Intelligent robotics and Quality of Life at work: compete, control or **collaborate?**

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As an in-house 'think-tank', the Sodexo Institute for Quality of Life is inspired by Sodexo's deeply held conviction that improving Quality of Life leads to the progress of individuals and contributes to the performance of organisations. Its role is to gather and develop insight to help Sodexo understand better what are the levers of Quality of Life.

This report is inspired by the Sodexo Institute for Quality of Life round-table 'Dialogue' that took place in Singapore on 23 May 2017 and whose participants were:

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As we approach the third decade of the 21st century, we expect to see even more significant workforce developments emerge than ever before owing to continued progress in the fields of data, artificial intelligence, augmented reality, machine learning and intelligent robotics

Introduction

Throughout our human history, technological progress and changes in relation to what work is done, by whom it is done and how it is done, have come together. As we approach the third decade of the 21st century, we expect to see even more significant workforce developments emerge than ever before owing to continued progress in the fields of data, artificial intelligence, augmented reality, machine learning and intelligent robotics.

The ubiquity, processing power, connectedness, ease of access and relatively low cost of modern technology continue to impact how we work across sectors. Indeed, there has recently been an explosion of writing and commentary on the labour economics of robotics and automation. This is hugely significant to policy makers, employers, trades unions, those responsible for education and training, and indeed workers themselves. However, it is not the only question that merits close consideration.

This report starts from the premise that new types of jobs will be created, existing types of jobs will be lost and many will change, but its purpose is to shed light on a different question, one that has attracted relatively little attention to date, namely: from a worker's quality of life perspective, what is the key to the successful integration of intelligent robotics in the workplace? In particular:

- what is the essence of our historical relationship with the tools we use?
- how is it changing with the advent of intelligent robotics?
- are these changes different from those we've seen with past technological change?
- what future scenarios can we envisage?
- how desirable are they in terms of workforce quality of life?
- how might we reach the more desirable scenarios?

To address these questions, this report reflects the broad range of responses of expert round-table participants with relevant knowledge, experience and insight, from business, academia and scientific research, healthcare, civil society and corporate responsibility.

By way of framing, the time horizon is set in the period 2025 to 2030: already close enough to be factored into organisations' plans but still far enough to allow for significant technological progress. 'Robot' is defined loosely on a scale that ranges from a task-related tool such as an exo-skeleton used for heavy lifting, to a more or less companionable 'social' robot whose use analysis includes an ethical or moral dimension and which may, at the extreme, involve seemingly genuine communication, aspects of intimacy or attachment. By 'intelligent' we mean a very high degree of adaptation to the task or role, environment or user, almost as if perceiving or understanding them. However, though robots may be able to learn and adapt in narrowly defined situations by 2025 – 2030, it is unlikely that they will develop the decision-making capabilities of humans by then.

The scope of this report does not address in detail the myriad governance or public policy concerns that exist around, for example, data and privacy or taxation and redistribution, but that is not to ignore or underestimate them. Also, while it addresses principally the perspective of employers and workers, it is mindful of a service provider conviction that "*we do not want to lose the human factor which forms the foundation of quality of life. Robots can contribute to the consistency of the service delivery but will never be able to provide the 'soul supplement' which makes all the difference for our client*"[1].

What is the essence of our historical relationship with the tools we use?

Archaeology the world over reveals that for millennia we have personalised the tools we use, made them reflections of us – their creators and users. We also tend to attach ritual and affective importance to our tools beyond their instrumental use. Ancient cooking utensils, hunting and gathering tools that were engraved, carved, painted and shaped to reflect the user's personal taste are examples of such expressions of individuality transferred onto tools.

