Future of Work

Understanding the impacts of technology on shared services

Ministry of Health NSW

FINAL REPORT

May 2020

Copyright

Inherent Limitations

This Report has been prepared as outlined in the scope and limitations section. The services provided in connection with this engagement comprise an advisory engagement, which is not subject to assurance or other standards issued by the Australian Auditing and Assurance Standards Board and, consequently no opinions or conclusions intended to convey assurance have been expressed.

KPMG has indicated within this Report the sources of the information provided as per our methodology. We have not sought to independently verify those sources unless otherwise noted within this Report.

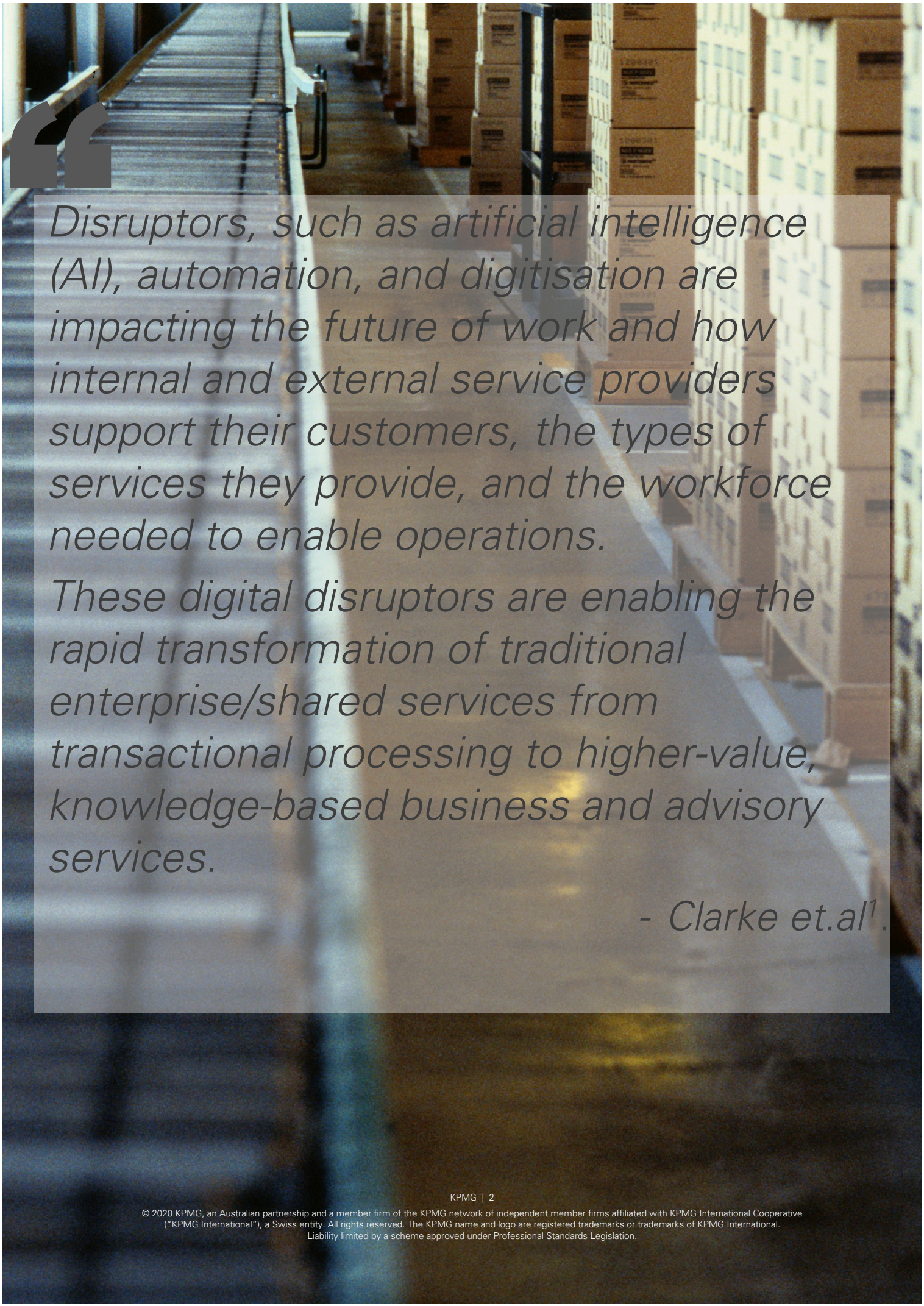
KPMG is under no obligation in any circumstance to update this Report, in either oral or written form, for events occurring after the Report has been issued in final form.

The findings in this Report have been formed on the above basis.

Third Party Reliance

This Report is solely for the purpose set out in the scope and limitations section and for the Ministry of Health's information, and is not to be used for any other purpose or distributed to any other party without KPMG's prior written consent.

This Report has been prepared at the request of the Ministry of Health accordance terms of the Agreement dated 14 June 2019. Other than our responsibility to the Ministry of Health, neither KPMG nor any member or employee of KPMG undertakes responsibility arising in any way from reliance placed by a third party on this Report. Any reliance placed is that party's sole responsibility



Disruptors, such as artificial intelligence (AI), automation, and digitisation are impacting the future of work and how internal and external service providers support their customers, the types of services they provide, and the workforce needed to enable operations.

These digital disruptors are enabling the rapid transformation of traditional enterprise/shared services from transactional processing to higher-value, knowledge-based business and advisory services.

- Clarke et.al[1].

Introduction

The shared services workforce underpins the health service delivery provided across NSW Health. In the NSW Health context, HealthShare NSW (who has the largest shared services workforce) are committed to becoming a valued and trusted partner for its clients, and delivering competitive services that improve outcomes across the NSW health system. This commitment to innovation to ensure that services meet customers' needs is driving a focus on the adoption of emerging technologies to deliver efficiency, quality, and better experiences. These technologies, in turn, are expected to augment and automate some transactional and repetitive tasks, allowing the workforce to focus on tasks requiring greater complexity, knowledge and skills.

Purpose of this Paper

This is the third in a series of papers that considers what the Future of Work means for the NSW Health system. This paper highlights the emerging technologies and resulting workforce changes that are expected into the future for the shared services health sector.

Shared services are defined as those which consolidate business operations that were previously used by multiple parts of NSW Health. They include food services, linen services, human resources, financial services, patient transport, procurement and logistics. The majority of NSW Health shared services functions are provided by HealthShare NSW, as the statewide organisation established to provide shared services for NSW Health. The maintenenace workforce are, however, employed through Local Health Districts (LHDs) or external providers.

Horizons scanning has been used to identify the emerging technologies and expected impacts across five key shared service functions. These are: food services; logistics and supply chain; linen services; business and administration services; and maintenance services. These have been selected as distinct workforce groups that will be impacted by technology in different ways.

The report's findings are designed to assist NSW Health with workforce implications for shared services and put in place a clear strategy and actions to support the workforce in embracing technologies that will provide benefits to the service and to the patient.

Scope and limitations

The scope of this paper is to understand the emerging technologies in shared services on the healthcare workforce, and the likely impact of these technologies on the workforce and the nature of their roles. The scope was limited to a scan of published and unpublished literature pertaining to the impact of emerging technologies on five nominated shared services; this includes peer reviewed literature, as well as 'grey' literature as at December 2019. In addition, the NSW Ministry of Health and Healthshare NSW provided information to inform the analysis.

Technology impacts across the whole of the shared services workforce

It is expected that there will be some technologies that will impact workforce occupations, functions and ways of working in similar ways across the majority of the shared services workforce, while there are other technologies that will only impact on specific industry sub-sectors or specific occupations.

The key technologies which are predicted to impact on the majority of the shared services workforce include the internet of things (IoT), artificial intelligence (AI), automation, and robotics (refer to table 1). These technologies will require digital literacy from the workforce, but the extent to which these technologies augment or automate current tasks is expected to vary for each occupation.

Overview of Key Technologies

Table 1: Overview of key technologies expected to impact the shared services workforce

Internet of Things	The Internet of Things (IoT) is the interconnection of a wide network of devices and systems through the use of sensors or intelligent devices that enable interaction between these devices and communication with humans.[2] It allows the sending, receiving, processing and storing of information from multiple devices and systems. IoT enables real-time data analytics to improve efficiency, enable regular monitoring and provide time-series data. For example, in logistics and supply chain, it is able to provide real-time information about the distribution of goods across the supply chain, provide monitoring information such as temperature control and expiry dates of goods, and is used to support predictive capabilities such as predictive maintenance.
Artificial Intelligence	Artificial Intelligence (AI) software applications are capable of mimicking or surpassing human cognitive or analytical capabilities to perform tasks. AI also tends to possess the ability to "learn", where its capabilities are improved by performing its intended action with varied and more complex data. AI has a range of applications in shared services such as in maintenance, where software can analyse large amounts of data collected from IoT devices and systems to identify anomalous behaviour and precisely predict when equipment is at risk of failing.[3] AI has the capability to improve workflow and quality of service. For example, in food services, AI can be utilised to assess the quantity of food and microbial debris for kitchen equipment, determine the optimum cleaning schedule and initiate automated cleaning with the correct intensity. This not only ensures that risk of foodborne bacteria and illness are minimised, but reduces manual labour hours in cleaning and allows cleaning to take place after hours to allow improved productivity.[4]
Automation	Automation is perhaps the most immediately realisable benefit of emerging technologies in shared services. There are numerous processes within the workflow of most shared services that not only have the potential for automation, but can be automated today. For example, within administration and business services, many finance processes, such as billing, expense processing and invoicing, along with end to end processes like procure to pay, are in the process of being fully automated.[5] These automated processes can significantly reduce processing costs, reduce errors and risk of fraud, and allow employees to focus time and efforts to solving more complex tasks through reducing the manual process workload.
Robotics	Robotics can assist the shared services workforce in different ways. It is generally the extension of the automation of certain processes that have traditionally required human interaction. The capabilities of robotics can also be extended when combined with AI to automate more extended and complex processes. This is most evident in the increasing integration of autonomous vehicles both within warehouses and hospitals in the form of automated guided vehicles (AGVs) in the delivery of food and linen, and also on the road in the form of driverless trucks to and from distribution centres.[6,7]

Factors influencing technology adoption in shared services

While the shared services workforces need to consider similar factors that determine the rate of adoption of technologies in any industry (such as time to adoption, funding availability, the cost to benefit ratio, maturity of technology and consumer demand), there are some more specific factors that need to be considered for the shared services workforces in the health sector.

A need to strongly demonstrate value for money

Efficiency and cost effectiveness are key considerations for many of the shared services functions within health.

While efficiency optimisation for many shared services has historically focused on lean supply chains and service delivery, new and emerging technologies are enabling or promising heightened efficiency in many tasks and functions that have been manually intensive and previously unable to be automated or augmented by technology.

Considerations of the needs of multiple stakeholder groups need to be considered in the future workforce and service design of the workforce, including expected outcomes. For example, patients want the best food and are not concerned about cost while the LHD is concerned with cost and providing nutritious meals.

Globalisation and wider industry trends

Much of the shared services workforce operate in occupations or industries that occur outside the health context, and these services need to keep pace with wider industry adoption of new technologies. For example, the logistics and supply chain workforce operates and impacts on the supply of goods across every sector in Australia. This means that emerging technologies that are being adopted in the logistics sector more broadly are likely to be adopted in the health context.

A key example is IoT use in logistics for the monitoring and tracking of goods across the supply chain. While the tracking of medical devices and supplies is, in and of itself, important to optimising the delivery of goods across the State, these IoT technologies have been adapted in the health context for the transportation of blood and tissue samples to ensure temperature control.

