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Mind over machines New technology and employment relations

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Executive summary

This report looks at the connections between the introduction of new workplace technologies and employment relations, based on 3 qualitative case studies with UK employers, interviews with numerous experts in management and a review of existing literature.

The ways in which technology can affect employees are numerous. Firstly there is the impact it can have on work intensity or difficulty. Most technology is introduced with the expectation that it will in some way increase productivity and we see numerous examples of where the technology has made employees' working lives easier, by automating some of their more difficult or tedious tasks, by saving time, by easing physical burdens or by providing helpful data and information.

However, we also see ways in which technology can increase the burden of work on employees, by enabling greater work intensification; by increasing the amount of work that needs to be done to analyse reams of new data, provide technical support and cyber security; and retrain ways of working, sometimes continuously, to keep abreast of technological changes.

The second major potential impact is on worker autonomy. New surveillance, data recording, analytics and scheduling technologies allow, in principle, a degree of employee-monitoring and control that surpasses anything previously seen. The emergence of this new 'digital Taylorism' has the potential to greatly undermine workers' autonomy and engagement if not carefully handled. This would be particularly unfortunate as autonomy is found to be one of the key contributors to employee productivity in general, and employee ability to learn and use new technology effectively in particular.

Third, we look at the effects of technology on employee health and wellbeing. We find a growing divergence between the effects of physical wellbeing and mental wellbeing – technology has been a huge benefit to workers' physical health and safety at work, replacing many dangerous or physically exerting tasks with robots and other machinery. However, the effects of mental wellbeing may be considerably more detrimental, with greater automation and technology associated with rising stress levels.

The causes of this stress can be manifold. The quickening pace of technological change and constant cycles of upgrades and retraining can take their toll on managers and employees alike. The ballooning volume of email communications can also overwhelm

workers' ability to cope.

In general, communication technologies have enabled greater breadth but possibly reduced depth of human interaction – we look at the decline of face-to-face conversations at work as a possible contributor to workplace conflict and reduced quality of interpersonal relationships. This is a problem particularly for remote workers, but increasingly affecting many other kinds of employees as well.

The spread of email-enabled smartphones is another area of focus – they bring new dimensions to the question of work-life balance, posing a particular challenge for those who prefer to clearly segment their work from home lives.

We also look at the spread of wearable technology, much of which is currently dedicated to monitoring health, fitness and wellbeing. These technologies bring great potential to improve wellbeing at work via the collection of data and targeted interventions, but also pose further challenges to worker autonomy.

Questions over privacy, consent, ownership, storage and use of data need to be carefully considered. The possibility that such metrics might find their way into recruitment processes or employee performance reviews could throw up new ethical quagmires in the future.

In addition to these ways that technology can impact on employment relations, there is also an important role that employment relations plays in determining the ability of organisations to implement new technology and successfully change associated processes and routines.

Many of the general lessons of change management are equally applicable to technological change – the importance of developing a clear plan, communicating objectives clearly and honestly to the workforce, consulting and engaging with employees in dialogue to make them feel involved in the process.

Technological change also poses certain more unique challenges of its own, however. Understanding the need that the technology is designed to meet and that the right tools are selected are vital to avoid falling into the trap of introducing shiny and exciting new technology for its own sake.

The question of the pace of technological change is also a difficult one, as technology itself increasingly advances faster than the ability of organisations to adapt their systems and processes to make use of it.

Similarly, it is important to question whether new automation technologies and in particular algorithms can reinforce or challenge human biases. The key insight appears to be to take time planning change carefully beforehand so that the actual technology itself can be rolled out as quickly and efficiently as possible.

Finally there is the question of reskilling and training the workforce. Evidence seems to suggest that successful organisations rely on a combination of both effective formal training and informal peer-to-peer learning within their teams. The latter of these, however, requires a high level of existing autonomy and engagement to be effective.

Looking further ahead on a macro scale, very large numbers of workers in the UK will likely need major reskilling in the coming years in order to meet the demands of a much more automated economy. Human and creative skills, including the ability to interpret and communicate data to other people, will become much more valuable than traditional domain-based knowledge and expertise.

The structures of workplaces may themselves change, with flatter management structures being potentially more appropriate for more highly automated environments, and line managers themselves facing the potential erosion of parts of their role as they increasingly compete with 'management algorithms' that claim to be able to do their job better.

These algorithms pose major dangers in terms of accountability, transparency of decision-making and ultimately the ability of humans to retain control of the workplace environment and ensure it is grounded in human values. However, these algorithms promise much greater efficiency of decision making based on the ability to process data far beyond human capabilities.

If managers are to remain relevant in the years ahead, it will only be by placing greater focus on the human elements of their role – compassion, empathy, understanding and the ability to engage and inspire workers in a way that remains beyond the capacity of any

machine.

1. Introduction – definitions, context and methodology

In this chapter we take a brief look at some of the new types of technology that are affecting the world of work, before introducing the aims and methodology of this research report.

1.1 What is the new wave of technology at work?

Often when discussing the impact of technology on the future of work, people's minds instinctively turn towards physical robots – either the autonomous robotic arms hanging from the ceiling of production lines or more humanoid robots that walk around and directly replicate the tasks of human workers. Yet robotics is just one small component in the field of technologies that are transforming the workplace for millions of workers.

Leslie Willcocks, Professor of Technology Work and Globalisation at LSE, outlined for us what he sees at the 9 key types of technology that are forecast to affect the workplace over coming years. These are:

- social media
- mobile analytics
- artificial intelligence (AI)
- cloud computing
- blockchain
- robotics
- automation of knowledge work
- Internet of Things
- digital fabrication

The evidence studied in this paper looks more at past and present technologies than these future ones, but throughout the paper it is worth keeping in mind of how some of these future technologies could lead to similar effects.

Some of these, such as social media, will already be familiar to many people and their impacts on workplaces have already been studied (see 'Going Digital? Harnessing Social Media for Employee Voice', IPA for Acas 2016). Others, such as blockchain or digital fabrication, are still in their infancy, making it difficult to imagine the complete set of effects they might have on the world of work. Taken together, these technologies form what is sometimes referred to as the 'Fourth Industrial Revolution'.

In recent years much attention has been focused on how these technologies might lead to the wholesale replacement of parts of the human workforce with computers, robots or other technology – one particular study that is often cited forecasts that "47% of total US employment is at risk" of computerisation by an unspecified future date (Frey and Osborne 2013).

Yet comparatively little attention has been given to how technology shapes the nature of employment for those workers who remain – in many ways the more immediate question given that the UK economy remains at or close to full employment – with most of the experts interviewed for this research being relatively sceptical of the imminence of any huge wave of technological unemployment.

As Professor Leslie Willcocks explained in his interview, "there are lots of opportunities to complement human skills rather than replace them and there is a misunderstanding as to how key a lot of human skills are that can't be replaced by technology".

That said, caution is needed as predictions about the future impact of technology are notoriously difficult. Anthony Bruce, Partner at PwC, pointed out that "if you believed the 1960s, we'd be on the moon, eating pills and living in spaceships. And now, if you believe the press, analysis and advisers you'd believe that everything will be in The Cloud and everything will be 3D-printed and replaced by technology. Seems unlikely to me".

Rather, he described a future where technologies do transform workplaces, but gradually over time and with human workers continuing to play a vital role for many years to come.

Janet Williamson, Senior Policy Officer at the TUC, also advised caution about any bold predictions for the future: "I think a lot of these things are relatively early days and that sort of speculations about where they're going some of which we don't really yet know. It's important to be looking ahead but also not to get carried away."

With that in mind, it is not the intention of this paper to try and predict what individual impact these 9 future types of technology are going to have. Rather than focus on future technologies that barely exist at present, this paper instead looks to a large extent at technologies that have already been shaping UK workplaces over the past decade, such as the spread of smartphones and iPads, communications technology from email to Skype and various forms of scheduling or monitoring tools.

We also briefly look at some emerging applications for wearable technology and virtual reality modelling in the workplace. This paper also looks at the ways in which organisations can handle the employment relations aspects of technological change management.

1.2 What are the effects of technology on employment relations?

Building on previous academic work in this area, this research asks the following questions:

- What effects does technology have on work intensity, worker autonomy and the nature of the relationship between workers and managers?
- How does technology change the way in which employees interact and communicate with one another and with their managers?
- What effects does workplace technology have on the mental and physical wellbeing of the workforce, both at work and in terms of their work-life balance?
- How should employers approach the question of change management when it comes to implementing new technology? And how does this work in practice?

The first question is covered in Chapter 2, which looks at the ways in which technology can make work both easier and harder, as well as the important but threatened nature of worker autonomy in the face of a new 'digital Taylorism' that threatens to replace human managers with algorithms.

Communications technologies are the focus of Chapter 3, which explores how email and other technologies have enabled greater speed, distance and breadth in communication, but may have made it shallower and be a source of conflict and unhappiness in the workplace for some even as it enables freedom through remote working for others.

Chapter 4 looks at wellbeing at work and how technology has shifted threats away from physical health and towards mental health, including the intrusion of work into our personal lives through our smartphones. This chapter also looks at the potential use of wearable tech by employers to monitor and improve employee health and fitness.

Change management is addressed in Chapter 5. This takes the established lessons of change management theory and looks at how they might need to adapt to deal with technological change, including the need for clear engagement and communication with staff to ensure their buy-in, and the importance of careful consideration of how the technology being looked at fits with employee needs.

Lastly, Chapter 6 draws together conclusions for the future – how the skills of the workforce are likely going to have to change in response to technology and how the structures of workplaces and traditional models of management might also come under pressure.

Throughout this report, we include lessons from our 3 case studies, conducted at:

- Siemens drive manufacturing plant in Congleton
- District nursing service at Whittington Hospital NHS Trust
- Jaguar Land Rover body plant at Solihull

The case studies included semi-structured interviews with managers who had been involved with leading programmes of technological change, as well as focus groups with some of the other staff who had been affected by the new technology.

Independently of the case studies, 6 experts including academics, professional advisers and trade union representatives were interviewed for the research:

- Anthony Bruce, Partner in the UK Human Resource Consulting practice at PwC and leader of 'Saratoga' workforce analytics business
- Harry Armstrong, Senior Researcher in Nesta's Policy and Research team and interim Head of Futures at Nesta
- Janet Williamson, Senior Policy Officer in the TUC's Economic and Social Affairs Department
- Professor Leslie Willcocks, Professor of Technology, Work and Globalisation at LSE
- Stella Martorana, Research Associate at the CIPD
- Professor Veronica Hope Hailey, Dean of the School of Management and Chair in Management Studies at University of Bath

The research also included an evidence review of existing literature and survey data. It is important to note that while the qualitative research included in this study is not representative of all employers, it does provide the opportunity to drill down and provide insights on people's views and experiences.

Case study organisations

Whittington Health, district nursing service

Over the past several years, the district nursing team at Whittington Health has been equipped with iPads, following a successful national technology funding bid.

The iPads are designed to allow nurses to receive their daily schedules remotely and complete many of the forms and documentation for each patient while they are with the patient, rather than returning to the office to fill out paper forms.

The iPads are also used by nurses to communicate with one another and with other healthcare professionals and use FaceTime to review patient wounds with specialist nurses, while following clear information governance protocols.

There are also a range of specialist healthcare apps being used, as well as common apps such as GPS for route planning, with additional software rollouts gradually expanding the capabilities of the technology over the past couple of years.

Jaguar Land Rover body plant, Solihull

At the Solihull plant, Jaguar Land Rover has changed the material used for its car frames from steel to aluminium to improve carbon emissions and car performance through weight savings. To accommodate this change Jaguar Land Rover replaced spot welding as the main joining method with rivets and glue joining technology. This task, unlike spot welding, is carried out by robots.

The work of the staff on the production line has therefore been greatly simplified, in that they now load parts into a machine and then press a button, rather than carrying out welding by hand.

Siemens drive manufacturing plant, Congleton

The Siemens plant in Congleton showcases for a range of new technologies in advanced manufacturing. Primarily 3 of these technologies are discussed in this report.

First is the use of a planning and scheduling software called Preactor, which is used to provide instructions to teams on the shop floor as to what parts they need to produce each day and in what order.

Second is the use of a 'virtual reality cave' which is used for design of new products and new workstations by envisaging how they will look in 3D.

Finally we discuss the planned introduction of a collaborative robot onto the shop floor, which is currently in testing and development and intended to work alongside human workers.

2. Work intensity, autonomy and intrusion

2.1 Does technology make work easier or more difficult?

Technology is usually introduced with the hope that it will increase an organisation's productivity, either by cutting costs, enabling greater output or improving the quality of their finished product or service. In some respects this will clearly also be of benefit to the workforce – workers have a natural interest in their employer being successful and productive, and insofar as the technology is solving problems that workers previously faced it will make their working lives easier.

Anthony Bruce, Partner at PwC who leads on workforce analytics, summed up a common view among experts that "where work is low value, highly repetitive and transactional in nature, technology is and will just take it away".

Leaving aside the cases where this might lead to wholesale replacement of the human workforce, this kind of automation of routine tasks can reduce pressures on human workers and free them to carry out more fulfilling, creative or human-facing tasks.

On the other side of the equation however, technology can also lead to the 'intensification' of work, as Professor Leslie Willcocks described: "What's happened in the last 7 years in my experience researching workplaces is work intensification. I don't know of anyone really, seriously, who could say they experienced anything other than work intensification."

Professor Willcocks explained one of the reasons why technology can create more work than it takes away:

> "I think in the case of technologies they don't just have side effects, they have serious repercussions and they generate new problems. Say for example let's get into business analytics. We've got all this big data we crack it through and then what do we do with the data that we've analysed? We have to deal with it and that creates more work. We have to respond to it, utilise it in some way. If we want to look at the malign side you only have to look at cyber security costs."

Our research sheds light on 4 main reasons as to why this can occur:

1. Because the technology itself enables longer and more uninterrupted work, such as the spread of lean or just-in-time production and delivery that allows no deviation from schedules, as well as greater monitoring of worker activity to ensure efficiency. The productivity tool Preactor in use in the Siemens case study, or the way in which performance and activity of district nurses at Whittington Health were measured through their iPads both provide examples of this.
2. Because more work is needed to meet the demands of the technology itself. This can be, as Leslie Willcocks described above, because the technology produces large volumes of new data that need to be analysed or because of new cyber security work required.
3. Because using and maintaining the technology adds additional burdens to workers. This can reflect the adjustment phase of any new piece of technology, when workers often need to spend time learning to use it as well as simultaneously meeting their usual production targets. It also, however, encompasses dealing with all manner of 'technical issues', bugs, malfunctions or other problems that workers could encounter which they need to resolve before resuming their usual work.
4. Finally this can occur simply because management adjusts expected production outputs for workers to account for the greater productivity that they believe the technology allows, erasing or even overcompensating for the gains workers originally experienced from the technology in terms of reduced work burdens.

With respect to this last point, as Janet Williamson, Senior Policy Officer at the TUC put it, technology can lead to "intensification because, in reality, if an organisation adopts new technologies they will adjust workloads and tasks to take account of technology. People aren't going to continue doing the same work in half the time and just have half a day free".

Case study - NHS Whittington Trust

Why were iPads given to district nurses?

iPads were given to the district nursing team in Whittington Health to replace previous paper files and enable them to write up patient visits when they were there, rather than returning to the office.

