cobot can free up welders from repetitive tasks and enable them to work on other non-routine tasks, which are perceived to be more interesting by the welders. From the perspective of the workers, the cobot can improve occupation safety as the welder (i.e., cobot operator) can control the cobot using a tablet at a safe distance from the welding table. This helps prevent minor injuries such as burning which is very common in manual welding.

After the cobot was implemented, we spoke to the welders to see how their jobs had been affected by the cobot, and how they see the risk and value of human welders compared with cobot welding. Instead of feeling they are at risk of replacement by automation, most of them are very optimistic about their future. For instance, skilled human knowledge is essential for setting up the welding robot correctly and designing and redesigning production processes. Producing a piece of equipment often involves multiple steps of metalwork (e.g., metal welding, folding, punching). Because the metal needs to be fixed on the table in order to be welded by the cobot, the production process needs to be designed in a way that can suit the robot. In comparison, manual welding offers more flexibility in the production process and is more cost-effective in a small patch production because a cobot needs to be programmed for each new job. Most importantly, a few welders told us that to achieve high quality production, an experienced welder is needed to supervise and calibrate the cobot during the robotic welding process. This is especially the case for welding aluminium: unlike steel, aluminium does not glow in the dark when it is heated, but its metallic nature does get affected. An experienced welder can ensure the aluminium is not overheated during the welding process, and this supervising role cannot be easily automated without making other significant investments in automation technology in the workshop. This theme is consistent among our three welding robot case studies: welders believe that their experience is essential to make cobots perform.

In this case study, we understand how humans and robots contribute differently to welding practices. While the welding robot is particularly good at welding small and repetitive products, human welders are more flexible, and can easily adapt to many different types of products and work sites. After speaking to all welders in this company, younger welders comparatively tend to be more engaged in the process of learning and working with the robot; older workers may not have the technology literacy required to get to grips with operating the robot. However, our interviewees believe that there will always be a need for skilled welders, especially those who are able to supervise and calibrate these machines.

# Case Study 7: Collaborative Welding Robot - Westholme, a specialist machine shop



In this case study we look into the implementation of welding cobot into a very different business context. Ray is the owner of a machine shop and fabrication service provider located in Darlington, Durham. His company, Westholme, specialises in producing replacement parts for offshore oil rigs and windmills in the UK and Europe. It is the supplier for major energy companies. Ray's business is sustained by taking high-value, small-quantity orders from energy companies and it prioritises quality in its production. Currently, he employs four full-time welders with top-tier skill sets. Two of the four welders are under 30 years old, and all of them have more than 10 years of experience in welding with one welder with an inspector qualification.

In 2023, Ray decided to invest in a collaborative welding robot (cobot) as a strategic decision in business development. He believes that investing in a cobot displays confidence to his clients and shows commitment to maintaining production quality. He also sees that installing a cobot in the workshop makes his welding team feel valued and invested in, which can improve morale and job quality. At the moment, the cobot is being used to build prototypes and to produce some small parts but not yet for large production runs.

As Ray told us, after the cobot was introduced, his welders had the opportunity to learn new skills such as how to programme a cobot. In addition, the programming process helps them to reflect on different ways of welding, making them more knowledgeable. When speaking with the welders, they said that they feel that they are in control of the robot as they are the ones who are responsible for programming it. And when it is

set up correctly, the cobot can take away repetitive tasks and improve the efficiency of production. During our field visit, we also noticed that working with the cobot gave welders a higher sense of morale at work: shown as they video-recorded themselves when welding with the cobot and shared these videos with their friends and peers.

