AUGMENTED WORK

HOW NEW TECHNOLOGIES ARE RESHAPING THE GLOBAL WORKPLACE

mirvac

WORKTECH™ ACADEMY

EXECUTIVE SUMMARY

There has been much research and many articles in recent years about machines automating humans out of the workforce. The reasoning goes that as robots improve, they can gradually do more and more of what a human can do without needing to sleep, have days off or be paid. This frightens many as they see robots and automation as a threat to their livelihoods.

More recent research, however, has shown that rather than whole jobs being at risk, individual component tasks of jobs are more likely to be automated.

Another way of putting it is that all jobs have elements that can be automated by machine, but no job is likely to be replaced entirely by a machine. Where it gets interesting, though, is where humans and machines can accomplish more together than separately. This is the world of augmented work – and it has significant implications for everyone engaged in procuring, developing, building and managing workplaces. Many advances in augmented work have been piloted in logistical and industrial settings, but now are ready to enter the office workplace.

This report considers five different models of augmented working and how they will affect the future workforce and the workplace. The five models are:

Assigned – the machine completes tasks unaided with different levels of instruction. Their inputs are typically given by a human operator.

Supervised – there is some level of automated decision making undertaken by the machine. The human operator retains a degree of monitoring as the machine will flag unknown situations.

Coexistent – machines will work alongside humans in parallel workstreams. Space will be shared and machines will need to be intelligent enough to navigate spaces together with difficult to predict humans.

Assistive – machines will help us complete tasks faster, more accurately and possibly even to a higher level of quality. At this level, machines should be able to discern human goals and learn preferences.

Symbiotic – still emerging, the most advanced form of human-machine collaboration. Humans should be able to input high-level, abstract objectives and strategic aims for the machine to provide appropriate output options.

This report from Mirvac and the Worktech Academy examine the models, evaluating examples where each one will have an impact on work. Being aware of these examples and able to leverage them going forward will be critical to how companies deal with automation, developers plan new buildings and workforces thrive in the 21st century global workplace. In short, it may spell the difference between success and failure in the future world of work.

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THE SIMPLE TRUTH IS THAT COMPANIES CAN ACHIEVE THE LARGEST BOOSTS IN PERFORMANCE WHEN HUMANS AND MACHINES WORK TOGETHER AS ALLIES, NOT ADVERSARIES, IN ORDER TO TAKE ADVANTAGE OF EACH OTHER'S COMPLEMENTARY STRENGTHS.

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Paul R. Daugherty, Human + Machine: Reimagining Work in the Age of AI

INTRODUCTION

We keep hearing that the robots are coming, and they are going to supplant humans because they are, or soon will be, better than us at everything. The truth is that the machines are already here, but they are currently not good enough at any job to replace us entirely.

This has not stopped people from being concerned about the ethical, economic and practical implications of relying more and more on a workforce that works in a fundamentally different manner to us. While machines are certainly better than humans at certain tasks, they currently do not have the flexibility to manage the huge range of tasks that humans do.

While a machine may be able to cut shapes out of metal more accurately and more quickly than a human, it cannot redirect its efforts to delivering the finished goods, selling products or a completely new job in a new industry. A human can do all of those things. Humans are also far better at certain types of unstructured tasks that require qualities like creative thinking, making subjective judgements and applying different approaches to problems. Humans are capable of negotiating abstraction or ambiguity, which are obstacles for machines.

Machines, on the other hand, tend to excel at tasks that require one specific or a range of pre-determined approaches to be taken, which they can do at great speed and with greater efficiency than most humans. The way that we think about work and the way that we design our workplaces will change significantly as more machines enter the workplace.

To truly understand where we are going, we first have to look at where we have been. Machines have been used by humans throughout our history and the story of their use stretches back as far as humanity itself. Machines are essentially just complex tools with moving parts[1], but our history with them is one of the things that sets humans apart from other animals. While other animals have been observed to use simple, usually naturally occurring tools (e.g. twigs) to accomplish modest tasks (e.g. fishing for insects to eat), humans are the only animals that can adapt to using tools for new tasks and using more complex tools, and one of the few animals that can create their own tools.

Anatomical and physiological differences in humans compared to other animals mark humans out as a species that goes a lot further with tool use than any other[2]. Due in part to larger and more developed prefrontal cortices, humans are able to examine the consequences of their actions at a much higher level of abstraction than most animals. Humans are able to pick up a tool, examine its properties and apply it to a task they have never completed before. This fundamental ability to reason beyond the parameters of the known and use the adaptable power of the human brain has resulted in humans achieving supremacy amongst animals and using tools to greatly enhance the ability to perform tasks outside of our evolutionary niche.

As humans began using their mental abilities to work out ways to solve problems, they began to identify tools that would extend or enhance their ability to perform useful tasks.

1 (Lilley, 1948)
2 (Vaesen, 2012)

KEY DEFINITIONS

AI – ARTIFICIAL INTELLIGENCE

This term refers to intelligence of synthetic machines as opposed to natural organisms. AI typically involves machines conducting tasks previously thought to be unique to fairly intelligent organisms, such as understanding and responding to human speech, strategic decisions and adapting to changing circumstances.

ROBOTICS

This is the study and use of machines that operate autonomously, with little or no regular human input. Robots have programmable code governing their behaviour and are generally designed with certain physical tasks in mind.

MACHINE LEARNING

This is a field of statistical and computational study that involves machines taking new data into account as they adapt to new parameters. Machine learning is key to a true AI, as learning is an important element of intelligence and is required for adaptability.

AUTOMATION

This is essentially getting machines to complete our tasks for us. All of these definitions provide automation to a degree, and many of the tools that humans use automate processes in some way.

This leads us into the next stage of tools themselves. Fast forward to the Industrial Revolution in 18th Century Britain and for the first time in history, use of machines was not only widespread, but becoming the dominant model of all human production and commerce. Humans had successfully applied their advantages in intelligence and reasoning to create tools that leverage advances in the understanding of physical and chemical processes to machines that allowed one person to do the work of many. These were the first tools we could think of as doing part of the work that a human would ordinarily do themselves.

The Industrial Revolution was also one of the first recorded times that people began to push back against the use of machines. In some areas, there was a perception that machines were taking jobs that humans could do, depressing wages and reducing quality. The now infamous Luddites were groups of textile workers who smashed machines that were enabling textile makers to produce more with fewer workers. The key detail to bear in mind in this history is that nobody had considered how machines would interact with humans. Indeed, when considering machines in the workplace, we must consider how they interact with both humans and with the physical space.

If we fast forward again to the latter half of the 20th century, we reach a time at which humans developed incredibly complex and adaptable tools: computers. Computers are machines that manipulate, process and output information. They are to data what looms are to wool.

The success of computers lies in the fact that they use programmed algorithms to be able to handle a diverse range of tasks. The hugely flexible nature of computers made them as universal a tool as humanity has ever had.

With more and more capability built into computers, the next frontier in computing has been revealed as intelligent machines. We are gradually building more and more intelligence into computers that allows them to take on many tasks previously assumed to require the unique capabilities of humans. In doing so, we have created tools that can not only be used by people, but can work alongside them and in some cases, may even one day replace them entirely, even in complex information tasks that were previously thought to be exclusively the domain of humans.

"OF COURSE, THE ROAD TO SEMI-AUTOMATED ECONOMIC RENEWAL WILL NOT BE PAIN-FREE—MANY JOBS WILL BE LOST IN PARTS OF THE ECONOMY, WHILE OTHERS WILL BE CREATED ELSEWHERE. BUT EVEN MORE WILL BE LOST IF THE ECONOMY CONTINUES TO OSSIFY."

- Kevin McCullough, Plan

Advances in computing lead to another highly relevant chapter in the story of humans and machines. Robots are machines that can handle complex physical tasks either autonomously or under direction from a computer. Robots are only possible in the context of computers; machines completing physical tasks have been prevalent for hundreds of years, but humans have always been the control systems. With the advent of computing, robotics has become an increasingly important part of the interplay between humans and machines.

All of these developments have paved the way for how the world of work looks today. Computers have changed the way we work, digitising and automating large parts of information work. Now robots are becoming increasingly capable at handling the physical side of work. While computers provide the brain of robotic devices, similar advances in sensors, actuators and other components have drastically increased the ability for robots to entirely replace humans in certain types of activity. The result of this has been significant fear around technologically-driven unemployment as machines become more and more capable of performing tasks that have typically been completed by humans[3]. Indeed, it has even been found that attitudes towards robots are experiencing a long-term decline, particularly for robots designed to assist people at work[4]. This is reflective of the general perception that machines of different types are going to automate whole tranches of work out of existence. This view is understandable but misguided.

The truth is a lot more nuanced though. Firstly, there is a significant (and growing) body of evidence that while greater use of machines and automation may remove some human jobs it may actually create far more through a combination of creating lower skilled jobs in other industries and higher skilled jobs in the same industries[5]. This can be seen in cases like bank tellers. Many basic transactions have been automated in recent decades, but this has not reduced the number of bank tellers as they have been redirected to other activities such as selling financial services, against a background of lower costs of operating branches[6].

Secondly, there is still a huge amount of work that machines seem unlikely to be close to being able to do. Recent findings have suggested that it may be misinformed to look at entire jobs being replaced, because actually, most jobs have elements that cannot be done by machines. Instead, we should be looking at which tasks within jobs should be automated[7]. Almost all jobs have some tasks that can be automated, but very few jobs are made up entirely of tasks that can be automated. This is because machine intelligence excels in a very narrow field but is not particularly flexible: the intelligence that predicts television programmes you might like on Netflix cannot drive your car and never will be able to. The reverse is also true.

Thirdly, and perhaps most fundamentally, humans and machines are good at different things. Machines excel at doing repetitive tasks quickly and constantly, getting potentially huge volumes of work done, but can only do a different task with difficulty. Humans are brilliant at using disparate and novel resources to solve a whole range of problems and apply flexibility of thought to problems. It seems likely that there will always be room for both of these specialities.

The truth is, the future of machines and humans in the workplace lies in harnessing the advantages of both to create models of co-operative work that are superior to what each could do alone. Machines are already being used to complete tasks where they have benefits over humans. Examples of this include machine learning being used to analyse and feedback on manufacturing processes[8] and assist clinicians with the diagnosis of various diseases[9][10].

3 (Daron Acemoglu, 2017)
4 (Timo Gnambs, 2018)
5 (Robotics, 2017)
6 (Robotics, 2017)
7 (Michael Chui, 2015)
8 (Drishti, 2019)

The point where things get really interesting, though, is not when machines can outperform humans, but when machines and humans working together can outperform each separately. With machines handling repetitive and precise tasks quickly, humans will be able to focus on creative, non-linear and empathic work.

There has already been significant thought in this regard. London-based product strategy consultancy Plan has recently highlighted that there are multiple different ways that humans and machines can theoretically work together.

They introduce five different models:

Assigned – the machine completes tasks unaided with different levels of instruction. Their inputs are typically given by a human operator.

Supervised – there is some level of automated decision making undertaken by the machine. The human operator retains a degree of monitoring as the machine will flag unknown situations.