In linen services, the industry as a whole has increasingly focused on water efficiency and environmental impact, which is resulting in new technologies that can be used for commercial laundries. These new technologies are being adopted for commercial laundry use in the health context.

If shared service functions are seen to lag in the adoption of emerging technologies, they are exposed to the credible threat of competition from those who are able to deliver with greater efficiency.

Relative labour cost

A further consideration of the adoption of technologies is the relative cost of labour for the tasks and functions that need to be undertaken.

There are a number of occupations or tasks within the shared services workforce which are relatively low-skilled and thus lower-paying occupations. The comparative cost of labour therefore becomes important in these areas, as it is not expected that the technology will be introduced if it remains more cost effective to use humans to complete a task (assuming quality remains the same and there are no other concerns such as occupational health and safety).

This means that a further indicator of business adoption will depend on the price competitiveness of labour. From a technology adoption perspective, countries with a higher unit labour cost may seek to introduce technological innovations more quickly to drive down costs and remain internationally competitive. This could mean that technologies are adopted internationally but may not be adopted in the Australian context.

A different client group

For many shared services provided to NSW Health, the client may be the LHD, particular facility, or clinician and may not directly involve patients. This may change some of the Future of Work primary considerations as, in a clinical context, the adoption of new technologies may be heavily weighted towards the impact on patient outcomes and patient expectations.

Despite this, there is a strong drive across the shared services sectors of food, linen, logistics, maintenance and business services to improve customer centricity and the user experience. There are significant changes in consumer expectations around many of the shared services functions, which is creating additional commercial pressure to evolve and adopt emerging technologies.

Technology supporting patient centred care

In the delivery of care, patients will be empowered to make decisions on their own behalf. Technology will be available to support the healthcare organisation meet the needs of patients, to support information and communication exchange in the form and time period that suits the patient, and to enable patients to participate in decisions about their healthcare in the way that they choose.

Emerging technologies will not only provide access to information about the patient's own care, but also support the delivery of personal health-related reminders, individual therapeutic recommendations and information about the patient's current health conditions to support improved health literacy. Consumer expectations and improvements in patient centred care are expected to drive the adoption of new technologies.

Workforce displacement

Unlike many of the clinical occupations in health, there are some occupations, tasks and skills within the shared services workforce that will not exist in the form that we currently know them due to these emerging technologies. In the majority of cases, technology is expected to impact on manual and highly repetitive tasks. This may both free the workforce to undertake higher order tasks, and may improve risks in relation to occupational health and safety for manual tasks but is also likely to reduce the demand for the workforce in some of these areas.

For some, this may mean a slight reskilling within the same sector or occupational job family but, for others, it may provide the opportunity for a new career. If carefully managed, this may provide staff with choice about what tasks and functions they would like to adopt based on their own capabilities and interests, allowing them to morph their role into the best fit for both them and the organisation.

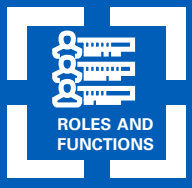
Limitations in predicting the impact of emerging technologies

In some cases HealthShare NSW is an early adopter of technologies. However, a significant limitation of becoming an early adopter in the use of emerging technologies is the limited evidence that purported benefits will be realised.

Despite this, early adoption of new technologies are correlated with better business outcomes and more sustained growth.[8] Given its recent record in technology integration and early adoption, HealthShare NSW is likely to continue being an industry leader in the adoption of emerging technologies.

Towards the future

Ensuring the shared services workforce are supported by NSW Health



In order for NSW Health to support the shared services workforce through periods of technological change, workforce planning considerations should be centred on the roles and occupations expected to be most impacted by the introduction of technologies that are planned for adoption within the next three years. A high level transition plan will help to determine the building blocks needed to bridge the gap between the current workforce and the future workforce. While this may take different forms, a high level approach could tag occupations based on whether they will remain as is, evolve, grow or be phased out. Each is likely to involve a different implementation approach to career development, education and training and change management and should become a core function of the human capital teams within NSW shared services agencies. It is noted that HealthShare NSW cites examples of successful implementation of reforms that impact the workforce, and delivering this in a positive way that supports the workforce.

In order for the implemented technology to deliver substantial and sustained benefits to the service, it must be integrated well into the workflow of those that interface or are impacted by it. Disjointed workflow, repeated or redundant tasks, inadequate education and training on how to use the implemented technology, and substantial or confusing changes in human tasks can decrease workforce satisfaction, and may impact negatively on service performance and organisational culture. It is, therefore, important that a granular analysis of exactly how the workforce will be affected, and how to best support them, is undertaken. Examples include through transparent and consistent communication of changes, adequate change management, early and comprehensive reskilling to use and manage new technologies, career coaching and development to support transition into new occupations and roles, and investment in education, training and lifelong learning.

NSW Health agencies will play multiple key leadership roles in helping to enable these changes, including as a large employer of the shared services workforce; a client to the shared services provided; an organisation providing on-the-job education and training for the workforce; a key investor in emerging health technologies that deliver consumer benefits; and through its role in providing accountability for the quality and safety of care that is delivered in the public health system.

Enablers to support change

Five key enablers were identified in the first paper that need to be harnessed to support successful adoption of the expected changes to roles, functions and workplace processes. While these are relevant across the entire NSW Health workforce, specific considerations for the shared services workforce are discussed below.

While some of the impacts and technologies are similar across the shared services workforce, many of the occupations within these workforce groups are from very different job families and industry sectors and, as a result, have very different professional requirements including education and training. To create an effective workforce blueprint, one of the key challenges will be in creating a compelling and easily understood workforce vision that also takes into account the nuance of these different functions, occupations, job families and industry sectors.

To remain both competitive and have positive and productive people, it will be important to develop a balanced business strategy that must both drive contemporary technological innovations and support the reskilling and reorientation of the workforce. It will be people who will remain critical to achieving customer centricity, driving innovation, and embedding and implementing the

transformational changes that are planned with technologies. Finally, it should be acknowledged that any workforce strategy may continue to change and evolve over time as new technologies emerge and that shared services will need to continue to adapt and evolve over time.

Education and training for the shared services workforce will need to support three different areas of focus:

1. Digital literacy across the entire workforce to support the adoption of new and emerging technologies for all staff;
2. Education and training to support reskilling for those who may have freed capacity as a result of technologies and need to be trained in higher order, more complex tasks; and
3. Education and training to support career transition for those whose roles are not required.

The implementation of each of these education and training elements will all be slightly different, however all will require clarity of the transition that is required (for example, through a training needs analysis); development of workforce capabilities through improvement of knowledge, skills and practice; investment in education and training including exploration of accredited and non-accredited opportunities and formal and informal professional development channels; and ensuring quality facilitators and trainers.

Leadership capabilities will be needed to help transform the shared services workforce. It is expected that this will require the leadership in shared services functions to have a mastery of digital concepts and emerging technology opportunities to drive decision making regarding the adoption of these technologies. This will include an understanding of cost benefit analysis as well as understanding the practical implementation challenges with the adoption of emerging technologies and the need for benefits realisation. In addition, leaders will need to be able to lead people through complexity to create cultures that emphasise adaptation, high performance and continuous improvement.

This will require leaders who are capable of supporting mindset and behavioural changes with an ability to be mobile diverse stakeholders, inspire new and better ways of working and interacting, and managing conflict, change, uncertainty and political dynamics. Given the scale and depth of change that will be required, leaders will also be faced with an increasingly important role of ensuring their own resilience, self-management and wellbeing as well as ensuring these factors are receiving attention across the workforce.

In order to capitalise on the most beneficial emerging technologies for the NSW population and realise improvements in health outcomes, quality, safety and efficiency, a culture of innovation and improvement is needed. NSW Health may support this through pilot programs, evidence-based research on the benefits of new technologies (and potential negative impacts), and harnessing national and international examples of emerging practice with these new technologies. Where NSW Health or HealthShare NSW is an early adopter of new technologies and ways of working, gathering evidence of the realised benefits will be important to ensure continuous improvement over time as well as working through any unintended consequences of the technology adoption.

Change management will be required to identify the impact of each technology on current tasks, functions and occupations. This will include the development of supporting and enabling processes, systems and scope of practice changes that are expected. It may also include communication with consumers and the public about the technologies as new methods and approaches are used in practice. It is important to note that the degree of change management required will be different for each occupation and will depend on the degree of change required into the future as well as other key factors, including the current level of education and training of the workforce, the organisational culture, the industrial environment and the history of previous reform implementation.

01. Food Services

What are the emerging technologies in food services?

Hospital food service operators around the world are faced with the need to better meet clinical expectations around nutrition and improve the patient experience, while at the same time operating in a financially constrained environment. This is leading many to explore the opportunities provided by technology to transform traditional food service models.

ICT Enabled Diet and Allergy Management and On-Demand Ordering

The operating model of services such as UberEats and Deliveroo, which use location-based, on-demand mobile ordering of food, is being adopted and tailored to healthcare. Examples in an Australian context include Fiona Stanley Hospital in Perth, the Prince Charles Hospital in Brisbane and the Mater Hospital in North Sydney.[9,10]

At Fiona Stanley Hospital, each patient bed is equipped with a touchscreen monitor where the patient can order a variety of food choices that are appropriate to their dietary needs and restrictions through an automated menu system.[11] For example, if the patient is a diabetic, they will only see food appropriate for them to eat.[12]

The food available at the hospital is mapped to 147 different allergens and 70 different diet codes through the ICT system, which enables catering to patients with complex diet types.[13] This database is connected to clinical systems which contain patient dietary requirements.[14] The system also allows for instant feedback and engagement with nurse unit managers and support staff.[15]

These capabilities enable the allied health services of Fiona Stanley Hospital to service 2,200 meals a day at less than $16 per patient per day, while maximising patient nutritional needs and improving the patient experience.[16]

In the food and restaurant services industry, it is expected that there will be a greater focus on the "digital DNA" of customers into the future. This focuses on remembering the client's food preferences, but also includes targeted engagement and marketing as well as online food selections prior to entry into the store.[17] The adoption of this customer oriented approach that takes a long term view of patient food preferences and health needs could be equally applied to the health context

Robotics

The delivery and collection of food within hospital settings can also be transformed to increase efficiency and reduce costs through robotics. The capabilities of robotics technologies is rapidly growing, with purpose built commercial offerings becoming more available to niche markets. This is no different for hospital-based food services. Robotic food delivery systems are already implemented in many hospitals across Europe and the United States.[18]

The Forth Valley Royal Hospital in Scotland utilise Serco AGVs to act as porters to move food trollies from the kitchen to service lifts where patient support staff collect them.[19] After completing tasks, the robots return to their charging stations and await their next delivery.[20]

The hospital infrastructure incorporated service tunnels for facilities management, which allows the robots to move without obstructing clinical staff or being visible to patients.[21] This food delivery robotics system has drastically reduced operational costs and

reduced manual labour and non-patient hours for porters and support staff. [22]

In an Australian context, the Royal Adelaide Hospital currently use 25 AGVs for food and equipment transport. These AGVs have additional capabilities which enable them to operate elevators to deliver food and supplies to different floors.[23]

The AGVs at the Royal Adelaide Hospital are reported to save around 200 labour hours each day, allowing staff to spend more time interacting with patients.[24]

Fully automated kitchens

The food service industry is projected to have one of the highest levels of automation in the future compared with other industry sectors. This is expected to have a significant workforce impact; half of all labour time in food services is attributed to repetitive tasks and operation of machinery which have the potential to be automated.[25]

The use of robotics in food manufacturing can either occur in primary processing of foods, where raw products are cleaned, sorted transported and blended, or in secondary processing where they are cooked, mixed or chilled. Robotics applications are better suited to the secondary food manufacturing stage because the food is generally more standardised, but robotics are increasingly being used in both applications.[26]

There are some international examples of fully automated kitchens on a small scale in other contexts. For example, a US company, Zume Pizza, employs pizza making robots which handle repetitive tasks such as dough pressing, sauce application, and transfer into pizza ovens. The operating model enables the company to cut food preparation costs and increase the speed of service.[27]

MIT students have created a fully automated mini restaurant system called Spyce Kitchen which can receive orders from a selection of five meals, and cook, serve and clean with fresh and customised ingredients, creating up to two meals at once. There are also examples of fully automated restaurants such as the Fu-A-Men restaurant in Japan which can make 80 bowls of food a day.[28]

Artificial Intelligence

AI has applications in a variety of tasks throughout the food service supply chain. AI can incorporate a large number of datasets such as price of ingredients, current inventory, and wastage reports to forecast and manage future cost of ingredients.[29]

AI can also be utilised to optimise cleaning schedules of kitchen equipment. The Self-Optimising Clean-in Place (SOCIP) is a cleaning system currently in the development phase.