In essence, our tools are an extension of our natural tendencies and they help us to evolve them. If we tend to favour communal eating, our utensils reflect this through their size and volume,

We do not want to lose the human factor which forms the foundation of quality of life

[1] Laurent Cousin, Senior Vice President, Research & Development, Sodexo in 'The new gen of robotics', 2017 Global Workplace Trends, Sodexo

The perceived threat of mechanised tools to human workers has persisted as technological progress continues to deliver increased efficiency and consistency in production systems

and facilitate it. If we tend to glorify conflict and make our weapons with unnecessarily scarce materials – for example inlaid precious stones – that reinforces the tendency. Our enduring personalisation, self-expression, rituals and affective attachment in relation to tools continue to fuel the remarkable variety of choice that is available today.

Industrialisation has transformed our relationship with tools. Hand production methods were replaced by far more efficient manufacturing processes through the use of powered machines, by new chemical manufacturing and iron production processes, thanks to the efficiency of water power, steam power and later electricity, the development of machine tools and the rise of the factory system. These new manufacturing technologies were largely 'deskilling'; they substituted for human skills through the simplification of tasks[2,3,4,5]. Although they largely reduced the probability of human error, they still required human input to ensure proper functioning and for regular maintenance work.

The perceived threat of mechanised tools to human workers has persisted as technological progress continues to deliver increased efficiency and consistency in production systems. From factory floor to office desk, the typewriter was introduced in the early twentieth century as we entered a new wave of mechanisation, with Dictaphones, calculators, mimeo machines, address machines and the predecessor of the computer – the keypunch[6,7]. In 1975, microcomputers were introduced into the small business sector and eventually replaced the typewriter to become an indispensable tool for the office worker. By definition, a 'computer' is a device that can be instructed to carry out an arbitrary set of arithmetic or logical operations automatically.

[2] H. Braverman, Labor and monopoly capital: *The degradation of work in the twentieth century*, New York, NYU Press, 1974.

[3] D. Hounshell, *From the American system to mass production, 1800-1932: The development of manufacturing technology in the United States*, Maryland, The Johns Hopkins University Press, 1985.

[4] J.A. James and J.S. Skinner, The resolution of the labor-scarcity paradox, *The Journal of Economic History*, vol. 45, no.3, 1985, pp. 513-540.

[5] C. Goldin and L.F. Katz, T*he decline of non-computing groups: Changes in the premium to education, 1890 to 1940*. Tech. Rep., NBER Working Paper No. 5202, National Bureau of Economic Research, 1995.

[6] J.R. Beniger, *The control revolution: Technological and economic origins of the information society*, Cambridge MA, Harvard University Press, 1986.

[6] J.W. Cortada, *Before the Computer*: IBM, NCR, *Burroughs, and Remington Rand and the Industry They Created, 1865-1956*, Princeton, Princeton University Press, 2000.

While it therefore serves a data processing and potentially intelligent functionality, so far, the majority of tools introduced in the workplace have served one of two functions: mechanical or computational. The human element has remained essential to completing the task by performing the missing complementary function - decision-making, creative, pattern-spotting, interpretative, etc. -, depending on the type of tool and the task at hand.

How is our relationship with tools changing with the advent of intelligent robotics in the workplace?

Some of the changes brought about by the introduction of intelligent robotics in the workplace will be similar to those we have seen with other tools in the past. They will take away painful, repetitive, boring, difficult or even dangerous tasks and thereby make room for more caring, nurturing, creative human work. In healthcare, for example, some workers would benefit from a tool that allows them to augment their own lifting capabilities in manoeuvring less mobile / more dependent patients. Not only do such potentially painful or harmful and difficult tasks pose a direct physical threat to patient and care worker, they also tend to detract from the overarching aim of providing care through empathy, emotional and physical comfort, and relief from pain.

Technological progress in intelligent robotics is giving rise to new questions surrounding the implications of integration in the workplace. Three axes serve to introduce them:

1. The merger of mechanisation and intelligence

Until now, it has been possible to characterise our tools according to which one of two separate functions they serve: mechanical or programme-running / computational. Advances in the latter have given rise to an 'augmented' type of functionality through computational intelligence. Today, mechanisation and intelligence are merging rapidly and giving rise to a novel form of human-machine interaction in the form of ever more sophisticated industrial robots, but also service and social robots.