The iPads also made many of their tasks more straightforward, such as pulling up necessary documents, making referrals or taking photographs of wounds that patients might have to assist with diagnosis. As one of the nurses described, "if you have access to the documents it's far easier to do the face-to-face assessment of the patient and just send an email to yourself and you can upload it onto [the system]".

Generally the nurses felt that the iPads made their work "much easier because you take your pictures, you email your assessments, you email directly whoever you want to contact", as well as allowing them to work more flexibly. "When we started using the iPad it was much easier for us to get our allocations and we can send them to [ourselves] and we can do that from home, so it's saved us that time."

iPads as a time saver

As one manager explained, "our aim became to free up clinical time – that was a big one. We realised that a lot of time was spent by staff coming to the office. They'd go and see the patient, they'd do this assessment, then they'd have to come back to the office and try and remember everything that happened".

By giving the district nursing team iPads to assist them, the Trust was able to restructure tasks to save time, "because they don't have to come in to the office – that gave us an extra 30 minutes of patient-facing time. You have 10 staff in an office on any given day, that's 30 minutes that they then have extra clinical-facing time. When you think about it that's 300 minutes, that's almost a full day of nursing".

While the main aim was to transform administrative time into patient-facing time, some of this saved time directly benefited the staff, who were able to take more complete lunch breaks, which had previously been eaten into by the need to complete their morning's work.

However, as another manager explained, while "the iPads have created more time, the rather unfortunate thing in the NHS is that the demand outstrips the resources. So that time has been swallowed up. I suppose as the management we can see how that created time has had an impact, but if you're on the front line and that created time's just been used up so you can see more patients or do more clinical tasks, I think that makes it feel like less of a win for you. And we need to create a win for the staff on the front line".

There were also some concerns from nurses that it might make work more difficult for the small minority of staff who had trouble with typing and using technology, particularly once the paper notes were phased out altogether.

"I wonder with those that are not as quick with typing, it is not going to help them to be efficient and cause them to struggle to meet and see all those patients when they are struggling to type all the notes."

Both the district nursing and Siemens case studies provided examples of this, to a degree. At Whittington Health the nurses reported that their allocated patient visit targets increased soon after the arrival of the iPads. As one nurse described, "they talked about the

advantages, it will be easier for you to plan your workload, carry out safe care for the patient, but the other bit of it that was later disclosed was that we are then going to increase our units, which was what happened last time, so instead of doing 14 units in the morning they increased it to 16 units in the morning".

At Siemens, likewise, the output targets were affected by the perceived increase in productivity after new technology had been introduced.

At the same time, all 3 of the case studies provide evidence of the various ways in which technology can make work easier for employees. The iPads were seen by the district nurses as considerable timesavers and removed the need for them to fill out paper notes to take back to the office to type up.

At Jaguar Land Rover the new machinery led to a significant reduction in the burden placed on employees and several of the innovations at the Siemens plant in Congleton reduced the number of difficulties faced by employees.

Case study – Jaguar Land Rover

At Jaguar Land Rover the change from spot welding to riveting carried out by robots had benefits for the production quality and the workers. One manager explained how "technology delivers a better quality of car, it certainly delivers it more repeatedly at a higher volume, but I think it's reduced the impact on the guys on the shop floor".

The level of manual work required from the employees had significantly decreased and as a result the production associates felt that their role had changed significantly. "We're not loading and then pulling the gun around, you are just loading and then pushing the button and letting the robot do the rest of it". Workers also reported that the "fault-finding is a lot easier than it used to be", thanks to the new technology.

There was a general agreement that the work had become easier in many respects: "I think it's definitely safer, cleaner and there are less physically demanding than it used to be". On the other hand, there were concerns that the work might have become so undemanding from workers that it was actually increasingly unfulfilling for some. One manager outlined this concern that was shared by others:

"When you were spot welding by hand there might be one where you've got a problem and you've got to think and put it right yourself, which is more engaging. Even if you have to take something apart, even putting the tips of the welding gun – it's engaging. Now you're just picking up a piece of metal and putting it in the jig for 5 days a week or 4 nights, whatever it is. And it's boring. It is boring – there's no two ways about it – it's boring."

Case study – Siemens Congleton

New technology increases efficiency

The aim of the range of new technologies introduced at Siemens Congleton was "about productivity benefits that do more of the same, quicker, better and more accurate ways of doing work".

One of the leaders of the technological change described how:
"These things are adding business benefit at the end of the day, we are producing products quicker right first time, we're eliminating waste out of the business. The reason we at Congleton are still here is the fact that we're able to produce year on year productivity to the business. These technologies are the new lean manufacturing."

While higher productivity does not necessarily translate into easier or more difficult jobs for staff, there was also a longer term view that the technology was going to lead to a general upskilling of the workforce away from the more manual labour that was currently in use.

"It's not just all about changing in terms of bringing in new technology, it's about upskilling like you said. About making sure that we're getting better productivity but using the people and skills that we've already got."

The workers themselves seemed to have a positive response to the technologies that they used in their daily work, feeling that it was brought in at least in part to make their jobs better.

"I think it was to make the line feeders happier to do line feed, I think also it's a [much] better process now. It's a lot quicker obviously not wasting time as much. Everything is better once people are used to what they're working with but it's getting used to new technology and trying to work it out."

The answer as to whether technology increases or reduces workloads for employees is therefore probably that it can do both, the ultimate net effects being more a reflection of management decisions coupled with changing levels of demand, rather than any inherent general effect of technology itself.

It can also be a reflection of relative bargaining power of the workforce as to how much they can translate gains from technology into easier work versus how much the gains from technology are used to increase output.

2.2 The importance of preserving human autonomy

While technology might in many ways make jobs easier for workers, there is an associated concern – can these 'easier' jobs also be dehumanising? While few workers would complain about their work being 'too easy', there is a legitimate concern that where technology replaces the need for human thinking and judgement, it might erode worker autonomy, an important component of wellbeing at work.

An influential definition of worker autonomy is "the degree to which the job provides substantial freedom, independence and discretion in scheduling the work and in determining the procedures to be used in carrying it out", (Hackman and Oldham 1975, p162).

This also extends to freedom to determine method of working, pace of work, place of work, work criteria, work goals, work hours, procedures, scheduling and type of work. Autonomy is seen as desirable because it is an important contributing factor to employee health and wellbeing (for example, Johansson and Aronsson, 1991, Kahn and Byosiere, 1992).

In addition, inhibiting autonomy is associated with reduced work motivation, flexibility and creativity, ultimately leading to lost productivity (for example, Theorell, Karasek and Enoreth, 1990).

Workforce autonomy is particularly important when dealing with technological change, because it enables and encourages group members to learn from each other. Even when there are "low levels of technically required interdependence, group interaction improves the use of technology, presumably through learning or problem-solving" (Batt, 1999).

In all 3 of the case study organisations, despite the importance of formal training processes, this informal peer-to-peer training and learning was a vital element in the success of the technological implementation.

There is therefore a risk that technology can erode worker autonomy, at precisely the same time as autonomy being an important contributor to the successful use of the technology.

2.3 Towards a new digital Taylorism

Concerns that human autonomy at work are under threat are hardly new. Over a century ago in 1915, the spread of 'scientific management' or Taylorism was being criticised by contemporaries for turning the worker into an 'automaton' or 'machine' (Drury, 1915 pp195-198).

In some respects the spread of new technology since then has enabled a growth in human autonomy at work – the increased abilities to work remotely and flexibly discussed below in Section 4 are one of the clearest examples of this. IT advances in HR mean that "HR professionals can spend less time on routine and repetitive tasks and focus on more meaningful information responsiveness, working autonomously and connecting with outside professionals to access information" (Gardner et al, 2003, p174).

Today relatively few workers are employed in the kind of 'automaton' production line roles that represented the Taylorist vision of a factory floor in the early 1900s. Instead those roles are now performed largely by actual automata, that is robots.

Instead, however, many workplaces have in recent years shifted to a new form of 'digital Taylorism' – a huge increase in the ability of management to break down, monitor and analyse performance at individual tasks, thanks to the spread of new technology.

This has enabled the spread of Taylorist management styles to knowledge professions previously regarded as higher skilled and immune to this kind of segmentation. Professors Hugh Lauder and Philip Brown describe this 'digital Taylorism' as "translating knowledge work into working knowledge through the extraction, codification and digitalisation of knowledge into software prescripts that can be transmitted and manipulated by others regardless of location".

They conclude that:

> "Future productivity gains will reduce the autonomy and discretion of the majority of managers and professionals. This encourages the segmentation of 'knowledge' work so that 'permission to think' is granted to a small proportion of employees responsible for driving the business forward." (Brown and Lauder, 2012)

At one of the case studies we spoke to a staff representative who raised this question in relation to their own work:

"I don't know if the people that make the decisions on the facilities that we actually use look at the impact on the people enough. They might actually think because the job is now lighter, friendlier, safer, that they've ticked all the boxes, but maybe one of the boxes they need to have a think about is, are we turning our own people into robots?"

Modern warehouse workers, such as those at Amazon, embody one of the clearest examples of this new technologically driven Taylorism. Workers carry handheld devices with them around the warehouse that issue them with step-by-step instructions on where to walk, what shelf to reach for, how many items to pick up and so on, all the time tracking and measuring the time taken against benchmark targets.

Companies such as Uber and Deliveroo similarly use technology to impart strict instructions one step at a time, only revealing delivery destinations after drivers have completed their pickup, and timing drivers along each part of the route, against 'target' times. Some delivery companies go so far as to instruct their drivers on which precise route they should take, discouraging driver discretion or deviation. According to Professor Jeremias Prassl of Oxford University, today "algorithms are providing a degree of control and oversight that even the most hardened Taylorists could never have dreamt of". (O'Conner, 2016)

Case study – Siemens Congleton

New software delivering production instructions

At Siemens they brought in a piece of technology called Preactor, which was described as "a planning and scheduling piece of software. The idea is that it should enable production orders to be sequenced and planned to the point of everything working in a way that stops bottlenecks, in a way that makes sure that if we have a delivery date we are meeting it and the flow through the factory should be seamless".

The impact of this on workers' roles was twofold. Firstly, it enabled much greater flexibility in being able to respond to changing consumer demand, as the software could easily be used to update the complex build plan in real time, something which would previously have been near impossible.

The other effect, however, was that workers have reduced autonomy in selecting and ordering their day to day tasks. As one of the shop-floor staff put it, "there's nothing you can do with it because they're giving you a list of the order of how to do the work. You can't turn around and say 'I think we should do it in this order'. Because that's not the way the orders are coming into the factory with Preactor – we're just given a piece of paper".

As managers were aware, some workers responded well to this change, particularly the cell leaders, as "they want to be told 'what do you need us to produce?' I'm sick of trying to figure out how best to fill my line", and they found themselves reducing the time taken to draw up each month's production plan from several weeks to just a few days.

However, some other staff felt it was "taking away a huge amount of the knowledge and experience. I think that you have to manage that bit very carefully because if someone said to me that 'you don't have to think any more, you just have to do whatever the screen tells you', I'd find that really hard".

The use of the Preactor planning and scheduling software in the Siemens Congleton study provides an interesting illustration of this. Rather than only relying on their human judgement and experience for deciding on the priorities to produce each day, the workers using the software are now given a specific set of instructions by the software which tells them in exactly what order to carry out each step.

The use of the software appeared effective at boosting productivity and has enabled a much greater level of strategic planning for each month in advance, with a somewhat mixed reaction from the employees. Some workers, particularly the cell leaders, were thought to welcome the simplicity and clarity of having the production plan decided for them by the software, valuing that it enables much greater agility and ability to replan in real time and in response to changing customer priorities.

Other workers, however, were felt to chafe against the loss to their discretion and autonomy, perhaps feeling that it devalued their skills and experience. As one manager put it, "the people who are more than happy to give up that autonomy are the ones who obviously buy into it, more than those who like the idea of making our own decisions".

As well as technology imparting instructions, a key component is also technology to monitor or track employees and their performance. Such technologies are hardly new, but are becoming increasingly popular and different forms now seem to be common in the retail, manufacturing and logistics sectors. While such technology can be very useful in certain cases, Janet Williamson of the TUC cautions against possible misuse:

> "Practices and ideas around using technology are likely to bring problems rather than the technology itself. I think the significance is not in this case in the technology, it's the fact that employers are trying to track the productivity – if you want to put it that way – of their workforce, and seem to think it's a good idea to use what are very blunt and can be very intrusive tools."

Case study – Jaguar Land Rover

Productivity monitoring and assessment through technology

The new technology in the Jaguar Land Rover factory enabled managers to collect specific data about productivity on the shop floor. One team leader thought this was helpful in managing staff by confronting them with evidence of poor productivity:

"We've got not a lot but a few people swinging their legs and they can pinpoint on different shops who's doing what. We can say 'you are doing this, this is you taking your time, this is how much you got out where the other two people on the other shifts are doing a lot. You're blaming maintenance, DHL and the facility [saying] it can't be you – it has to be you' and you can pinpoint what you've done on [the monitoring system] this week."

As a result, the team leaders felt that "it's improved the cycle time because people know that they're watching you".

However, as another team leader pointed out, this tracking can also increase pressure on them to deliver increased numbers. "From my side as a group leader there's a lot of tracking of the operators. They can track them while they're building, how many they build per hour, then we're put under pressure to get those figures."

There was discussion particularly around the tracking and increased accountability of losses on the production line and team leaders seemed to be feeling the pressure on this. As one team leader said:

"It's put more pressure on us to be more accountable and more efficient. It filters down and we're the ones standing there trying to account for 2 to 3 cars lost an hour or you've got no apps cover, you've got no toilet cover – you're running around trying to do stuff as the associate needs to go to the toilet, it's not being loaded. So if you do lose a car because they've not given you the cover, you stand there and say that and that's not acceptable [to management]."

While they can be effective in combatting poor behaviour and performance, productivity measurement systems in this way can be a blunt tool for managing staff – not taking account of these kinds of issues such as lack of cover or maintenance support to deal with problems with the technology itself.

As one of the staff mentioned, however, their collective bargaining agreements protect them from what are perceived as the more intrusive potential uses of the technology: "They can't use it because they haven't been approved by the union."

When employee monitoring is done poorly by using methods that are too 'blunt' or 'intrusive', businesses may find that what they hoped to gain in productivity is undermined by what they lose in engagement. In some cases this can demonstrate a breakdown in trust between the employer and workforce and some studies in the past have shown a relationship between electronic monitoring and higher staff turnover (for example Carayon, 1994, Shaw et al, 1998).

Stella Martorana of CIPD agrees, saying "I think that if we talk about digital surveillance it might have negative effects on employees, so we move away from a culture of trust".

The case study of the district nursing team at Whittington Health provided a clear example of this. There are clear potential benefits to the employee as well as the employer of being able to track the iPads they are carrying, not least to employee safety, but some of the productivity gains may be jeopardised if the nurses feel their autonomy is being eroded and not enough is done to sooth anxieties over the use of the data.