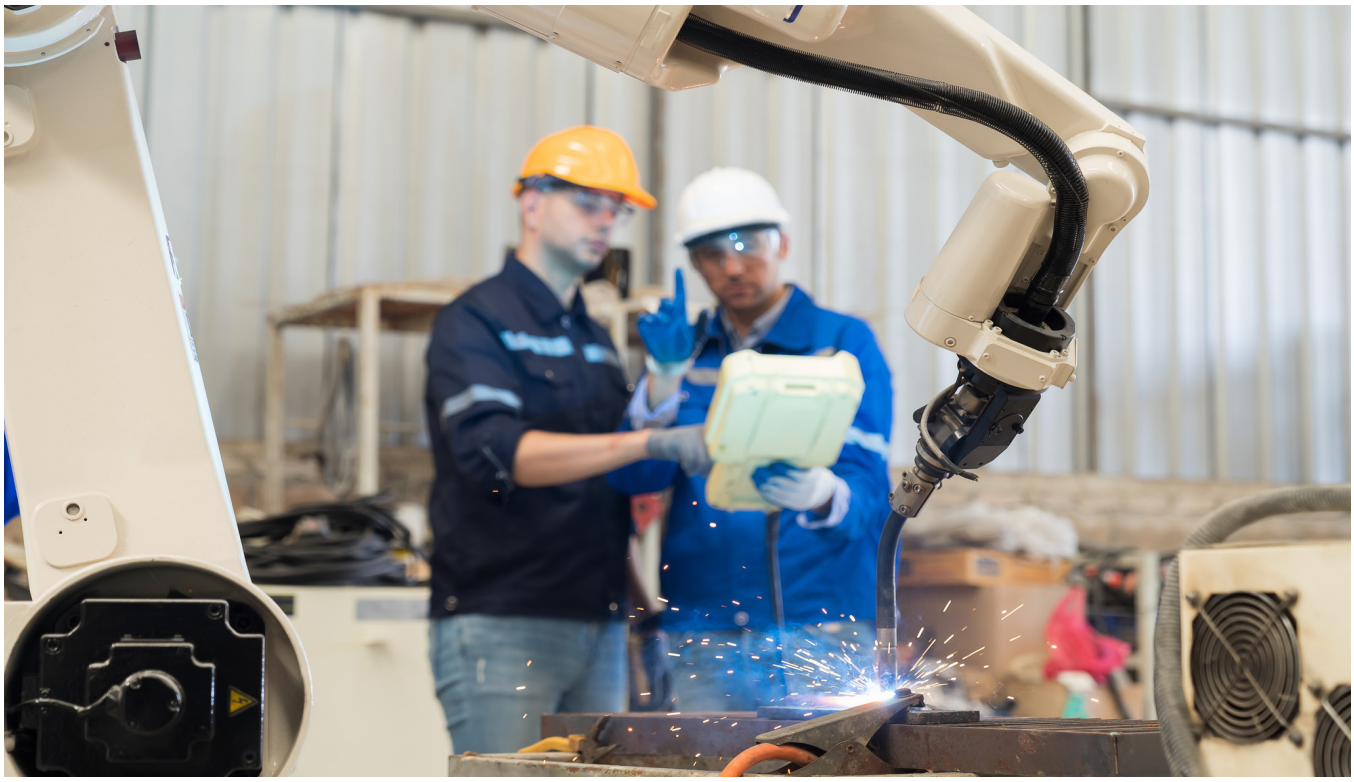
However, working with the cobot is not without challenges. For example, compared with manual welding, the cobot has a much lower engineering tolerance. This creates problems when preparing the material in batch production because raw materials such as steel might contain inconsistencies within a batch order. For instance, 0.2mm engineering tolerance is considered acceptable for manual welding because humans are more flexible and can adjust to inconsistencies more easily. But this same engineering tolerance could have a larger impact on cobot welding as it is programmed and does not self-adjust while it welds. This makes material preparation more difficult and potentially more costly.

When welders were asked if they were worried about losing their jobs to the cobot, none of them showed a sign of concern. They believe their occupation relies on production quality, and experienced welders make the cobot perform better. Welders we interviewed thought that it might take someone with no experience in welding a week to learn how to operate the cobot. However, to optimise its performance and produce high-quality welding requires in-depth knowledge of welding and metallurgy. Far from the company losing job, by winning more orders and expanding the business, Ray plans to hire more workers in the future. Despite having a cobot, he said that the new hires must be skilled welders, not just merely operators, in case the cobot isn't operating properly. More importantly, he undertstands that the cobot is capable of doing high-quality welding only if a skilled welder sets it up correctly

In a recent study conducted by MIT (Helper et. al, 2021), researchers found that large manufacturing companies in the US tended to have more initiatives to adopt AI and automation, whereas small and medium-sized companies, especially those who are producing 'high-mixed, low volume' orders (just like Westholme) were less fit to adapt these technologies. This is mainly due to the high implementation cost and lower availability of digital and/or computing resources. They argue that large manufacturing companies find it easier to overcome these frictions, and the implication is that this might contribute to a divided workforce and widening inequalities. However, in this case study, we can see how the collaborative welding robot can offer flexible automation with a lower cost and technology requirements. This contradicts MIT's study and showcases how small and medium-sized companies can - and do - benefit from implementing automation technology in the workplace.