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Attachment theory[8] research suggests that we tend to seek alternative, non-social sources of security including objects to compensate for the perceived unreliability or unavailability of our relatives and friends[9,10]. While we may derive a sense of satisfaction from acquiring and interacting with inanimate objects, an excessive valuing of belongings can have negative long-term consequences for psychological health[11]. What could this mean for social interaction, health and wellbeing at work if we were required to interact with a robot that can move and respond to different types of environments and situations independently?

2. Machine learning and the simulation of human emotions

Recent advances mean that we can expect to see more human-like robots; androids with synthetic parts designed to resemble and appear to act like a human. Advances in machine learning are set to allow these robots to develop without being explicitly programmed. From their interactions with humans they may learn to simulate emotions, sympathy and empathy; to demonstrate learned emotional intelligence by simulation. However, this 'artificial', 'learned' or 'simulated' display of emotion is not exclusive to robots; some humans learn social skills and behaviours when these are not intuitive and train themselves to simulate different kinds of emotions suited to different social contexts. In these cases, such displays of emotion do not necessarily detract from the recipient's experience; in fact they might not even notice that they are simulated or learned.

In the case of robots, it is also interesting to note the 'uncanny valley' phenomenon which is characterised by a dip in emotional response that happens when we encounter an entity that is almost, but not quite, human in appearance. Hypothesised by Japanese robotics Professor Masahiro Mori, the phenomenon suggests that we find robots more acceptable and appealing

[8] 'Attachment theory' seeks to explain how and why we develop close interpersonal relationships e.g. parent and child.

[9] L. Keefer, M. Landau, D. Sullivan, 'Non-human Support: Broadening the Scope of Attachment Theory', *Social and Personality Psychology Compass* vol. 8/9, 2014, pp.524–535.

[10] L. Keefer, M. Landau, Z. Rothschild, D. Sullivan, 'Attachment to objects as compensation for close others' perceived unreliability', *Journal of Experimental Social Psychology*, vol. 48, no.4, July 2012, pp.912-917.

[11] T. Kasser, *The high price of materialism*, Cambridge, MA, Bradford, 2002.

than their mechanical counterparts as they become more human-like, but only up to a certain point. When a robot is close, but not quite human-looking, we tend to develop a sense of unease and discomfort. If human-likeness increases further beyond that point however, the emotional response returns to being positive. What degrees of human-likeness should we be asking for? On which sides of the 'uncanny valley' should we position ourselves?

3. Compete, control or collaborate?

The fear that intelligent robotics in the workplace will compete with us is well established: tools have displaced people throughout industrialisation and the combination of mechanisation and intelligence is expected to have even greater impacts. If intelligent robotics are developed and deployed responsibly, they should collaborate with us in the workplace, assist us as tools have always done, but with added functions to help us deliver services with greater value for workers and consumers. In the alternative, there are concerns that, over time, intelligent robotics may develop to control us. This is not entirely a new issue if we consider 19th century textile factories in which people were arguably more or less subservient to machines. However, with the advent of internet of things, big data processing, and the automatic allocation of human workers to rosters, locations and tasks, all issues related to the organisation of our work could be decided by algorithms. Tools have not 'controlled' us or substituted for human decision-making autonomy in this way before.

Our relationship with the tools we use has always evolved in line with the progress of technology broadly designed to support human workers in completing different types of tasks more efficiently. The merger of mechanisation and intelligence heralds a major shift in the nature of our relationship with tools, one that can even be characterised as a threat to the uniqueness of human identity and purpose.

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With the advent of intelligent robotics, are changes to the essence of our historical relationship with tools different from those we've seen with past technological progress?