SOCIP utilises sensors and artificial intelligence to assess the amount of food and microbial debris present to determine cleaning frequency and intensity, allowing significant time and cost savings through reduction in use of cleaning products and elimination of manual cleaning tasks.[30]

AI applications can also assist in patient-facing roles. Hitachi is using AI to monitor food leftovers on plates in hospitals to assist in patient care and waste reduction.[31] The system works by using cameras mounted on food collection carts to analyse what the patient has not eaten.[32] The post-meal analysis can be used to establish nutritional patterns and personalised food profiles, assess nutritional needs and prescribe future meals to accelerate patient recovery.[33]

Current progress of NSW HealthShare Food Services[a]

My Food Choice

My Food Choice was implemented in 2015 to personalise the food service delivered to patients in NSW public hospitals. In 2019, 60 percent of eligible beds have access to My Food Choice. The initiative has patient centricity at its heart, empowering patients through improved choice, engagement and adaption to feedback.

The program enables far greater choice in the meals that patients can receive and uses technology to improve the ordering process while decreasing the time between ordering and receiving meals. It also allows for early identification of patients who are not receiving the correct nutritional intake, allowing support staff and clinicians to intervene faster.[34]

Prior to the implementation of My Food Choice, a tray ticket run or a tray line start was utilised. This was a highly inefficient process that involved manual recording of the patients' food order, and extended time periods between delivery of the food order to kitchen, causing large delays between ordering and delivery of meals.

With My Food Choice, a diet order is automatically uploaded into the patient admission system and supporting intranet upon the patient's admission.[35] This notifies food services staff to engage and interact with the patient. The staff use a meal image chart to guide the patient through their choices and use a tablet to record and wirelessly transmit the order to the kitchen.[36] Meals are then prepared and delivered by small teams which likely consist of the same staff who took the order. This enables a deeper relationship to be formed between the patient and the support staff.

Collection of finished meals has also changed to increase sustainability and extract useful nutritional data relevant to the patient. The description and quantity of uneaten food is recorded and items are manually separated and discarded into organics, landfill, and recyclables.[37] The extracted data is automatically transmitted to a dashboard accessed by clinical dieticians to examine the patient's nutritional intake and assess whether intervention is needed to achieve nutritional requirements. This allows for decreased recovery times and improved patient experience.[38]

The technological changes for the My Food Choice program were a significant change for food services staff and dieticians. During the program, food service staff were trained and supported in the use of the tablets and the system, new infrastructure and equipment, and new workflows. Dieticians also had new workflows and had to be upskilled in key technologies to support this change

Health Share NSW is exploring the evolution of My Food Choice, focused on further improving the patient experience.

Packaging Accessibility Rating

The Packaging Accessibility Rating (the Rating) is a design and sustainable procurement tool developed in collaboration with HealthShare NSW, Arthritis Australia, Nestle and Georgia Tech Research Institute. The Rating estimates the percentage of the population that can safely open packaging.

The Rating is mandatory in food contracts at HealthShare NSW and Health Purchasing Victoria, making it a requirement for suppliers to assess and disclose food packaging accessibility ratings on all pre-packaged food items in public hospitals in those states.[39]

The Rating ranges from +8, which means the product can be easily accessed through the packaging for those with physical disabilities, through to a -8, where a product is impossible to use for people with limited functional abilities.[40]

The Rating gives consideration to the autonomy of elderly patients or patients with

[a] Information in this section was provided by HealthShare NSW

limited functional abilities who are unable to access food through packaging, which causes frustration and discomfort. Patients may even choose to not eat the product as they are unwilling or unable to ask for help in opening the package.[41]

This rating system allows procurement services to select products that have a high rating. Local suppliers are more likely to be aware of the Rating and innovate their packaging to receive higher ratings, and so they are more likely to be chosen in the procurement process, giving greater chance for local suppliers to be engaged over the cheapest supplier.[42]

Food Service Supply Chain

The Food Services Supply Chain program was implemented in 2018 to support food services across HealthShare NSW with the goal of providing patients with choice and a better meal experience.

The Food Service Supply Chain program transforms the way food is ordered, stored, distributed and managed in hospital kitchens via improved processes for inventory management, distribution consolidation, planning and forecasting, hospital kitchen and supplier management.

Prior to this initiative there was inconsistent management of storerooms across hospitals resulting in items being difficult to find for food services staff, significant waste and product loss and a manual process for ordering of stock, which resulted in regular over/under-ordering. As well as inconsistent management of storerooms, there was limited central oversight and management of the end-to-end supply chain.

The Food Services Supply Chain program implemented a series of technological and process changes to address the areas listed above. Sites now actively manage their storerooms against a set of processes, called Tidy Stores, for supply chain and store room management, thus ensuring accurate ordering, forecasting and reporting.

The initiative implemented a series of dashboards to allow better management of the supply chain to ensure sites and suppliers perform as required to deliver the right patient outcomes, deliver value to the LHDs and maximise the value of food-related contracts.

There is now active monitoring of each sites' compliance against the supply chain processes, and support is provided to resolve process, system, data and capability issues. There is also improved management of supplier relationships, performance monitoring and monthly forecasts to ensure agreed service levels are met.

The Food Services Supply Chain is an effective and efficient change delivering improved patient choice and a better meal experience through higher availability and fresher product, faster and more efficient service, minimised waste and cost for the LHDs, and is more environmentally sustainable. This program created a more streamlined, consistent approach for food service staff, particularly within the storeroom. For HealthShare NSW suppliers, this delivers higher performance and a more viable contract over the medium to long term.

Impacts of emerging technologies on the workforce and considerations to ensure appropriate adoption

Emerging technologies have the potential to radically shift the workforce skills and capabilities required to support food services. On-demand food ordering, and its interplay with automated back of house processes, all managed through artificial intelligence-enabled systems, is likely to result in a significant reduction in workforce demand for the food services workforce and a material shift in the capabilities required for the remaining workforce. The decision to adopt new technologies in food services must consider not only the workforce implications, but also any impacts on consumer expectations and experience to ensure that the quality of patient care is not compromised.

Increased efficiency and reduction of waste

It is predicted that technologies will support the automation of predictable physical activities, which account for 78 percent of time spent in food preparation and packaging.[43]

Advances such as My Food Choice and on-demand ordering have demonstrated positive impacts for both workforce and patients. These advances not only enable increased process efficiencies and reduction of waste, they also allow the extraction of higher quality data that can be used to provide better nutrition and care.[44]

Efficiencies such as eliminating tray ticket runs through electronic systems allow staff to spend more time in patient-facing roles to guide patients through their food choices and also be the one to prepare and deliver meals. This enhances the patient experience and can increase job satisfaction for staff.[45]

Patient Experience- ensuring a net benefit

Care must be taken in the adoption of automation in food services processes to ensure that technologies improve patient experience. For example, robotic food service delivery may create workforce efficiency but take away the opportunity it provides for personal interaction, and checking in on a patient that occurs with human interaction.

An example is the future adoption of automated kitchens, which are yet to offer both large scale preparation of dishes and a large variety of customised meals. This means that large scale automated kitchen solutions are less able to manage dietary needs or individual food preferences, which are important in a hospital context for both nutritional value and patient experience.[46,47]

The adoption of new technologies must also consider human factors, including the welfare of patients who seek human interaction in their recovery process.[48] For example, at Jennings Gardenside Rehabilitation Centre, the ancillary care team (including food service delivery staff) are included in the patient care team discussions through the team A.W.A.R.E. program. Their inclusion is seen as valuable for the identification of earlier and more effective communication of worrisome signs and symptoms in patients.[49] Technology that reduces this patient contact may

therefore impact on the identification of early warning signs and reduce patient interaction opportunities.

Financial Implications

Cost reduction which is the primary expected benefit of automation, may not necessarily be realised at some sites. This is because automation in kitchens, robotic porters, and implementation of ICT infrastructure to communicate between systems and facilitate the entire process may require significant implementation investment. In addition, maintenance of these technologies will require specialists such as hardware and software engineers or third-party contractors. These additional maintenance and implementation costs may not be offset by savings in the demand for the food services workforce and should be carefully considered.[50] This is particularly important for NSW Health, where many sites are very small and it may therefore, be likely that it will not be financially viable to adopt new technologies at all sites.

Workforce implications

The implementation of these technologies must also consider the social factors and the dynamics of labour. The central dilemma in the automation of these processes is the possible displacement of certain workforce groups where technology may automate, rather than augment, current tasks and functions.[51] The expected reduction in the workforce demand for food services staff presents additional responsibilities for NSW Health and HealthShare NSW.

Where workforce roles will be replaced or redesigned, a considered approach to retaining and retraining highly experienced and patient centred staff to enable them to thrive in new and emerging roles should be considered.[52] This may be supported by encouraging staff to identify new health career options or pathways that align to existing skills, or retraining to support new food-related technologies.[53]

New functions may include back of house tasks where staff work alongside automated tasks to prepare meals and clean, recharge, and maintain equipment.[54]

New roles may include technology maintenance roles for robotics, and skilling in other roles could include wardspersons who interact regularly with patients and improve and support patient experience.

Lifelong learning and career pathway planning should be facilitated to ensure the impacted workforce is able to continually transform and seek rewarding new occupations and tasks that draw on existing skillsets and capabilities.[55]

02. Logistics and Supply Chain

What are the emerging technologies impacting the logistics and supply chain workforce?

The warehousing, logistics and distribution sector in Australia, including those providing supplies for hospitals and health services, have been evolving significantly over the last decade. This has occurred due to a variety of factors including consumer expectations, increased focus on the customer experience, larger warehousing footprints, emerging technologies and value chain optimisation.

Internet of Things (IoT) and real-time data

IoT is being used to transform the warehousing and distribution of goods and services across every industry sector, including health.

The use of IoT systems in the logistics sector has been estimated as a $1.9 trillion opportunity internationally, due to its ability to inform smart warehousing and stock maintenance, real-time transport monitoring, and predictive delivery.[56,57]

IoT is achieved by making devices "intelligent" through the addition of radio-frequency identification (RFID) tags, GPS and in-vehicle monitoring systems (including temperature-dependant products such as bloods and vaccines), and other relevant sensors.[58] The real time data collected through these sensors enables the application of powerful data analytics through human input or embedded software to substantially increase efficiencies across the supply chain.

The combination of GPS, RFID and AI technologies are also able to be used to track goods through the supply chain, and predict delivery times. Domestic consumer products already demonstrate this today. AI-enabled tools such as Amazon Echo are able to be used to track parcels and shipment information.[59] These technologies are already being used for tracking, monitoring and recovery of high value military assets to assist with real-time visibility, alerts and reporting.