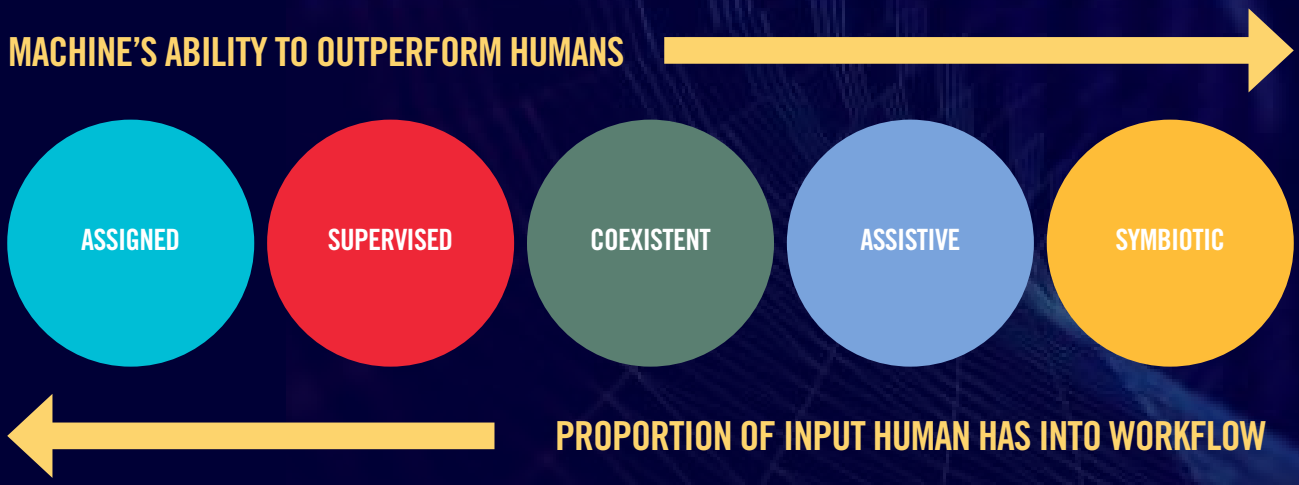
Coexistent – machines will work alongside humans in parallel workstreams. Space will be shared and machines will need to be intelligent enough to navigate spaces together with difficult to predict humans.

Assistive – machines will help us complete tasks faster, more accurately and possibly even to a higher level of quality. At this level, machines should be able to discern human goals and learn preferences.

Symbiotic – still emerging, the most advanced form of human-machine collaboration. Humans should be able to input high-level, abstract objectives and strategic aims that the machine can provide appropriate output options for.

9 (Taylor, 2014)
10 (Doi, 2005)

If we examine these models along with how much human interaction is required, we can see that they vary according to the level of human input, or machine capability involved:

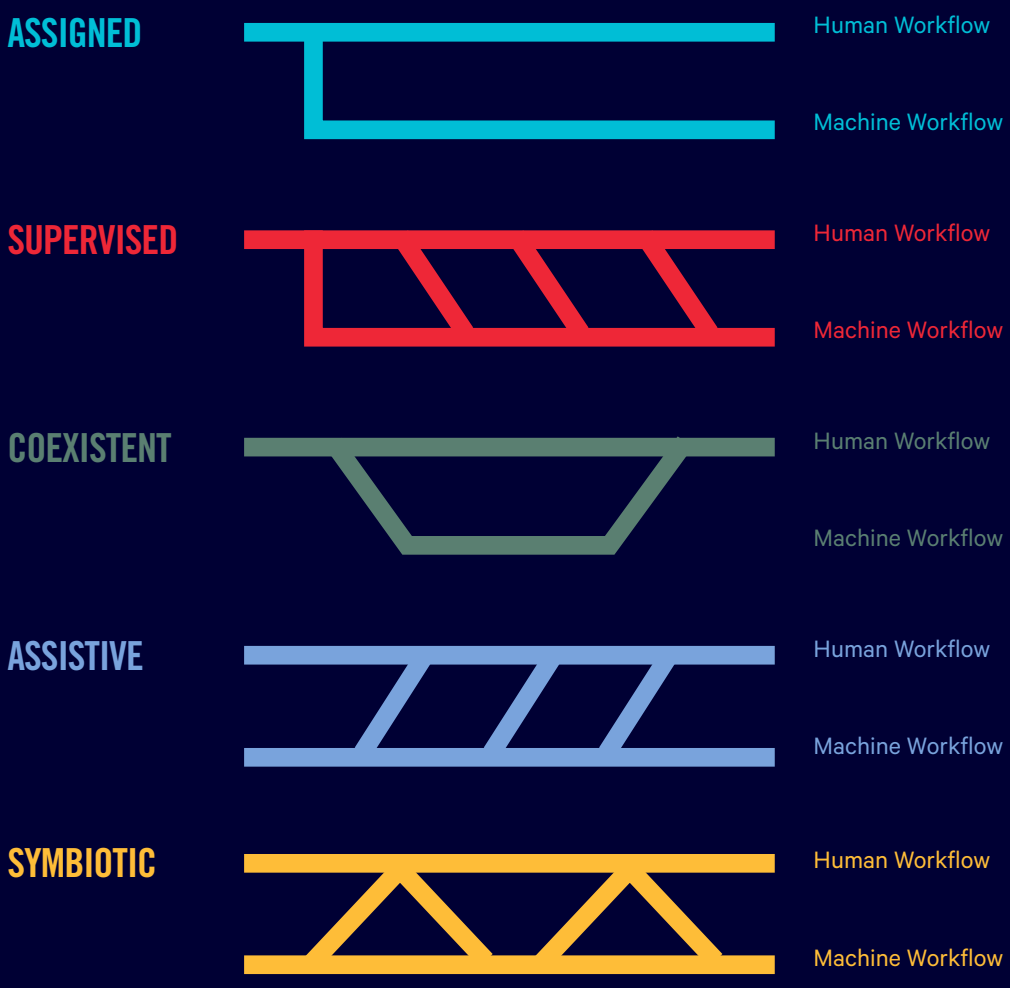


These models account for the majority of the ways that humans and machines can be seen to interact in the workplace today. An often-overlooked corollary of machines working with humans is that this will affect the way that we think about and design the workspace. It is certainly true that as human workers are freed up or supported by machines to undertake higher-value and more creative tasks, so the workstations, floor plans, collaborative spaces and immersive technology suites of the future workplace are likely to evolve rapidly to enable people to constantly update their skills and companies to attract the right talent. This report examines these different models for working with machines as well as how these will change the future world of work.

THESE DIFFERENT MODELS OF WORKING ALSO HAVE A VARYING IMPACT ON WORKFLOW STRUCTURE.

The graphic diagrams below present some of the differences in the way that the workflows interact. For assigned working, the human workflow branches out to assign a task to a machine, which then completes that task. For supervised working, the beginning is similar, but the human has periodic inputs.

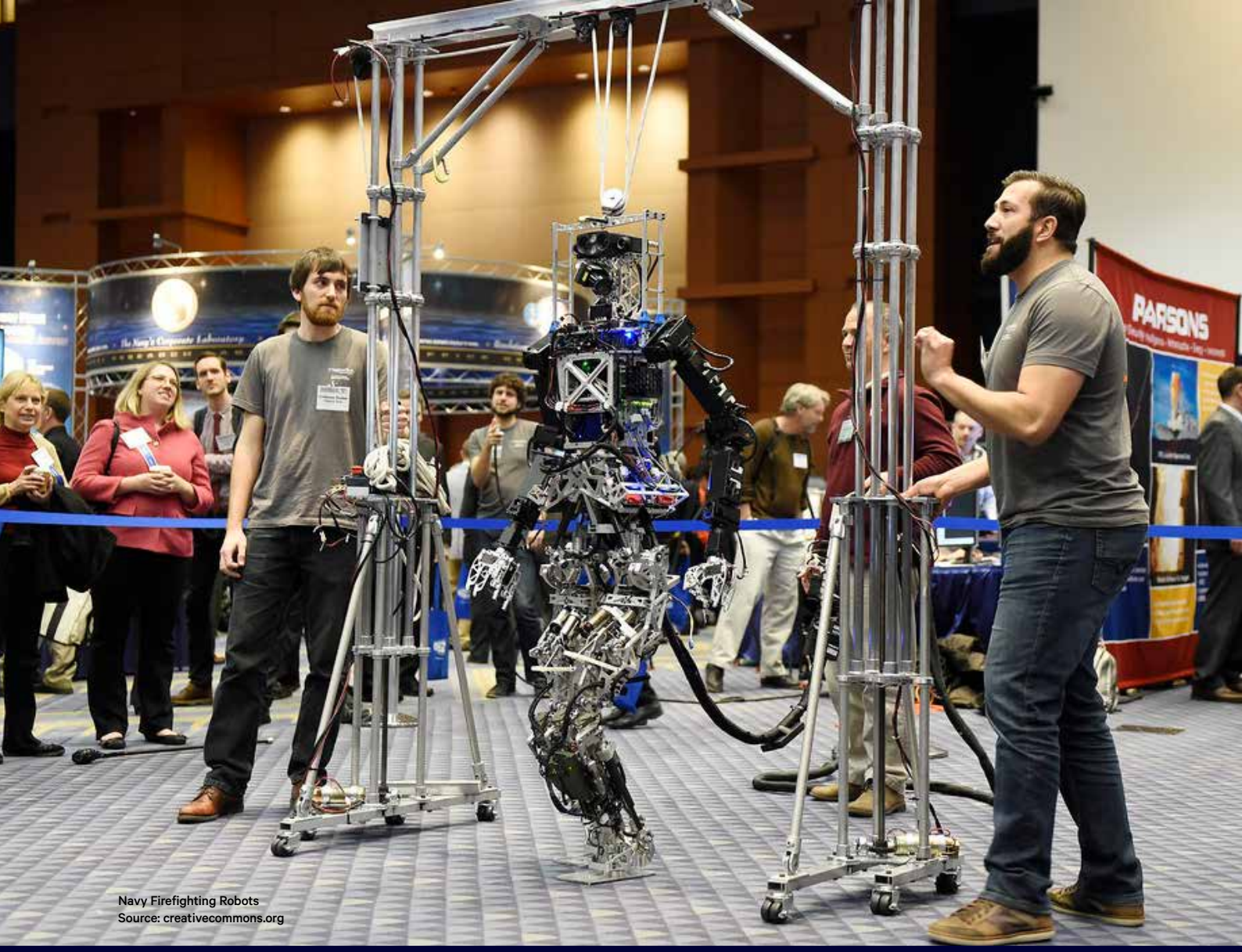
Coexistent working sees a closer integration between the workflows, with them being parallel at certain points. For assistive working, the workflows are generally separate, but the machine inputs suggestions to the human workflow. Finally, for symbiotic working, the inputs and outputs are reciprocal, with information flowing both ways.



THESE DIFFERENT TYPES OF WORK WILL ALSO VARY IN THE WAY THEY AFFECT INDUSTRIES.

The diagram below shows some of the industries that will be impacted most by the different types of augmented working.

Assigned and supervised augmented working have a long history of use in heavy industries and logistics, while coexistent, assistive and symbiotic augmented working can apply to many different fields. This is reflected in the industries that are going to benefit most from them. Industries like manufacturing and transportation that involve many linear processes are likely to benefit from automating simple tasks that machines can handle on their own. As we move through the types of augmented working, knowledge work like design and information jobs will benefit more from automating tasks that require more judgement and working with data.



Navy Firefighting Robots
Source: creativecommons.org

ASSIGNED

Assigned machine working is probably the most well used and well understood type of augmented working. Much of the world is already familiar with assigned robots being used to augment human work through the extensive use of robots in the automotive manufacturing industry.

OVER THE PAST 57 YEARS, ROBOTIC MACHINES HAVE BECOME SYNONYMOUS WITH THE MANUFACTURING INDUSTRY. NOW THEY OFTEN HAVE MULTIPLE DEGREES OF FREEDOM, COMPLEX CONTROL SYSTEMS AND VARIOUS END-OF-ARM TOOLS TO ACCOMMODATE A WIDE RANGE OF TASKS.