Case study – NHS Whittington Trust

Mixed feelings due to perceptions of being tracked

One of the apps on the iPads had been designed with geographic tracking features that enabled nearby nurses to be allocated to urgent visits, and also to protect the safety of the nurses as lone workers. While the use of the app for urgent visit allocation was not currently in use at the time of this research, having been suspended due to technical issues pending the rollout of a new update, this feature still prompted considerable discussion from both nurses and managers.

One of the managers described how they could use "the iPad to track members of staff. That's not done because we want to catch them shopping or stopping to get a drink, it's because we can see if they've been in [with] a patient for too long and actually can call them to find out what's going on".

While in practice there was no active monitoring of nurses' location by their managers taking place, this app was still perceived as troubling by some members of staff. One nurse felt that "this was concerning – I know we live in a technical age but for someone to say

they can track you and see how long you have been in a particular place it is unnerving".

However others were quite comfortable: "I can see it from a positive point of view – that it's a safety feature and it's useful to know where people are and if they're new to a patient they've been seeing. If someone comes into difficulty then we can help."

Some also saw the data collected on the iPads as an opportunity to increase the autonomy of nurses and push back against difficulty the district nurses sometimes faced in meeting their targets.

One of the team leaders saw "it as an opportunity to demonstrate how much work we're doing if we are not meeting our targets or not able to see 7 patients because of an emergency, we can see that patient hasn't been seen. Then we have the data to say we can only do 5 instead of 7."

While very few of the staff seemed openly hostile to the idea of being tracked, there was a general sense of unease which seemed connected to a lack of understanding on the nurses' part about who had access to the data on their whereabouts, what security provisions were in place around it and what it was being used for.

Greater information on these points seemed likely to help in providing reassurance and gaining acceptance of the technology. The fact that some nurses felt they had only learned of the existence of the tracking potential after the technology was already in use was a contributor to their suspicions about its purpose.

2.4 Machine learning from human biases

One increasing trend is the replacement of human judgement-based management with management by algorithms and data.

Percolata is one example of a growing number of companies that provides such a service, using footfall sensors in high street retail outlets to measure the flow of customers and combining this data with per-employee sales figures to generate a 'shopper yield' metric of sales divided by traffic, which is then used to assess sales-employees' performance.

The technology can then schedule employees in what are calculated to be optimum shift patterns based on their yields, availability, calculated colleague interaction and projected customer footfall from weather forecasts and other signals.

According to the company founder, Greg Tanaka:

> "What's ironic is we're not automating the sales associates' jobs per se, but we're automating the manager's job, and [our algorithm] can actually do it better than them."

This can benefit employees by reducing biases and human favouritism. US company Infor Talent Science provides software to predict performance of candidates to assist firms in hiring – their data suggested an increase of 26% in ethnic minority hires after companies shifted to their software assisted hiring decisions.

However algorithms can also embed and even amplify biases themselves. A 2015 research study by Carnegie Mellon University suggested that Google's algorithms were much more likely to show ads for high-paying executive jobs to men rather than women. The male accounts were shown the ads 1,852 times while the otherwise identical female accounts were shown them only 318 times (Datta et al, 2015).

Other examples of human biases being replicated in algorithms include the infamous 'Tay' chatbot launched by Microsoft in 2016. Designed to learn from conversations on Twitter and to mimic the language of a 19-year-old American girl, the chatbot did indeed learn from humans. Unfortunately what it learned included inflammatory racist and sexist language which it quickly began to reproduce, leading Microsoft to take it offline after only 16 hours.

While this might be a more overt example, more subtle algorithmic biases are still widely prevalent online. In 2015 graphic designer Johanna Burai set up an initiative called World White Web to combat racial norms on the internet, after finding all white hands in the top Google image results for a search for human hand images. Meanwhile Facebook came under intense pressure over its algorithms spreading 'fake news' relating to the 2016 US presidential election.

Ultimately the quality of algorithms' outputs will always depend on the quality of their inputs – what we as humans feed and teach them. Unless we take great care to address our own biases when selecting what data to allow algorithms to learn from, we will inevitably find ourselves faced with those same biases thrown back at us, often amplified, by the software.

Given the levels of prejudice and discrimination deeply embedded at all levels in the social and economic world around us, not least in the workplace, allowing algorithms to learn freely from that world could well serve to trap us in our existing network of biases.

Managers would do well to approach such technology with caution rather than risk discrimination claims and negative publicity that could result from the deployment of a 'Tay' style algorithmic learning process in their business decision making.

2.5 Management by algorithms?

A key challenge for organisations adopting more algorithmic decision-making processes, is to decide and train employees carefully on how to identify the situations to rely on the technology and algorithms and when instead to ignore them or move beyond them in favour of privileging human judgement.

As Harry Armstrong of Nesta describes, "there's this balance between mistrust and over-reliance on technological systems". He discusses cases of doctors being reluctant to use flowcharts and tick-off sheets, which have been shown to reduce bias in clinical decision making and avoid missing things, because "there's a kind of assumption you should be intelligent enough without the algorithms", but also opposite cases including an airline company "who are worried that their staff are over-reliant on basic algorithms. They don't think beyond them so when they've come to the end of the tick-box they don't go any further".

Managers need to provide clarity on when employees should go along with the algorithms and when they should exercise their judgement and discretion, to avoid employees feeling like they are being unfairly blamed for automated decisions when things go wrong.

There also needs to be clear lines of responsibility so that when an algorithmic decision leads to things going wrong, it is still possible to identify a human being who can be held accountable.

The reputational risks to business of algorithmic failure should also be a wakeup call for managers considering outsourcing responsibility in this way.

As Nicholas Diakopoulos and Sorelle Friedler (2016) put it, simply saying "the algorithm did it" is not an acceptable excuse if algorithmic systems make mistakes or have undesired consequences".

In their article, 'How to hold algorithms accountable' they outline 5 key principles which they believe decision-making algorithms need to exhibit:

- responsibility - that there should be clarity over who has authority over the process and can make changes or provide redress when needed
- explainability - that those affected by the algorithms, such as employees being denied a raise or promotion, should be able to understand the reasons behind the decision
- accuracy – that any sources of error and uncertainty in the calculation are identified and investigated with a view to reducing them
- auditability – that it should be possible for third parties to monitor and review the way in which decisions were being arrived at and the outcomes they were leading to

- fairness - that decision making is checked for possible discriminatory effects and efforts made to remove any trace of existing human and societal biases from the algorithms

Regardless of how well they are designed, Anthony Bruce warns against management coming to rely solely and exclusively on data-driven metrics for assessing employee performance, stressing the "value of conversation".

While some data gathering and analytics can enhance performance management, he cautions that "there will be value lost if we replace [human interaction] entirely with technology – an algorithm which tells you what your number is and therefore what your pay is. Just because the technology enables you to do it doesn't mean it's right".

Janet Williamson agreed, arguing that "when you replace management of people with something that is just tracking numbers, you are always losing your ability to get the best out of people and you may experience big problems".

3. Isolation and the importance of human relationships

The spread of new communications technology allows people to keep in touch with one another like never before. Yet, just as in our personal lives, this does not necessarily translate into improved social relationships, so at work the spread of technology can lead to increasing social isolation in the workplace.

This is something studied at least as far back as Trist and Bamforth's 1993 paper on 'The stress of isolated dependence' in semi-mechanised coal mines, where they found that "the effect of the introduction of mechanised methods of face preparation and conveying, along with the retention of manual filling" served to "isolate the filler from those with whom he formerly shared the coal-getting task" and leave them with "no secure relationships in face of the bad conditions they may encounter" (Trist and Bamforth, 1993).

3.1 Is remote working helpful or harmful for employees?

One of the primary ways in which technology has changed the nature of human relationships at work is by enabling the significant growth in remote and flexible working arrangements. In 2014 the Office for National Statistics (ONS) reported that 13.9% of the UK workforce were homeworkers, the highest since records began. A 2015 survey by British Chambers of Commerce (BCC) and BT Business found that 86% of firms in Britain have at least one employee working from home (BCC, 2015).

A large part of this growth is thanks to the spread of Cloud technology, allowing workers to access, share and edit remotely stored files, coupled with improvements to teleconferencing abilities, with free software such as Skype or Slack now able to largely replicate what was previously the exclusive preserve of state-of-the-art boardrooms.

For many employees, homeworking can provide major gains to their autonomy and ability to balance home and work commitments, as well as being an indicator of a strong relationship of trust between the worker and management. The spread of these remote communication technologies has been a particular benefit to 'on-call' workers, such as out-of-hours IT support, who are now often able to be at home resting rather than having to sit in the office in case a call comes in.

A US survey of remote workers found that they were on average happier at work (8.10 on a 10-point scale, compared with 7.42 for other workers) and felt more valued at work (7.75 vs 6.69) than their office-based peers.

However, they did rate their relationship with co-workers as lower (7.88 vs 8.47) and only 52% reported having contact with their direct supervisor at least once per day, mostly by electronic means. If proper policies and technologies are not put in place for remote workers, there is a risk they end up feeling cut off from the wider organisation, which could inhibit rather than boost their engagement.

As Janet Williamson from the TUC put it: "I think there's a whole lot of issues and challenges with remote working. I'm not opposed to it but as with everything it needs to be managed well, with adequate resources, and working entirely remotely can be quite challenging."

Some of these challenges were explored in the 2013 Acas Research Paper 'Home is where the work is', which concluded that individuals benefited most from using homeworking only "moderately" and making sure to "put in place work-home boundary management tactics". While providing the right technology was essential to enable homeworking, this was only effective "when managers trust their employees, when the performance management system is based on results, when communications between managers and employees are effective, and when comprehensive training on the different aspects of homeworking is available for managers and homeworkers".

The lessons of homeworking also affects other emerging technologies dependent on remote operation or control, such as robotic surgery where the surgeon is physically removed from the operating theatre.

A 2016 paper on this topic showed how surgical robots can "reduce stress and tiredness and enhance surgeon decision making", but the physical separation of the remote surgeon from the patient and the rest of the team can "compromise communication" and is "associated with increased operation duration, which has implications for patient safety". They note, however, that this "may be overcome through the use of standardised communication" (Randell et al, 2016).

A separate study into the same topic concurred with the view that new communication protocols were needed to overcome the barriers of physical distance, concluding that "scripted speech can facilitate team communications and adaptations to new technology" (Webster and Cao, 2006).

3.2 The decline of face-to-face conversation

While new communication technologies are a big enabler of engagement for those physically separated, however, they might ironically be undermining human connectivity within workspaces.

Professor Veronica Hope-Hailey was particularly concerned by the effects that email has had on workplace communication, criticising the growing tendency for workers to send emails to communicate with colleagues a matter of metres away:

> "Our over-reliance on electronic forms of communication is actually changing behaviour in the workplace. They are creating more connection internationally, so our ability to connect immediately with Shanghai and Lima – yeah, we can do that quickly. But paradoxically it's stopping us connecting with each other in the workplace, and I think this has a huge impact on trust and I think it is really not helping employee relations."

One major reason, she explained, was that "people will put stuff in emails that they would never dare to say to each other face to face" – often perceived rudeness, sarcasm or hostility in emails or texts, whether intended or not, can be a major cause of friction and conflict in the workplace.

There is evidence that growing proportions of younger workers instinctively choose to communicate electronically at work and shy away from personal face-to-face conversations. A 2011 PwC study of millennials found that 41% "say they prefer to communicate electronically at work than face to face or even over the telephone".

Meanwhile, data from WERS shows a rise in the use of email as a means of direct consultation with employees rose from 35% in 2003 to 49% in 2011, a trend which Acas Chief Executive Anne Sharp suggested "is indicative of a decline in the quality of communication" (WERS, 2011).

This trend could be harmful for organisational performance. A 2008 study found "that in contrast to email networks, cohesive networks in a rich communication medium such as face-to-face interaction are associated with higher employee performance". The paper described how:

"Although face-to-face communication is typically the most costly communication channel (in time, effort and energy), it is preferred when transferring complex knowledge because it can facilitate the resolution of confusion and misconception." (Wu et al, 2008).

Case study – Jaguar Land Rover

The sound of silence on the shop floor?

Particularly where technology replaces individual workers, or where it solves problems that would previously have needed dialogue and cooperation between people to fix, it can cause a significant drop in the level of conversation at work. The Jaguar Land Rover factory had experienced this effect very noticeably over recent years, something that many of those interviewed commented on.

The main cause was simply the reduced numbers of people on the shop floor – as one staff member put it, "if you were to take a photograph of 15 years ago the biggest difference you'd notice is the amount of people versus the amount of robots".

One worker reminisced about how in previous years, "you'd be there and you'd be on the shop floor taking the mickey out of one another, generally having banter. You go in our rest areas now and they're quiet. They're a lot quieter than we use to be. Maybe it's because we get used to not talking to each other or because you're tired and you want to get your food down".

This growing quietness had even led to "a longstanding joke on this site about 'can't we have some piped music just to have the day go by', you know what I mean and maybe the senior management team need to have a look at it. I'm not suggesting that that's the answer but maybe they need to look at that. Obviously this is a noisier environment than some parts of the plant. But now it's a lot quieter than it used to be".

The reduced staff numbers had also led to more solitary working on the shop floor. A union rep at the plant described how in "some of the jobs you are on your own so the only time you engage with somebody could be if there's a breakdown or break time. You could be in a couple of the cells where you don't see anybody at all". This was felt to have a potential impact on job satisfaction: "[It's] a bit soul-destroying, because we're social animals aren't we?"

Managers were also aware of this issue, with one commenting that "8 hours is a long day not to talk to anybody and your group leader and us will walk around throughout the day and we will only see them for a snippet of the day. That is definitely in the back of our mind – how can we manage it?"

As Anthony Bruce of PwC described, even the best modern communication technologies cannot fully replicate the nuances of face-to-face human interaction:

> "We have evolved over millions of years to operate in a certain ways. Technology evolves in months. Take a simple example of face-to-face conversations or Skype or video conferences. People are human beings as well as employees and they have got used to being able to read body language, being able to understand the reaction they're having by reading someone's eyes, or face, or hands, or mood, or tone. Some of those things get lost when you do things through technology."

There are also suggestions that declining human contact at work, in offices where much of the work day is filled with solitary computer use, or in factories where employees increasingly work around and alongside robots rather than human co-workers, could be damaging for mental health and wellbeing. One of the managers at Jaguar Land Rover admitted that "there's a lot of jobs now where you're barely around anyone".

As Veronica Hope-Hailey argued:

> "Because people have stopped communicating with each other, very quickly losing out are some of the cushioning effects of being in a workplace, where you would get this sense of a support mechanism from other people around you. And so there is an element of alienation going on I believe."

Even where technology is designed explicitly to foster more human interaction, such as with workplace engagement apps or social media tools, Anthony Bruce warns that the results can be less authentic than natural human face-to-face conversation:

"One of the consequences of that is people choosing what persona they want to portray. Are you the happy successful consultant who is always winning? Are you the half-empty consultant or employee who tells it how it is? What image do you want to put out there and how do people react to that? That hasn't happened before because you've controlled it by having interactions with people face to face."

Case study – Whittington NHS Trust

A little less conversation with colleagues?

The iPad technology allowed the Trust to get rid of the morning handover which required nurses to come to the office in the morning to prepare for the day.
"We use the iPad from home so instead of the 40 minutes to get [your] allocations and [do the morning] handover you can start from home. [Meaning] at 8.30am you're with the patient and you have more time for your patient."