The use of IoT technologies provides the potential to shift away from the traditionally linear supply chains, towards more of a dynamic 'value web' supply chain that connects all the suppliers and partners in the chain.[60] It can also be used to assist with determining the most efficient method of inventory storage through dimensioning data which is being used to optimise storage space and improve operations.[61]

Commercial applications include Weka and Microsoft, who have collaborated to develop an IoT-enabled visualisation of vaccine inventory as well as processes to manage inventory and temperature through IoT sensors which provide proactive alerts if there are shortages in inventory and / or temperature changes.[62]

Transition to 5G connected networks will further increase capabilities by substantially decreasing latency to improve real-time processing and management of applications to the cloud.[63] One of the key challenges around use of IoT technologies into the future is expected to be cyber-security risks. [64]

The vast amounts of data that are collected through sensors and intelligent systems in IoT technologies, which are enabled by Big Data, require advanced data analytics capabilities. In most cases this is supported by embedded software that draws on AI functionality.

AI and predictive analytics

As well as improving back-office automation, AI is being used to provide predictive analytics and improve inventory management.[65] This assists in ensuring wastage is minimised, particularly for goods that have an expiry date.

This technology can be used in the health context to reduce commercial food waste, and wastage of medical supplies which have surpassed their expiry date. In a survey of supply chain administrators undertaken by Cardinal Health in Ohio in 2017, it was estimated that an average of $500,000 per facility could be saved through implementing more-high tech supply chain technology for medical supplies to ensure they were both in date and that the correct medical supplies were available for use.[66]

Robotic Process Automation

Robots are increasingly being used for process automation in the warehousing and logistics sector, which are extending beyond current automated storage and retrieval services (ASRS) and slotting automation systems, which have been in place in the logistics sector over the last few years.

An example is Vecna Robotics which offer a combination of collaborative picking and conveyor robots, which can work in warehouses with conventional shelving to pick cartons and boxes, and then move them to pallet-building areas. One of the most advanced features of Vecna's robots is their ability to work alongside humans, unlike Amazon's Kiva robots for example, which must have their own distinct operating environment. The Vecna automatons use innovative vision systems, similar to those being developed for autonomous cars, to navigate complex environments and avoid colliding with human operatives, human-controlled warehouse trucks, or other robots.[67]

Autonomous Vehicles

Robotics and AI have already been operationalised in autonomous vehicles (AVs), which are being used in warehouses. Commercial AVs are emerging, such as the Tesla Semi, which is a semi-autonomous all-electric truck, which is planned to enter production in 2020.[68] These are of significant benefit for use inside warehouses, particularly with the push for larger warehouse footprints. AVs not only provide significant savings in costs, they are also capable of 24 hour operation, significantly decreasing delivery times.

While not yet widely adopted, into the future the use of AVs and semi-autonomous vehicles in long haul transportation could impact on the workforce requirements for transportation across the supply chain, and possibly reduce delivery times and eliminate fatigue issues.[69]

There are a number of benefits to autonomous trucking in long-haul transportation, however there are a number of barriers to its adoption in Australia, including perceptions around quality and safety, road quality (particularly in rural and remote areas), the cost of AV fleets, and the benefits of human monitoring of transported goods which may prevent this from being adopted in the near term.

Unmanned Aerial Vehicles

Unmanned Aerial Vehicles (UAVs) or drones are starting to be adopted in supply chain management. In warehouses, drones with cameras can be used for security and safety, and have the potential to be used to move small items around reducing the need for conveyor belts and forklifts.[70]

Shipping firms have adopted drones as way to optimise delivery of goods, by monitoring traffic conditions and updating drivers' routes based on real-time data.[71]

Logistics (or Supply Chain) Control Towers

Logistics control towers are emerging infrastructure which combine software management solutions, IoT and real-time monitoring, AI and cloud technologies to provide visibility and control across the entire supply chain and enable optimisation across the network.[72]

Logistics control towers are able to send information between both internal and external systems to eliminate duplication of data entry, reduce errors and optimise workforce efficiency.[73]

This requires new occupations and roles to oversee, interface, and manage IoT-enabled devices and systems, robotics, AI-enabled software, and 24 hour autonomous deliveries in these control towers. This is creating demand for deep data analytics capabilities in the workforce.

Exoskeletons

Some technologies sit outside the IoT ecosystem and can be implemented much sooner to provide immediate benefit to the workforce and operational efficiency.

Bionic exoskeletons are an emerging technology being used in warehousing to support the lifting and rotating movements of humans in an effort to reduce load bearing injuries and improve the health and safety of logistics employees.[74,75]

Examples include LG's CLOi SuitBot, Panasonic's Assist Suit and GEODIS. These exoskeletons aim to support mobility, reduce fatigue, prevent injury, and increase lower limb strength.[76,77,78] Exoskeletons are already being adopted in manufacturing, for example in Ford and BMW factories.

Blockchain, dimensioning and assisted visual inspections supporting end-to-end digitisation of freight

A significant barrier in the uptake of digitalisation of warehousing and logistics is the shortcomings in current ICT infrastructure and the concerns of threats to cybersecurity.

Blockchain technologies record chains of digital information, such as the date, time or dollar amount of a purchase in a secure way. Blockchain and dimensioning are technologies being introduced to support the end-to-end digitisation of freight deliveries and significantly increase security of transactions.

Blockchain and other distributed ledger technologies can remove layers of complexity in supply chains and facilitate greater trust and transparency between supply chain stakeholders. A key example of this is a recent DHL/Accenture blockchain project for pharmaceuticals that allows tracking and tracing, and through this seeks to eliminate counterfeiting of drugs.[79]

Dimensioning, which involves the use of a 3D camera and software algorithms, is able to support the fast and efficient measurement of freight, allowing for dynamic load capacity optimisation and volume-based pricing.[80]

Aquifi is an example of this technology and uses deep learning-assisted visual inspection to evaluate quality and cosmetic defects with high precision.[81]

Green Technologies

Innovations in facility management and adoption of renewable energy sources will drive "green" transformations across the warehousing and distribution sector. This is particularly the case in last mile delivery through electric vehicles and cargo bikes. An example is Germany's commitment to put one million e-vehicles on the road by 2020.[82]

Smart Containerisation formats (such as DHL Cubicycle) that are intelligent, modularised and allow for more efficient load utilisation are being developed and are expected to provide environmentally friendly storage in warehouses, and be particularly useful in congested metropolitan centres where space is at a premium. [83]

Current progress of HealthShare NSW Logistics and Supply Chain[b]

HealthShare NSW is responsible for managing the procurement and supply chain for medical consumables on behalf of NSW Health entities. From May 2017 to April 2018, NSW Health spent over $1 billion on medical consumables, which are any goods or limited-use piece of equipment used in the delivery of health services to patients.

Current State Assessment

A current state assessment has identified a series of challenges, namely:

- the ordering process takes a significant amount of time for clinical staff, shifting their focus from providing clinical care;
- sixty-one percent of requisitions incur higher prices because they are completed via free-text instead of through the catalogue, often resulting in higher non-contracted prices;
- LHDs incur financial costs from inefficiencies in the ordering process; and
- cumbersome administrative processes of nil-stock management and back orders between customers, the warehouse, and distribution teams.

The Supply Chain Operations team has implemented a series of technological and process changes to address these areas.

Nil-Stock Management Dashboard

One change implemented is a Nil-Stock Management Dashboard providing communication of nil-stock items across all stakeholders. Teams are able to simultaneously monitor nil stock information, and assist with reviewing and taking action as required.

The introduction of the dashboard has significantly benefited customers by enabling visibility of data that is updated regularly and assisting customers to identify and proactively address issues.

HS Scan

There are two ways of ordering medical consumables, via Imprest or iProcurement. To improve the Imprest ordering process, a new scanning solution called HS Scan has been implemented.

HS Scan is a method of ordering performed by HealthShare NSW stores staff and can be performed independent of clinical staff. It involves scanning of a unique barcode, which facilitates creation of a requisition, purchase order and auto-approval in iProcurement. The quantity of the order is governed by pre-agreed minimum and maximum levels by the LHD.

Staff are also able to order products directly via iProcurement. This process, performed by clinical and administration staff, takes longer and requires an approval, which can result in delays – 42 percent of requisitions are not approved on the same day and 14 percent take three days or longer to approve. The manual creation of purchase orders also has a financial cost to LHDs.

HS Scan gives administrative users product controls for managing nil stocks and back orders by providing substitute products that have been approved. These product controls can be centrally managed by administrative users on a web-based application which is synchronised to devices including iPads, iPad minis and mobile devices. The two month pilot has seen improvements in the management of nil stocks, approved substitute products and duplicate back orders at Royal North Shore Hospital, with duplicate back orders trending down in comparison to the State.

[b] Information in this section was provided by HealthShare NSW

How will these emerging technologies impact the NSW Logistics and Supply Chain workforce?

While traditionally, the bulk of the logistics workforce has been employed in manual, 'blue collar' occupations like delivery driving and warehouse work such as order picking,[84] automation and other new technologies are changing the nature of the occupations, tasks and skills required of the logistics workforce. The demand for this workforce has grown significantly in recent years, and provides career opportunities through new and emerging occupations.

A move away from traditional warehousing and logistics roles

The workforce of the future will need to increasingly be skilled in the operation and maintenance of emerging technologies, rather than undertaking sorting and stacking work themselves.[85] This may take time, and there may always be a need for a level of picking, sorting and stacking by humans for certain types of goods, or where the size and scale does not support the costs associated with the technology.

The challenge with this expected change is that the logistics and supply chain workforce has traditionally attracted a relatively unskilled workforce, with higher turnover than across other industry sectors. Traditionally, employers have supported employees who remain in their roles in undertaking their "tickets" in forklift driving and other specialist equipment as a way of adding variety to their roles and retaining the manual labour workforce.[86]

As AVs, advanced robotics and other technologies reduce the need for certain occupations, careful consideration will be needed in retaining and retraining some lower skilled workforce segments to prevent high turnover, low job satisfaction and low morale, particularly where manual labour is still required.

Role redesign may be particularly useful given that the logistics and warehousing workforce has been experiencing significant growth (and workforce shortage) in particular occupations over the last few years.[87]

Logistics Managers and digital capabilities

In Australia, the last few years has seen growth in demand for specific warehousing and logistics workforce occupations, such as logistics managers and roles involved in warehousing operation.[88]

These manager level roles assist in providing improved oversight, real-time monitoring, and identifying areas for improvement across the supply chain. At this level, strong capabilities in digital literacy, data analytics and dashboards, and an ability to draw on real-time data to drive changes in decision making for business optimisation have already been taking on increasing importance.[89]

Impact of consumer customisation

At the same time, consumer customisation (for example, to meet the needs of specific hospitals and surgeons) across the sector will require the workforce to extend their skillsets. This may include improved supply chain management capabilities, ability to understand and predict procurement trends, adaptation to changes to the manufacturing of products (for example, through 3D printing), and an ability to understand end-to-end web supply chain approaches.

New roles

The introduction of key technologies, such as logistics control towers, are expected to lead to demand for new occupations, such as Control Tower Engineers, Analysts and Lean Specialists.

As well as this, warehouses are increasingly becoming specialised, turning their attentions to particular products, supply chains, customers or distribution networks. In turn, this process is increasingly requiring the logistics workforce to become more specialised.

This includes roles such as an inventory control specialist, or Data Warehousing/ Business Intelligence Specialist. Emerging technologies are likely to impact on the demand for these roles, as well as requiring specialist knowledge of the technologies and systems that help drive business improvement.

03. Linen Services

What are the emerging technologies impacting the linen services workforce?

There are a number of emerging technologies being developed for commercial laundries which are being driven by a need for water saving efficiency, as well as reducing the demand for repetitive, manual tasks such as collecting, sorting and folding of linen.