In terms of job satisfaction, this case study demonstrates the uneven impact of automation on the manufacturing workforce. On the one hand, welders experience augmentation and upskilling as well as the social prestige of working with a robot. On the other hand, flexible automation requires higher engineering consistency (as the robot has less engineering tolerance than human welders) potentially creating more pressure on the metal fabricators preparing the material for the robot, thus negatively impacting their job satisfaction.

# Case Study 8: Collaborative Welding Robot - Daver Steels, heavy steel manufacture and construction



Our last Collaborative Welding Robot is Daver Steels - a heavy steel manufacturer located in Sheffield. It specialises in producing structural steel packages and components for infrastructure such as bridges and railways. Currently, there are six wielders working for Daver Steels and last year the company introduced a cobot to increase production capability. Currently, their cobot is mainly used for welding large-quantity, small-size items (e.g., 500 pieces of small steel brackets), while human welders are responsible for welding small-quantity and larger-size items (e.g., metal boxes, heavy steel bars, etc.).

As Lee – a company director – revealed, when they first brought up this idea of introducing a welding robot, there was some pushback from the shopfloor because welders were worried about losing their jobs. To ease their concerns, the management of Daver Steels promised that 20 per cent of the annual profit would be shared by the workers as a bonus. The benefit of having a cobot is that it could help achieve higher productivity on the shop floor, yet the cobot does not take a cut in the bonus.

Very soon after the implementation at Daver Steels, the welders learned that the cobot has many limitations. For example, the metal to be welded must be lightweight enough to be fixed on the welding table; that is, it must be below 25kg. Also, its structure must be simple enough for the robotic arm to operate from certain angles on the welding table. For these reasons, human welders became more optimistic as they saw that they remained integral to the company's operations, able to work with heavier pieces of metal and – according to an experienced welder - 'getting into places the cobot cannot get into'. Some welders we interviewed even believed that they could weld better and faster than the cobot.

Compared with the previous two case studies, the implementation of a cobot is more complicated in Daver Steels. This is because the British Constructional Steelwork Association (BCSA) requires every British steel manufacturer to come up with a Welding Procedure Specification (WPS) to ensure that its steelwork is handled by qualified welders following carefully specified procedures. However, industry insiders revealed that there is no qualification requirement for a cobot operator when conducting robotic welding. Yet, Daver Steels dedicates Jack, a qualified level-two steelwork fabricator, as the cobot key operator. This ensures that the company can pass the audit by their clients when it tenders for new contracts.

During our interviews, the management believed that the cobot could increase the efficiency and productivity of the workshop while maintaining production quality. It also helps remove the repetitive, tedious tasks from welders and enables them to focus on heterogeneous tasks – which managers believe will improve welders' job satisfaction. In reality, the impact of robotic welding on welders' job satisfaction is found to be more complicated.

When speaking with an experienced welder, he said that 'doing repetitive tasks is never a problem – it only gets easier'. While other interviewees appreciate the cobot shouldering these homogeneous tasks, Jack, the fabricator who operates the cobot, said:

> *Operating the cobot should not be a job for a welder/fabricator… it is just pressing a button. It should be a job for an operator.*

Although he agreed that it is important for someone who has knowledge about welding/fabrication to operate the cobot for quality control, Jack believed operating the cobot actually devalued his skills.

Other drawbacks of implementing the cobot include: the welders and the fabricators interviewed during the fieldwork said that a significant part of their job satisfaction came from the pride of using their hands to finish a steelwork, yet running the robot took away this sense of pride, impacting their job satisfaction.

In addition, whilst human welders are more flexible and adaptable, and can work around small individual differences between metal pieces, the cobot cannot cope with these usual engineering tolerances. This could put pressure on the fabricators who prepare the metal as they now have to maintain a higher consistency in their work. This makes the cobot become 'a checker' of the fabricators' production quality.

In summary, while welders and fabricators experience a similar impact on their work experience, in this case study we highlight the need for regulation when cobots are deployed in steel manufacturing. For example, for which tasks should a qualified welder be required to operate the robot, and who is responsible for the robot's work, the programmer or the operator? Currently a grey area in governance, these questions will need to be discussed by industry stakeholders and documented in the National Structural Steelwork Specification (NSSS).