This replaced the previous morning routine which, as one manager described, used to involve "coming into the office, writing down the list, doing a handover, chatting, having some social time – which is good! But it meant that they didn't get to their first patient until 9.15 or 9.30 in the morning, so that was 45 minutes or an hour of clinical time, perhaps more, that you would lose each day and cumulatively that is a lot of time, a lot of money".

Nurses also no longer needed to return to the office during the day, as one nurse in the focus groups put it, "you don't need to go back to the office to send an email or do a document – you can do it there and then".

While all the nurses recognised the benefits of having more clinical time with their patients, there was a sense of regret around the loss of the interaction with colleagues in the office: "We had a specific time of day – you lose a bit of the staff social aspect of work and you maybe feel isolated".

Another nurse said, "I like the iPads but I do miss the social part where you meet your colleagues and talk about your concerns like 'how was your day?' We're just in people's houses – and they're sick". The suggestion being that it could potentially be demoralising for nurses to spend all day with patients and have no conversations with their peers.

A little more conversation with patients?

On the other hand, from the patients' perspective, the iPads have facilitated greatly improved conversation and communication. One nurse described how "you can show the patients what you're recommending to them, you can show them what it looks like", making sure the patients were happy with anything being ordered for them, or able to sit in on videoconferencing calls between the nurse and other healthcare professionals about their treatment, which previously would have been made over the phone after nurses returned to the office. Patients were therefore much more involved in discussions and decisions about their care, to their obvious benefit.

However, some nurses also felt the iPads could be a distraction from talking to their patients while they were with them, saying "we need to learn actually [to] put that in a different box and deal with it. I'm doing that at the moment but when I started with the iPad it was like that. Because I do everything on my iPad, I do my assessment. It's true when you're with a patient you should focus on them and you need to be there mentally too".

The ease of email via iPad was also felt to facilitate improved communication with other key medical professionals "because most of the GPs don't [respond] by phone, we just do email". Of course, the fact that email was the only form of communication certain people would respond to could be seen as a problem itself caused by technology.

4. Health effects and the work-life balance

Technology in many ways has enabled great improvements to health and safety at work. Many highly dangerous occupations and tasks have already been almost completely automated or rendered safe through use of machinery and technology.

The hardships faced by the 1950s' coal miner outlined at the start of the previous section, for example, are now experienced by very few modern workers. Industrial welding is another example of a previously hazardous job that can now be undertaken more safely, with human workers operating at a physical distance from the noise, heat and toxic fumes produced.

Overall, the rate of fatal injuries at work in Britain has fallen steadily over the past 20 years, from around 1.1 per 100,000 workers in 1996 to under 0.5 per 100,000 in 2016 (Health and Safety Executive, 2016).

Case study – Siemens Congleton

Ergonomic improvements through virtual reality

The Siemens Congleton case study provides some great examples of the improvements still being made in this area, including their use of a ‘virtual reality (VR) cave’ to plan the design of their new work stations, enabling significant ergonomic improvements such as removing the need for workers to stretch and risk back injury in order to reach items that were placed too high.

One of the transformation leaders described an example where this had helped someone:

"One of the digital tools, it's called 'Jack and Jill' – a digital mannequin – you can simulate the operation of the cell using a digital person and you can look at the health and safety and ergonomic output. The digital tool actually said there was a particular activity that was a strain on a person and the lady who was actually performing that task disagreed with the tool. 'No, I've been doing this for years and years – your tool's wrong'. And it wasn't until she went back to her job that she realised she was actually standing on a piece of equipment to pick that thing up and actually said 'do you know what? I'll take that one – the digital tool was right."

This has saved time in the design process and ensures that when new cells are designed, they can be rolled out on the shop floor with far fewer problems "for the install and lean cell design and when the finished area goes down on the shop floor. The issues that the operators find with the new area is dramatically decreased. The final finished structure has to have less changes done to it when it's in full operation, because they can do the checks in the VR cave".

Overall, the level of 'manual' work in the economy has fallen in recent decades and work in general has become much less physically demanding. However, this has been coupled with a potential increase in the mental demands of work, such that as physical health improves, mental health may be deteriorating. As Professor Veronica Hope-Hailey put it:

> "I suspect that physical wellbeing at work is much better but mental wellbeing is less good because actually the employer has in effect invaded the psychological space that used to be your own."

It is estimated that mental health is increasingly one of the largest contributors to working days lost due to illness in the UK and that more than 1 in 6 of the UK's working age population have a common mental disorder (Adult Psychiatric Morbidity Survey, 2014). Partly this reflects the threats to worker autonomy and human contact discussed in previous sections, but can also be seen in the increased speed of communication. Overflowing email inboxes are often cited by workers complaining of work-related stress.

In addition, the increased presence of and dependence upon technology at all levels of an organisation can lead to significant anxiety and stress for workers should the technology fail or malfunction for any reason – workers who may or may not have the requisite technical skills are often faced with the need to diagnose and fix technical problems at the same time as complete their usual work

objectives.

Sometimes the problems of excessive communication and technical difficulties can be combined – one of the managers overseeing technological delivery in one of the 3 case study organisations was forced to take a significant period of time off work due to stress, in large part caused by being constantly bombarded with technical support queries from staff at a rate far greater than could reasonably be processed.

In Germany, the government has recently published its vision for the future of work, which recognises that "in many occupations, a shift is taking place from physical to primarily mental demands" and recommends the development of a new code of 'Occupational Safety and Health 4.0', that explicitly focuses on the duty of employers to safeguard mental health at work alongside physical health.

As these technological trends are likely to continue and accelerate into the future, the need for employers to place a greater focus on mental health at work will only become more pressing (Federal Ministry of Labour and Social Affairs, 2016).

Case study – NHS Whittington Trust

Weighing the benefits of iPads

There were a small number of nurses in the Whittington Health NHS Trust study who complained that the iPads were a pain for them to carry around as "they are heavy", with one saying "my shoulder hurts me, I'm not ashamed to say". However, the iPads were also in the processes of replacing large volumes of paper notes that the nurses have previously had to carry around.

One nurse explained how "there's more and more that we're about to do with them which means carrying less paperwork – if we've got a new patient we have to carry a big heavy folder. If you've got 3 new patients, that can actually hurt your back. At the moment we're still doing that but they're looking towards not having to take those big heavy folders and things".

The general consensus was therefore that, although in the short term they represented an extra weight to carry, in the long run, having the iPads would replace a lot of other weight in documentation and so reduce the risk of injury from carrying heavy bags while travelling.

The iPads also compared favourably with the use of less suitable technology which had previously been trialled both at Whittington and elsewhere, with one of the nurses saying "these are not that light but they're alright aren't they? I worked somewhere before and we were all given laptops and they were really heavy".

A secondary concern about the iPads was the anxiety it sometimes caused with carrying them around in public as lone workers operating in an area they felt was "a major hotspot for mobile phone thieves". One nurse described how "sometimes when you're walking around you feel like someone might snatch it from you", while others explained that "I'd never get it out on the street".

These concerns are clearly less likely to be a cause of anxiety for workers using technology that is fixed in their workplace, but for any kind of portable or wearable tech that is carried in public, these concerns are likely to apply generally to any lone workers. In this case, management had issued guidelines to nurses that the iPads should not be openly carried in public, which is likely a good policy for other organisations adopting similar technology to consider.

Overall, the iPads were seen as a significant benefit of working at Whittington from the nurses' perspective, compared with most other UK nursing services which were yet to provide such technology. Managers reported an improvement in recruitment and retention figures among their district nursing staff since the iPads were introduced over the past 3 years, suggesting that having access to new technology can be an important attraction in a workplace, when it is well geared to the needs of the workforce.

Case study – Jaguar Land Rover

Less manual work, more time to think

The change in manufacturing technology and processes at Jaguar Land Rover provides the clearest example of this divergence in terms of mental and physical wellbeing for workers.

The management team saw the introduction of the new more automated shop floors as a major benefit to working environment and physical health and safety. "I go back to [old days] and I saw some very hard manual labour work in there. Very, very hard manual labour work and we were asking those guys to make a lot of cars in shifts and it must have been very difficult to maintain that level of performance throughout the shift. What I've seen now is the loading of the role itself is light, so I think for quality of life it's brought benefits".

The staff representatives agreed that "I think it's definitely safer, cleaner and less physically demanding than it used to be. We have less people getting hurt and the degree of those injuries apart from one or 2 cases is by and large far better than it's ever been".

However, there will again be associated concerns that the work had become "more boring" and that changing role for staff as part of this was potentially having a negative impact on their mental health in the view of some staff representatives who said that:

"Now I think we suffer more with stress and anxiety related illnesses. People have more because they have more time to think about what's happening. There's more time where you can mull things over in your head because the job is not physically demanding. We've noticed that stress and anxiety and pressure, sick levels have gone up because people have more time to think about it – what's going on in their lives and everything else. We've certainly had more cases with that, but the actual working environment – we used to have fumes, smog, acrid smoke, you can imagine metal being burnt and stuff like that – it's cleaner, it's brighter, it's far better in that respect. But with every upside there's a downside."

4.2 The boundaries between work and personal life

Part of the psychological intrusiveness of technology reflects the intrusion of work into personal time outside the office. Much has already been written about the effect of technologies such as email-enabled smartphones on work-life balance.

On the one hand, such technologies allow greater flexibility, with workers able to choose when and where to work. Particularly for those who previously would have stayed late in the office, the ability instead to go home earlier, have dinner with family and perhaps put their children to bed, before finishing off some emails from home, is a huge benefit to their ability to balance their commitments.

However, smartphones can also engender the expectation of availability and responsiveness. For some workers, the stress caused by the sense of being part of an 'always on' culture prevents them from being able to switch off and relax at home.

In France, the government recently introduced a measure to give employees a 'right to disconnect' – to negotiate with their employer over their right to ignore their smartphones outside the office.

Taewoo Nam in 'Technology use and work-life balance' (2014) describes such new communications technology as a 'double-edged sword', both enabling more flexibility but also more permeability of the boundary between work and home life.

This will be an issue for some workers more than others. Previous research has found that employees are roughly evenly divided between 2 types – 'integrators' who prefer weak boundaries between their home and work lives, perhaps going home early but then responding to email throughout the evening, and 'segmenters' who prefer to keep strict boundaries that separate their home from work lives, staying at the office as long as necessary but then wanting to switch off completely when they go home.

It is this second group in particular who are threatened by the encroach of smartphones and other communication devices – Nam found that segmentation between work and private spaces may be increasingly difficult in an environment where high commitment and productivity is expected.

He recommended that managers make more of an effort "to recognise more specified categories and patterns of work-life balance as a personal preference", rather than assuming that their workforce could be treated as all 'integrators' or all 'segregators'.

To prevent negative outcomes, managers would do well to recognise the existence of these different preferences among their employees and to respect individual choices in this area, which may themselves change over time and in response to different technologies.

Another key lesson from the academic research is that having a strong base of autonomy and engagement in the workforce, as well as management behaviour and role modelling, are key to moderating any negative effects from smartphones.

One study found that the receipt of work-related communications outside of regular work hours "was associated with higher levels of work-to-family conflict, distress and sleep problems. In addition, we found support for the 'resource hypothesis' – the positive association between work contact and either distress or sleep problems – is weaker among workers with more job autonomy, schedule control and challenging work" (Schieman and Young, 2013).

A more recent study, 'Smartphone use and work-home interferences', expands upon this, concluding that where there were increased expectations of availability from employers, this spread of smartphones was a major contributor to 'work-home interference', where the demands of employees' work and home lives become incompatible (Derks et al, 2015).

To moderate this effect, the study concluded that 2 things were key – avoiding creating an 'always on' culture, which required role-modelling by supervisors and managers to avoid sending emails after work hours, as well as the important role of having an engaged workforce.

This mirrors findings from the Acas research paper, 'The management of mental health at work', which found that late-night emails from colleagues was a cause of anxiety among employees and that if managers failed to lead by example, it created a sense of expectation that other employees should be responding to emails even at very antisocial hours (Acas, 2016).

Case study – NHS Whittington Trust

Nurses find they need to learn to switch off

The district nurses were allowed and even encouraged to take their iPads home with them after work and use them for personal use, provided that staff connected to their home wifi network and avoided using mobile/4G data.

This, however, had a side-effect of giving most nurses for the first time access to their work emails whilst at home in the evenings. There was no sense among nurses that they were expected by managers to check their emails at home, "they'll send emails out of work time but they are not expecting you to action it until the morning", and indeed managers emphasised that doing so was not encouraged, saying "it's their choice if they choose to look at emails outside of hours. It's their choice, it's not encouraged".

Communications had been issued by managers informing staff that they were not required to check emails outside of work hours.

However, a significant minority of the nurses reported that they found it difficult to resist the temptation the technology presented them to check their emails at home. "I think with the iPad you kind of always go 'I'll do that when I get home', which is not necessarily a good thing in terms of work-life balance."

"Yeah I think I've got a bad habit of checking my emails but it's just I guess we don't completely switch off. We can use it for personal

use as long as it's not excessive, so obviously you can see you've got an email, so sometimes it’s difficult to not read an email. It's hard I think. It's discipline."

Having this mental 'discipline' to avoid emails at home was easier for some nurses than others. Email is known to have some of the same addictive qualities that social media has, and it is possible for workers to find the urge to check or respond to emails irresistible if they have constant access to them.

Even when they chose not to reply to emails, some nurses still felt that the simple fact of having access to them at all times could be intrusive. As one said, "you're connected at all times and you'll go to the app to look at the weather and you'll see the email there so it's like you're working."

One manager emphasised that they were clear that "there is an off button" and many of the nurses did find themselves taking this route, avoiding using the iPads even for personal reasons out of concern that they would be reminded of work. "As soon as I finish my shift I switch it off but if it's on it's going 'bling bling bling' in my bag and that intrudes on my own time."

Another manager was more reflective about the need for both staff and managers to take responsibility for allowing staff to 'switch off', both literally and mentally, saying "I don't think it happens that often but maybe we should be saying something about it. I think it's important to switch off. Also we don't want to be prescriptive [and] say don't use your iPad to search for something online."

4.3 Targeting employee fitness

As well as relieving the burden of physically exerting or dangerous work, there are other, broader opportunities that technology offers for improving employee health and wellbeing.

One of the managers at the Whittington Health district nursing team even came up with an idea during their interview for a 'mindfulness' app that could be added to the nurses' iPads in order to help support their wellbeing at work.

As Anthony Bruce of PwC describes, one key advantage of technology "is the availability of reaching people as individuals as opposed to approaching people en masse. I can deploy to an individual a targeted app based on wellness, on how you are feeling and understand in real time how people are".

Monitoring technology can increasingly be used to track not only physical health and fitness of employees but also their psychological wellbeing, tiredness and sleep quality. New technologies are now emerging which can take note of verbal or written cues to indicate emotional state, or use ECG monitors to measure heart rate variability as a warning of stress.

Network Rail, for example, has worked with business psychologists Robertson Cooper to develop an 'i-resilience' report and 'wellbeing snapshot' for their staff through the use of online self-assessments, which have allowed managers to identify areas vulnerable to work-related stress. High stress levels were found in their finance and legal departments, allowing the organisation to take action to support these groups.