THE MIRVAC PERSPECTIVE

"We should be wary of a possible false economy where making one task more simple and cost effective actually creates downstream effects that make it more expensive overall."

Robots in the automotive industry first entered factories in 1962, at a GM facility in Trenton, New Jersey[11]. This was a simple die casting machine that could only perform one task. Over the past 57 years, robotic machines have become synonymous with the manufacturing industry. Now they often have multiple degrees of freedom, complex control systems and various end of arm tools to accommodate a wide range of tasks. The fundamental features of this type of augmented working comprises a machine that performs a narrow range of repetitive tasks assigned to it by a human operator.

The way that this works in practice is that the target item will be moved into place near a robot, the robot will be instructed to fulfil its pre-determined set of instructions and will then continue to do so until all are executed, or it is instructed to halt. In the meantime, humans may be supervising and/or working to complete more complex tasks. In car logistics, this may be loading up a delivery robot and sending it to a location. So how might this change in the future and how will the workforce and workplace have to adapt?

The overarching trend for these types of robots is one of increase. New uses are being found for robots that can complete assigned tasks all the time. The International Federation for Robotics reports that in 2018, global robot installations increased by 6 per cent[12], growing much faster than many other mature industries. While the largest customer industry was the automotive industry, this accounted for only 30 per cent of total installations, showing that robots are becoming increasingly prevalent in other industries.

CASE STUDY: HULL CLEANING ROBOTS

In our connected world, shipping physical items is a huge part of the global economy. Efficiencies that can be realised through improving shipping procedures therefore represent huge potential gains in real terms.

Assigned robots now hold the key to making this industry more efficient. Marine organisms and other detritus building up on a ship's hull increase drag, reducing hydrodynamic performance of a ship and increasing its fuel consumption. Fuel consumption can be increased by anywhere from 35-50 per cent depending on ship size and shape, with a commensurate increase in range of the ship. This costs the industry US$5.7bn annually. Now, several different robots are available that can be assigned to automatically clean the hull of ships. This greatly reduces the cost involved with hull cleaning as robots can easily scrape the hull including underwater with little human involvement or danger. Robotic solutions include the Hullbot, Keelcrab and Hull BUG.

Hull Cleaning Robot
Source: commons.wikimedia.org

But nowadays there are more subtle and software-based examples of assigned work. These are often found on the internet and take advantage of anonymity to masquerade as humans. These are the chatbots, minebots, spambots and others that are responsible for automating tasks that would take humans huge amounts of time. By combining these software bots with the reach of the internet, programmers have created robots that both help humans and perform a new function that they would not be able to. Chatbots help answer simple queries while more complex ones are directed to a human and spambots can repeatedly post messages much faster than humans would be able to. This is all done using software rather than expensive and static physical robots. This also means that when replacements or upgrades are needed, it is simply a matter of changing code rather than physical parts.

Another consequence of this dichotomy between hardware and software is that industries using hardware are a lot more cognisant of the strengths, limitations and opportunities of using automated machines. There is already a great deal of understanding around how advances in machinery will affect work and workplace, but those in jobs that are going to be disrupted by assigned software robots are a lot less prepared. Their disruption may indeed prove even more troublesome as the pace of change is likely to be far faster; all that is needed is someone to write a new piece of software rather than design and build an entire physical machine. Changing code rather than re-tooling a workshop or replacing physical machines will be faster, cheaper and easier, making roles traditionally thought to be "white collar" even more vulnerable in the future than "blue collar" jobs are currently.

As robotics advances, the pool of tasks that robots can handle independently grows. So too does their ability to interact safely and appropriately with other robots and humans, further increasing the jobs that they can do. This has already led to new uses for robots, such as in security and delivery. At the Slack offices in San Francisco, robotic security guards roam the hallways at night on pre-programmed routes, ready to raise the alarm at any intrusion. They can now even send messages through Slack Workspace[13]. In Milton Keynes in the UK, robots are delivering parcels in the first full-scale use of autonomous delivery robots. They navigate roads and streets independently using cameras, GPS and a range of sensors in order to deliver packages from a depot straight to people's homes[14]. So, these assigned tasks are already being used and results thus far seem positive. So how will this change things?

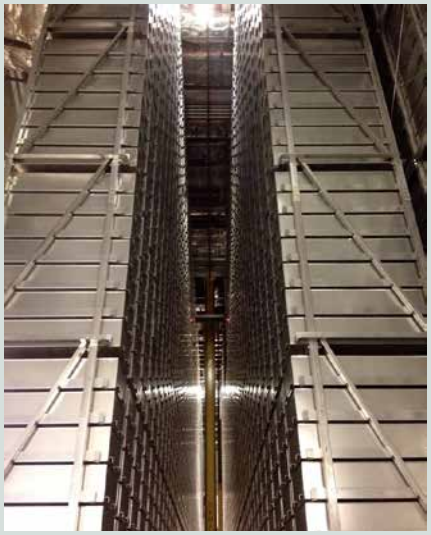
ROBOT CENTRIC DESIGN

With a force of assigned robots entering the workplace, we will need to rethink the way that we design buildings.

But first, an important note on robotic design. During much of the 20th century, robots were assumed to follow a human, bipedal design: two legs, two arms and a head. This was in keeping with optimistic notions of how quickly robotics would advance, fed by rapid developments in science and engineering during the Victorian era. More recently, however, most robot designs have diverged from this approach. Robotic forms are generally either highly specialised to a specific task (e.g. welding arm) or are being modelled to take advantage of varying animal forms (e.g. spider-like robots for locomotion over uneven terrain). This means that they will no longer need the same workplace infrastructure that humans need as they deviate further from the human form.

Take for example the robotic deliveries in offices. Companies like accounting software firm Intuit are already having robotic deliveries of food items, with plans to roll this out to other items. Currently, robots deliver coffee and lunch around the campus, but users often have to step outside of a building to collect their delivery[15]. Robots will find the complexities of different offices harder to navigate than a street, but in order to get more out of robotic services either the buildings or the robots (or both) will have to adapt.

In the future, buildings will be built with robotic service tunnels, in much the same way that utility tunnels run through many buildings today. Robots will not only benefit from having their own space, humans will too. There will be fewer robots cluttering up the workplace, moving around people to try and make deliveries. Instead most of their journey will simply be through these tunnels where they reappear for the last metre. These access tunnels can be small, much smaller than a human would need and can also be designed to different environmental specifications. Robots won't need light, heat or air conditioning for example, so the robotic infrastructure will have very different design constraints from human-accessible areas.



Mansueto Library Robotic Book Search: creativecommons.org

PREPARING FOR THE FUTURE:

Companies that want to make the most of the benefits of robot-centric design will need to reorganise their working environments to add elements that help make the most use of machines and remove elements that are irrelevant to them.

In 2016, the shipping company Maersk predicted that container ships will not dock at all in the future, but drones will be used to transport containers to and from the shore. This is a good example of a company beginning to think about how robot-centric design will affect their business and preparing to re-imagine their physical space.

Eventually, these areas will even incorporate charging and maintenance areas so that robots can remain discrete. Examples of this are beginning to appear, with developments like automated drone ports at the top of buildings. In this way, robots can even make use of spaces that never would be accessed by humans, repurposing them into useful spaces for machines.

This robot-centric design has already taken place in some buildings. At the Mansueto Library at the University of Chicago, the entire 3.5 million book collection is housed in high-density racking in 15 metre high shelves[16]. It is managed by a robotic retrieval and delivery system in a 743 square metre underground complex. This area is designed exclusively for the robotic system to work in and cannot be used by humans. This aspect of design extends further than just maximising storage space. Dangerous tasks that humans have had to do in the past through necessity can now also be handled by robots. The US Navy for instance, has a firefighting robot designed to enter areas that would be unsafe for humans such as spaces that are extremely hot or filled with smoke. Using the same principles, it is easy to see how robots will need vastly different conditions to humans, many of which could be turned into an advantage when considering building design.

"THE NEED TO ATTRACT AND RETAIN HIGH-QUALITY 'DIGITAL TALENT' WILL CONTINUE TO BE A MAJOR ECONOMIC CONSIDERATION FOR COMPANIES AS ALL COMPETE FOR HIGHLY VALUED TALENT NEEDED TO POWER THE 21ST-CENTURY DIGITAL ENTERPRISE. DIGITAL TALENT MAY BE DEFINED AS ENTERPRISE TALENT THAT POSSESSES ESSENTIAL DIGITAL TECHNOLOGY SKILLS AND CAPABILITIES."

- Pete J. Miscovich, JLL New York

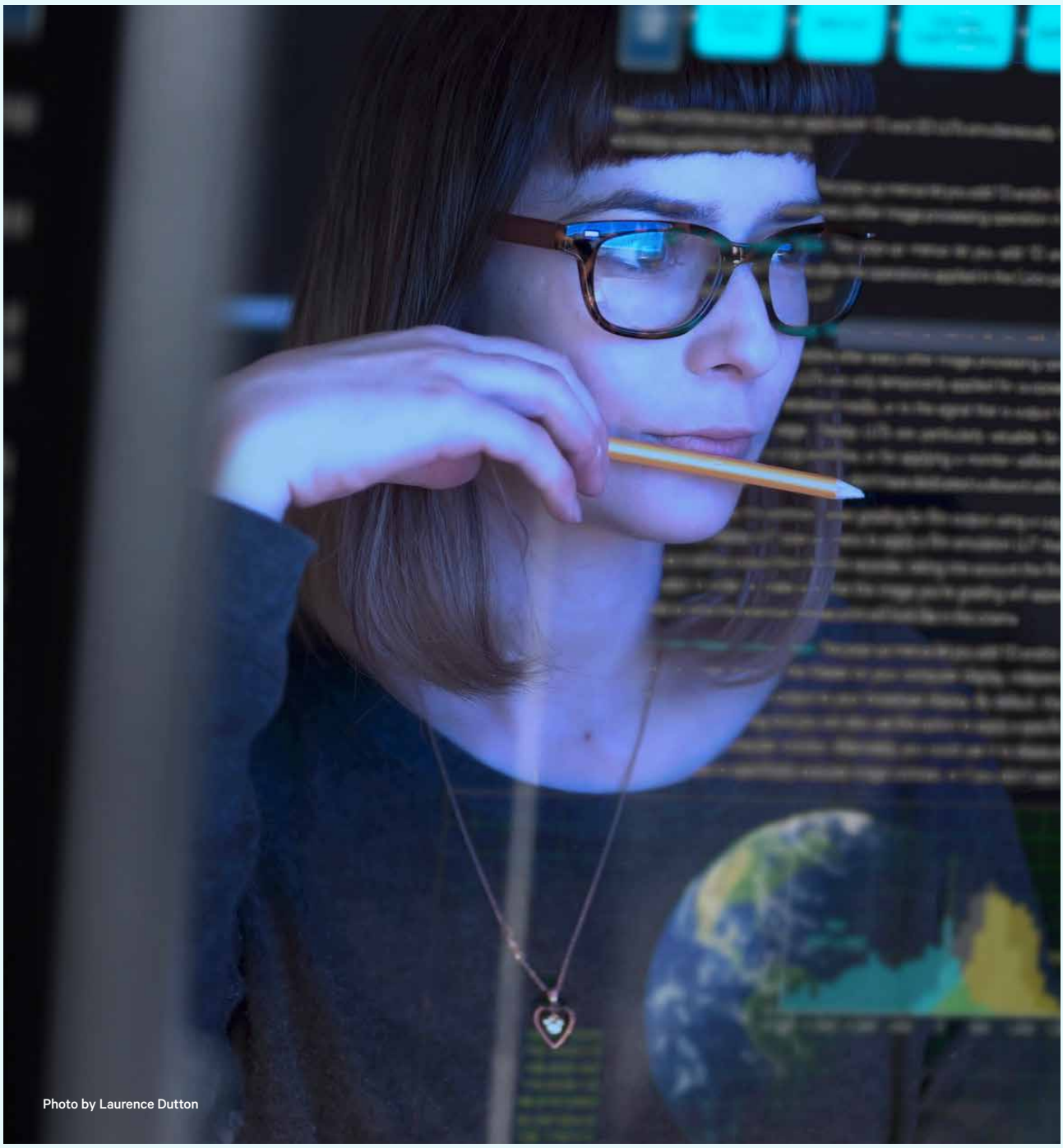


Photo by Laurence Dutton

PREPARING FOR THE FUTURE:

As skills continue to shift from the physical to the digital, in order to get access to the skills they need companies will need to re-think how they approach education and training in the workforce.