# Case Study 9: Robotic Process Automation - Police force


In this case study, we interviewed members of the IT and Digital Technology team at a branch of the police to understand how the force has undergone automation in recent years. This police force is one of the largest in England. In 2018, they started a business case to implement Robotic Process Automation (RPA) software in some aspects of police work. They set up a digital technology team to be responsible for the implementation process, and regular police staff (except those working with information management) were not involved in the process, apart from being the end users. The automation takes place at the back end and it is invisible to the users such as frontline police officers. Below are some examples of how the software could bring benefits:

Firstly, when a police officer arrests somebody and places them in custody, the detainee may not always provide the correct personal details (i.e., name/ date of birth /address). As a result, there will be duplicated records of the same individual. This introduces risks and complications to police work. One function of this automation software is to use the 'match and merge' algorithm to screen and combine information, and then assign a unique reference number in the police's recording management system. This is done by matching similar names, the same date of birth, or similar cases that took place in the same locations. This has resulted in a significant improvement in data quality: since 2023, the software has successfully merged about 67,000 duplicate records, saving an estimated 3000 hours of human labour.

Secondly, when someone is a victim of a crime, the police will refer him/her to a charity that provides victim support. Each time the police make a change in the system, the

charity receives a notification. Given relatively frequent changes, this creates a poor experience for the charity's volunteers. Now, the police will store all the updates in the new software, and at the end of the day, the software will automatically send over a single file with all the updated information to the charity. This function has been live since 2022, and the total number of processes is 547 (that's 547 days, one report sent a day). This saves the force 120 hours of human labour. However, the point of this automation process is not about cost-saving but is to ensure a better service to the charity and the public.

After speaking with the IT team, we interviewed a police inspector who is responsible for managing the police record management system. As he said,

> *Certainly, from my perspective as a sort of manager over this process, you know it was a massive relief because the impact, as I say, wasn't something we could tackle while throwing people at it in any sort of economic way.*
>
> *There was probably a little bit of resistance and hesitation about "is this robot going to replace me?" But actually, now they've seen it in action, they've seen it clear the backlog. They know they can then concentrate on the more difficult ones. If you see what I mean, if anything, it's kind of to enhance their sort of self-status that they're doing, the stuff that automation can't.*

The software can also provide better information for frontline police officers to help with situation assessment, enabling them to provide better police service. According to Calvin, the Head of Digital Technology:

> *[There is a] positive impact for the officer because the robot is removing laborious, repetitive tasks that they once had to do to give them more time to get to more incidents or spend more time with the victim. Talking to them, reassuring them, gathering further evidence which is the value add as to what a police officer should be doing rather than processing paperwork.*
>
> *So, I can honestly say this has had nothing but positive impacts, not only for the officers, because that is important because they're my colleagues, but moreover, a positive impact on the members of the public of West Midlands Police because of the time that I'm saving for officers. What we aren't doing here for staff or officers is using robotics to reduce headcount. We are using it to free up their time to do more valuable tasks.*

He added:

> *The digital technology team is also going to be expanded due to the increased demand of the automation process within the Force.*

The automation process is invisible to the frontline police officers meaning that no additional training is needed to be provided to them. Human intervention in the automation system is conducted by the digital technology team to minimise the risk of human errors. The team also logs everything so that in case of software malfunction they can identify any records that have been processed incorrectly. This 'traceability' is for risk mitigation.

In this case study, RPA software is used to save the cost of the police's operation, as well as helping the Force to provide better services. Instead of implementing the technology at the frontline, this police force strategically centralises the technology at the backend, to minimise any workforce erosion. Some police officers who provide frontline service might not even be aware of the changes. As the Head of Digital Technology told us during our interview, having a dedicated IT team allows them to take more control of the technology, and they deliberately chose an RPA software that has great flexibility for them to (re-) programme to fit the Force's needs.

In the future, this police force will continue its effort to integrate automation into more parts of the police service, including considering the deployment of automation to its contact centre to support answering 999 and 101 calls to provide better service to the public.

# Case Study 10: Agricultural Robotics - Antobot, crop protection and logistics

Marc is the Business Director of Antobot, a company based in Chelmsford that develops robots for agricultural use. The philosophy of his company is to provide affordable automation technology to help the declining workforce in the British agricultural sector as well as improve growers' operational efficiency. Antobot has developed a modular robotic platform that can be used in multiple tasks, including harvesting, detecting, logistics and information gathering.

According to Marc, labour shortages have been a problem in the British agricultural sector for decades. These jobs aren't popular amongst local people mainly because of the physical hardship, and because they are often seasonal. As a result, vacancies are mostly filled by migrant workers from Eastern European countries such as Romania. However, recruiting migrant workers/employing returning workers has been increasingly difficult, even if employers are willing to pay higher wages. Therefore, the growers we spoke to in this project are very keen to adopt robots and automation technology to decrease their reliance on human labour.