Tools are essentially about utility and application to a task. At one end of the spectrum, intelligent robotics are utility-based tools to assist us in tasks. At the other end, they are destined to fulfil a social function and may even become the subjects of emotional attachment similar in some aspects to pet-like companionship (or more). This represents a departure from the essence of our historical relationship with tools.

While popular discussion of intelligent robotics tends to focus on the potential implications of android companionship, within the time horizon of this report (2025-2030), the more likely evolution is the integration of task and utility-based intelligent robotics in the workplace such as robotic arms or exoskeletons, even if they are increasingly 'collaborative' or intelligent. This type of advance may be particularly relevant in contexts such as senior care, nursing, medicine and remote work environments in which intelligent robotics will assist human workers in their tasks, for example by enhancing their strength, precision or stability. Even in these scenarios, the type of human-machine interface must take into account our susceptibility to become emotionally attached to inanimate objects and the 'uncanny valley' phenomenon. With the latest changes in the essence of our relationship with tools, even the interface design raises ethical questions.

We should expect to encounter increasingly sophisticated human-machine interfaces in the context of some of the most meaningful, service-user environments with wide-ranging implications for organisations. The underlying system complexity and interconnectedness with intelligent robotics inevitably give rise to new questions surrounding the ability to build interfaces that inspire confidence. If we are to collaborate with an intelligent robot, what features must it possess for us to develop trust, for example in relation to the robustness of its data analysis in risky environments? Similar concerns arise surrounding data privacy issues and cyber security. Depending on the task at hand, a human worker may rely on an intelligent robot's sensor or internet of things network to be alerted of a particular risk. We must understand the needs of human workers in terms of establishing a level of trust towards intelligent robots in context. This is likely to be very different to the mutual interdependence or

'skin in the game' that helps human workers to develop trust in each other. While we seek to solve technological challenges we must not lose sight of the psychology of adopting and using new technology.

With the advent of intelligent robotics, we are witnessing different types of changes to the essence of our historical relationship with tools from those we've seen in the past. New tools have threatened, created and changed jobs before but the potential future development of intelligent robotics means that they are becoming a perceived threat to the essence and uniqueness of human identity, and this is novel. It is a valid question whether with intelligent robotics, we are creating '*being*' - not just 'doing' - tools that have a 'presence' unlike others before and therefore give rise to new ethical considerations.

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What future scenarios can we envisage?

In 1930, the British economist John Maynard Keynes imagined that his grandchildren might live in a time with little need to work though it would still be valued and carefully distributed for the meaning and purpose it brings us. In a similar vein, a number of more recent approaches have been used to explore the impact of automation on work. These approaches can help us to envisage different future scenarios. Three, drawn from academic research, the public sector and the private sector, are set out below by way of illustration:

(1) In 2013, the University of Oxford Martin School published research by Osborne and Frey[12] that made '47%' one of the most feared figures in labour economics almost overnight. Drawing on advances in machine learning and mobile robotics, the researchers categorised 702 detailed occupations in the US according to their susceptibility to computerisation and estimated that just under half of total US employment is at risk. The variety of occupations in this estimate is remarkable; it ranges from legal drafting to truck driving whereas those heavily dependent on skills such as persuasion are spared (though even the art and skill of persuasion is surely changing given increasingly easy and cheap access to data).

[12] C. Frey and M. Osborne, '*The Future of Employment: How Susceptible are Jobs to Computerisation?*',Oxford University Programme on the Impacts of Future Technology, Oxford University Press, 2013.