Affordable and expanded access to higher education will help to mitigate the effects of robotic takeover and companies can best prepare by supporting this. According to McKinsey research, 58 per cent of executives say that corporations should be taking the lead in reducing the skills gap. These are the companies that will be best prepared for leveraging necessary skills in the age of the robots.

PROGRAMMING: FROM ARCANE ART TO VITAL SKILL

As assigned task robots increase in the workplace, so too will the need to assign work to them.

At the moment, most programming is done through writing lines of code in a language that the computer running the machine can understand. The issue here is that programmers typically know little about the eventual tasks that the robots will be undertaking. They can programme a robot to be able to move in certain ways or respond to certain circumstances, but they do not know the route it might have to take a package or what kind of environment it may be operating in.

This necessitates human operators of robots to be well versed in programming so that they can use the machines effectively.

Robots and humans will have to adapt to new ways of communicating with one another but this does not mean that every factory or delivery worker will have to learn a programming language to continue in their job. At a fundamental level, programming just involves a series of instructions. Industrial robots can already be programmed using methods that do not require the use of a computer, intended to make them more accessible for end-users.

One method commonly used is the teach pendant[17]. This is a button box of controls used to program robots with simplified commands, such as moving to a certain location, spraying paint for a number of seconds, then moving onto another section, spraying for some more seconds and finally moving back to the initial position. Just like programming through language, such systems allow a series of instructions to be input once and then carried out any number of times. Some robots can even be programmed manually by using a joystick. The joystick makes the movements for the machine while the control system records the actions and writes the code.

What all of this means is that programming will gradually change from a mysterious discipline studied and implemented by the engineers creating the robots to a skill of vital importance in the modern workplace. There will also be reciprocal changes in the way programming works as the need to increase the accessibility of robot management and programming grows.

MIRVAC ADVISES

Robots will need to be considered in future designs. Consideration for how they move through an office, arrive at a workplace or industrial shed will be critical in future proofing real estate for the next generation of workplace. As robots in the workplace move from a toy or demonstration to reality, the physical structure will need to be flexible enough to meet their needs.

11 (Walén, 2008)
12 (International Federation of Robotics: World Robotics 2019 Edition, 2019)
13 (Richard van Hooijdonk: Blog, 2019)
14 (BBC News, 2018)
15 (Olson, 2018)
16 (Watercutter, 2011)
17 (Owen-Hill, 2016)

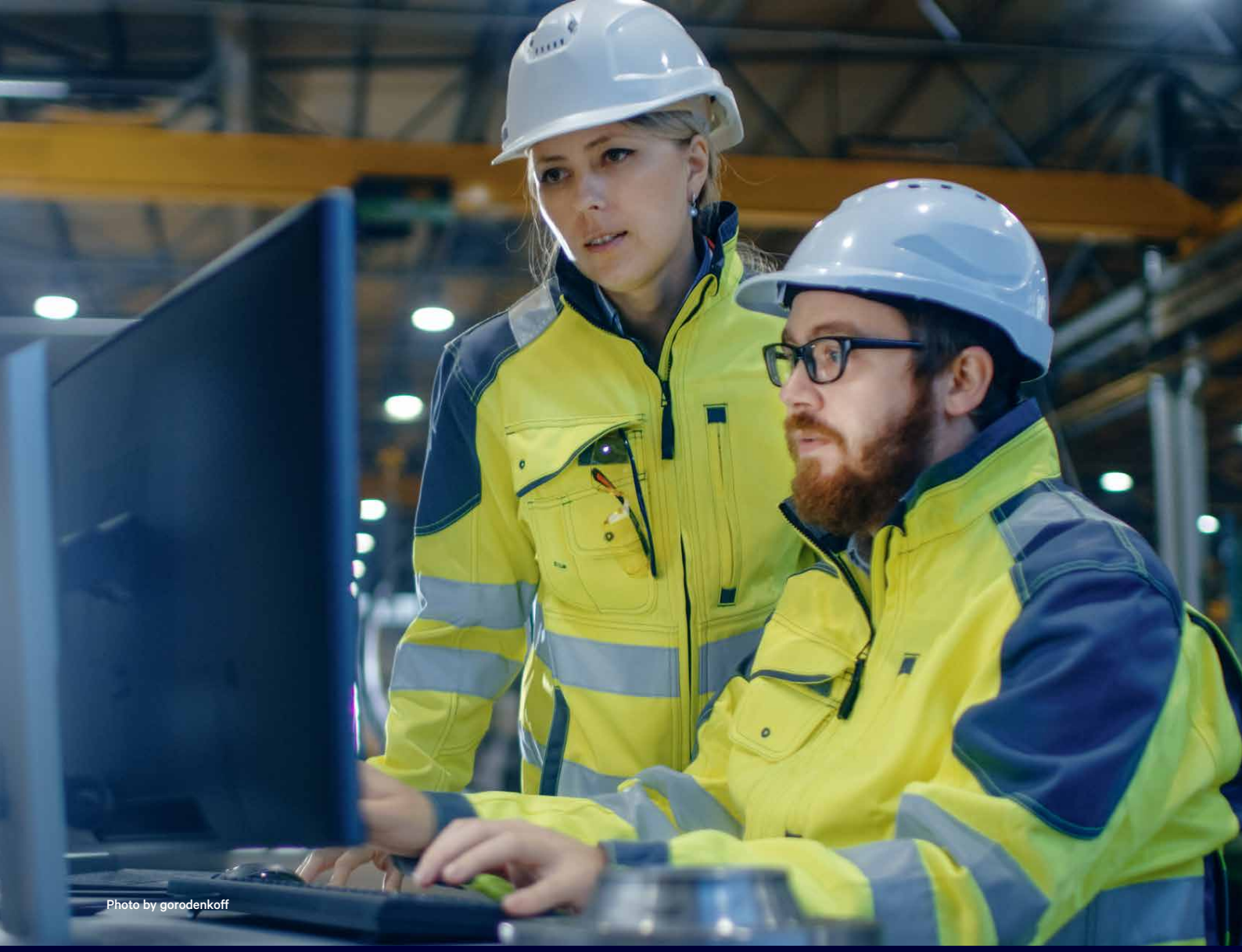


Photo by gorodenkoff

SUPERVISED

The next model of human-machine, supervised work, involves more machine autonomy than assigned work and reduces the level of human involvement considerably. In this type of augmentation, a machine works on a task that takes advantage of its strengths (e.g. sifting through huge amounts of data quickly) while flagging any nuanced eventualities which may require human input.

Warehouse robots charging at charging station. Advanced warehouse robotics technology concept. 3D rendering image. Credit: Chesky_W

THIS AREA IS WELL PLACED TO AUTOMATE LARGE PORTIONS OF REPETITIVE PROCESSES RELATING TO EXTENSIVE DATA SETS THAT WOULD HAVE BEEN PROCESSED MANUALLY IN THE PAST

One of the most prevalent examples of this is in aeroplane autopilots, where the vast majority of flight time is conducted via computer.

Other than take-off and landing, most of the flight time sees the flight computer actively manipulating the controls of the aircraft[18]. However, this does not make pilots redundant. Pilots are actively monitoring and supervising the flight computer to ensure that it is not making any errors and that any changes in circumstances are accounted for: checking calculations, making sure that the flight computer is reporting flight data accurately and inputting new information as the situation requires. This type of work is another remarkable example of humans and machines playing to their strengths and achieving better results together. Where the computer identifies that human judgement is required, it alerts the pilot; when the pilot knows that the work will be routine and repetitive, they turn control over to the computer.

This type of augmented work is notably different from assistive work in another way. While assistive augmented working often involves the use of robots and hardware, a lot of supervised augmented working is more closely related to the use of software. We have seen recent expansion of this model through work with information because this area is well placed to automate large portions of repetitive processes relating to extensive data sets that would have been processed manually in the past. This is a particularly effective niche for highly structured data sets that have a limited number of permutations, but may require human nuance when certain flags are raised. This type of augmented working is more collaborative than assigned working as there is more interaction between human and machine.

THE ALWAYS-ON WORKPLACE

One way that supervised working is already being used is in banking to sort through huge quantities of data in real time, something that no human would be able to do.

In the past, banks would process all transactions manually at the end of designated periods, for example at the end of the day. Now, electronic transactions form the bulk of banking transactions. Visa alone are responsible for processing 24,000 transactions per second[19]. With more and more transactions taking place in the world, the menace of crime has risen at a commensurate pace. As ever, banks need to be constantly vigilant in detecting fraudulent activity but now they have the added challenge of having to process these transactions and accept or reject them in the few seconds it takes for an electronic card transaction to go through.

Once again, this is where machines come to the rescue. With the ability to process significant amounts of data, banks have begun using artificial intelligence to sift through huge sets of transactions and approve or reject in real time[20]. This has also allowed banks to spot patterns related to money laundering and terrorist financing, patterns that would be difficult for human analysts to detect. The crucial part of this partnership however is that the software is not autonomous.

For many transactions, an answer may be obvious: if a UK customer is conducting normal transactions in the UK, then suddenly in the same day their card is used for an unusual transaction in Australia, it is clear that there is suspicious activity on the card. However, if a transaction for something fairly routine appears in another part of the same country, the situation becomes murkier. Here is where the supervision element comes into play. For transactions that may raise some flags but not others, the AI will have difficulty balancing the risk of stopping a legitimate transaction against the risk of allowing a fraudulent one. At this point, it will raise the occurrence to a human supervisor who will make a judgement on whether the transaction should go ahead.

This combination of machine speed and human judgement has the natural corollary that each respective workstream meets the other only at certain points in the process, meaning humans and machines will not necessarily need to work in close proximity to one another in either space or time. This will lead to a change in how many workplace processes work. As machines become more capable and more tasks can be delegated to them with supervision, offices will not need to close. Instead, they can open 24/7 as machines handle their own workstreams. Employees coming into the future office will then have a list of tasks that have been flagged for their intervention.

In the further future, this could even lead to the fully dark office, an office in which machines carry out physical work that does not need human-visible light. The human element of the job could then be conducted in an entirely different part of the workplace, or at a different time when the office would be lit. For example, logistical sorting centres may be entirely dark, with packages featuring illegible labels directed to an adjacent, ancillary human sorting centre.