Radio-Frequency Identification (RFID)

The introduction of IoT is providing greater efficiencies in the supply and management of linen in hospitals. This technology enables linens to be tagged with RFID technology chips that contain a variety of information. RFID uses electromagnetic fields to transfer data through tags attached to (or sewn into) the linen. These tags carry electronically stored information in order to identify and track them.[90]

The use of RFID technology has a number of benefits, including[91,92]:

- improved inventory control;
- optimised lifecycles of linen;
- real-time tracking of linens;
- decreased manual labour; and
- reduction in loss and theft.

An expected benefit of this technology is a reduction in the costs of the supply and management of linen due to efficiency gains. These efficiencies may include[93]:

- reduced labour costs through automated sorting as the type of item is identified through the RFID tag and can be sorted appropriately;
- reduced loss and/or theft of linen, meaning less need to replace this linen; and
- knowledge of the life cycle of the linen through a greater visibility of the number of washes an item has been through or how long it has been stored, thereby providing an indication of when it is likely to need to be replaced or rewashed.

IoT and smart laundry machines

Emerging technologies are able to track and launder linen. Chips embedded in linen can contain a variety of useful information, such as item type, manufacturing information (e.g. textile, date of production) and even embed Global Positioning System (GPS) technology to track where the linen is and how it has been used. This information can be useful in better understanding the type of work being undertaken; the ward on which a garment was worn; or the length of time worn. Combining this information enables a smart laundry machine to work out what kind of soiling may be present and hence determine the type of wash cycle and treatment that is required.[94]

Smart laundry machines are also able to take spectroscopic scans of the washing liquid, where this information, along with the predictive soiling information, can be analysed and compared to databases. By continually doing this, the machine will be able to determine if most stains have been removed or if additional action may be required.[95]

Maintenance of machines

IoT and telemetry data is being used to assist with maintenance of laundry machines. These systems can provide remote monitoring of the machines, providing real-time alerts when a machine malfunctions, enabling the problem to be fixed immediately, thereby reducing downtime.[96]

In addition, remote monitoring can allow analysis of machine water levels, temperature and length of cycles to ensure that the machines are operating optimally and to the level required for thermal disinfection.[97] Thermal disinfection refers to holding the correct temperature for cleaning for a specified period of time, and becomes a shorter duration the higher the temperature. This is an important issue for hospitals.

Water / energy efficient machines

Laundering of linen requires water and energy, and there is a push across the industry to become more environmentally friendly and optimise the use of water and energy, as well as achieving the benefits of reducing operating costs.

New technology has seen the development of water-efficient washing machines. For example, technologies in use today include the use of sophisticated water filtration techniques, such as the Blue Ocean filtration units. These systems allow water to be harvested from specific parts of the wash cycle, which is filtered, heat is extracted from it, and it is then recycled back into other stages of the wash cycle. Spotless has estimated that its implementation of Blue Ocean filtration in its five largest laundries in Australia has resulted in a saving of 290 million litres of water per year.[98]

Another example is through reducing cycle times, which also aids in reducing water and energy usage. An example is the Russell Hobbs 1250RTG washing machine, which uses a twin jet system, where water and detergent are added through one nozzle, saving time on the cycle and increasing sustainability of the machine itself.[99]

Sanyo Electric has developed machines that use ultrasonic wave technology comprised of electrolysed water and ultrasonic waves which replace the need for washing powder.[100]

Other water-saving technology in linen services includes the use of polymer beads. These polymer beads are introduced to the machine in place of regular detergent and require only a small amount of water.[101] The molecular structure of the bead means that dirt from soiled items is attracted to the bead.[102] The beads are reusable, although periodic washing may be required to remove the dirt that adheres to the beads.[103]

Autonomous vehicles

Many hospitals have introduced AVs to deliver linen. These vehicles are able to deliver fresh linen to wards and return soiled linen to the laundry with the benefits of operating 24 hours a day, in poor lighting, and with increased safety and less material damage. RA Health are in the process of implementing this technology in Australian hospitals, after successful implementation in Germany.[104] Royal North Shore Hospital has used AVs since 2012 in the delivery of linen.[105]

Automation of manual laundry tasks

Many repetitive laundry tasks have begun to be automated. X-ray technology can be used to identify foreign objects in the laundry so they can be automatically removed from the process, avoiding contamination of the wash and reducing the need for staff to manually remove items. An example is the ODIN X-ray scanner used in commercial laundries.[106]

Advanced robotics capable of folding laundry are emerging, such as the Foldimate Laundry Robot. The Foldimate is able to fold a range of linen types commonly used in a hospital, including towels and sheets. Some machines are also able to fold incontinent products. Once folded, the machine is able to stack the linen ready for distribution.[107]

Current progress of NSW HealthShare Linen Services[c]

Current State

Linen services across NSW were transitioned from Area Health Services in 2006 and consolidated in HealthShare NSW (then HealthSupport). The service now operates across seven laundries, with one metropolitan laundry located at Parramatta and seven regional laundries located at Newcastle, Illawarra, Orange, Wagga Wagga, Tamworth and Lismore, and supplies over 40,000 tonnes of linen per year.

Linen services is a critical enabler of patient flow through the NSW health system, as shortages or delays in provision of linen can result in beds being unavailable for patients, or can pose a health and safety risk if it is not clinically safe for use.

There are several challenges that will continue to impact the Future of Work for linen services for NSW Health:

- Increasing demand for linen services – Between 2007 and 2017, the NSW population increased by 1.03 million people, representing a 15 percent increase in population, with metropolitan regions seeing the largest levels of growth over the decade.[108] The population growth has increased demands on the health system resulting in increased demands for linen services with population growth expected to increase further over the next decade. The main challenge for linen services is the single metropolitan laundry in Parramatta which currently operates at maximum capacity. To meet the current demand for metropolitan hospitals, linen is brought in from laundries in Newcastle and Orange however, as new beds are brought online in metropolitan areas, further capacity will need to be leveraged from regional laundries.
- Changing nature of demand for linen services – In recent years, the services delivered by linen have transformed based on the changing needs of the health system. One example of this change is exiting the market for theatre linen, as hospitals have moved to disposable theatre linen. This has resulted in changes in how laundries are designed, as theatre linen was laundered in different sections and with specialised equipment.
- Environmental impacts of laundry services – The environmental impacts challenging linen services include water consumption, energy usage and waste management. Sustainability is a core focus for HealthShare NSW, particularly with the severity of drought in regional areas where laundries are located. HealthShare is committed to addressing these challenges and has implemented several initiatives over recent years to address the challenges, however this will continue to be a consideration in the Future of Work with a greater focus on water savings and recycling initiatives in regional areas.

To continue to meet the needs of the future and deliver a value for money service, HealthShare NSW has leveraged and implemented new technologies to optimise the service.

Capital investment in automation

HealthShare NSW has an increased focus on investment in automation. Within linen services, new machinery and equipment have been rolled out across laundries to increase the automation of washing, drying and folding processes. This has increased the efficiency of the service. It has also reduced the work health and safety risk profile of manual tasks in linen services.

The lost time injury frequency rate[d] for linen services has decreased from 27.2 in June 2017 to 5.1 in June 2019.

[c] Information in this section has been provided by HealthShare NSW.

[d] Lost time injury frequency rate measures the number of injuries that result in a shift or day of work being missed per million hours worked in the financial year.

Implementation of water recycling systems

In 2017, Blue Ocean water recycling system was implemented at Wagga Wagga laundry. The recycling system reduced water usage at the laundry by 35 percent, and by 2018 had been rolled out to all seven laundries. Water consumption has decreased by six kilolitres per tonne of linen laundered from 2017-18 to 2018-19 (a decrease of 55 percent).

Implementation of a world first automated tailgate barrier system

In 2017, new truck bodies were introduced, which had an internal drop down wall system to allow mixed loads of linen to be carried in segregation. The impact of this new truck body has been that more trolleys could be carried on a truck, thereby reducing costs and improving efficiencies for the delivery and pick-up component of linen services.

These initiatives reflect a longer-term vision of adopting and utilising new forms of technology to increase the value for money proposition of the service.

How will these emerging technologies impact the NSW linen services workforce?

As with many other shared services areas, emerging technologies provide the opportunity to reduce the laundry workforce involved in repetitive manual tasks, while increasing the demand for a workforce with data analytics capability.

While many emerging technologies are available for use in commercial laundries, the commercial viability of all of these technologies will need to be carefully considered, including ensuring that any adopted technology maintains compliance with relevant regulations in relation to laundry practice, soiled linen and infection control.

Replacement of repetitive, manual tasks

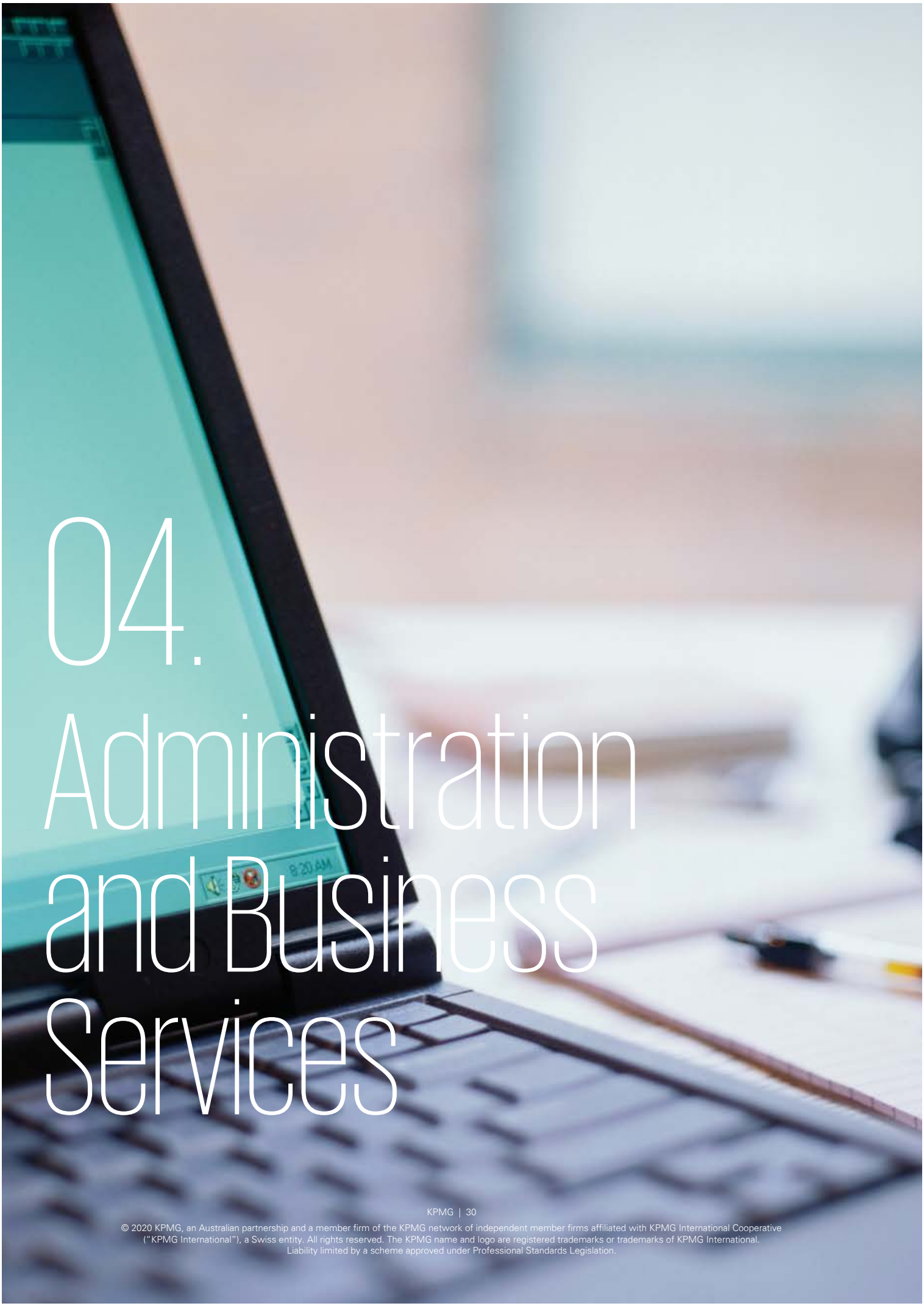
If implemented, technologies such as advanced robotics and AVs would be expected to reduce the demand for the workforce involved in the collecting, sorting, washing, folding and distribution of linen services in the health context.