It is estimated that pickers on a farm spend 20 to 30 per cent of the time on heavy physical labour such as moving trays full of produce and returning empty trays. Antobot's logistics robot can move these trays back and forth between 2 set points, reducing the physical labour needed in the harvest as well as improving pickers' occupational health and safety. It also enables pickers to do more within a fixed period of time, which increases their yield and thus their remuneration.

UV treatment is an increasingly common alternative to chemical agents used by growers to kill plant diseases. This used to require a driver to run a tractor equipped with UV light very slowly – thus taking many hours of labour - to sterilise and kill pests on the plants. Now, an autonomous robot can replace the tractor, releasing a worker from this boring task. Additionally, using the robot, growers can deploy a stronger UV treatment as there is no human worker around the UV light. This provides another improvement in occupational health and safety as workers no longer need to get close to the UV system.

Antobot have also developed a robot that can replace human labour in information gathering. Skill, experienced workers used to be needed to walk along the columns of produce to count and observe the condition and number of fruits on a tree or within a field, allowing the grower to understand what will be available for sale when, and to ensure that the fruits are healthy. However, these workers could only inspect small sample sizes and could be affected by human errors. The scanning robot can provide a more accurate account on the size and ripeness that gives the grower better information about their yield.

While Antobot can assist and replace human labour in the three tasks mentioned above, when we spoke to the growers, they believed that agricultural work still demanded a high level of human involvement that would be very difficult to automate fully using digital/robotic technology. Robotic automation also has its limitations. For example, growing fields are usually located in remote, rural areas that may not have broadband coverage and may not cover terrain that is amenable to robots. Unless a growing field was totally redesigned - like an automobile factory with robots and conveyor belts installed - growers felt that it was unlikely that human involvement would be totally removed from agricultural work.

Jamie, who is a seasoned grower, said that different types of agricultural products may require totally different ways of handling and treatment, and robotic companies are more interested in developing robots for generic agricultural production but ignoring the specific needs of sub-sectors within the agricultural industry (e.g., tree seeding).

Robotic automation is likely to bring new people into the declining agricultural workforce, taking some new roles such as robot operators, robot engineers, and robot supervisors. This is evidenced in Jamie's own recent recruitment: for the first time in over 20 years of his business, he needs to hire an "IT person" to program his robots.

In summary, agricultural robots can help growers reduce their labour demand, as well as to improve occupational health and safety: farm work becomes less physically demanding, and farm workers get less exposure to chemical agents and UV light. An unexpected benefit is that the implementation of new technology could potentially bring new people into the declining agricultural workforce, which would help deal with the long-lasting labour shortage. However, automation in the agricultural sector remains constrained due to infrastructural limitations and the high costs of setting up a comprehensive automation system. In this regard, collaborative robots such as those studied in this case study are one possible solution to help bridge the gap between cost-effectiveness and technology needs.

# Case Study 11: Service Robot, Service industry

Case study 11 is a special case based on an in-depth interview with Frank, a company director at one of the main robotic service providers in England. They work with companies in different sectors to provide consultancy and robotic services to them. His clients range from restaurant chains, to aerospace and fast-moving consumer goods (FMCG) manufacturing. He specialises in supporting his clients with deployment problems, optimising their current processes and addressing their labour needs. For example, in a restaurant, there were waiters walking around to serve and pick up dishes. Frank's task was to supply robots to the restaurants to get rid of a lot of the repetitive tasks, and thus enhance the efficiency and productivity of the team.

To Frank, service robots are increasingly becoming central to businesses in the UK because they can address the labour needs due to the ageing workforce. In some industries such as aerospace, a lot of the older, highly-skilled engineers are leaving the workforce and younger engineering students may not have the necessary skills to replace them. He also sees that Brexit has caused a lot of skilled labour to return to Europe worsening the labour shortage. With many of his clients, Frank witnesses how implementing service robots can improve workers' job experience, but these benefits come with some pre-conditions. In his words:

> *So a robot is just a tool. So if the robot is deployed correctly with the right safety around it, then it should be there to enhance the workforce - a bit like a bicycle. You know you get on a bicycle because it makes you go further and faster and that is what a robot does. But again, you have to have the right robot doing the right application.*

That means, simply deploying robots does not necessarily improve people's work experience. Just like human workers, robots need to be controlled, managed, and supervised. To Frank, many business owners did not understand the importance of human supervisors in robotic operations. As he added:

> *Businesses really need to have a robot person just as you would have an IT person within the business, … What we see is that they [robots] get given to the IT person or to the engineer [who are not specialising in managing robots]. But ideally if a company wants to deploy robots, they really need a sole person whose job is to look after them and then you have a good deployment with good paybacks.*

Implementing service robots in businesses also creates new needs in governance, especially related to safety and maintenance. In the UK, occupational health and safety law demands that every employer must ensure that work equipment is maintained in an efficient state, in working order and in good repair. To what extent these regulations apply to service robots is a question that concerns many industry insiders like Frank and his colleagues.