Having an office that is always on brings with it a number of design and operational challenges. As robotics become more capable, it is not just knowledge and information work that this will apply to. There are plenty of manufacturing and logistical tasks that can follow the same pattern: machines working throughout the night and humans either checking the results or evaluating flagged cases. This will mean that buildings will have to be designed to facilitate this style of usage. Depending on the type of work, entire floors or buildings may need to be designed to run constantly, along with the electrical, environmental and technological requirements this brings. For some industries, this could be as simple as leaving servers running, while for others could see an entire robotic assembly line still running overnight.

"[IN A SMART BUILDING] AI IS THE MECHANISM WORKING BEHIND THE SCENES MAKING SURE EVERYTHING IS WORKING PROPERLY AND EFFICIENTLY. IF IT IS USED EFFECTIVELY, AI IS ULTIMATELY THE BEST FRIEND ONE COULD HAVE IN THE WORKPLACE."

- Nigel Miller, Cordless Consultants

CASE STUDY: QINGDAO GHOST PORT

The Eastern Chinese city of Qiangdong features the first fully automated shipping port in Asia.

Trucks and loading machinery is controlled by artificial intelligence, which can use laser scanning and positioning to accurately determine the orientation and location of each container. Autonomous electric trucks drive containers between cranes and automatically navigate to their charging bays when they need more power. All of this can be done 24/7 with no lighting required in the main port area.

Management report that labour costs have been reduced by 70 per cent. Performing work through the night has also increased efficiency by 30 per cent. Where unloading a cargo ship used to take around 60 workers, now it only requires nine.

Automated Port Qingdao: commons.wikimedia.org

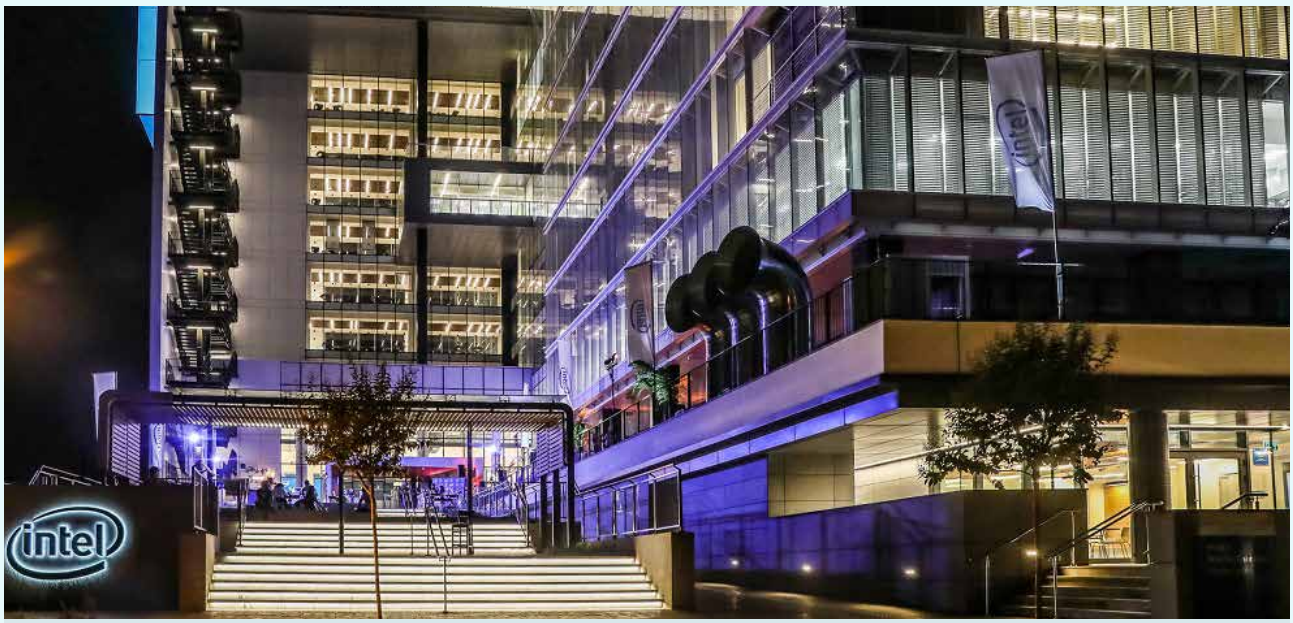
SMART BUILDINGS

Operating a building itself will increasingly become a form of supervised augmented working. Smart buildings are buildings that analyse and automate building functions.

They have the ability to make decisions themselves and suggest courses of action according to received parameters. This can be everything from simply counting how many people are in the building up to shutting down empty floors. Smart buildings can monitor occupancy levels and suggest that people move to different areas to use the space more efficiently, keep track of visitors to the building, monitor security at night and inform facility managers of maintenance issues. Smart buildings are gradually taking on more and more work that would have previously been manual, allowing facility managers to have more free time to focus on tasks that humans excel at, such as strategy, improvements and human interaction.

There are already numerous examples of how smart buildings can change the way that we work. Edge Olympic in Amsterdam is the next level up in smart building from The Edge, itself a trend-setter in the field. The whole Olympic building is designed on the principle of everything being connected and leveraging data to provide the best workplace possible for occupants. The building is created specifically to be as environmentally sustainable as possible, while unlocking human potential through flexible and interconnected digital infrastructure. Olympic has sensors covering the full gamut of environmental and human data: from temperature and water consumption all the way to noise and occupancy levels. The building constantly monitors the flow of energy, people and information around the office and analyses these terabytes of information in real time to build an immensely accurate model of how the workplace functions. All of this data is fed back to facility managers via comprehensive dashboards in a single user interface. This leaves human operators with a focus on improving the building and leveraging the next insight rather than trying to work out whether or not they need more desks. In this way, the building has almost become a machine that runs itself and raises issues to its human supervisors.

18 (The Telegraph, 2016)
19 (Visa, 2019)
20 (Teradata, 2019)



CASE STUDY: INTEL PTK1

Intel is a company already well known for innovation and it has made itself a workplace that embodies that ideal.

The new office in Petach Tikva in Israel boasts 14,000 sensors, which between them generate 50-100 terabytes of data every day.

The building management system of 970 APIs and 60,000 input fields uses AI to analyse this data in real-time and adjust systems based on the readings. Lighting, temperature, ventilation and meeting rooms are all controlled by this system and Intel report that it is 40 per cent more energy efficient and consumes 75 per cent less water than an equivalent 800,000 square foot building. The aim of the building is to create an environment that stimulates teamwork, creativity and inspiration for its 2000 users and reports so far indicate that it is succeeding.

THE MIRVAC PERSPECTIVE

The term "smart building" has been around for many years but we are really only at the beginning of what could be possible. Buildings produce incredible amounts of data, but determining the use cases which unlock value will be the key to success. The best outcomes will be delivered when tenant and landlord combine data and insights with AI, to achieve the best experience for the customer. As our customers businesses change to incorporate the supervised model, so will their property requirements. A smart building therefore, is not simply a building that collects data but one that is flexible and adaptable to new customer scenarios, both virtually and physically.

Mighty Mouse, a Robotic Vehicle Range (RVR) at Sandia National Laboratory.
Photo by Science in HD on Unsplash

COEXISTENT

Machines working together with humans in the same workflow is where work activities begin gaining even more from the presence of robots. A coexistent form of augmented working combines the abilities of humans and machines in a way that unifies their workflow, with both working together in the same space and interacting with one another.

"THE BUILDING SHOULD BE LIKE A CLOUD – YOU WANT THE BUILDING TO ADAPT TO YOU. IT NEEDS TO BE ABLE TO ADAPT TO BE A MEETING ROOM, WAR ROOM, OPEN SPACE, WHATEVER IT NEEDS TO BE."

– Mark Blum, Cognian

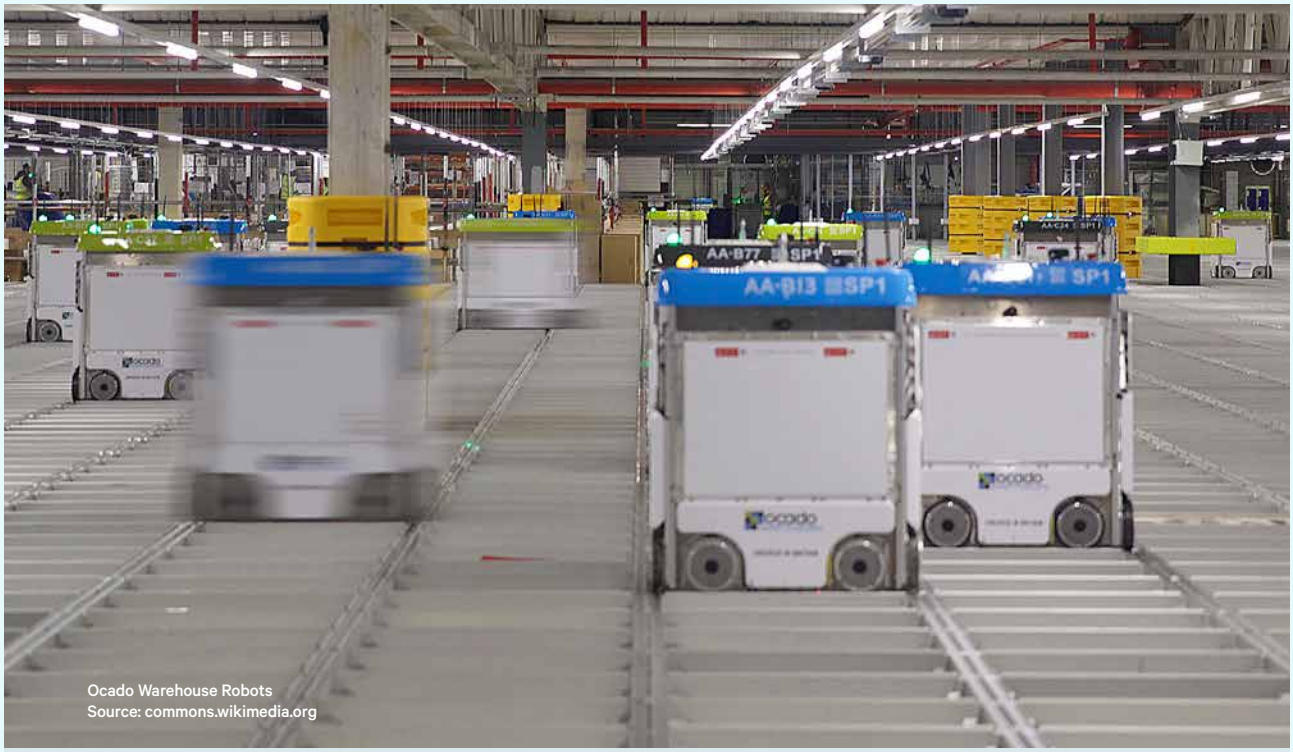
While assigned robots will perform their task in a narrowly defined field (and may even need a cage that humans cannot enter), a coexistent robot will work throughout the whole workplace, avoiding, interacting with and assisting humans as appropriate.

This will form the basis for augmented working in many industries, particularly those in which machines will be completing an increasing proportion of physical tasks.

One industry which is set to experience huge gains from such robots is the logistics industry. As the retail market has swung from the physical towards the digital, the logistics industry has had to rapidly scale up to cope. In the UK alone, the courier market has grown 62 per cent between 2014 and 2018 to become a £12.6bn industry delivering 3.65bn packages[21]. While at present deliveries still need to be taken by humans, the repetitive tasks and controlled conditions of the warehouse are a natural illustration of the potential for robotic intervention.