The impact of this on the workforce may depend on a range of factors, including the turnover of the workforce, outsourcing arrangements and the availability of other tasks and skills within the commercial laundry and / or hospital. It is anticipated that upskilling in other higher order functions and tasks would be required if the workforce are retained.

Creation of new functions and tasks

With new technology comes the creation of new functions in linen services that have not previously been required. For example, the addition of RFID will require new workforce skills in the real-time monitoring of this data, including ensuring that any alerts are actioned and optimising the service to create efficiencies, and ensuring the adequate supply to the hospital.

Into the future, the maintenance of smart washing machines, advanced robotics involved in sorting and folding linen, and AVs will be required. The impact of this on the workforce is difficult to quantify but may include demand for basic level troubleshooting and maintenance as well as specialist engineering or maintenance workforce. In addition the management workforce will be required in the future to more rapidly assess the potential benefits of emerging technologies and support their implementation. This will significantly change the management role of commercial laundries compared to what was required ten years ago.



04. Administration and Business Services

What are the emerging technologies impacting the administration and business services workforce?

Many business and administrative functions are being disrupted by emerging technologies that automate current processes, provide real-time information, and provide significant efficiencies. This is leading to significant pressure for many organisations to automate front and back office functions which, in turn, is challenging the tasks and functions undertaken by well-established professional occupations, particularly in accounting, finance and procurement.

The administration and business services workforce is broad and covers a range of different, well-established professional occupations and job families, including across accounting, finance, business administration, procurement, legal services, human resources and marketing functions. Part of the challenge in understanding the impact of technology on these functions is that they are varied, with differences in technologies impacting front and back office business functions, as well as technologies that will impact specific occupational clusters more than others. This paper discusses some of the key emerging technologies.

Financial Enterprise Resource Planning (ERP) systems

While ERP systems are not new, contemporary ERPs allow numerous business processes to be automated and provide expanded functionality from older platforms. Many finance processes, such as billing, expense processing and invoicing, are still in the process of being fully automated across the health system. For example, for invoicing ERPs allow an invoice to be submitted by the payee into the invoicing platform, which then captures the data on the invoice, it is processed and approved, with payment then sent to the payee.[109]

There are a number of cloud-based, end-to-end ERP system options available, which typically vary dependant on the size of the organisation; examples include Tipalti, Netsuite, Oracle, SAP S4 HANA, Microsoft Dynamics and SYSPRO.

A key challenge for many larger government clients has been financial and procurement legacy systems that are more than five years old, often with multiple financial, accounting or procurement systems which duplicate data entry, have limited functionality and prevent a streamlined process.

Benefits of an ERP is that it can significantly reduce processing costs, considerably increase the speed of the processing cycle and provide greater transparency and visibility of transactions and payments by supporting the end-to-end process. In addition, increased payment data is generated and the risk of fraud is reduced.[110]

However, the implementation of new financial systems in the government and health context in other jurisdictions has identified a number of lessons learned in order to effectively realise benefits, including around data cleansing prior to transition, data migration and transition planning, data loading and templates, clear identification of business reporting requirements, complexity of implementation, testing and piloting, and

bespoke system elements (as well as investment in workforce development and change management which are discussed in the next section).

Kiosks

Kiosks are increasingly being used for front office administrative processes, such as booking systems, automated arrival terminals and queue management in the health context.

There are a range of booking systems on the market, such as QLess and InTouch, that allow a person to book their own appointment time that is convenient to them, saving administrative time in manually booking and rescheduling appointments. Systems also send automated reminders to patients in order to reduce 'no-shows'. Some systems place the patient in a virtual queue, keeping them updated about the waiting time, which can be automatically adjusted should factors change, such as walk-ins or longer than expected appointments.[111]

In the public health context, systems such as Queue Manager are being used in outpatient clinics in the Sunshine Coast University Hospital and, in late 2019, ACT Health announced it would implement Queue Manager and Electronic Wayfinder kiosks in the Canberra Hospital, University of Canberra Hospital and four Community Health Centres.[112,113]

Fintech

Fintech, a term used to describe disruptive technologies in financial services, is reshaping the marketplace for incumbents. Investment in the Australian FinTech sector has risen from USD$53 million in 2012 to over USD$675 million in 2016.[114] New approaches, such as crowd funding, peer-to-peer lenders, mobile payments, digital crypto-currencies such as Bitcoin, and robo-advisers, are being introduced to benefit consumers by increasing choice and stimulating more competition.[115] The combination of integrated and efficient digital financial services with smart devices and the IoT are expected to enable businesses to gather exponentially more information and use this data to deliver tailored solutions for their clients.[116]

Blockchain

Blockchain is a simple way of passing information from one point to another in a fully automated and safe manner. The advantage of Blockchain is that it creates a unique record with a unique history that is unable to be falsified.[117] This means Blockchain is also able to execute a 'smart contract', which is a self-executing protocol that enforces a previously agreed arrangement; this can eliminate delays in financial processes, while increasing transparency.[118]

The fact that Blockchain produces an immutable record means that it is highly applicable for use in back-office functions, including within the health system. The Blockchain therefore acts as a highly robust, reliable accounting system.[119]

> Blockchain is able to automate high touch processes within finance and accounting, reducing errors and inefficiency from manual processes. In addition, the unalterable and always up-to-date Blockchain improves transparency, timeliness and traceability of transactions.[120]

Blockchain's benefits may be realised in invoice processing, which is automated and payment is triggered by smart contracts; and reporting: with agreed protocols guiding the Blockchain, to enable real-time reporting to support predictive budgeting and forecasting.[121]

Robotic Process Automation

The use of robotic process automation or 'bots' (disembodied and narrow AI) is expected to impact significantly on the administrative services industry over the coming years, although their use is not widespread across the industry at the moment.

One of its key applications is in providing online customer service. Some key examples of bots being used to drive customer service are across a number of Federal Government agencies, including the Australian Tax Office (ATO), National Disability Insurance Agency (NDIA) and Department of Human Services.[122] For example, Alex, a bot created for the ATO had logged 950,000 conversations between March to December 2016; and Nadia, a bot created for the NDIA's eMartketplace to improve access to goods and services for NDIS participants.[123,124] However robotic process automation should be used with care, with examples where errors have been made in the processes and requirements of the automated system, such as with Centrelink's robo-debt system. [125]

It is predicted that global chatbots in the healthcare sector market will be increasingly adopted, and reach a value of $498 million by 2029, after generating $36.5 million in revenue in 2018. Medical triage chatbots currently hold the largest market share and are expected to replace non-emergency hotline services into the future.[126]

Virtual platforms

Virtual platforms are being introduced, automating a range of processes that are conducted by various business services staff such as human resources.[127]

A range of virtual HR platforms currently exist that are able to perform a range of functions including applicant tracking (job posting, recruitment and onboarding), payroll, performance management, benefits/salary administration, scheduling and rosters and online learning.[128]

The use of these virtual platforms can provide increased connectivity and faster access to data. Benefits include increased transparency, reduced rework, process compliance (which can be useful for areas that could be subject to audit or review such as recruitment), security of personal information and validation of documents. These tools may also help with some predictive analytics, for example with workforce planning.[129]

An example is the Queensland Police Service that automated its end-to-end recruitment process with Objective ECM, and reported a 15 percent gain in productivity for each round of recruitment. It changed the process from one that was complex, manual and paper-based to one that was consistent, automated and traceable.[130]

Virtual reality training

Virtual reality training is being used to support learning and development and has been found to be more effective than online learning platforms because of the 3D experience. Virtual reality learning has been found to improve participant recall and creates a stronger emotional reaction.[131] It has been used by organisations such as NORCAT to simulate dangerous and risky environments as a learning and development tool in sectors including mining and firefighting.[132]

Current progress in NSW in administration and business services[e]

HealthRoster

Since 2015, HealthRoster has been implemented in waves across NSW. HealthRoster allows managers to more effectively roster staff according to the time of day, day of week and skill level of staff. Users get dynamic feedback on the set parameters as well as on award compliance during the building of rosters. When rosters are built and modified, managers receive alerts if there is over or under-staffing or if award conditions may be violated.[133]

Key benefits of HealthRoster include improved transparency over the allocation of shifts, improved access to data to inform decision making, and access through any device for staff to view and check adjustments.[134]

Human Capital Management

The Human Capital Management program (HCP) has been developed to introduce workforce systems for managers and employees to attract, manage and develop the NSW Health workforce.[135]

The first stage of the program includes:

- eRecruitment and onboarding solution, to provide up-to-date recruitment tools, efficiencies and reports;
- performance and development management system;
- eCredentialing system for Senior Medical and Dental officers; and
- electronic forms, workflow and self-service of existing tools.[136]

It is expected that HCP will result in a simpler recruitment and onboarding process, improved workforce analytics and decision making, improved tracking of performance management cycles and staff development and consistency in credentialing.[137]

Search and Request Anything (SARA)

In June 2019, HealthShare NSW partnered with eHealth NSW to introduce the user-friendly customer portal called SARA (Search and Request Anything) using the ServiceNow platform. SARA has been visited over 1.4 million times since it went live.

SARA provides a faster, simpler, more transparent way for NSW Health staff to access many human resource, payroll, and information and technology services through online forms, centralised in one location. The self-service capability on the platform enables employees to make a request to change, update or order a service; get online assistance; source knowledge articles; and to provide feedback and suggest improvements. Additional services are regularly released and, in the future, it is anticipated that all NSW Health employees will use SARA in some capacity.

SARA has improved the user experience by replacing paper-based forms with intuitive, online forms using pre-populated employee data from StaffLink. Automated workflows mean that approvals are faster and route to the correct HealthShare NSW team for processing. Employees can track the progress of their current requests through to completion online, and can view details about recently completed requests.

Online guided tours provide a seamless learning experience for new users, while self-service knowledge articles assist employees with a wide range of information about services, processes and contacts.

HealthShare NSW now has greater visibility of demand with real-time data presented in simple dashboards. This provides clear and easy to interpret analytics to support improved decision making and the identification of areas for improvement.

[e] Information in this section has been provided by HealthShare NSW.

How will these emerging technologies impact the NSW business and administration workforce?

Reduction in workforce required to undertake low level functions

With basic processes being automated, there will be less need for staff to undertake functions such as data entry, booking, rostering, and processing of invoices and expenses. Office support roles are predicted to be one of the workforce groups most affected by job displacement due to technology.[138]

Consideration will need to be given as to how to manage affected staff. Some staff will still be required and so some workforce reduction may be managed by natural attrition. Remaining staff may be retrained into roles that add greater value to NSW Health or are focused on monitoring and / or analysing the data outputs of the automated processes.

Patients presenting to hospital will still want to be greeted by a human, so some staff will still be required to provide a personalised service, however, the function within their role may change. For example, they may focus more on interacting with patients and answering any questions they may have, rather managing queues and scheduling appointments.[139] A further consideration may be regarding those who are disadvantaged or have low levels of digital and / or health literacy. For example, a queue management kiosk or booking system may not be suitable for those from a non-English speaking background.