The detail reveals huge variation in the proportion of existing roles that could be automated

(2) At the end of 2015, with a keen eye on the future, the chief economist of the Bank of England, Andrew Haldane, shared his insights into the last 250 years of labour economics and what we might see in the coming decades at the Trades Union Congress[13]. Pointing to rising skills levels, steady employment and the distribution of wages since the mid-19th century, he set out a tempting conclusion:

"*Viewed over the sweep of history, then, there is essentially no evidence to suggest technology has damaged jobs and plenty to suggest it has boosted wages. Technology has enriched labour, not immiserated it… Labour is not dead wood to be carved up between tasks. It is a tree whose trunk and branches have lengthened and thickened with time.*"

However, Haldane tempered this seductively reassuring view with reference to ever faster, wider and deeper 'hollowing-out' of the labour market - the loss of mid-skill, mid-pay work and widening distribution of income - as technology advances. In the longer term, he briefly addressed three responses:

a) *relax* with shorter working weeks as human capital is replaced by automation

b) *retrain* to meet demand for new skills

c) *redistribute* resources to help bridge the income gap resulting from 'hollowing-out'

(3) Also drawing on the field of macro-economics for framing purposes, McKinsey Global Institute's 2017 publication of its research on the potential effects of automation technologies nevertheless focuses on micro-economics, the individual activities or tasks within roles[14]. The 'big picture' backdrop to its analysis is the estimation that about 50% of all paid activities could potentially be automated by existing technology. The detail reveals huge variation in the proportion of existing roles that could be automated: less than 10% in the case of a psychiatrist, over 90% in the case of a fruit or vegetable grader, about 50% in the case a nursing assistant.

[13] Speech given by Andrew G. Haldane, Chief Economist, Bank of England, Trades Union Congress, London, [online video], 2015, www.bankofengland.co.uk/publications/Pages/speeches/default.aspx, (accessed 14 September 2017).

[14] J. Manyika, et al., A future that works: automation, employment and productivity, McKinsey Global Institute, January 2017.

How desirable are the different approaches set out above in terms of quality of life at work? The first scenario - in which 47% of US employment is said to be at risk – is startling, but we know that quality of life at work is a hugely complex area that requires us to look beyond the sheer scale of what might be termed a 'worst case' macro-economic scenario to address it. More relaxation time and the redistribution of resources combined with retraining point to the need to fundamentally reconsider our relationship with work and the source of our material wellbeing in the second scenario. However, it is the third scenario's approach, a focus on tasks *within* job roles and the content of what we actually do at work, which comes closest to helping us outline desirable scenarios in terms of quality of life at work. A task-based approach infused with quality of life considerations can serve as a window on the myriad different circumstances of individual workers, the potential threats and possibilities that they face.

By any measure, we are once again on the cusp of far reaching changes in terms of what kind of person does what sort of work for what level of remuneration, where and over what time period. However, the half of our paid work activity that could be automated has not yet been automated; we stand in a position in which we can take steps to ensure that we shape the changes to come with a bias in favour of individual workers' quality of life.

How might we achieve a scenario that focuses on tasks within job roles *from a quality of life perspective*?

Autonomy, behaviour that is founded on the individual and consistent with their values and interests, is known to contribute to quality of life and has been linked to enablers of individual progress such as:

- more creative learning and engagement
- greater energy and vitality
- lower stress
- higher wellbeing
- better relationships

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Whether or not we are as autonomous as we think, as reliable moral agents as we pretend, we see both in the essence of what it is to be human

One of the key aspects of autonomy is 'control', which is characterised by the absence of control or pressure, external or internal. We like to manage our workplace tools and systems, and we currently lead the learning process that allows us to apply our tools to better and more efficient uses over time. However:

- could the combination of machine learning and learned or simulated (but not felt) emotional intelligence result in intelligent robotics developing greater cognitive ability and displaying greater emotional intelligence than human beings in a 'run-away' fashion leading to human workers being 'controlled' in a way that would make even the most sophisticated task allocation systems of today seem tame?
- is there a risk that machine learning will lead to less human autonomy and agency?

We pride ourselves as a species endowed with autonomy and moral agency that has been capable of adapting its environment like no other species. Whether or not we are as autonomous as we think, as reliable moral agents as we pretend, we see both in the essence of what it is to be human. As an overarching principle, a scenario that focuses on tasks within job roles from a quality of life perspective must acknowledge this perception.