Almost every industry that involves the manipulation of physical objects can stand to benefit from coexistent working. One particularly interesting example comes from the fast food industry. In Mountain View, California, Zume is using coexistent robots to bring the time it takes to make a pizza down to 22 seconds[22]. Humans knead the dough, passing it along to robots that separately squirt and spread the sauce, before toppings are added by another human. A final robot picks up the pizza and puts it into the oven. They are not stopping there either, with plans to use robots for even more tasks.

Zume Pizza
Source: www.bloomberg.com



Ocado Warehouse Robots
Source: commons.wikimedia.org

CASE STUDY: OCADO

As a direct result of more devices being in the workplace and more bandwidth being consumed with a vast array of personalised devices, buildings will have to operate communications networks in a different way to before.

Online grocery delivery service Ocado has been an early adopter of autonomic and robotic technology from the beginning of its life. It has never owned physical shops and relies on a model of fulfilment through a network of warehouses and delivery trucks. Ocado has developed warehouses that use a combination of human and robot skill to process 65,000 orders per week. What makes this delivery centre special is that it is not just processing uniformly shaped and weighted objects (e.g. standardised containers) but the full range of products and packaging that can be found on supermarket shelves: all 50,000 of them. The packing robots use computer vision, suction and sensors to identify the best way to pick up and manipulate items, as well as set them down without damaging them. Crates are also moved to and from the robot pickers by other robots, which can even work collaboratively through 4G to get to boxed in crates and accomplish other tasks. Human workers are present at different stages of this workflow, both as pickers and supervisors of the robots.

THE MIRVAC PERSPECTIVE

"The most prevalent and obvious opportunity for automation is materials handling and storage. Supply chain automation is the most obvious one in the market. "

THE CURRENT REQUIREMENT TO ISOLATE ROBOTS FROM HUMANS NECESSITATES RE-THINKING THE WAY THAT ROBOTS INTERACT WITH THE REST OF THE WORLD.

CYBORGS & COBOTS

As we interact more and more with robots, so too will we need to integrate more technology in our lives.

To operate successfully, robots will need know where we are, what we are doing and what we might do next. Not all of this can be achieved using machine vision - humans will have to make adaptations to working closely with machines as well.

Amazon has already made a name for itself as an innovative and creative retailer. One aspect of this is evidenced by how far ahead of the curve it is when it comes to robots and logistics. Amazon has developed its own bespoke robots with the aim of automating much of their package sorting process. At sites across the world, Amazon is already using coexistent augmented work to deliver packages. At their Manchester warehouse for example, they have an army of 2,500 robots moving shelves full of packages. These robots navigate the floor space and each other to deliver shelving units of up to 340kg to human workers who can then pick up the items for packaging[23]. The robots do the heavy lifting, while humans have an opportunity to confirm items are not damaged and performed the more dextrous task of packing.

But there is still something missing from this approach. While human and machine are working together in a continuous, integrated workstream, the robots are still working in a fenced off area of their own, separate to humans. As they are carrying heavy loads and their obstacle-detection systems are not yet infallible, this is a measure designed to safeguard the human workers. The current requirement to isolate robots from humans necessitates re-thinking the way that robots interact with the rest of the world.

Advances in communication technologies like ultra-wide band Wi-Fi will pave the way for new location and tracking protocols that will help determine locations reliably down to the level of centimetres. This will lead to a new frontier in wearable technologies: those that enable machines to track human movements to such a degree that they can safely work side by side. For example, gloves that can track small movements of the fingers and transmit movements electronically to robots in real time will allow them to safely work alongside humans on tasks that require fine motor skills. More accurate and reliable positioning systems will also make it easier for robots to navigate a busy workplace alongside other workers. As humans continue integrating technology more closely with their bodies, this will enable the next stage of coexistent robots: the cobot or collaborative robot. If interconnected networks are the Internet of Things, soon the workplace will experience the Internet of Employees.

This development will combine different technologies to eventually create a new type of workplace. Three Square Market, a provider of self-service vending machines, is a company that has already started going down this unusual path, offering to install RFID microchips in its employees. These can be used for a range of basic activities at present, such as opening secure doors and logging into computers[24]. When combined with advances in robotics around fine motor control, haptic feedback and remote control systems, this will open up the workplace to entirely new forms of working. The Shadow Robot Company for example has already developed a remotely-operated robotic hand system that has the dexterity to manipulate small objects almost as well as a human[25]. It has pioneered the world's first telerobot to transmit touch to the operator from around the world. When this technology becomes more commonplace, workers will be able to use wearable and implanted technology to move between manipulating different robots as they move fluidly between tasks. Cobots can be taken over to be used by a human when necessary and return to their automated tasks when no longer needed. This will enable more work with hazardous machinery, chemicals, products and more.

PREPARING FOR THE FUTURE

Although very much in its infancy, cybernetic advancements will increasingly blur the lines between humans and machines.

In a sense we are already cyborgs as we regularly outsource functions to machines (remembering telephone numbers, communicating, planning etc.). As we use more technology, we run the risk of increasing our reliance on it to such a point that we lose the ability to do certain things without it.

Reliance on calculators for simple arithmetic or phones for remembering phone numbers reduces the ability to use those skills surprisingly rapidly.

As we hand over more and more control to machines, we need to be aware of how cybernetics will affect skills in the workplace. To prepare, companies must review their processes to ensure a balance between machine autonomy and human oversight. Enhanced governance will need to be put in place to make certain that machine elements of the workflow do not have absolute, unsupervised control, especially when it comes to decision making and judgement.

DIGITAL CEILINGS & PERVASIVE WI-FI

As a direct result of more devices being in the workplace and more bandwidth being consumed with a vast array of personalised devices, buildings will have to operate communications networks in a different way to before.

It will no longer be acceptable to have devices that cannot connect to the internet or corners of the building that have no service. In a world of cobots, this could easily result in an accident if a machine cannot interact with a human in a safe way. Wireless networks will need to converge into single, unified fields that can serve the entire workplace reliably.

One technology that is already building this future is the Digital Ceiling solution by Cisco[26]. The Cisto Digital Ceiling is a converged IP network that has the ability to host a huge range of integrated services. Using Power over Ethernet (PoE), the Digital Ceiling is essentially a single network layer located in the ceiling that leverages the universality of lighting to carry the unified network everywhere in the building. Hosting all workplace services on the same network makes it easier to monitor data in real time to generate immediate insights into workplace activities. This makes it perfect for managing multiple constant inputs and outputs that are required when working with cobots. As we move towards an environment in which robots and humans will be working more closely together, buildings will need to ensure that they provide this digital backbone to support coexistent augmented work.

21 (Mintel Press Team, 2019)
22 (Kendall, 2016)
23 (Pooler, 2017)
24 (Ghose, 2017)
25 (The Shadow Robot Company, 2019)
26 (Cisco, 2019)

MIRVAC ADVISES

We believe that the future is all about the connected customer. We are constantly looking at ways to create a new level of connection between our customers, devices and the spaces themselves, ensuring the necessary speed and latency.

Mechanical engineer develops sustainable agricultural robotics
Photo by ThisisEngineering RAEng on Unsplash

ASSISTIVE

As the ability of machines to outperform humans in certain tasks increases, we move into the realm of assistive augmented work. In this model, as humans perform tasks, machines actually come to their aid, using their advantages to help make humans faster, more accurate and more capable in their tasks.

THE CORE OF ASSISTIVE WORKING IS THAT RATHER THAN MACHINES WORKING THROUGH THEIR OWN TASKS, THEY ARE INSTEAD DIRECTLY ENHANCING HUMAN TASKS.

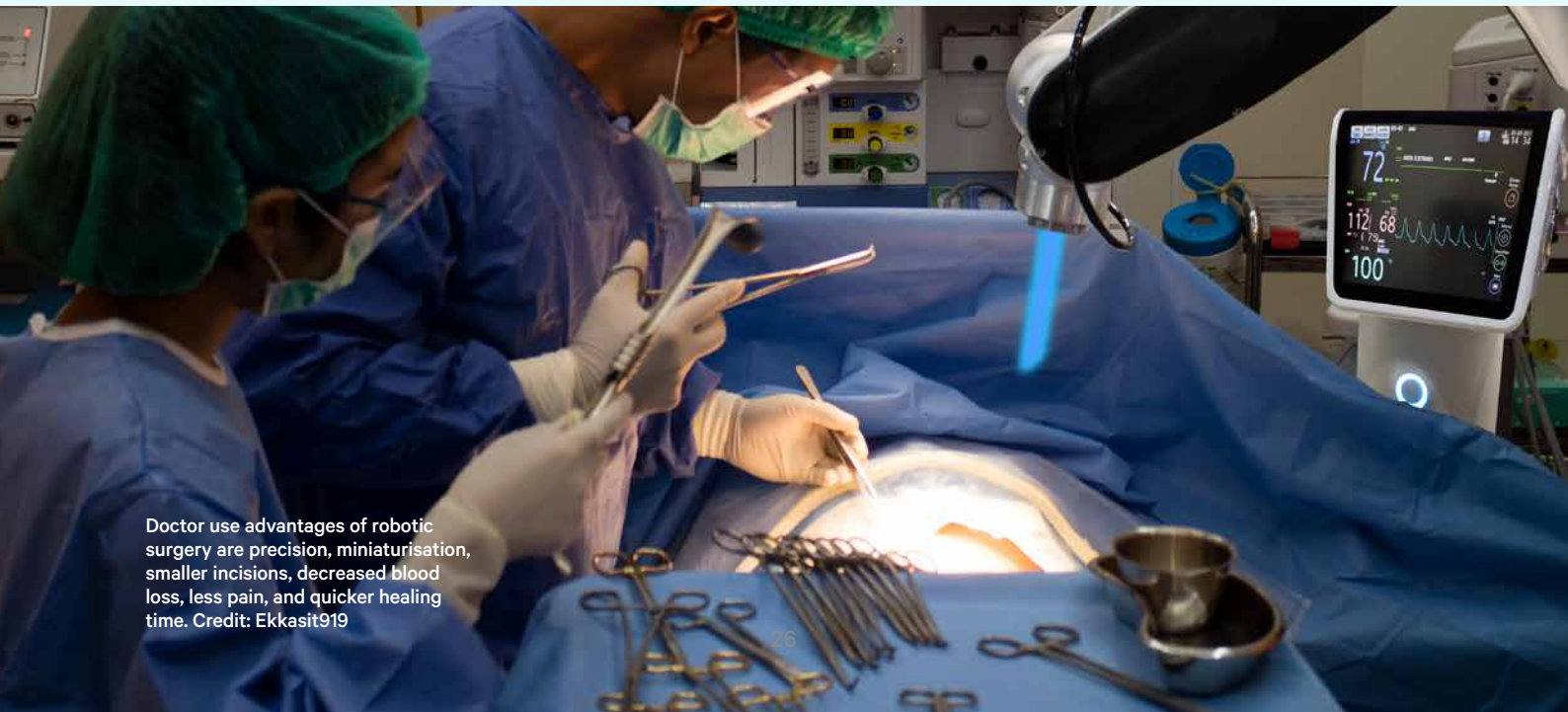
MIRVAC ADVISES

We are beginning to think about our portfolio as a platform, linking different spaces across the portfolio to benefit our customers who can begin to think about Location Based Working (LBW). As machines become better at mapping real estate needs to workflow, humans can spend less time thinking about where they want to be and what tools they need and more time at the right space with the right tools and people present.

Unlike some of the other models presented here, this model is still in relative infancy.

The core of assistive working is that rather than machines working through their own tasks, they are instead directly enhancing human tasks. This is the first model in which, by definition, the robot would never be able to replace the human; its job is to improve human work.