Increased focus on strategy and insights

The automation of many business processes provides the opportunity for staff to focus on providing insights and contributing to strategic priorities. For example, an accountant may use technology for processing of payments and focus on analysing their significance to enhance financial performance.[140] In a complex environment like healthcare, freeing professionals' time to allow more strategic thinking is expected to assist in operational efficiency. In finance, it is predicted that the workforce will be enabled to focus on promoting the integrity and stewardship of tangible and intangible assets, ensuring compliance against financial regulatory requirements, and ensuring that new technologies introduced that impact on financial processes are designed in a way that improves workflow, drives value and more effectively supports business objectives.

Similarly, for human resources staff, it is expected they will have freed capacity to provide greater value through considering strategic planning and in functions that require strong negotiation, communications and emotional intelligence skills, including managing grievances, industrial negotiations and strategic and workforce planning.[141]

Creation of new roles

The introduction of new technologies in areas such as finance and legal services has also increased the demand for new capabilities in areas including cybercrime, fraud and corruption. It is expected that new cyber-legal occupations will emerge as will the demand for niche occupations such as forensic accounting.[142,143] It is also expected that there will be increased need for people with knowledge in data science and for data-related professions.

Given the impact of technology on the workforce, it is expected that new roles and tasks will emerge in human resources to assist in managing the Future of Work challenges. Growth areas are predicted in areas such as career planning, talent management, change management, and organisational design.[144,145]

05. Maintenance

What are the emerging technologies impacting the Maintenance workforce?

Significant advances in technologies, such as IoT and AI, are being further enabled by telemetry data, 5G connectivity and edge computing to significantly improve predictive maintenance and real-time diagnostics and repair capability in repair and maintenance occupations.[146] While some industry sectors, such as automotive repair, may be more advanced in the use of some of these technologies, they are being increasingly applied to the health context.

Predictive Maintenance

Advancements in enabling systems like 5G connectivity, edge computing, edge analytics (which brings data computation closer to the location it is needed), and AI has expanded the capabilities of IoT in applications such as industrial maintenance.[147]

In maintenance management, interconnected devices with wireless sensors allow for automated data collection. Leveraging AI, the underlying software can analyse the vast amount of collected data and identify anomalous behaviour to precisely predict when equipment is at risk of failing.[148]

Remote monitoring systems allow the AI-enabled software to communicate predicted failures to a central location with information on the exact location of the device so that maintenance technicians can identify and repair or replace the system very near to the end of its operational life.[149]

This can drastically reduce downtime of systems and devices. Costs are controlled through leaner inventory management processes. There is potential to reduce the quantity of stocked items due to increased reliability of devices and immediate use of ordered parts in predictive maintenance.

Predictive maintenance can also reduce costs and inefficiencies associated with personnel management as it minimises unplanned or reactive maintenance call outs, allowing for more efficient task loading and shift scheduling.

The primary barrier in the current uptake of IoT-enabled software in industrial maintenance is the consumer concerns of cyber security, technical expertise, data portability, return on investment, and transition risks.[150] However, vendors, such as GE, Siemens, Schneider, and Honeywell, are investing heavily in IoT-enabled software to address these concerns and accelerate uptake.[151]

Intelligent Real-Time Diagnostics

The use of intelligent, real-time diagnostics on complex mechanical systems are changing the maintenance process undertaken in a range of industry settings, including automotive repair, and could be expanded to the health context. This technology involves the use of artificial intelligence, telemetry data, and sensors to identify maintenance needs and troubleshoot identified problems in real-time. As well as providing real-time diagnostics and solutions, the technology is able to search, translate and configure information based on manuals and reference documents.

An example is Predii Repair Intelligence used in the automotive industry which uses

learning algorithms to form correlations between symptoms, components and diagnostic trouble codes. Predii is able to search manuals, warranty data and specification documents from the original equipment manufacturer. It is also able to analyse data from similar repair orders to assist in solution design. The use of this technology is reported to increase the accuracy of discovering a symptom, component and trouble code by 94 percent compared with human capability.[152]

Augmented Reality

Low cost augmented reality (AR) equipment is attracting the attention of various industries due to its intuitive interface and ability to superimpose crucial information that enhances workflow.[153]

Commercial AR solutions are already delivering benefits to the maintenance and repair industries.

An example of this is the Google Glass system which uses AR technology and provides assembly or repair instructions through a viewfinder. This technology is custom-made for the client and can provide instruction for over 1,000 precise steps. [154]

Google Glass has partnered with AGCO, which manufacture complex agricultural equipment, to develop a digital work instruction and inspection platform.[155] This enables AGCO workers to perform their work using Google Glass, which shows step-by-step walk-throughs in the head up display. The Google Glass system also allows the employee to record and send data for quality assurance to line managers.[156] This has resulted in a 25 percent reduction in production time on low volume, complex assemblies.[157]

With the variants and complexity of medical devices continually increasing, assistive virtual reality (VR) can provide maintenance technicians easy-to-follow instructions to repair devices. Diagnostic healthcare company, Sysmex, is currently using AR technologies by equipping their field service engineers with AR devices to assist them in standardising its workflow and assist them in performing operational tasks by projecting step-by-step instructions onto their AR headset.[158]

Commercial solutions, such as Skylight by Upskill, are building augmented reality software specific to companies' workflow with relevant information and documentation that is reported to increase productivity by up to 32 percent in some applications.[159]

Impacts of emerging technologies on workforce and considerations to ensure appropriate adoption

Widespread automation, smart systems, human-machine interfacing, and machine learning offer substantial benefits to the maintenance of complex devices.[160] However, these advances are set to evolve the maintenance workforce and supporting initiatives are crucial to ensure successful transition.

New capabilities in data analytics and technology

The implementation of IoT and the communication of intelligent devices and sensors will create vast amounts of data. Although integrated AI systems will assist in the management and interpretation of these data, a completely "hands-off" data management solution cannot be expected in the near future. Humans, in addition to actioning maintenance, will be required to interface, manage, store, interpret elements of data, and troubleshoot errors of this technology in their day-to-day role. Digital literacy and data analysis skills will be a core requirement for system managers all the way through to field technicians.[161]

These skills do not necessarily need to be outsourced. Employer-sponsored apprenticeships for Industry 4.0 capability building is already being implemented in the manufacturing industry. Siemens in Australia has collaborated with the Australian Industry Group to develop the skills of its workforce through the Industry 4.0 Higher Apprentice Program.[162] The Program involves training on using cyber-physical systems and exposure to the digitisation of manufacturing processes, digital ecosystems and value chains.[163] This ensures that technicians are well equipped to transition and thrive into Industry 4.0

Upskilling will also need to be a priority at the management level. Industry 4.0 systems will also increase the rates of non-routine tasks.[164]

> System managers will need advanced cognitive skills, not only to coordinate service effectively, but to demonstrate leadership, empathise with technicians through their change, and foster a supportive culture of continuous skill development.[165]

Leaders will, firstly, need to be aware of the drivers of change and advances in technologies that will increase efficiencies in the system. They also need to be supported to drive cultural and technological change.

Establishment of workforce transformational leadership programs may be needed that assist these individuals in navigating the complex technological landscape, assess the value of emerging technologies in their service, and implement a strategy for adoption that will facilitate this.[166]

Changing workforce to sustainably thrive through technological change

Ensuring sustainability in this transitional era and maintaining an innovative culture will enable maintenance services to continually integrate advanced

technologies to improve operational capabilities and efficiency.

> This will need the service to change the work and career expectations of new entrants into the field. The next generation of the maintenance workforce will need to attract young people with VET and university training to the workforce with emphasis on technologically rich roles.[167]

With higher education student numbers growing rapidly, maintenance and operation roles must be presented as a strong career choice for science, technology, engineering and maths graduates.[168] Understanding of roles within the services must be updated to assure potential entrants that roles are secure, diverse, and beneficial to career progression. This may be achieved through strong and effective partnerships with universities, TAFEs, and schools and creating well-advertised and dedicated entry pathways.[169]

New roles to lead implementation and management of the vast ICT and IoT infrastructure, analysis of collected data, and continual expansion of technological capabilities will require sourcing of experienced lateral hires. The number of careers that people have in their lifetime is increasing and, as such, supporting these experienced individuals to consider maintenance as an exciting new opportunity is essential.[170]

Pathways to attract skilled workers are not necessarily limited to the employed worker pool. Structural changes in the economy will result in displaced skilled workforce from other industry sectors which could be utilised including from the mining, marine, and agriculture sectors.[171] A robust and accelerated credentialing process to formally recognise prior experience will allow maintenance to integrate experienced hires into the workforce to meet demands.[172]

References

[1] Clarke, T . 2019. The Future of Work for Enterprise/Shared Services: Human Capital Considerations.
[2] Xia, F; Yang, L; Wang, L, and Vinel, A. Journal of Communication Systems. (2012). *Internet of Things.*
[3] Hosny, A et al. (2018). *Artificial intelligence in radiology*.
[4] Martec. (2019). *Self-Optimising CIP.*
[5] Business Insider. (2019). *Accounts payable automation: the multitrillion dollar accounts payable market is finally digitizing.*
[6] Deloitte Development. (2017). *The Hospital of the Future.*
[7] Turpen, A. (2019). *Tesla Semi truck's battery pack and overall weight explored.*
[8] Harvard Business Review Analytic Services. (2014). *The Digital Dividend: First-Mover Advantage*.
[9] St Vincent's Health Australia. 2018. Announcements- Mater's Room Service wins international awards.
[10] Dymond, D. Serco. (n.d.). *Delivering better healthcare and improving patient outcomes*.
[11] Mackenzie, M. ABC News. (2014). *New face of hospital food*.
[12] Mackenzie, M. ABC News. (2014). *New face of hospital food*.
[13] Dymond, D. Serco. (n.d.). *Delivering better healthcare and improving patient outcomes*. .
[14] Dymond, D. Serco. (n.d.). *Delivering better healthcare and improving patient outcomes*
[15] Dymond, D. Serco. (n.d.). *Delivering better healthcare and improving patient outcomes*.
[16] Mackenzie, M. ABC News. (2014). *New face of hospital food*.
[17] Deloitte. 2016. *The restaurant of the future, creating the next generation customer experience.*
[18] Building Better Healthcare. (2012). *Robot helpers revolutionise new Scottish hospital.*
[19] Building Better Healthcare. (2012). *Robot helpers revolutionise new Scottish hospital.*
[20] Deloitte Development. (2017). *The Hospital of the Future.*
[21] Health Business. (2013). *The Forth Valley FM experience.*
[22] Health Business. (2013). *The Forth Valley FM experience.*
[23] Total Facilities. (2018). *The New Royal Adelaide Hospital: Futuristic and State Of The Art.*
[24] Total Facilities. (2018). *The New Royal Adelaide Hospital: Futuristic and State Of The Art.*
[25] McKinsey Global Institute. (2019). *The future of work in America.*
[26] Owen Hill, A. 2017. Top 5 ways robotics is changing the food industry.
[27] Tanyeri, D. (2018). *The Future of Automation in Food Service*.
[28] Garfield. 2016. MIT students invented a robotic kitchen that could revolutionise fast food. Tech Insider.
[29] Research and Markets. (2019). *Global Artificial Intelligence in Food and Beverages Market 2019-2024.*
[30] Martec. (2019). *Self-Optimising CIP.*
[31] Marr, B. Forbes. (2019). *The Amazing Ways Hitachi Uses Artificial Intelligence and Machine Learning.*
[32] Marr, B. Forbes. (2019). *The Amazing Ways Hitachi Uses Artificial Intelligence and Machine Learning.*
[33] Adams, K. (2018). *How AI is Being Used to Reduce Food Waste.*
[34] HealthShare NSW. (n.d.). *Food and Patient Support Services*.
[35] HealthShare NSW. (n.d.). *Food and Patient Support Services*.
[36] HealthShare NSW. (n.d.). *Food and Patient Support Services*.
[37] HealthShare NSW. (n.d.). *Food and Patient Support Services*.
[38] HealthShare NSW. (n.d.). *Food and Patient Support Services*.
[39] Packaging News. (2016). *Elderly patients welcome easy-open packaging mandate.*
[40] The Institute of Hospitality in Healthcare. (2019). *Packaging Accessibility Rating.*
[41] HealthShare NSW. (n.d.). *Food and Patient Support Services*.
[42] Packaging News. (2016). *Elderly patients welcome easy-open packaging mandate.*
[43] McKinsey Global Institute. (2019). *Where machines could replace humans – and where they can't (yet).*
[44] HealthShare NSW. (n.d.). *Food and Patient Support Services*.
[45] HealthShare NSW. (n.d.). *Food and Patient Support Services*.
[46] Hana Kitchens. (2018). *Food Business Education: Automation in Production*.
[47] Sawyer, K. (2019). *The Pros and Cons of Running an Automated Restaurant.*
[48] McKinsey Global Institute. (2019). *The future of work in America: People and places, today and tomorrow.*
[49] Duffy, E et al. 2016. Transforming the patient centred care team to include ancillary staff: Creating team A.W.A.R.E. The Gerontologist 56 (3) 552.