To structure our task-based scenario further, we can draw on a number of dimensions of quality of life that may take on different meanings and levels of importance in different cultures but provide a valuable framework. They are:

- the **physical environment** as it relates to our sense of comfort and safety. Many tasks still involve human beings entering uncomfortable or risky physical environments such as heights (window-cleaning, roof-top snow removal, operating theatre disinfection), extremes of temperature (cold-room storage), exposure to harmful gases and liquids (tank inspection), dark conditions (many car parks). In these uncomfortable or risky physical environments, there is scope to improve the quality of life of workers with intelligent robotics that may accompany workers or enter the physical environment in their place.
- **social interaction** or the factors that mediate and strengthen workplace relations. Over time, we may come to see intelligent robotics as a form of workplace 'peer' and be grateful for valuable contributions in areas such as safety, security and surveillance, data gathering and processing, physical, precision and repetitive work. These contributions should be used to free workers to interact and be more empathic, patient, compassionate, caring and focused on the personal touch, whether with each other or towards those they serve.

Where human capital is in short supply or absent, we may endow intelligent robotics with aspects of social intelligence, to perceive and simulate emotions accurately and appropriately, though not to lose patience, shout in anger or frustration.

For remote workers, socially intelligent robots may develop to afford a degree of companionship, perhaps similar to that of a domestic pet though less charming, mischievous or spontaneous than a cat or dog.

- the **ease and efficiency** with which we carry out our workplace activities could be revolutionised with intelligent robotics. To many people, a large part of their appeal is that they would free human workers from dull, repetitive or computational tasks that we find particularly demanding, and increase the scope for less routine, more creative, imaginative and empathy-based work. This is surely welcome, but only so long as we remember and accommodate people who genuinely enjoy repetitive work, who take pride in doing it well, and derive a sense of purpose or meaning from it. Not everyone can or wants to manage the responsibility and challenge that comes with work which revolves around creativity, innovation, demands on emotional intelligence or enterprise. The question is not so much whether we can be freed to do less dull or repetitive work, but the extent to which we can consider people's likes and strengths in relation to tasks so that in the future, even more people can do the sort of work that they aspire to, are best suited to and enjoy.
- **health and wellbeing** – even in advanced economies occupational health remains a concern. For example, according to the US Occupational Safety and Health Administration (2014), work-related musculoskeletal disorders in the US account for over 600,000 injuries and illnesses and 34% of all lost workdays reported to the Bureau of Labor Statistics. It is possible to imagine many largely physical tasks that could be enhanced by intelligent robotics assisting workers, ranging from lifting or moving patients and older adults in care, to stacking shelves.
- **recognition** or the factors that make us feel valued can play a significant part in how organisations prepare for the advent of intelligent robotics in the workplace. The inclusion of workers in task-related consultation and design can be indicative of genuine recognition and make sure that local and workplace cultures are factored in. At a leading healthcare establishment that automated back-of-house medicine dispensing to allow workers to focus on front-of-house delivery to patients, the key drivers of success were:

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The evolution towards roles with tasks supported by intelligent robotics requires us to envision the future of current roles and consider what needs to be done to make sure that workers have the right skills

Before automation:

- allowing ample time for advance preparation
- reassuring dispensary workers that automation being introduced consistent with the principle that they should feel more valued following automation
- taking time to know workers well, their skill sets, and what they appreciate in their tasks so as to match the type and level of automation to them in context

During the process of automating:

- giving workers a meaningful role in task re-design and new skills training
- thorough testing and demonstration that a human-controlled 'fail-safe' mechanism exists

After automation:

- ensuring that technical and maintenance support are readily available
- ensuring no extra work is involved
- integrating user needs and user support

Throughout the process of automation:

- adopting a human social interaction value maximisation approach, not a cost minimisation approach
- remembering that it is possible to integrate different levels of automation over time
- acting and communicating consistent with the conviction that the rationale for change is task 'enhancement' for better service dispensing service outcomes

- **personal growth** or the factors that enable us to learn and progress. The evolution towards roles with tasks supported by intelligent robotics requires us to envision the future of current roles and consider what needs to be done to make sure that workers have the right skills in time. One approach is to superimpose tasks, skills and technology to make sure that they overlap and avoid skill gluts or gaps. If organisations plan and execute human-robot collaboration well, workers should benefit from more diverse and novel ways not only of achieving their objectives

but of surpassing their previous achievements. For this to be possible over working lives with unprecedented technological progress will require equally unprecedented flexibility, adaptability and agility on the part of workers and organisations.