A 2014 study by the Institute of Management Studies into the impact of wearable technology found positive impacts on performance at work after equipping workers "with one of the 3 devices – the GENEActiv high-velocity accelerometer wristband which measures movement and activity, the NeuroSky Mindwave portable biosensor EEG which monitors brain activity, and the LUMOback posture and activity coach which issues a pulse to remind its wearer to sit up straight" (Rackspace, 2014).

Consumer data from Vision Critical shows that 21% of UK working-age population is already using some form of wearable technology – primarily for personal health and fitness purposes. New research from PwC shows that more than half of employees would consider wearing a smartwatch from their employer if their data was used to improve things such as working hours, stress levels and where they can work from (Vision Critical, 2017).

As Anthony Bruce pointed out, these technologies when applied carefully to an engaged workforce and with a high level of trust can make a big positive impact on improving wellbeing at work. However, he also cautioned that such technologies raise important questions "about data, trust about how that information is going to be used. Is it going to be used for the benefit of that organisation?"

Any data related to physical or mental health is likely to be regarded as 'sensitive personal data' under the Data Protection Act, meaning employers that want to embark down this road need to give serious consideration to how they are going to store and use it.

There are risks that employers rush in without taking the time to fully consider privacy implications. A survey of 300 IT decision-makers in the US and UK about equipping their employees with wearable fitness-measuring devices, such as the GENEActiv accelerometer or brain-scanning NeuroSky mentioned above, found that only 20% cited concerns about employee privacy as a reason for them not introducing such technology.

Another risk is that some employers move beyond voluntary use of such technology to improve employee health and wellbeing and start treating it as an expectation, to put pressure on employees to maintain their physical and mental health.

If taken to extremes, this could result in companies penalising employees if their fitness and wellbeing fall too low – hardly an ideal outcome. Anthony imagines a case where data might lead a company to conclude that "actually Bob is a bit overweight and is a heart-attack risk because we can see his blood pressure and his levels of activity and his level of stress", and could lead them to "misuse this and mismanage his career because we don't want him in the organisation because he’s going to be a drag on us".

Such metrics might also find their way into the recruitment process. Chris Brauer, director of innovation at Goldsmiths, University of London, has floated the possibility of 'biometric CVs' becoming part of the job application process, containing data on sleep patterns, fitness and responses to stress that are collected by wearable tech.

While these technologies might have many valuable applications, they could also open the door to a range of new forms of discrimination claims against employers if employees or job applicants feel they have been unfairly penalised because of their mental or physical health.

Overall there would appear to be a huge wealth of technologies currently in development that might allow users to monitor and assess employee health and wellbeing like never before. The open question to be determined is whether the primary 'user' of these technologies and, therefore, the person in control of the data, is going to be the employer or the employee themselves.

While there are major potential gains to employee health and fitness, there are potential risks to engagement and employment relations from overuse of these technologies. A discussion needs to be had about where the boundaries of acceptable use might be. As the PwC report into wearable technology puts it, "trust must be at the foundation of the wearable relationship, from implementation to action. 'How far is too far?' is a question enterprise can never stop asking or respecting" (PwC, 2014).

5. Technological change management

5.1 The theory of change management

Change management theory provides useful lessons for managing technological change. The core insights include the need for clear engagement and communication with staff to ensure their buy-in, and the importance of careful consideration of how the technology aligns with employee needs.

Change management first emerged as a discipline in the early post-war decades, with psychologist Kurt Lewin being one of the early pioneers with his theory of a predictable and planned approach to change, involving 3 distinct stages:

- 'unfreezing' the status quo

- 'moving' the workforce
- 'refreezing' to stabilise an organisation with the new practices

In more recent years, scholars have instead emphasised the more fluid and experimental nature of change – that not everything can be predicted in advance and that a large part of change management consists of preparing contingency plans and managing challenges as they emerge (Hughes, 2006).

Among the most influential models of managing change is the 8-step change process introduced by Harvard Professor John Kotter in his 1995 book 'Leading Change':

1. Establishing a sense of urgency within the organisation that change is needed, by identifying threats and opportunities and starting conversations.
2. Creating the guiding coalition of key people from different areas and levels within the organisation who will lead the change.
3. Developing a vision and strategy about why the change is happening, what values underpin it and how it is going to be executed.
4. Communicating the change vision clearly and repeatedly to employees, taking care to address anxieties as well as leading by example.
5. Empowering employees by removing obstacles, changing structures, providing help to those resisting and rewards to those making it happen.
6. Generating short-term wins that staff can see, focusing on easy and achievable targets in order to motivate and encourage staff through success.
7. Consolidating gains by analysing what goes well and badly at each stage and setting goals to continue building on momentum achieved so far.
8. Anchor changes in corporate culture in order to make sure that they stick, publicising every success and including change values in training for new staff.

Many of these lessons are equally applicable when it comes to technological change for organisations, particularly those around having a clear plan, communicating it clearly and then empowering and valuing employees through the process. Veronica Hope-Hailey described research that had shown the importance of maintaining a positive message throughout the transition from one technology to another:

"Those who were successful, who managed change well, have these conversations that celebrate what you have achieved – thank people for using mode A today and explaining to them why they are using mode B before they press that button on the day."

Anthony Bruce of PwC lists many of the common problems managers can face when it comes to implementing new technology with their staff:

"They don't want to do it in a new way, they don't understand why they have to change, it doesn't link back to their job. Maybe the organisation doesn't invest sufficiently in training and education. They don't invest sufficiently in hearts and minds so people don't want to go on the journey and people inherently fear change. This is all in the change management 101 book."

However, he goes on to point out some ways in which new technology is changing this rulebook. One new difficulty technology poses is around trust relating to the collection, storage and use of data, which can introduce additional workforce anxieties, as seen in the Whittington Health district nursing case study, that complicate the question of winning over 'hearts and minds'.

Another technology-specific problem is that the pace of change is often accelerated, such as when adopting new systems that are Cloud-based and therefore use infrastructure that already exists – in these cases Anthony says "it's going to take 3 months, not 18". Therefore, he concludes that "good old management techniques, while they apply, they are in some ways redundant".

5.2 The pace of technological change

All of the experts interviewed for this research agreed that the pace of technological advancement itself was accelerating, something that poses serious challenges for organisations' abilities to keep up. How quickly can and should organisations move when it comes to implementing new technology?

Anthony Bruce pointed out that employees, being generally of a younger generation, might increasingly "have grown up with an expectation that things move quicker" than their older managers' generation, who might have the view that "it's going to be difficult, we should go slow and be cautious".

Therefore, he explained, it might be the case that "the population you're trying to change are probably more ready for it than you think they are". This will clearly be truer for organisations with a younger employee profile, while managing change among a population of older workers might require a slightly more measured approach.

Veronica Hope-Hailey agreed with the view that that the change itself can and often should be executed at pace, not least because it maintains the enthusiasm of the workforce rather than allowing them to become impatient or disillusioned.

She discussed a case study of newspaper digitalisation where: "they found that actually the journalists got impatient because 'if we can do that technology change, I'm somebody who works to deadlines, I'm used to delivery at pace with the deadline so actually don't slow this down, speed me up'. And they did it very successfully – not a single edition of either the paper version or the online version was delayed. That was a really interesting revelation to me that actually pace sometimes can help you and if you delay too much, actually it can become quite tedious."

There is, however, an important need for careful planning and preparation before technology is brought in – as Harry Armstrong put it, "try and do as much as possible to understand what the impact is going to be and mitigate issues before they happen and stay responsive when issues arise and you know what you can do about it".

One of the managers at Jaguar Land Rover also made this point, stressing the need for "getting that balance between wanting to deliver on time vs having the capability and the projects being at the right level of maturity so the technology will actually work".

Harry Armstrong also made an important point that the technological change process does not end once the technology is operational – it is important to keep continually asking "how are you monitoring its impact over the long term and how are you monitoring how effective it is through evaluation?"

Leslie Willcocks pointed out that many modern organisations lack the ability to implement change this quickly, partly because work has already intensified to the point they have little time for forward thinking, partly because of resource shortages and partly because of the speed of technological advancement itself. He argued that these trends mean that:

> "People have transformational fatigue at the moment – they've seen too much change and they want to slow down. I think organisations' capacity to change has slowed down. I think organisations are going so fast just to cope with the uncertainty around and so focused on just getting today's work done that, although everyone uses the rhetoric of change and innovation, their actual organisation's capability to change is slowing down."

One of the things that organisations had lost over recent years, in his view, was the ability to be 'ambidextrous':

> "They talked a lot about the ambidextrous organisation in the 2000s which was an organisation that could do operations and run things as they are, but also could identify and innovate very quickly in response to changes in the marketplace, assuming there's a very dynamic context out there. I'm not sure that there are many ambidextrous organisations in the world."

The general lesson for organisations on the pace of technological change seems to be 'prepare thoroughly, implement quickly', something that all of the case studies also seemed to bear out. The difficulty is that organisational ability to meet this timetable will likely come under more and more strain if work-related technologies continue to advance at an exponential pace over the coming

decades. As Leslie Willcocks cautioned, the theoretical capabilities of technology might soon be advancing far ahead of the practical ability of organisations to adopt and implement it successfully:

> "One of the things future of work studies never factor in is the speed of transition. They assume that a) the technology is very perfectible very quickly, which it isn't, and I mean I know a lot about technology so I know how imperfectible it really is, and b) they assume organisations' capacity to change is instant, which it isn't. If you make these false assumptions then you make statements like 'we're all going to be automated by 2020'."

Case study – Siemens Congleton

Robots on the horizon

At Congleton, "we bought a universal UR10 collaborative robot, probably about 18 months ago. The idea was it would be used in our labs so again we're trying to expose people to the technology, have a bit of a play with it".

Currently the robot is in testing in a visible location and with all shop floor staff taken on an early tour to view the robot in action so that they are less anxious about its development and future introduction.

A manager described how the current plan is that "one of them is going to go onto the shop floor in the next year, we'll have one helping us manage and test it. Then through that we'll increase the exposure people get to the technology".

Most of the shop floor staff who were interviewed were aware that a robot was in development and remembered their tour where they had seen it. However, their expectations seemed to be that nothing much further was likely to happen for a long time – when asked when they expected to see the first robots on the factory floor, the shop floor staff seemed not to be expecting anything within the next year:

"20 years' time" / "I think that's quite far in the future" / "I think it will be a long time before anything like that takes over." / "It's been there a while, it's locked in a room and you never see anyone going in there. I do sort of think they will come in but I think it will be a long time before they actually come in."

One problem seemed to be that the development of the robot was such a long process that some workers had forgotten the effective communications that they had received at the start of the process. Managers seemed to be aware that the project was not proceeding particularly quickly, that "on the engineering side there's frustration that they'd like to go quicker but they haven't got the resources – they have to do so much day to day."

"I was going to say particularly on the robot we could have done better. In an ideal world the people would have a bit more time to work with the technology - we've got various health and safety issues. We can't have people just leaving the line to go play with the robots."

Long process ahead to transition workers to new roles

Part of this challenge related to the need to upskill the workforce before they could even spend time learning to work around the robot, as it represents such a radical advancement in the technology and working practice. One manager described how, in order to get things right and not rush the introduction, they were currently working "to upskill [staff] in preparation for when the robots come in. We fell flat on our face sometimes before when we brought technology in. We got so excited we bring it straight onto the shop floor before people have been trained in the skill to use it and then it's not accepted as well as it could have been if we maybe planned to implement it a bit better. I think we haven't included the shop floor this year but I'm not sure 100% if we're in a position to do that – they haven't got the skills or understanding of how to implement it from a usability point of view. We're not getting the engineer involved to

do that and when it's on the shop floor I think that's when the operators will actually get involved with it."

The expectation was therefore that shop floor staff would gradually become more familiar with and acclimatised to the robot over the coming year or two, at the same time as being upskilled themselves for future working with it. At this stage the project is still at a relatively early stage, but it is clear that a lot of thought is being given to preparing workers well in advance of the technology itself even being ready for introduction.

One manager concluded by saying, "I think there's probably frustrations on the shop floor because they know a robot is coming in and there's all the questions of how it's going to affect my job and I understand from the shop floor the impotence that they've probably got but from a higher level I think we're doing it probably right. We're introducing it step by step."

5.3 Understanding the need for new technology

One of the core lessons of change management revolves around communicating to employees the reasons for the change – in this case the need for the new technology. First, of course, leaders need to make sure they do have a genuine reason for introducing it and are not simply bringing in what Anthony Bruce from PwC described as "technology for the sake of it".

Adopting new technology is essential to sustained competitiveness for many organisations, but there is still need to consider the precise value of any particular innovation and whether it fits with the organisational and human context. When considering whether and what technology to introduce, Stella Martorana from CIPD listed some of the factors that managers need to consider:

> "It's very important to look at the context, the type of organisation, the type of workers, the technologies, otherwise we end up with conclusions that don't help anyone, that look abstract."

Anthony Bruce from PwC summed up the importance of having clear objectives and an understanding of the business need, by contrasting two successful and unsuccessful approaches he had seen companies taking to technology. On the one hand, he describes a positive approach:

> "It was done at extremely low cost, very quickly, as a pilot with a clear set of non-technology based outcomes about leadership connectivity, about speed of decision making, about engagement, about authenticity from a people perspective, so people felt they could bring themselves to work. Those were non-technology based outcomes and that was an immense success in achieving some simple business goals which were done in a very efficient way and technology enabled it."

In contrast, he describes organisations that fail to carefully consider their needs properly or come up with these business objectives:

> "I guess on the other end of the spectrum we have organisations looking at technology - as an end in itself for large back office processes, but not thinking about the customer or the employee or the outcome they are trying to drive and perhaps going slower than they need to. Perhaps designing systems that aren't built around the employee experience or the customer experience - 'if we build it they will come' type thinking - and it doesn't happen because of those change management reasons, because people haven't thought about that user journey or that customer journey. I think having a clear business need and then understanding the customers and employees who every technology is targeted at. It's being really clear on need, I think, that is the defining characteristic of success, not whether it is a cool technology or not."

Lessons from the 3 case studies - choosing the right tools for the job

In all 3 of the case studies, the technology that was being brought in was carefully considered for its suitability to fix particular problems that the organisation faced – generally the need to meet increased levels of demand. One of the Jaguar Land Rover managers

explained how "we explore new technology all the time, so my role is that I'm always looking for components that increase reliability, cost save etc".

They emphasised the importance of "the preparation - how to visualise how it's going to look, how to explain to the people the benefits to them".

At Siemens one of the managers talked about how "we have a lot of conversations around where we are asked frequently to get into groups for productivity and say right what causes the problem, what do you need to solve? What could it make better? Comments have come from my team, saying well that's really awful, that's really hard to deal with".

This focus on the needs of the staff was also evident at Whittington Health, where the district nursing team had previously trialled laptops, before realising that tablets were a better fit for their nurses' needs.

"We had a mini run of that and it was connectivity problems, laptops were heavy, it took a while to sync, the technology did not work so well with Windows. In a sense we've been through that process before and we know that we want something lighter, a bit smarter. We wanted better connectivity, we knew those things beforehand and lots of people had smartphones and smart devices and were using those already. It seemed that using a smart device was less of a sea change for people."