In summary, Frank's interview gives us insight into the needs of management in human-machine collaboration at work: He believes that robots are the solution to the labour shortage in many economic sectors in the UK, but that the implementation of robots also requires human control and supervision in the workplace. Frank also poses questions about the governance of these technologies, especially in relation to safety and maintenance.

# Insights from our case studies

In this section, we revisit our key research questions, addressing how the implementation of new technologies changes the way people work and impacts on their experience of work. We summarise our findings into four key insights:

1. **The implementation of new technology has not directly contributed to any layoff or job displacement, though changes to the nature of work are significant, with divergent impacts on different people, from different demographics, in different roles.**
2. **The impact of having to transition the workforce to new types of tasks, requiring new training, is large.**
3. **Despite promise of great gains, the relationship between automation and productivity is currently nuanced.**
4. **The adoption of these new technologies highlights the need for new governance and regulation.**

## 1 - The Impact of new technologies on jobs

First, when talking about the future of work, many authors and commentators have suggested that new technologies, including artificial intelligence and robots, are taking over jobs, and workers will lose their jobs to automation. **However, in all of our cases, none of the employers told us that the implementation of new technology directly contributed to any layoff or job displacement.** The only exception was in CS 4, where they used to outsource some writing tasks to an external copywriter, but now this is done in-house by workers themselves, using ChatGPT in the short-term. This could be due to the selection bias in our case recruitment strategy, as companies who lay off workers might be less willing to talk to researchers; but this also can be explained by the possibility that human knowledge and activities remain valuable and irreplaceable by automation in business reality.

In multiple cases, despite many of the tasks at work potentially being highly automatable by technology, human employees are still involved in the business operation as gatekeepers. For instance, in CS2 physicians need to proofread and edit the dictation provided by the DDS software. Similarly, in CS3, humans check the content generated by ChatGPT to prevent hallucinations. Also, many interviewees told us that automation works better when it is under the supervision of human experts. This is noted in our welding robot case studies (CS6, CS7, and CS8), as well as the robotic process automation in the UK Police (CS10), where the IT teams constantly monitor the performance of the software and debug the algorithms.

Moreover, compared with robots, human workers still have the advantage of being more flexible and adaptive to changes. Welders we spoke with in CS6, CS7 and CS8 told us that they can attend to environments in which it is difficult to set up robots, or they can

handle far more complicated welding procedures. In CS1, nurses and other members of the surgical team were also present inside the operating theatre to deal with all possible contingencies.

Last but not least, automation comes with a cost, and for some tasks it is more cost-effective to deploy human workers. For instance, instead of using the robots, in our welding robot case studies (CS6, CS7 and CS8), human welders were tasked with manufacturing small batch runs, avoiding the hassle of programming the cobot. Growers in CS11 also told us about the difficulties of achieving full automation in the agricultural sector because of the remote locations, lack of infrastructure, and the exceptionally high cost of the technology.

**In the foreseeable future, we expect to see increasingly more advanced automation and human-machine collaboration in different economic sectors in the UK.** Our case studies provide some empirical insights for employers, workers, educators, and policymakers to help prepare for this transformation. Employment contributes enormously to people's wellbeing, and harnessing the power of new technology could help deliver more good work. However, as noted elsewhere in the Pissarides Review (Soffia, et al., 2024), the impacts of exposure to workplace technologies on job quality and wellbeing is divergent, and needs very careful attention.

## 2 - The impact of new technologies on skills and training

Second, as noted by researchers and previous work by the Institute for the Future of Work (Costa et al., 2024), one of the biggest impacts of the new technologies is the transition of the workforce to new types of tasks that will require new training. We have presented in detail how new training opportunities could have both positive and negative impacts on people's experience of work in the short-term. In CS1, the possibility of upskilling one's surgical skills also comes with the pressure of learning; CS6, CS7, and CS8 show that the impact of robotic welding on job satisfaction is mixed, varying among individuals with different positions, technology literacy, and welding skill sets.