Although less developed than some of the previous examples, this type of assistive work is already taking place. For the past few years DHL has been using a combination of Google Glass and the augmented reality software xPick to create an augmented reality system for its packing and sorting employees to use. Augmented reality consists of using a virtual overlay to show digital information over the real world. At DHL's sorting warehouses staff use this system to guide them to packages and display information about what they are picking up and where it needs to go. On the back end, it also automatically logs information about what items have gone where, without the need for additional barcode scanning. DHL reports that using this assistive system has increased productivity by 15 per cent[27] and driven significant accuracy improvements. Thanks to the intuitiveness of the system, it has even made training far simpler and easier, making savings for the company and improving the staff experience.



Doctor use advantages of robotic surgery are precision, miniaturisation, smaller incisions, decreased blood loss, less pain, and quicker healing time. Credit: Ekkasit919

PREDICTIVE & AUGMENTED MAINTENANCE

At a certain point of functionality, a machine working with a human stops being supervised and becomes assistive - this is typically when the machine is outputting more than is being input.

The implications for buildings and the property industry are vast and wide-ranging. One of the biggest will be the ability to both predict and augment maintenance processes. Assistive machines will be able to help predict, detect and fix faults in real time, driving cost savings and increasing building efficiency. They will be able to identify when equipment will fail and when it is likely to need replacing based on a set of key indicators. This will reduce human error and change the way building management roles work.

Nowadays, virtually all activity leaves a digital trace. Plenty of things that would have gone unnoticed in the past now generate a digital trail in many settings. Your calendar knows which meeting room you have booked; your phone knows where you have been all day. The coffee machine knows what the office's favourite type of coffee is. In many cases this data is already being collected, but nobody knows what to do with it. This is where big data comes in: data sets so large that traditional data analysis methods tend to be less useful. Modern buildings generate huge datasets that are an excellent source of information and should be utilised.

With the rise of augmented working systems and smart buildings, building maintenance will become a very different activity. Rather than overworked facility managers reactively directing maintenance staff to broken equipment, a smart building will utilise its vast dataset to proactively flag up potential issues before they arise. Staff will be notified and will be able to replace or patch equipment before it breaks. The building will even be able to guide them to specific units using augmented reality and display exactly which part of a large assembly requires attention. By using building data to build models and augmented reality to guide workers, the building itself will become an assistive augment to human working.

CASE STUDY: DEUTSCHE BAHN

As the provider and operator of transport routes across Europe, Deutsche Bahn is the largest railway operator in Europe and the largest in the world by revenue.

Photo by Daniel Abadia

With its vast infrastructure of trains and railways, failures are inevitable. With so many people and industries relying on transport networks, these failures are expensive. Knowing when things will fail is therefore a great opportunity for a transport firm.

Deutsche Bahn has made a number of steps to achieve these gains. It has conducted a year-long pilot project with Siemens to collect data from trains, analysing it in a dedicated service using bespoke algorithms and autonomous models to predict future train behaviour. Data is fed back to operators and maintenance technicians for real time benefits, reducing unscheduled down-time. Deutsche Bahn has also started using smart sensor technology from KONUX to allow autonomous data collection and transmission. Pre-processing occurs in the sensors and cloud machine learning algorithms help detect component wear. This has contributed to a cost reduction of 25 per cent through minimisation of downtime. Deutsche Bahn has also acquired the predictive maintenance solutions provider infraView to start bringing more predictive maintenance capabilities into the company.

DIGITAL TWINS

As buildings get smarter and more and more devices connect and communicate with one another, this interactive ecosystem becomes exponentially more difficult to manage and interact with from a facility management point of view.

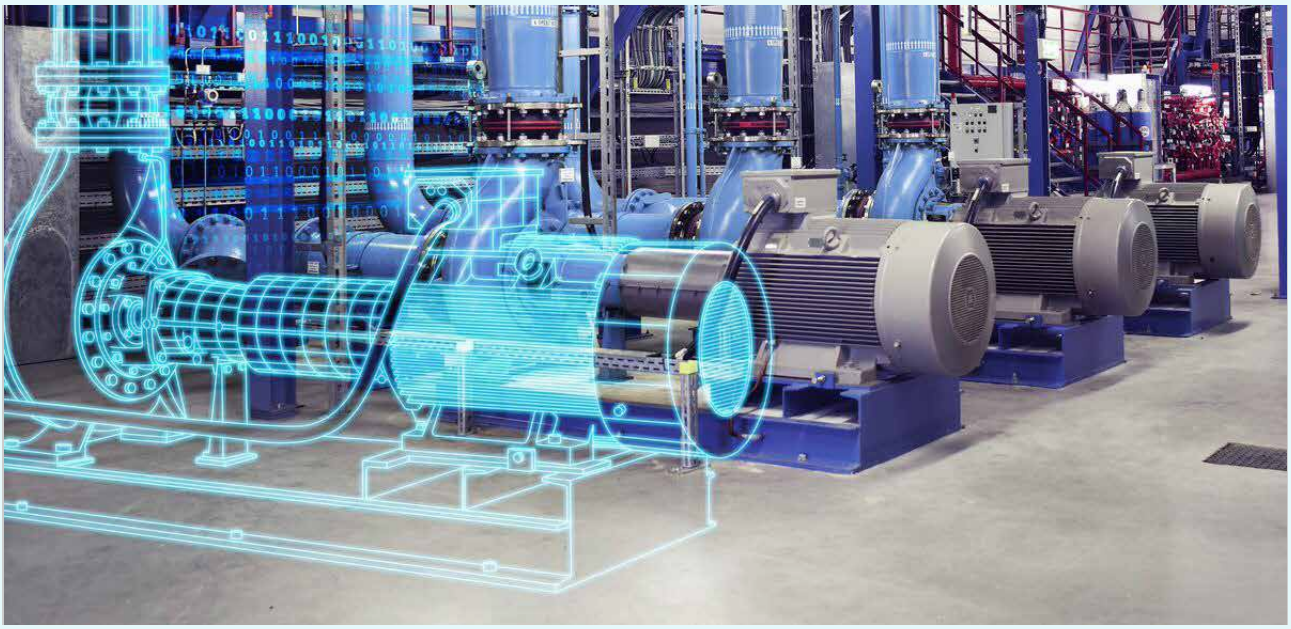
Enter: digital twins, which form an interface between a smart building and those managing it. A digital twin is essentially a digital representation of all facets of the building that are networked. It is an extension of the building into the digital realm. Almost any device or piece of equipment can be linked to the building using IoT technology and a digital twin will be able to communicate with all of them to generate real-time insights and predictions into the functioning of the building.

A digital twin will be able to accurately unify data from a range of different sources and IOT devices to model how the building is functioning at the time, how it might function under different circumstances and where it is not functioning as expected. When coupled with machine learning, collecting and integrating all this data can be used to help humans solve problems that they would find difficult without all of the information to hand. For example, if a certain air conditioning unit keeps malfunctioning, but only when the building is at over 70 per cent occupancy, this may indicate an issue with air flow in the area. A digital twin system can then flag this to a human user so that it can be further investigated. Real-time feedback on equipment performance can also help diagnose errors faster and more accurately, necessitating fewer inspections and saving time.

Optimising the running of the building using a digital twin shows the vast potential of assistive working for the real estate industry. By amalgamating diverse sets of data and using machine learning to flag issues, buildings can operate more efficiently and effectively. Not just buildings either: in fact, almost any process can benefit from having a digital replica of it. Through the use of digital twins, real estate costs will be lowered.

A whole range of other industries can also benefit. Logistics companies can track assets through their entire process; facilities managers can have a full scale digital model of their entire building functioning; and maintenance companies can better diagnose faults and have fewer site visits. Digital twins will not only change how buildings function, but they offer a mode of assisted working that can achieve more than humans alone are capable.

Digital twins will also open up further avenues for long-term strategic sustainability goals. For example, buildings can be designed to reduce and manage waste to limit the footprint a building has on the planet. This will enable better use of real estate and more opportunities for flexibility and efficiency, driving a new kind of real estate strategy.



21 (Mintel Press Team, 2019)
22 (Kendall, 2016)
23 (Pooler, 2017)
24 (Ghose, 2017)
25 (The Shadow Robot Company, 2019)
26 (Cisco, 2019)

Photo by ipopba

SYMBIOTIC

Symbiotic augmented working represents the final evolution of augmented working. Going beyond ways of doing things faster and more accurately than humans or simply gathering and analysing large amounts of data, symbiotic working is a type of augmentation that raises the machine almost to the level of the human worker.

SYMBIOTIC MACHINES AUGMENT THEIR HUMAN WORKERS BY AUTOMATING DIGITAL PROCESSES AND BEING ABLE TO GENERATE OPTIONS FROM A GIVEN RANGE OF INPUTS.

It takes assistive working a step further, operating at a higher level of strategic input.

Symbiotic machines augment their human workers by automating digital processes and being able to generate options from a given range of inputs. The nature of the relationship becomes much more two-way in this model, with reciprocal communications between the human and the machine and a workflow that is inextricably linked.

As with assistive working, symbiotic working represents a new field of augmented work, one which thus far has few examples. This is likely to change as more workplace tasks are able to incorporate machine input. However, symbiotic working is already changing the world of work with machines being used symbiotically in a range of different areas from designing offices to working out ideal routes for freight.

THE MIRVAC PERSPECTIVE

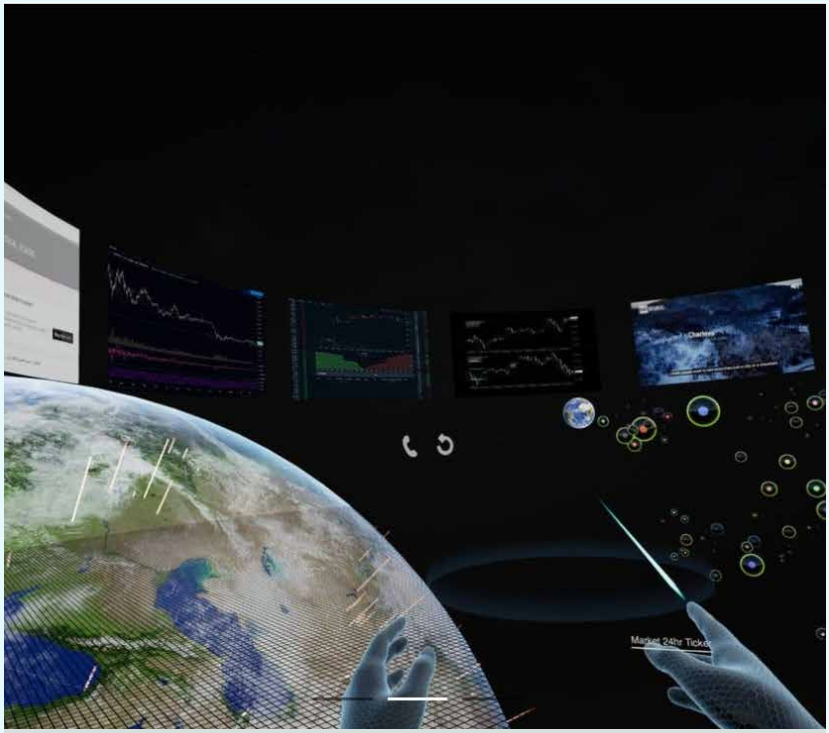
"We have a lot of discussions around the ability to forecast. Typically, these solutions require a lot of investment up front. Investment is becoming cheaper all the time, and payback time is getting shorter. Bringing automation is having a shorter payback and it needs this to continue being effective. Longer term investment decisions are being driven by these assets as it means that people are staying for longer."