5.4 Communicating the need for new technology

Once the organisation is clear about the need for change, the challenge becomes communicating that need, along with the accompanying plan and objectives, to employees in a convincing way. At the same time, they will need reassuring about many potential anxieties they may have. One of these will be the potential short or long-term fear that technology might replace their job.

In some cases this is less of a concern – in both the Siemens and Jaguar Land Rover case studies the technology was being brought in to expand the organisations' capacity to deal with increased demand, rather than with an immediate view to reducing overheads, so there were no immediate employee concerns about redundancy.

Nevertheless, there was an awareness that such heightened demand might not last forever and so both organisations pursued a proactive approach to dealing with any potential employee fears of replacement. Soothing these concerns is important not just to ensure the success of technological change, but also more widely to maintain productivity and service quality. Studies have shown that perceptions of job insecurity can be associated with decreased service quality (Batt 2000).

Technology itself can also allow a more tailored, personalised approach to communicating with and managing change for individual employees. Anthony Bruce describes how when managing change, leaders can personalise the "type of messaging, engagement and training and I can push those sorts of messages to them individually in real time at low cost and make it much more context specific to their job and their role because I have more information".

This might mean, for example, personal updates to individual employees about how the technology is going to impact their specific role, how it will help them with their tasks and perhaps the preparation of a bespoke digital training package for that employee based on how they are forecast to interact with the technology.

However, Veronica Hope-Hailey cautioned that technologically assisted forms of communication should not be allowed to substitute entirely for traditional face-to-face conversations. In her view, what was needed was "face-to-face conversations, town hall meetings, none of this 'I'm going to send something to Instagram, I'm going to tweet what's going on, I'm sending a very long email because I'm actually too scared to tell [the workforce] and justify my decision'. It's paradoxically new technology that has actually, I think, damaged our ability to lead in times of change".

Her concern was that new technology has allowed so many ways for managers to avoid having face-to-face conversations with their employees about change, that it provides a temptation for them to avoid the difficult conversations that really need to take place.

Important attention also needs to be placed on the emotional response of employees towards technology. Academic evidence suggests that the framing of technology as either an opportunity or threat to employees can make a big difference to how they react (Stam and Stanton 2010).

As described below, the 3 case studies provide good examples of management efforts to frame the technologies in a positive way. Particularly important to framing new technology as a positive opportunity for employees is choosing the right technology for the organisation in the first place. As Stella Martorana described, "if the top management chooses the right technology there won't be so much resistance because it will be welcomed much more because it looks like a solution to the problems".

Case study – Whittington NHS Trust

Reaching out to nurses through team meetings

At Whittington Health, there was a range of different communication channels used in order to reach nurses, though the one that was felt most valuable by both managers and the nurses was the face-to-face communication by the project managers attending team meetings. As one of the managers explained:

"Face to face is the best way to communicate change to people, however when you have a large workforce in multiple locations that's not always the most ergonomic thing to do. Sometimes you have to use the technology to bridge the gap. The problem is a lot of people don't read their emails. I guess yes, you have [to] use different platforms to reach everyone."

It was also considered to be important to reach out early in the process to those staff who might face the greatest difficulty in using the technology. "I would say you want to probably engage your people who aren't pro users of technology. You want to engage them first because that's where your trickle will be in terms of getting through". The nursing team invested considerable attention throughout the 3-year process to providing extra support for this group through one-on-one sessions.

A different manager also picked up on this point, stressing that taking the time to answer questions, even if they were really basic questions from people that were less technologically literate, was very important:

"Being accessible to answer questions, realising that people will always be at different levels so you might have to pitch it differently. Every question is a valid question, don't make people feel stupid."

Management seemed to have taken on board the lessons from the earlier rollout of the iPads where issues with communications about the location tracking function had fuelled some suspicions among staff. For an upcoming software update that would greatly expand the role and use of the tracking function in helping allocate nurses to nearby patients, the project leaders were planning a new round of clear messaging to be sent to staff in order to inform them about the plans and provide reassurance.

One of the programme leaders said that the number one lesson they had learned was "communication and being really open about communication is so important, which we learned from and we've done better this time. Involve the staff, tell them as fast as you can even if it's really basic – this is going to happen, but we don't know how and do you want to help?"

Generally, the sense from the research is that employees are more often than not welcoming and enthusiastic about the prospect of seeing new technology at work. Leslie Willcocks described how workers' increasing exposure to technology in their consumer lives meant that they were more willing and prepared to accept the need for new technology at work:

> "I think if you said to people, 'we have to go digital', they'd say, 'you do, because I've gone digital - I've got 5 devices on me!'. They can see the positive benefits of it personally and so they make the assumption corporate can do this. I think that corporates have a lot less resistance at the cerebral level and even at the emotional level against digital than many of us think."

However, he warned, while workers are in principle welcoming of technology, their concerns about management intentions and potential control over it might be the bigger source of concern.

"I don't think they're suspicious of technology, I think they are suspicious of corporations and the businesses they work for much more. They get what technology can do, they fear whose hands it falls into, which is why that then gets displaced into a debate on automation and the future of work [and how] the technology somehow will take your jobs. Yes, but behind that is the suspicion – not of the technology but of who will manage that. It's been made out that the boogieman is technology, but really it's not technology at all."

Therefore, perhaps the most important lesson for managers is the importance of clear communication of objectives and intentions about the technology. In all 3 case studies, face-to-face meetings between management and employees, either in small group meetings or larger town hall settings, were very valuable for communicating the plans to the workforce.

Organisations that instead rely solely on an email notification about forthcoming technology or, worse still, simply produce the technology one day with no prior warning, face the risk of major resistance as employees adopt the 'prevention-focused' frame.

Case study – Siemens Congleton

The rumblings of discontent over robots?

At Siemens there was also a multi-channel approach taken to communication of plans, but once again the most valuable was found to be face to face, at their town-hall style sessions for all employees, at which "the information about [the technology] is passed on to employees and they get an opportunity to ask questions about things and all of that".

The management team were also particularly sensitive to potential flashpoints of employee discontent, such as concern about the impending arrival of robots. As already mentioned, one of the approaches taken with the robots was to physically place the testing area in a location visible to the employees to improve familiarity, but there was also more active dialogue with employees to address these concerns.

"The forum is good because you get to ask questions open and honestly. [The manager] goes around and anyone can ask questions there and then. You've also got question boards and message circles – sometimes questions come out of that. I know that with the robot, because we were conscious of people being nervous of robots coming in and taking jobs and stuff, we had a team brief [and] someone suggested that we communicate a little bit earlier than we usually would."

"He heard rumblings of discontent if you like and he put together a fantastic presentation – it was called 'collaborative robots' where it said it wasn't to replace people. As soon as he made that presentation – it was 10 minutes – people's mind-set was completely relaxed."

Being open and honest about plans is very important. At Siemens the managers were very keen to emphasise that their new collaborative robot in development "isn't hidden away, it's in the production area, the operators walk past it every day, they can see what it's doing, it's all glass windows, so it’s not like it's in a back room somewhere, it's visible for everyone to see".

Leslie Willcocks stressed the importance of this transparency, saying when asked what the most important lesson is for managers when introducing new technology:

"I think it's about messaging and integrity, which is that the worst thing you can do for your employees is to leave them uncertain, leaving them in an ambivalent situation. It's when corporates go secret and managements go secret these days that people say why aren't they telling us this, they assume the worst. Much more so than ever before really."

Case study – Jaguar Land Rover

Clear communication key to overcoming workforce resistance

Managers at Jaguar Land Rover were well aware that resistance is an inevitable part of technological change - "everyone has resistance to change, no matter what it is, and for some people it can be really big for them – to change the work environment can be massive".

The approach taken to limit this resistance at Jaguar Land Rover was through clear and consistent communication and information "to share with them as much as you can because at the end of the day we've got nothing to hide – we're going to put a robot in and take 3 people out, that's what we're going to do so we might as well get that information out there".

As another manager described, "communication of this is absolutely key. If people don't understand what you're changing and why then why are they going to accept it? The better the communication normally the better the result. If you communicate it poorly generally it falls over and you have to pick it up or abandon it. In a plant of this nature with this complexity with the workforce we have communication is king. If the people don't feel they're being talked to or involved they will just be sceptical and push back".

The way in which this was approached also relied on a sensitivity to generational differences in the workforce, including "a lot of people who are long serving who have worked for all their life on similar processes – they are not going to naturally warm to change. You've then got the other extreme now where we've hired 5,000 to 6,000 people, younger generation, different background actually probably don't want to do the same thing all the time. I think the lessons learnt are that you've got to find a way to engage and communicate with all your people. Different ages, different diversity of backgrounds, you've got to be able to make that connection when you are going through periods of change. I think that one of the things that we have done well is communication and bringing people with us because we've been able to convey to them why we're changing".

This success was reflected in the views of the workforce, who all seemed to accept the need for new technology and innovation. "You've got to be using the technology - you stand still and we lose income and we go down the drain because of it. You've got to keep changing, you've got to keep evolving yourself and moving the product on."

5.5 The role for staff involvement

One key lesson for those managing technological change is that communication with employees should not be only in one direction. While clarity of management plans and intentions is important, it is also necessary to get feedback from employees at every stage in the process and make them feel that they are involved in the technological change, not merely passive subjects of it. As one of the managers at Jaguar Land Rover put it, "my biggest concern is if we don't encourage engagement then the resistance to change is quite high".

As Stella Martorana of CIPD made clear her view, "I'd say it is very important to get them involved from the beginning so they feel they are part of the decision". Harry Armstrong of Nesta agreed and also said it was important that this involvement was maintained at every stage of the process:

> "Definitely, if you are going to involve staff within consultations then it's important that you maintain involvement in that process and you are transparent about why decisions have been made and as much as possible you get acceptance of why decisions have been made."

Leslie Willcocks described how, in his opinion, trade unions had become much more willing to support technological change over recent decades:

> "Back in the 1980s we used to say 'do you think that trade unions resist change, or might be helping managers and organisations?' My sense is that trade unions attempt to be much more helpful than they ever did, but the question is whether managers accept that help or just want to do their own thing."

Despite this consensus view from the experts interviewed that involving employee representatives or trade unions where they exist would be beneficial, all of the case studies found that there was in practice very little formal role for employee representatives in the process. Generally the view from managers and the workforce was that trade unions or staff representative bodies seemed only really to get involved when, for example, jobs were lost or shifts changed to the detriment of workers - otherwise they were largely left out of discussions around new technology.

As Stella Martorana put it, "if they introduce new technologies and jobs are lost then we can talk about trade unions, otherwise it usually happens internally within the organisation without the involvement of other people".

While all three of the case studies looked at in this research were broadly successful in their deployment of new technology without unions being involved, there is evidence that more formal involvement for staff representatives might be helpful. Academic research suggests that "a long history of mature collective bargaining created a climate of trust, and union support for [a] program provided employees with confidence to fully participate in ways that otherwise not have occurred" (Godwyn and Gittell, 2011).

In Germany the new Industry 4.0 White Paper recommends a vital role for trade unions in reaching agreements with employers around the use and limits of new technology. Deutsche Bahn and the Railway and Transport Union (EVG) are leading the way with negotiations over a 'Collective Agreement 4.0' to govern the way in which their workers will be affected by future trends including new technology.

Veronica Hope-Hailey agreed that a model of more explicit union involvement might benefit organisations trying to bring in new technology, because it forced management to tackle some of the difficult questions about engaging with the workforce about technology head on, rather than avoiding accountability:

> "I wonder whether we were actually better at management accountability in the 70s or 80s, with strong union representation, a strong understanding from employers with accountability and strong trade unions actually taking the onus of communication with workforce on themselves to explain why technologies are coming in. Research showed family businesses, partnerships and heavily unionised organisations came out well because of the notion of accountability – 'I can't just push this change through, I must be accountable, I must explain, I must the share data and I must listen to employee voice'."

Where unions or other staff representatives are going to be involved in the process at some point, one lesson would be to start discussions with them at an early stage, even before the plan to introduce the technology has been finalised. The leaders of the Whittington Health district nursing case study all felt that their rollout would have been smoother if staff had been involved and consulted earlier, as it would have secured staff buy-in to the project from the beginning.

Harry Armstrong of Nesta made the point that, where employees were only consulted later on in the process, "it becomes more of a tension, more of a conflict, because they are trying to push back on things that have already been decided, and unions definitely would be willing to have conversations very early on".

Janet Williamson of the TUC agreed with this view of union involvement:

> "From our point of view our biggest problem is a lack of consultation with staff before things happen rather than after. Making sure that the workforce is fully consulted about what's happening, what's being proposed and can feed in both any kind of concerns that they might have about the impact on our workers, and also and as important – any suggestions and so forth".

With or without a formal role for trade unions in the process, it is still vital that managers consult thoroughly with staff both before and throughout the introduction of new technology. Evidence, however, suggests that this is often not done as much as it should be.

In the 2011 WERS, employers said that the introduction of new technology was the one change that had the greatest impact on employees in the workplace. However, this was also one of the areas on which employers were least likely to consult staff – and the least likely to see actual negotiation with staff or representatives (Table 1).

The Fabian Society's Good Work Survey 2016 found that 46% of workers say they have little or no influence over how they work with new equipment or software.

Incidence of workplace changes and involvement of employees

Reproduced from 2011 Workplace Employment Relations Survey. Base: 2,680

Incidence of workplace changes (%)

Workplace change	Overall incidence	Most important change
Introduction / upgrading of new technology	48	19
Changes in work techniques	44	16
Changes in work organisation	39	17
Product or service innovation	33	10
New employee involvement initiatives	28	7
Changes in working time arrangements	22	8
Introduction of performance-related pay	8	3
None of the above	21	N/A

Involvement of employees for the most important change (%)

Workplace change	Any consultation with employees	Negotiation with staff or representativ
Introduction / upgrading of new technology	45	7
Changes in work techniques	52	11
Changes in work organisation	62	11
Product or service innovation	42	8
New employee involvement initiatives	52	22
Changes in working time arrangements	50	22
Introduction of performance-related pay	45	35

To achieve better outcomes, changes should be accompanied by a continued and consistent consultation with employees. This helps ensure employee buy-in and acceptance of the technology, as studies in India have shown: "A key factor in the acceptability is by taking the unions and the employees into confidence before introduction of automation" (Krishnan, 2010).

Again, thinking about this in the context of employees' emotional reactions to the technology can be helpful for understanding the dangers of not involving staff properly. Affective Events Theory "suggests that features of the work environment (for example authoritarian management) can often lead to workplace events or 'shocks' of a certain type in the workplace (for example a new technology is deployed without employee input) to which the employee displays an emotional response (for example feels angry)" (Stam and Stanton, 2010).

In addition to just avoiding antagonising them and securing acceptance, a more engaged workforce is much more likely to contribute good ideas towards helping solve problems and make the most of the new technology. At Whittington Health for example the district nurses, once they had been properly engaged in a dialogue with management, were an important source of suggestions for new and useful apps to be added to the iPads, in order to expand the ways in which the team were able to use them.

This illustrates a more general lesson – that, as Anthony Bruce said, employers need to think of their "employees as consumers" of the technology. This is important because it focuses employers' minds on what the actual needs of the employees or the company are, rather than the risk that the company might "end up with solutions looking for problems and not really focusing on the employee need, the social need, the profit imperative or whatever it might be, you've really got to hold onto deep clarity on what you want".