**One of the insights our case studies offer is that the positive and negative impacts of new technology can be two sides of the same coin, and managerial support and other organisational factors can play a vital role in amplifying the positive inference and levelling off the negatives.** For instance, in both CS1 and CS3, the management put in extra effort to provide/facilitate training activities to workers, to ensure they can be in total control of the technology. Indeed, whether or not (enough) training is provided to workers is a determining factor on the impact of their job quality and can have a long-term effect on the workforce: training provides opportunities for workers to upskill themselves or switch to other roles so that they can remain relevant in the workplace. Interviewees in CS5 suggest that when members of the shop staff no longer need to handle the pick-up/delivery inquiries, they could focus more on providing better customer service.

**However, the ability to provide and receive training is also where the friction hides. In our case studies (CS1 and CS6), age is found to be one of the main challenges for workers (scrub nurses, welders) to keep up with the technology as they see themselves without the technology literacy to learn these skills.** Particularly in sectors that have a labour shortage, removing workers from their posts and sending them to attend training programmes is a major challenge for HR managers. And the economic costs of taking

training are also mentioned as another layer of fiction to workers who are considering changing their roles and keeping up with skill demands. As a concluding question, in CS6, CS7, and CS8, when welders were asked how they see the future of welding, opinions between young and seasoned welders were divided. Young welders tend to think that robots would take over the workplace and make human labour increasingly redundant in the future; seasoned welders tended to see the essentiality of human labour in welding, yet there could be some degree of deskilling as more unskilled people could work in this trade with a cobot.

## 3 - The impact of new technologies on productivity

Third, apart from job loss and training, how are new technologies impacting the way people work and experience their work? One popular belief is that the implementation of automation technology will directly contribute to an increase in efficiency at work because, unlike humans, robots and software do not need to rest. **However, our case studies suggested that, in reality, the relationship between automation and productivity is more nuanced.**

A positive association can be observed in our welding robot or algorithmic automation case studies, showing that new technology can quickly augment workers and boost their productivity at work, saving time (CS3, CS4), generating more profits (CS7), or saving labour costs (CS5, CS10). However, such benefits should not be taken for granted, as there could be a long learning curve following the implementation of a new technology. Especially for workplaces that have a minimal tolerance of risk and failure (e.g., the healthcare sector), the learning process can initially inhibit productivity gains, creating a J-curve (Brynjolfsson et al., 2020) as the digital transformation takes place in a much slower phase. This could even slow down an organisation's productivity (CS1) before the transformation process is completed.

Another organisational factor affecting the adoption of a new technology is the support provided by management to users. As we presented in the Digital Dictation System (CS2) case, for some physicians, the introduction of the software actually creates instant new barriers to their work, because of the mismatch between the technology's features and physicians' work practice. **In this sense, it is important not to see the implementation as the end but rather the beginning of the transformation process. It is crucial for an organisation to collect users' feedback and review performance regularly, and provide support to them when needed.** The DDS case study also raises a question about discretion in navigating technological change in the workplace: whether physicians and medical secretaries have agency to decide whether they can – or cannot - use DDS for particular tasks can have a huge impact on the way they work as well as how they experience the technology. This will require more discussions between the management, technology provider, and the users, but we believe this communication will be essential to successful implementation in the long run.

A feature that is less discussed in the implementation of automation technology is the standardisation of the labour process, which comes with its own benefits and drawbacks. As noted in CS3, standardisation brought by automation can help eliminate human error and ensure a unified labour process in office work. In another case study (CS1), moving from laparoscopic to robotic surgeries also standardised the approach between surgeons, so that there is less inter-surgeon variability and surgical outcome become more predictable. However, the sociology of work literature also reminds us about how

standardisation of work can result in alienation (Marx, 1964 [1844]) meaning that workers feel separated from their colleagues or the product they produce. This is observed in our welding robot case study (CS8), with some welders reporting that the welding robot takes away part of their satisfaction at work as they were no longer directly involved in the manufacturing process. Past studies on blue-collar work (e.g., Thiel, 2007) suggest that one important aspect of manual labour is the demonstration of masculinity at work; the welders' experience poses a new question to reflect on the relationship between (physical) hardship and the values and meaning at work.