Conclusion

Fuelled by rapid technological advances, questions and concerns surrounding the advent of intelligent robotics in the workplace will persist. Efforts to anticipate and plan for the economic and social impacts on human labour will rightly require much attention from organisations and policy makers. However, while $14 trillion of human activity or one billion jobs could be automated with current technology, it has not yet happened[15]; organisations can envision and plan for desirable scenarios to make them reality. In doing so, there are many trade-offs to be navigated. For example, between a focus on cost-minimisation framed in terms of human–robot competition for jobs and resources, loss of human control or decision-making autonomy and, in the alternative, a focus on value-adding human-robot collaboration framed in terms of worker quality of life. The latter approach can be founded in the context of the evolution of our relationship with tools to help us understand better what is the key to the successful integration of intelligent robotics in the workplace.

If we look at the detail of tasks and activities rather than jobs and roles, by applying a quality of life lens we can see how to develop valuable human-robot collaboration. From reduced exposure to dangerous, risky or uncomfortable environments, to more time for human workers to spend interacting with other people, the potential benefits of intelligent robotics in the workplace are widespread. The extent to which they are realised will depend on our ability to prepare, engage and value human workers.

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[15] J. Manyika, et al., *A future that works: automation, employment and productivity*, McKinsey Global Institute, January 2017.

References

J.R. Beniger, *The control revolution: Technological and economic origins of the information society*, Cambridge MA, Harvard University Press, 1986.

Braverman, H., *Labor and monopoly capital: The degradation of work in the twentieth century*, New York, NYU Press, 1974.

Cortada, J.W., *Before the Computer*: IBM, NCR, *Burroughs, and Remington Rand and the Industry They Created*, 1865-1956, Princeton, Princeton University Press, 2000.

C. Frey and M. Osborne, '*The Future of Employment: How Susceptible are Jobs to Computerisation?*', *Oxford University Programme on the Impacts of Future Technology*, Oxford University Press, 2013.

Goldin, C. and L.F. Katz, The decline of non-computing groups: Changes in the premium to education, 1890 to 1940. Tech. Rep., *NBER Working Paper No. 5202, National Bureau of Economic Research*, 1995.

Hounshell, D., *From the American system to mass production, 1800-1932: The development of manufacturing technology in the United States*, Maryland, The Johns Hopkins University Press, 1985.

James, J.A. and J.S. Skinner, The resolution of the labor-scarcity paradox, *The Journal of Economic History*, vol. 45, no.3, 1985, pp. 513-540.

Kasser, T., *The high price of materialism*, Cambridge, MA, Bradford, 2002.

Keefer, L., M. Landau, D. Sullivan, 'Non-human Support: Broadening the Scope of Attachment Theory', *Social and Personality Psychology Compass* vol. 8/9, 2014, pp.524–535.

Keefer, L., M. Landau, Z. Rothschild, D. Sullivan, 'Attachment to objects as compensation for close others' perceived unreliability', *Journal of Experimental Social Psychology*, vol. 48, no.4, July 2012, pp.912-917.

Manyika, J., et al., *A future that works: automation, employment and productivity, McKinsey Global Institute*, January 2017.

Speech given by Andrew G. Haldane, Chief Economist, Bank of England, Trades Union Congress, London, [online video], 2015, **www.bankofengland.co.uk/publications/Pages/speeches/default.aspx,** (accessed 14 September 2017).

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