Where technology is just imposed by management without proper consultation and dialogue, it runs the risk of not fitting properly with the needs and working practices of the employees. As Janet Williamson said:

> "Employers are not as good as they should be at realising that when new technologies are introduced at work, consulting and engaging with their workforce is a crucial part of making that innovation, that investment work well. I think there has been research that shows that when new technology doesn't work effectively, work organisation is often a major part of that and a lot of that is down to employers not sufficiently consulting with their staff about how things should be done."

It is also worth making the point that in some cases technological change can be entirely driven from below as well as directed from above (though more often with smaller rather than major change projects). Even when the project is large enough that it clearly requires oversight and leadership from management, allowing a degree of employee autonomy in freedom to experiment with how they use the technology can lead to better results. Self-directed teams have been found to exhibit improved learning and problem-solving when it comes to handling new technology (Batt, 1999).

Anthony Bruce pointed out that, where given more autonomy in using new technology the natural enthusiasm of employees for technological change can come through more strongly, avoiding "a presumption that people don't want to do it – they're reluctant, therefore they need to be told".

Instead, "I think 'letting the children play with it', engage them in it in a controlled way and let the self-empowered teams run, I think that's something specifically that people can do".

Lessons from the 3 case studies: Evidence of the benefits of staff input

At none of the case studies were trade unions the main focus of staff involvement in the technological change, though at Jaguar Land Rover the trade union did have a slightly larger role in consultations around the introduction of new technology, particularly regarding staff training.

At all 3 case study organisations, however, there was evidence that directly involving frontline staff in the projects, listening to staff voice and feedback and allowing a degree of involvement in decisions around how the technology was used led to considerable benefits.

At Whittington Health the nurses were the source of several good ideas for new apps that could be added to the iPads in order to expand their use, as well as pointing out technical issues that managers had not originally thought of. "It was helpful in that they would say 'we have this but it doesn't work so well'. It was helpful for them to point out the things that we hadn't thought about."

The back and forth with staff was also important to secure "buy-in certainly from your user group. Accepting that there will be dissent and having a plan to deal with that dissent. Accepting that there will be some toing and froing until the idea cements". One manager expressed a view that higher levels of staff involvement at the very beginning of the project would have been even more beneficial, saying "I think if staff had been more involved we wouldn't have encountered the resistance that we did".

At Jaguar Land Rover the managers felt similarly that many of the better ideas came from using workers' knowledge and experience:

"The leadership might have good ideas in the office but it's the ideas from the workforce that really matter. Because if the guy that works on the machine all the time, he might be able to come up with the repair or a way around or a solution to a problem and if he's done it himself it will mean a lot more to him and he will take great pride in it."

"The experienced guys are critical in that sort of implantation, they've seen it before, they know the tricks to look out for and what the vendors try and do versus what we expect them to do."

Value of employee voice depends on engagement levels

Another Jaguar Land Rover manager argued that their experience was more mixed and that the value of staff input really depended on how engaged the staff felt at a baseline level:

"I think it's useful but it depends on the level of engagement you get back. I've had some really positive experiences and some less positive experiences where people who have been involved in the change have been firmly engaged and want to be part of it and want to be there and describe what process they think is best. I have had other experiences where people do not want to engage in it and are reluctant to be part of that change and we've had to encourage them to be part of it, then be part of the training, then be part of the change."

At Siemens there was a sense that staff were not so much involved in initial planning stages, but that "when we're trialling the process or the new technology they're involved massively". One manager at Siemens described how they had been "delegating that task of the trials to [staff] so their role now as part of the trial they can make notes as they go through the areas, so that ownership that partner process is been given to them to own completely", which had led to a very positive "ownership culture" among the team.

Staff themselves at Siemens sometimes disagreed with decisions around new technology, but were prepared to admit that they were given a real voice in the process. "Yeah they do listen to you but if you're telling them something is bad that they're convinced is good, then it's them who are right and not us".

5.6 The importance of training and adjustment

One clear lesson from the case studies is the need for proper training and support of employees who have to work with the technology – simply relying on workers calling up technical support every time they need help is not a good solution.

Firstly, it places a considerable burden of resources on the IT staff who might not be in a position to constantly respond to issues, but secondly it can also lead to conflict where workers do not properly know how to use technology and then get blamed by their managers for technology-related mistakes and failures. All 3 of the case studies showed examples of workers wishing they received more training from their employer.

Learning how to use technology, however, is not only about formal training sessions. The training of one another by colleagues is also a key part of the learning process that needs to be supported and encouraged.

Referring back to Batt's study of call centres discussed in section 2.2, she concludes that "effective sales as well as service quality depend on continuous learning, processing of information and tacit knowledge that group collaboration appears to foster".

As well as spreading technical knowledge, it is also important that employees pick up social knowledge – who knows what and where to turn for assistance. In all 3 of our case studies, there was a combination of formal training and informal learning from colleagues, both of which were essential to the projects' success.

Technology researchers point to both organisational and technological features that can enable or hinder the adoption of new technologies. Having adequate resources in place to support workers through the transition is one such factor.

Organisations that are under significant budget pressure might not feel able to release workers from their regular duties to take part in training, discussion and feedback sessions about the technology, despite these being essential to success.

As Janet Williamson pointed out, if these resources are not put in place, "people may not feel equipped and if people are insecure about whatever is happening, the changes, they may not feel so motivated to make a success of things".

Team structure is also important – clear leadership is important to drive change forwards, but an overly hierarchical structure might not allow for the autonomous learning and experimentation that, as discussed above, is an important component of success.

Team stability is another factor that can have two opposite effects - some element of stability is important to support learning of new technology, making sure that knowledge is not lost through staff turnover faster than it is gained. However, where teams are too stable it can lead to teams getting stuck in routines and not being able to adapt their process well.

Edmonson, Bohmer and Pisano discuss this issue in their 2001 paper 'Disrupted routines: team learning and new technology implementation in hospitals', where they stress the importance of establishing new organisational routines to accompany the new technology. They outlined models of effective and ineffective approaches to implementing new technological routines based around the degree of feedback, consultation and interaction between leaders and followers.

They found that a failure to properly change the underlying routines was associated with failure of the overall technological implementation and that the hospitals they studied "exhibited striking differences in the extent to which they were able to implement a new technology that required substantial changes in the operating room team work routine. Successful implementers underwent a qualitatively different team learning process than those who were unsuccessful.

"Analysis of qualitative data suggests that implementation involved 4 process steps: enrolment, preparation, trials, and reflection. Successful implementers used enrolment to motivate the team, designed preparatory practice sessions and early trials to create psychological safety and encourage new behaviours, and promoted shared meaning and process improvement through reflective practices".

Anthony Bruce was also of the view that the difficult and less glamorous work of changing underlying processes was at least as important as getting people enthusiastic about the shiny new technology itself:

> "You can assume that because it's intuitive, easy and technology related, that everybody will know how to do it, they'll want to do it and you'll get the minds on board because it looks cool. I think you get an earlier adoption of technology when you do that but I don't think you systematically change the way things happen and the way the work gets done."

Two final lessons from the 2001 hospitals study: "How a technology is framed can make the challenge of learning compelling and exciting rather than threatening and painful. This study also calls attention to the role of team leaders rather than the role of senior management in leading change" (Edmonson et al, 2001).

A final lesson from the case studies we examined was the need to provide time for employees to adjust to using the new technology, rather than expecting an instant shift from the old system to the new system with no teething problems.

Tensions can arise if employees are expected to be proficient straight away and no provision is made for any short-term loss of productivity during the transition. At Siemens, the workers described how managers "adjusted what they were expecting" once it became clear that a new piece of technology was slowing down their production for the first few months.

Case study – Whittington NHS Trust

Peer to peer learning vital in supporting iPad adoption

The nurses at Whittington Health each received approximately 1 hour of training in team sessions led by one of the project managers when the iPads were first distributed.

For most workers this was adequate as the iPads were relatively straightforward to use for those staff who were familiar with similar consumer devices. For the small minority who required extra support, in addition to the formal training provided, they also relied on colleagues taking time to help them learn how to use the iPads.

The managers of the programme were explicit in expecting colleagues to support one another in this way:

"Hopefully what would have happened is that people would go to the ones who are stronger in their teams and say 'I'm having this problem'. Also something that did help quite a lot is [that previously] if people needed new software they would have to go up to IT [off-site] to get the parts. Now with AirWatch we can just push apps onto people's iPads."

Generally most of the staff reported getting used to using the iPads relatively quickly, within a matter of weeks from first being issued with them. However, after the initial training, no further face-to-face training sessions were provided after new apps were rolled out, which sometimes led to staff feeling unsure how to use the latest updates.

One nurse said: "It was all in bits like 'here's the iPad', 'this needs to be added'. If we had a fully loaded iPad with everything we need and then a full afternoon about how to use it and all the functions it does it would have been smoother."

Over-reliance on a single manager to coordinate support was also a problem for the nursing team, as the manager themselves described: "Every iPad-related issue or problem came to me, which turned into every technology issue came to me, which turned to everything to do with IT came to me and no matter how much I pushed back it became just unmanageable."

Harry Armstrong describes the risk that sometimes too much pressure is put on humans to adapt to fit around the machines, rather than adapting the machines to better fit human workers.

"I think one of the major problems with technology, especially when its rolled out and adopted, is that often it's not designed well from a user side and because humans are much more adaptable than technology is, the reliance is on the people to retrain and adapt the way they do their job and that is always more efficient but we might run into problems" around employee frustration and resentment.

And, in addition, the problem that "in the short-term and the mid-term the technology doesn’t get used properly so the potential benefits from using it are lost".

Case study – Siemens Congleton

Workers wish for more training

At Siemens the workers had mixed views about the level of training they received. On the one hand, several employees felt that it had been very thorough: "We've had a lot of training, we had 4 to 5 books we had to read through before we were even allowed to touch the machine and we had to say that we'd read everything."

However, another worker had a less positive view: "I think the training is useless. They don't give you enough time, they just quickly show you how do something once or twice and then let you get on with it. If you break it then just ring a technician."

One employee who had recently been away on leave when they changed a technological process appeared to have missed whatever retraining or instruction was given and had not been caught up before being put back on the shop floor: "They changed a process on a pre-tester and I was on holiday last week, I've come back off holiday and no one's said anything about it. I've been getting this process wrong for a couple of hours. It's been failing and I didn't know why but obviously they haven't relayed that."

One of the workers concluded that "I think it was easier when we used to have training reps – people who were paid to do training".

There was a clear and responsive maintenance and support team who would help with problems, but again there was also a sense

that workers would turn to peer-to-peer support when problems came up.

The difficulties of this approach were however highlighted by one worker at Siemens who pointed out that it was dependent on the attitude of their co-worker:

"If you're working next to someone who is willing to help you and they see you doing something wrong [that's fine], but there are some people who just come in, put their headphones in and crack on". The workers interviewed themselves did, however, suggest that "I would go over and give them a hand" if a colleague needed help with training.

Case study – Jaguar Land Rover

Learning on the job

One of the Jaguar Land Rover managers explained how early worker involvement means that less training is felt to be needed afterwards and help to avoid situations where workers feel training is lacking, that could lead to conflict.

"What will happen is that the production numbers will fall off or the quality defects will rise then the interaction with the leadership team [will be negative] – 'you haven't shown me this', 'you haven't taught me what to do', then there's a friction there. [But if] right upfront and we've included how do we operate this process, we've included you in the writing of this process and you've been part of this risk assessment and what hazards can we see generally, the relationship comes very smoothly."

Workers themselves felt that there was a lot of learning on the job involved, rather than formal training in how to use each piece of equipment or machinery they were given:

"To this day [I] have not had any training on a riveting robot and a gluing robot. I don't know how the gluers work or the riveters, I just had to get in the cell, press a few buttons and go 'oh I didn't mean to do that'. It's self taught."

The maintenance staff also felt they did not have very much formal training on the technology, so there was a lot of learning on the job: "You just pick up over time you learn the cold faults and the common things and you target them first."

The consequence of this was that when there were more complex faults they needed to use an escalation process: "We've got a fault and it could be basic and they don't know how to operate the equipment is quite unique in some ways and because of the lack of training the escalation process is used all the time."

A lack of training could also lead to unnecessary levels of escalation when trying to solve problems: "It's like 'we'll get a group leader in, oh he doesn't know, we'll get a control engineer', then they'll get tech support and before you know it you were the first one on the job but you're back here handing out cable ties."

6. Conclusions for the future

This report will now draw together the conclusions for the future and in particular put forward 3 main themes emerging from the research:

- Changing skillsets
- Changing workforce structure
- Defending human values

6.1 Changing skillsets

However significant changes have been over the last decade, there is little doubt that the next decade will bring even greater disruptions to the nature of human work. Harry Armstrong, Head of Futures at Nesta, sketched out some of the changes that lie ahead:

> "If we look at the conversation around AI, new forms of materials, more forms of production, 3D printing or new types of robotics whether there are collaborative robots or autonomous robots. All of these things present potentially quite big disruptions but more than anything they will reshape the ways that jobs are."

One of the main ways in which it will affect workforce composition is in the relative demand for different skill levels.

Recent research in Greece and Switzerland has demonstrated this effect, with the authors concluding that "technology (ICT) has been found to have a strong and robust effect on the demand for employees' skills. For both countries, we found a positive effect on the demand for high-qualified personnel and a negative effect on the demand for low-qualified personnel." (Arvanitis and Loukis, 2015).

More training and upskilling of adult workers is likely to be required in order to make use of the technology that is becoming increasingly prevalent. Many jobs that would previously have been medium-skilled, clerical work might increasingly be done by higher-skilled workers using more advanced tools.

Stella Martorana described how "statistical clerks were needed in the past but now you need scientists to master more advanced statistical knowledge and techniques".

One of the leading managers at the Siemens plant described how in his view the future roles for their shop floor workers would be different:

> "I think they'll be more technical, more maintenance, technician level roles where you're interpreting a mechanical system and how you can improve that system and how you make that system produce things better for you rather than 'can make what we make quicker'. It will be much more engineering and technically based, maybe more data driven as well. Like Preactor – it's more setting up algorithms and setting up patterns."

A lot of this is a result of the huge explosion of data that is now available to work with as a result of the increased ability to monitor and measure every aspect of the human and physical world. There will likely be a major increase in the proportion of jobs that involve working with data in some form.

As Leslie Willcocks said, at present for many organisations, "it's obvious that they are drowning in information, they have more than they can deal with, let alone keep afloat. In the organisations that are automating, the reason they are automating is that they can't cope with the amount of data they have". White-collar and professional jobs are likely to be particularly transformed by this data explosion.

A look at HR shows one example of how technology is already changing the nature of some professional work – research indicates that the HR profession is becoming increasingly skilled and focused on more complex rather than routine tasks.

"It appears that rather than deskilling work, IT can reduce the amount of time that individuals spend on routine tasks and thus, at least for HR professionals, require that individuals learn new skills that will aid them in corresponding new job expectations" (Gardner et al, 2003).