GENERATIVE DESIGN

Symbiotic working is already carving out a niche in generative design. Generative design is an iterative process whereby a computer will generate outputs according to a given set of parameters and feed these back to a human designer.

The computer can use its immense processing capacity to generate thousands or even millions of permutations of the desired design which the human operator can then compare and judge. The human operator can then adjust the parameters and generate designs again. It is this reciprocal communication that marks out this type of working from the others detailed in this report; information is flowing both ways and the ability to utilise the strengths of human and machine is enhanced.

Generative design has already been used to help architects create the very buildings that we are working in. Zaha Hadid Architects has used generative design software to design buildings that takes into account a huge range of different factors like team adjacencies, lines of sight and number of steps to key people. This is another area in which machines can thrive. This is because one of the capabilities of machines that humans lack is the ability to integrate vast amounts of data into an optimum design that balances a huge range of variables.



PREPARING FOR THE FUTURE:

Generative design will have a significant effect on the division of workflows.

As machines do more and more work generating ideas and plans, humans will need to become adept at integrating ideas from machines and judging the relative benefits of some designs over others. Human workers will need to be prepared for significant job changes as they become managers and judges of machines and generate less content themselves.

Companies will need to understand how generative design will affect not only their business, but also the actual jobs that their workers are doing. This may change the skills they are hiring for, the backgrounds they want employees to have and even their workplace. This will even change the make-up of the workforce, with potentially more and more workers being used on an ad hoc basis as machines begin taking on more of the work for these types of time-consuming tasks.

This can help achieve the best possible fit that takes account of a much higher list of variables than humans can, and do this much faster than humans can. When it comes to buildings, this can involve assessing and balancing factors like sunlight, acoustics, distances from fire escapes and entrances, ratios of desks to other work spaces and adjacencies of teams and key personnel. This represents a key change in the property sector as it becomes possible to closely tailor buildings to occupants, delivering the buildings themselves more cheaply and faster.

Autodesk has already produced a machine that can do just this. Project Discover uses generative design techniques to create offices that balance the wide needs of users. Moreover, Autodesk has actually used this system to design its own office[28] in the Innovation District of Toronto. This process began by extensively surveying the 300 employees and then generating 10,000 designs with different combinations of various parameters[29]. The software then works through the designs, matching employees to their preferences as best as possible, while working within the limitations of the building. This would have been an impossible task for a human to compute alone: having to draw out 10,000 designs unaided would be a monumental task in itself, not to mention the number of permutations that would need to be evaluated to determine the best possible fit for the workplace. The power of generative design is one of the best examples to date of symbiotic working unlocking the potential of human-machine collaboration.

MIRVAC ADVISES

A symbiotic working process with a smart building using predictive analytics would be able to totally change the way we think about building operation and lead to new capabilities in both building design and management.

Photo by Brett Boardman

CASE STUDY: MIRVAC AND HUMANYZE

From smart sensors to data scraping, Mirvac is trialling a host of new technologies and approaches using new data streams to understand organisations and their real estate needs.

An example of this is Mirvac's pilot and partnership with Humanyze, a software company which helps organisations measure digital communication and collaboration patterns by scraping data.

This experiment used Mirvac data to pilot a new approach to understanding an organisational network. The experiment scraped anonymized digital metadata from selected collaboration and communications tools, analysed it and provided Mirvac with a dashboard to enable Mirvac to review its organisational health, understand internal networks, communication lines and to review collaboration patterns.

From Mirvac's perspective, if we can better understand how our people are using space, we can develop new ways to improve productivity, efficiency and collaboration – and extend that knowledge to our customers as they design their future workplaces.

PREDICTIVE ANALYTICS

All types of symbiotic working have one thing in common: data. The information that we collect about what we do and how and where we do it is becoming increasingly important.

The real success of many modern companies has been in data; Amazon has not prospered because of what it sells, Google and Facebook have not succeeded due to advertising, but all have thrived because they understand data and how to monetise it in a way that meshes with their business activities. For the first time in the history of work, we are at a time when we can measure and analyse almost everything. IoT (Internet of Things) sensors are cheap and powerful enough to collect data on almost any device or process. We also have the correct techniques and technology to analyse this data to generate insights about what is occurring in such systems. The next frontier in data analytics is predictive analytics.

Predictive analytics take the modern study of data analytics further than anything before it. While modern analytics can help us solve problems in the workplace, predictive analytics systems will be able to solve problems before we even know they exist. Predictive maintenance is an example of this - as more systems become integrated into a common digital infrastructure, the way that buildings are run is going to change entirely. When buildings have the ability to predict things like which days of the year are going to be busiest and how much energy will be used throughout the year, humans will be able to feed in different parameters to see how these might change predictions. Building operators will be able to lower costs as they accurately model how many people the building can actually support, rather than just calculate how many desks can be fitted in. They will also be able to more accurately determine what the strategy for the building should be: where teams may be located to be most effective, who may benefit from better technology and even when the office should shut because of low demand.

CASE STUDY: 3M

As one of the largest companies in the world, global conglomerate 3M already has a huge amount of data at its disposal. Recently it has recognised that using this data is the key to remaining competitive.

3M has partnered with C3 IoT to aggregate, maintain and analyse all their clinical and supply chain data through deploying AI at scale. By leveraging their data, 3M is beginning to predict supply, demand and more. Its package is built to be customisable as well, allowing it to extend functionality to different areas of the business as they develop capability.

28 (Autodesk, 2019)
29 (Bien-Kahn, 2017)

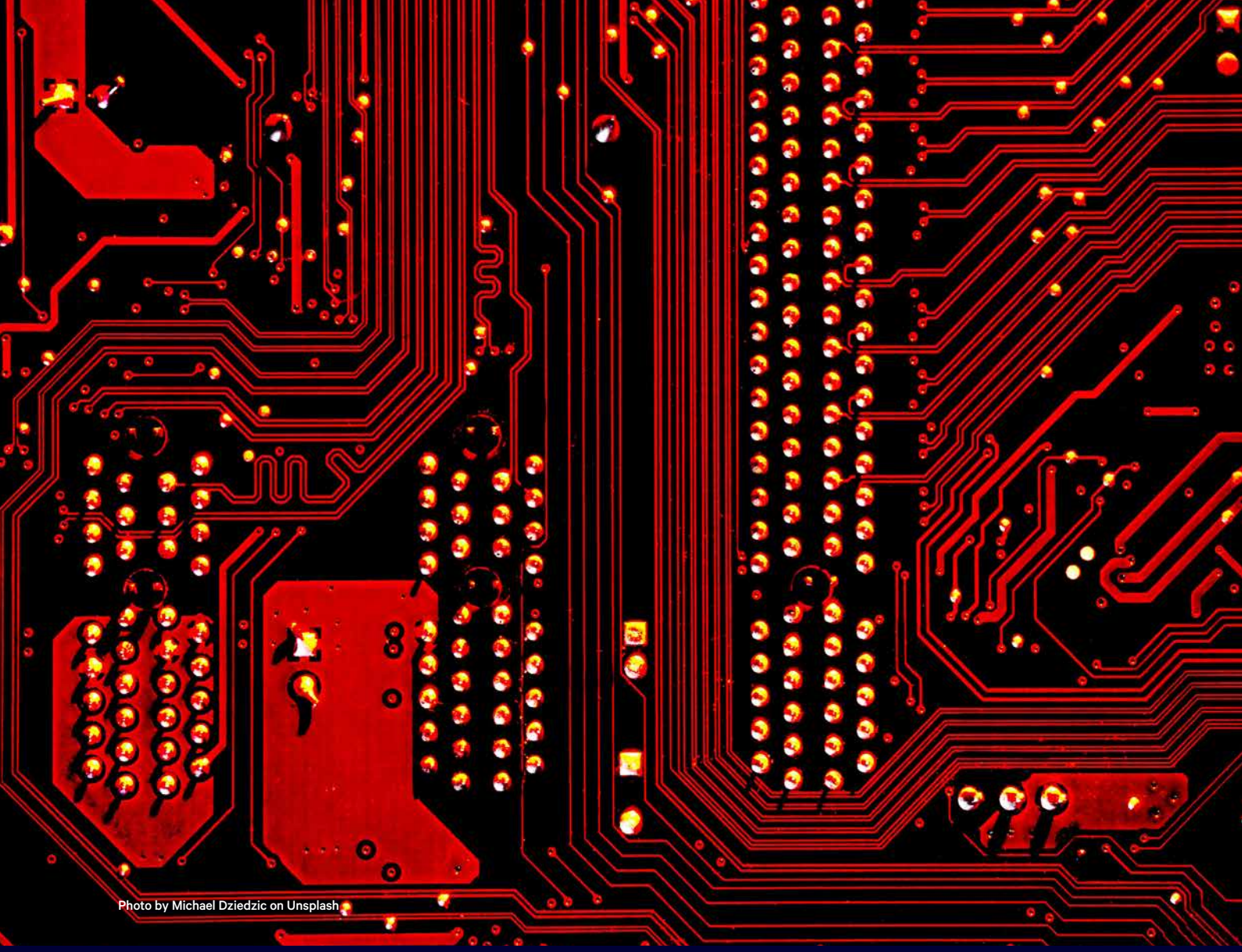


Photo by Michael Dziedzic on Unsplash

CONCLUSION

The way that we work is constantly evolving. The boundaries within which the workforce, buildings and technology operate are shifting through social, cultural, economic and technological processes that are beyond the control of individual companies.

In order to be successful, companies need to understand how these forces are going to affect them and their workforce.

The intent of this report was to examine in detail the contribution of different kinds of augmented work to the future of the workforce and workplace. It has done this by using examples from across industry and focusing on two consequences of each type of augmented working. Assigned covered robot-centric design and programming; supervised looked at the always-on workplace and smart buildings.

For coexistent working, the rise of cyborgs and cobots as well as digital ceilings and pervasive Wi-Fi were examined. The section on assistive working considered the impact of predictive and augmented maintenance as well as the digital twin. Finally, symbiotic working provided an opportunity to look more closely at generative design and predictive analytics. Some of technologies and types of augmented working are in their early stages, presenting an excellent opportunity to get ahead of the curve and be cognisant of these ideas before they become mainstream.

FIVE THINGS COMPANIES SHOULD DO TO GET AHEAD OF THE CURVE:

1. Ascertain which tasks can be automated and what proportion of jobs will be affected
2. Analyse what effects this will have on the workplace and the workforce
3. Understand which type of augmented working will have the most impact on your industry area
4. Identify where opportunities exist to develop processes that are not possible without augmented working
5. Ensure that staff can be re-trained as tasks are automated to best retain domain-specific knowledge

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I THINK THE BIG MESSAGE WHEN IT COMES TO THIS NEW WAVE OF AUTOMATION TECHNOLOGY…IS THAT THEY WILL PROFOUNDLY IMPACT BOTH THE NATURE OF WORK BUT ALSO THE NATURE OF HOW WE ORGANISE OUR BUSINESS. SO IN TERMS OF HOW THEY CHANGE WORK, SOME OF THE TASKS THAT WE DO WILL BE ENTIRELY AUTOMATED, BUT THERE WILL BE OTHER TASKS THAT WILL BE EITHER AUGMENTED, MEANING THAT WE WILL BE ABLE TO DO MORE WITH THE TECHNOLOGY THAT IS AVAILABLE NOW, OR THERE WILL BE A THIRD CATEGORY OF TASK THAT ARE PURELY HUMAN BECAUSE THEY WILL BE THINGS THAT WE DO WHEN WE COLLABORATE.

”

George Zarkadakis, Willis Towers Watson

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