## 4 - The demand that new technologies make for new governance and regulation

Finally, **our research findings also provide implications for the need for governance and regulation.** Our robotic case studies reported that the implementation of new technology can improve surgeons' ergonomics at work (CS1), lower the chance of getting minor injuries and protect welders from flaming gas (CS6, CS7 and CS8), and significantly reduce the physical demands experienced by fruit pickers (CS11) - all of these contributing to an improvement of occupational health and safety at work. This is welcome, but some of our interviewees also mentioned that **as robots are increasingly adopted in the workplace, new needs in regulation and governance related to safety and maintenance are created.**

According to the occupational health and safety law in the UK (Heath and Safety Executive, n.d.), every employer must make sure that work equipment is maintained in an efficient state, in efficient working order and in good repair. There are also outlines of responsibility and instructions for equipment users or operators (i.e., commercial vehicle drivers) to check their equipment before work. A robot service provider (CS9) mentioned that these guidelines must catch up with the development of robotic technology in order to ensure that they do not pose any safety hazard to workers and customers in the long run. In this regard, industrial associations and regulatory bodies should take the initiative to navigate this regulatory grey zone. One example is noted in CS8: whether or not a qualified welder is needed to operate a welding robot in construction steel manufacturing will require discussions between different industry stakeholders including the British Constructional Steelwork Association, employers, and workers themselves.

Apart from the robots, there are some specific concerns found in our case studies regarding the use of generative AI at work. The first is related to data transparency: our interviewees (CS2) mentioned that they have problems with adopting generative AI in their work because they have no way to trace how the algorithm will use their data and whether or not the data they input will be used as output for the other users. This is a risk of data leakage if they cannot ensure that the data they input will be confined in the digital space. Others (CS4) also suggested the need for best practice and ethical guidelines for developers to follow, but at the same time, they questioned if laws and regulations are able to keep up with the proliferation of generative AI and whether increased regulation would stifle the future development of the technology. Recent debates on copyrights and trademark laws are two areas that require close attention.

Algorithmic management (as seen in CS5) is also another topic that generates debates on workplace surveillance, employers' control of workers' personal data, as well as the rights to be disconnected. However, limited by the scope of our study we are unable to provide more empirical data regarding how these regulations might impact people's experience of work. This could be a direction for future research.

# Limitations

Lastly, we must acknowledge some limitations and disadvantages of our method. While we strive to present the most accurate pictures of how jobs and people's work are affected by the introduction of AI and robotic technology, these cases nevertheless should not be seen as a representative sample of the experience of people working in a particular economic sector. Apart from the relatively low acceptance rate, another challenge we faced during our data collection was that, because we relied mainly on interviews with individuals in their capacity as company employees, in many cases we had to go through the company's gatekeepers to access these people. Some of these gatekeepers were concerned that our research might reveal some drawback or imperfection of the implementation process of the new technology, which can damage the reputation of their companies. To mitigate this, we shared interview questions with our participants in advance and, in every case, we explained our research project in detail to gain their trust.

Our approach here is exploratory, qualitative, and mostly descriptive. One of the criticisms of the case study method is that the research findings from a particular case study may be difficult or impossible to summarise into neat scientific formulae, general propositions or theories. However, in this study, we did not aim to generalise or reduce our findings into one theory. Instead, our goal was to present the complexity of experience of people working with AI and robotic technologies, and explore the relationship between humans and technologies in specific organisational contexts. We believe that there is real expertise about technology adoption in the workplace for readers to discover in the nuanced differences across our case studies, which can answer questions related to the future of work and employment. We hope that what we have presented in this report can provide an empirical ground to promote such discussions.

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The Pissarides Review into the Future of Work and Wellbeing

Automation technologies are transforming work, society and the economy in the UK in ways comparable to the Industrial Revolution. The adoption of these technologies accelerated through the COVID-19 pandemic, and the ongoing impact of automation is unevenly distributed, with a disproportionate impact on demographic groups in lower pay jobs.

IFOW's Pissarides Review into the Future of Work and Wellbeing - led by Nobel Laureate Professor Sir Christopher Pissarides, is researching the impacts of automation on work and wellbeing, and analyse how these are differently distributed between socio-demographic groups and geographical communities in the UK.

For more information on the Review, visit: pissaridesreview.ifow.org

If you have a professional or research interest in the subject of the impact of automation technologies on work and wellbeing and have insights to share, please contact Abby Gilbert, Co-Director at the Institute for the Future of Work at abby@ifow.org

If you are a member of the press and have an enquiry or would like to receive new press releases by email, please email Kester Brewin, Associate Director: Communications and Training Development at the Institute for the Future of Work, at kester@ifow.org