Harry Armstrong raised medicine and law as two other professions which have seen relatively limited technological impact up to now, but might see the nature of their jobs change significantly in the near future:

> "So paralegals as an example – there are a lot of tasks in paralegals' jobs that can be automated and as a result maybe some paralegals will lose their job. What is more likely to happen I think is that paralegals who stay within their job – the tasks and nature are going to change quite a bit. Rather than doing what the machines are able to do, they will be more of a translator getting the insight the machine gathers from data mining, finding correlations and using that in a way that is then useful for other aspects of their job."

Medicine and other 'knowledge' professions could therefore becoming increasingly like 'translators' of data that is gathered through new technology and increasingly analysed by AI and algorithms. The nature of their skills will correspondingly move away from a focus on the knowledge required to be 'experts', and more towards the human-focused skills of interpretation and communication.

Generally, human and creative skills, such as those that Frey and Osborne list as "assisting and caring for others, persuasion, negotiation, social perceptiveness, fine arts and originality" are likely to become increasingly valued in the workforce across multiple sectors, as they are the hardest skills for computers to replicate (Frey and Osborne, 2013).

Leslie Willcocks was also convinced of the importance of these human skills for the foreseeable future:

> "I've been through this with service providers for an hour. Intuition, judgement, leadership, decision making, empathy, social interaction – I get technologist who say 'oh machines can do all that', and I say 'I think you'll find they can't do the things we're talking about and they certainly can't do them all in one machine'."

The upskilling and retraining of workers to meet the changing demands technology places on them might prove a particular challenge for older workers. Older members of the workforce can be less initially welcoming of new technology, as we found in our 3 case studies, often facing a steeper learning curve.

However, they also have the potential to benefit more from some technologies, for example tools and machines which make work less physically demanding can help older workers to keep working for longer, without having to worry about the effects on their health.

A 2014 paper by Singh finds that older workers are not 'phobic' of technology, but rather 'selective' about when to use it – for instance preferring face-to-face conversations when possible rather than digital communications. Given the discussion in Section 3.2 above about the benefits of face-to-face dialogue, these preferences are not necessarily a bad thing, providing older workers can be supported to use technology when it is genuinely beneficial.

Singh concludes that "it is imperative to understand that the older generation, despite knowing the positives and the importance of technology, is reluctant to use it" (Singh, 2014). He also puts forward suggestions for managers to tackle this:

> "For instance, reverse mentoring can be adopted, wherein the younger generation could educate the older generation on the usage of technology on a regular basis to reduce the approach-avoidance dilemma. Formation of cross-generational teams will increase the level of communication between generations and will help the older generation to alter their selective mind-set in relation to technology."

Meanwhile, younger workers can present difficulties of their own according to Anthony Bruce, who argues that there can be "quite a short term view amongst younger people around what technology is going to do for them. They don't stay with it for very long so there's a risk that organisations wait too long to benefit".

Overall, the effects of the coming wave of automation are likely to prove quite different to "the general pattern observed in the 19th century, [which saw] physical capital providing a relative complement to unskilled labour, while substituting for relatively skilled artisans" (Frey and Osborne, 2013).

Instead, today's wave of automation and technology is likely to do the opposite – enhance and complement high skilled (programming, design) or creative work, whilst eroding the value of unskilled work. Those at the bottom end of the labour market are likely to fare badly unless action is taken to provide new skills or workplace protections, with remaining manual workers coming under increasingly strict technological control and direction (see Section 2.3).

Medium-skilled workers, particularly those carrying out routine, predictable tasks that require some intelligence but little creativity, such as back office support functions, are also likely to be at serious risk of obsolescence.

The longer-term impacts are less certain but most expectations are that low skilled non-social work will start to disappear completely in certain sectors, due to driverless cars, delivery drones, completely automated factories and the Amazon warehouse workers being replaced by Kiva robots. Meanwhile a higher premium will likely be placed on work that relies on social skills over the next few decades.

6.2 Changing workforce structure

As technology takes on a greater role in most workplaces, organisations may need to consider changes to their management structures in order to adapt. This report has already laid out some of the benefits of more autonomous working groups – workers learn to use technology more quickly and find ways of putting it to more productive use when they have more freedom and involvement in decision making.

Professor Leslie Willcocks talked about the seminal 1988 book 'In the Age of the Smart Machine' by Shoshana Zuboff:

> "She was the answer to all this in those days, she created two concepts – you either 'automate' which is what I'm describing: centralisation, standardisation of work, displacement of workers through technology, using information in a top down way. Or you 'informate' - you actually allow people to work with the technology, you allow them to make decisions and you empower them through the technology and use it to complement their skills. And by 1988 most of the managers were doing exactly what she said they shouldn't be doing which was 'automating' and not 'informating'. I don't think managers have lost that bug but I think that the technology is much more pervasive now and it can do many more things that they would be stupid as managers to just automate."

This would suggest that as organisations rely more on technology, they might be better off adopting a flatter management structure with a high focus on employee autonomy and self-directed teams, similar to how many tech startup firms are typically organised. Technology itself could also enable this, as it can empower a single manager to oversee a larger number of workers (Krishnan, 2010).

Anthony Bruce raises some of the ways in which technology might additionally undermine the traditional role of managers by eroding some of their control over specialist knowledge and decision making:

> "It's quite challenging as leaders – it used to be that I ran the meeting I got everyone together in the room, I knew everything and I was an expert and therefore I had power and organisational currency as a result of that. Technology has taken 2 or 3 of those things away so what does leadership now look like? Is it now about knowing more than a 20 year old? Probably not. Does it come from having a better idea quicker, does it come to judgement? In part, but data gives us an ability to form opinions, so if you look at people's value as leaders technology has dramatically changed that."

When all employees have access to the same data and data analytics software as the managers, it might mean that managers are no longer uniquely best placed to make decisions. When decisions themselves are outsourced to algorithms that have a 'proven' track record of beating human judgement, the value of management seems to be eroded even further.

However, Harry Armstrong of Nesta raised the point that managers still need to be knowledgeable enough to understand what the systems are doing, so that they are able to support staff when they want to question the decisions of algorithms or AI:

> "The biggest issues when it comes to this question of mistrust and over-reliance is an understanding of when it is right to question the system, the algorithm or the machine and there are a couple of things especially with AI that make things a little more difficult. The system tends to be quite complex so there is an issues of transparency – how easy it is to actually question what the machine is doing? The second one is about responsibility - if the machine does something wrong who is responsible? It's much easier to blame a human than it is a machine, right? This will have huge implications for managers in particular, so staff who are doing analysis or clinicians who are providing or doing the work, they need to know when they can question and when they can't question."

The other potential area of major impact is the growth of the 'gig economy' – the spread of online platforms such as Uber and Deliveroo through which workers provide services without having the status of employees. This type of work has grown significantly over recent years but is still only a small share of the labour market. As Anthony Bruce of PwC said, "I think that is the trend, but I think it's difficult to put a time frame on when it will reach a point when that is the dominant model".

This 'gig economy' model takes the challenge of technology to traditional management structures to an extra level – platform workers have no manager to whom they report. In one sense they are their own managers, as self-employed workers, yet in another sense it is really the platform itself which is managing and directing their actions through algorithms behind the scenes. Unlike traditional employees, in most cases they lack even the option of appealing algorithmic decisions to a human manager.

In the extreme, one can imagine an entire industry based on platforms in which many tens of thousands of people work, but where there are no managers employed at all – simply programmers who write algorithms that in turn control the actions of human workers. Technology therefore has the potential to completely upend traditional concepts of management – though whether it would be wise to discard decades of human management practice in place of an algorithm is a matter for debate.

6.3 Defending human values

Despite Greg Tanaka's view that, "we're automating the manager's job, and [our algorithm] can actually do it better than them", there are still advantages that human managers have over AI.

First human managers are essential in promoting employee engagement through human interaction and the value of face-to-face conversations. Second, for the foreseeable future we lack the ability to program algorithms and AI with the myriad complexity of overlapping and even contradictory human values that most people take completely for granted. It will be a long time before a management algorithm can take account of 'fairness', 'decency' or 'compassion' in its decisions, at least as we understand those concepts.

For every rule that is calculated to maximise productivity, humans will need to carve out exceptions, on ethical grounds if nothing else. For these reasons we need to make sure that humans maintain a role in managing the machines, even when the machines are also managing them. As Janet Williamson put it:

> "I think some of those scenarios are unlikely to be fulfilled in their more extreme form. Having said that, some of the challenges around work organisation, power at work, work distribution, some of those issues which are thrown up by new technologies are going to be challenges and to some extent we have a role in trying to shape the outcome of those."

There are other areas too where it is vital that we consider how to protect human values and interests in the face of new workplace technology. In Chapter 3 we explored the ways in which technology can erode face-to-face human contact at work and the potential negative consequences this can have for the employer and the workers themselves.

In Chapter 4 we saw even more starkly the contrasting effects that technology can have on employees' mental and physical wellbeing. If we want to make sure that technology is being used for the betterment of human welfare, business leaders have to be aware of

these potential consequences when considering new technologies for their workplace – simply doing cost benefit analyses of new systems that do not account for their effects on the physical and mental wellbeing of workers should no longer be acceptable.

Where these downsides are still considered worthwhile, businesses should have active plans for mitigating the social harm they might cause in terms of stress levels, work life balance or lost autonomy, from clear guidance on sending out of hours emails to strict policies on the use of data collected about employees. This also means having a positive and proactive policy when it comes to looking for and embracing new technologies that could be used to enhance the wellbeing of the workforce.

The list of ways in which technology at work can impact on human values is practically endless, but this paper has identified 6 particular points of crucial importance for employers to consider:

- Be aware of the impact that technology can have on the autonomy of the workforce and that technology which erodes human autonomy, even if it increases efficiency in the short term, can over longer periods threaten creativity, innovation, productivity, job satisfaction and staff retention.
- Set clear policies around communications technologies, limiting their use out of office hours and ensuring managers lead by example in opting for face-to-face conversations where possible.
- Conduct assessments of the likely impact on the mental as well as physical health of the workforce of any new technology, taking steps to mitigate any risks accordingly.
- Make sure that any algorithms that play a role in decision making that might affect employees exhibit the 5 key features of accountability outlined in Section 2.5.
- Include employees meaningfully in all stages of technological change, including consulting them over the choice of the initial technology and making sure it meets a genuine need.
- Engage with the workforce in forward looking discussions about how new technologies on the horizon might impact their jobs over the longer term, how their jobs might change as a result and whether new skills or training might be required.

Ultimately, there is no doubt that UK workplaces need to embrace new technology. Where it is used wisely, it can not only boost productivity, but facilitate relationships at work, enhance employee health and wellbeing and reduce the burdens of work for many. The challenges for employers, for unions, for policymakers, are these:

- To provide the necessary new skills for employees.
- To establish new workplace structures.
- To guide organisations through the difficult and ever faster cycles of innovation and implementation.
- To achieve this, while respecting human autonomy and privacy and, most importantly, never forgetting that human interaction and engagement are essential components of success, regardless of how fantastic the technology that is available.

Appendix 1 - Copy of sample questionnaire

Focus groups

General

How long have you worked for [organisation] and what is your role?

What is the size of the team you work in?

Can you give a brief overview of what [the technology] is, what it does and how it fits into your role in [organisation]?

Wellbeing at work

What was the biggest change to your work, if at all, when the technology was implemented?

How long did it take you to get used to using / working with the new technology?

What impact, if any, has the technology had on your workload? What impact, if any, has the technology had on the nature of your job role? [Probe for if it's made things easier, more difficult, level of autonomy etc]

How have your working patterns been affected, if at all by the technology? [Probe for increased flexible working, remote working if necessary]

How has your wellbeing at work been affected if at all by the technology? [If it has been affected, probe for increased stress / anxiety, dealing with change, possible isolation if remote working]

Can you describe your relationship with your manager since the introduction of this new technology? And with your team / colleagues? Has it changed from before?

How has your sense of job security been affected, if at all, by the technology?

- Did the technology lead to job losses within the organisation?
- Did the technology lead to jobs being created? Or new roles being formed?

Overall, how do you feel about working with the new technology? [Probe for what they like, dislike etc]

Communication and implementation

Where did the idea originally come from to bring in this new technology?

- Why was the decision made to bring in this technology? What were the objectives?
- Are you aware of any other options that were explored?
- How informed were you about the decision making process for this new technology?

How was the decision to introduce the technology initially communicated to you?

- When was it first communicated
- Was there a consultation period? How long did it last / what form did it take?

Did you feel that you have any input or influence over how the technology was implemented?

- Was this influence / involvement via a trade union or other representative body?
- How happy were you with the degree of input or influence that you had?

What enabled you to use the new technology?

- Was training provided? What kind?
- Did staff train or assist each other in the use of the technology?
- Was it clear who you could approach if you needed technical support with the technology?

What were the biggest problems, if any, that you faced in using the technology?

- Were the managers aware of these problems?
- To what extent have these problems been overcome? If so, how?
- To what extent did the managers do a good job of helping you overcome these problems?

What, if anything, could have been done to improve the process of implementing the technology?

Summary questions

How has this new technology affected your quality of working life? [Probe for better, worse, or not affected it]

Can you describe your relationship with management in your organisation as a result of bringing in this new technology? [Probe for whether it's improved, stayed the same, worsened etc if necessary]

Overall, how well do you think that the technological change programme was managed?

Overall, how successful would you say that this new technology has been for the organisation?

- What have been the main benefits?
- What have been the main drawbacks?

Any other comments on the introduction of the new technology and possible impact on employment relations?

Leader interviews

General

How long have you worked in this organisation and what is your role?

How many individuals do you manage?

What was your involvement in the introduction of the new technology?

Can you give a brief overview of what [the technology] is, what it does and its place in [organisation]?

Change management

Why was the new technology introduced?

- Whose idea was it originally?
- Who made the final decision?
- What were the objectives it was designed to meet?
- Were these objectives communicated to the workforce?
- Were you aware of other options considered?

How were the original plans for the change communicated to staff?

How involved were staff in decisions about how the technology would be implemented?

- Were there formal or informal consultations with staff representatives / unions?
- If so, were these consultations helpful?

Overall, how do you think the workforce felt about this change programme and why? [Probe for enthusiastic / resistant at different stages in the process]

Before the change, did you have any concerns about the implementation of the new technology? [If yes, probe for why]

What were the biggest problems and / or obstacles you faced if any, in actually implementing the new technology?

- Were these problems overcome and, if so, how?
- Did the workforce help in solving these problems or did they contribute to them?

Did the final role the new technology played and the way it fitted in with working practices change at all from how it had originally been planned?

What were the key enablers to the successful implementation of new technology? [Prompt: this could include things like having a clear plan and objectives, relationship with the workforce, the nature of the technology itself or support from third parties or other factors.]

Effects on the workforce

What impact, if any, did the new technology have on your own job? If so, how did it impact your quality of working life?

- Were your working hours or patterns affected?
- Were your stress levels affected?

What do you think the impact on the working environment was for workers? [Probe for change in working hours, stress levels, interaction with staff etc]

- If there were problems, was any extra support or benefits provided to compensate workers?

How would you describe the relations between the workforce and management as a result of bringing in this new technology? Why do you think that is?

Summary questions

Overall, how successful would you say that this new technology has been for the organisation?

- What have been the main benefits?
- What have been the main drawbacks?

What lessons, if any, have you learned about how to manage people during these kinds of programmes?

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