[50] Sawyer, K. (2019). *The Pros and Cons of Running an Automated Restaurant.*
[51] McKinsey Global Institute. (2019). *The future of work in America: People and places, today and tomorrow.*
[52] McKinsey Global Institute. (2019). *The future of work in America: People and places, today and tomorrow.*
[53] McKinsey Global Institute. (2019). *The future of work in America: People and places, today and tomorrow.*
[54] Building Better Healthcare. (2012). *Robot helpers revolutionise new Scottish hospital.*
[55] McKinsey Global Institute. (2019). *The future of work in America: People and places, today and tomorrow.*
[56] DHL. (2019). *Logistics Trend Radar 2018/19.*
[57] Cisco. (2015). *Internet of Things Will Deliver $1.9 Trillion Boost To Supply Chain And Logistics Operations.*
[58] Logistics Bureau. (2018). *Supply Chain and the Internet of Things – Towards New Paradigms.*
[59] DHL. (2019). *Logistics Trend Radar.*
[60] Deloitte. (2018). *Future of Work: Occupational and Education Trends in Supply Chian and Logistics.*
[61]SICK AG. (2019). *Enhancing Supply Chain Management with Accurate Dimensioning Data.*
[62] Thomas, J. (2017). *Weka Health Solutions uses IoT to improve vaccine storage.*
[63] DHL. (2019). *Logistics Trend Radar 2018/19.*
[64] DHL. (2019). *Logistics Trend Radar 2018/19.*
[65] DHL. (2019). *Logistics Trend Radar.*
[66] White, J. 2017. Fix issues with supply chain management in your hospital. Healthcare IT.
[67] Vecna Robotics. (2019). *Technology.*
[68] Turpen, A. (2019). *Tesla Semi truck's battery pack and overall weight explored.*
[69] DHL. (2019). *Logistics Trend Radar.*
[70] Lacefield, S. (2016). Drones in the supply chain: more than just last mile delivery. *Supply Chain Quarterly.* Quarter 3 2016. https://www.supplychainquarterly.com/news/20160912-drones-in-the-supply-chain-more-than-just-last-mile-delivery-/
[71] Doyle, M. (n.d.). The Impact of Drones on Supply Chain Management. https://www.americanexpress.com/us/foreign-exchange/articles/drones-impact-supply-chain-management/
[72] E2Open. (2019). *Nucleus Research: Control Tower Technology Value Matrix 2019.*
[73] E2Open. (2019). *Nucleus Research: Control Tower Technology Value Matrix 2019.*
[74] Queensland Health. (2018). *Clinical services capability framework.*
[75] McGlade, C. (2018). *Exoskeletons in the Warehouse.*
[76] Queensland Health. (2018). *Clinical services capability framework.*
[77] McGlade, C. (2018). *Exoskeletons in the Warehouse.*
[78] Waters, W. (2019). *DB Schenker tests use of bionic 'exoskeletons' in warehouses.*
[79] Taylor, P. (2018). *DHL joins with Accenture on blockchain project in pharma.*
[80] DHL. (2019). *Logistics Trend Radar.*
[81] Aquifi. (2019). *Automation of Repetitive Visual Tasks for Manufacturing and Logistics.*
[82] DHL. (2019). *Logistics Trend Radar.*
[83] DHL. (2019). *Logistics Trend Radar.*
[84] Australian Industry Standards. (2018). *Transport and Logistics Industry: 2018 Key Findings Discussion Paper.*
[85] Transport and Logistics Industry Skills Council. (2015). *2015 Environmental Scan.*
[86] Kahlert, P. Melbourne International Specialised Skills Institute. (2016). *Improving workforce attraction and retention rates for Australian transport and logistics companies.*
[87] Australian Industry Standards. 2018. *Transport and Logistics Industry: 2018 Key Findings Discussion Paper.*
[88] Australian Industry Standards. 2018. *Transport and Logistics Industry: 2018 Key Findings Discussion Paper.*
[89] Australian Industry Standards. 2018. *Transport and Logistics Industry: 2018 Key Findings Discussion Paper.*
[90] Datamars. (2019). *How RFID works*, https://www.textile-id.com/rfid-basics/
[91] Century Europe. (n.d.) Industrial Laundry: How RFID technology can help to optimize laundry service management, https://www.hydrofinity.com/blog/ways-to-improve-your-commercial-laundry-services
[92] RFIDinsider (2019). *What Can RFID Laundry Tracking Do For You?* https://blog.atlasrfidstore.com/what-can-rfid-laundry-tracking-do
[93] RFIDinsider (2019). *What Can RFID Laundry Tracking Do For You?* https://blog.atlasrfidstore.com/what-can-rfid-laundry-tracking-do
[94] Abeliotis, K et al (2015). Trends in laundry by 2030. *Household and Personal Care Today.*
[95] Abeliotis, K et al (2015). Trends in laundry by 2030. *Household and Personal Care Today.*

[96] Sierra Wireless. (2019). *How Commercial Washing Machine OEMs Benefit from the Industrial IoT.* https://www.sierrawireless.com/iot-blog/iot-blog/2019/05/commercial-washing-machine-industrial-iot/
[97] Sierra Wireless. (2019). *How Commercial Washing Machine OEMs Benefit from the Industrial IoT.* https://www.sierrawireless.com/iot-blog/iot-blog/2019/05/commercial-washing-machine-industrial-iot/
[98] Spotless. 2017. Blue Ocean: Transformation for Water conservation. https://www.spotless.com/insights/blue-ocean-water-filtration/
[99] Smithers. (2019). Making Laundry Cool: washing trends and innovations.
[100] Smithers. (2019). Making Laundry Cool: washing trends and innovations.
[101] Hydroinfinity. (2019). *How it works*. https://www.hydrofinity.com/how-it-works.
[102] Benjamin, J. (2013). *Polymer Bead Technology & Commercial Laundry Operation*. https://www.cleaningproductsconference.com/news/2015/making-laundry-cool-washing-trends-and-innovations https://www.greenlodgingnews.com/polymer-bead-technology-commercial-laundry-operation/
[103] Alvarez, A. (2014). Eco-conscious cleaning with polymer beads. Physics Today.
[104] Robotic Automation. (2019). Hospital AGV's. http://www.roboticautomation.com.au/agvs/hospital-agvs
[105] Minister for Health. (2012). *New Robots Call Royal North Shore Home*. Media Release. 2 December 2012.
[106] Inwatec. (2019). Public laundry aims for more automation. https://inwatec.dk/news/
[107] Kannegiesser. (n.d). Fully Dried Work Folding Technology. Product specifications.
[108] Trends in NSW Population Growth – NSW Parliamentary Research Service February 2019 e-brief 1/2019.
[109] Business Insider. (2019). *Accounts payable automation: the multitrillion dollar accounts payable market is finally digitizing.*
[110] Business Insider. (2019*). Accounts payable automation: the multitrillion dollar accounts payable market is finally digitizing*.
[111] Hague Australia. (2019). Queue Management. https://hagueaustralia.com.au/services/queue-management/
[112] Queensland Government (Sunshine Coast HHS). (2019). Clinical check-in kiosks.
[113] ACT Government (Media Release). (November 2019). New kiosks to reduce queues at health facilities and help people find their way.
[114] Pollari, I., Mabbott, J. 2017. *Scaling the Fintech Opportunity for Sydney and Australia.*
[115] The Treasury. 2016. *Backing Australian FinTech. Australian Government.*
[116] Office of Chief Economist. *Australian Industry Report 2016*.
[117] Rosic, A. (2016). *What is Blockchain Technology? A step-by-step guide for beginner*s.
[118] KPMG. (n.d.) *Blockchain in finance*.
[119] Conduent. (2018). *Blockchain and the back office: why transforming finance & accounting takes a trusted partner action*.
[120] Conduent. (2018). *Blockchain and the back office: why transforming finance & accounting takes a trusted partner action*.
[121] Conduent. (2018). *Blockchain and the back office: why transforming finance & accounting takes a trusted partner action*.
[122] Altis. 2016. *The world of bots.*
[123] Justin Hendry. 2017. *NDIS participants could use the Nadia bot to shop.*
[124] Yolanda Redrup. 2016. *The ATO's virtual assistant has already answered almost a million enquiries this year*.
[125] Commonwealth Ombudsman. 2017. Centrelink's automated debt raising and recovery system: A report about the Department of Human Services online compliance intervention system for debt raising and recovery.
[126] Pennic, F (2019) Global chatbots in healthcare market to reach $498 million by 2029, HIT Consultant.
[127] KPMG. (2016). *Rise of the Humans*.
[128] Rafter, M., Martinez, J., & Watts R. PC Mag Australia. (2019). *The Best HR Software for 2019*.
[129] KPMG. (2016). *Rise of the Humans*.
[130] Objective ECM (u.d.) Automating recruitment processes at Queensland Police Service.
[131] Hughes, A (2019) 5 virtual reality training benefits HR managers should know.
[132] Moore, P (2018) NORCAT unveiling new AR and VR training and learning for mining at PDAC.
[133] NSW Government. (n.d.) *HealthRoster*.
[134] NSW Government. (n.d.) *HealthRoster*.
[135] NSW Government. (n.d.) *Human Capital Management (HCP).*
[136] NSW Government. (n.d.) *Human Capital Management (HCP).*
[137] NSW Government. (n.d.) *Human Capital Management (HCP).*

[138] McKinsey. (2019). *The future of work in America: people and places, today and tomorrow*.
[139] Hague Australia. (2019). *Queue Management.*
[140] Villanova, P. Accounting Today. (2019) *Why automation is a positive turning point for accountants.*
[141] KPMG. (2016). *Rise of the Humans*.
[142] International Federation of Accountant. (2019) Future fit accountants: CFO and finance function roles for the next decade.
[143] Green, R et al. 2016. Future skills, industry policy and a new social contract. Available in CEDA. 2016. Australia's future workforce?
[144] World Economic Forum. 2016. The Future of Jobs: Employment, Skills and the Workforce Strategy for the Fourth Industrial Revolution.
[145] McKenzie, F. 2016. Megatrends and Australia's future: Older and wiser? Available in CEDA. 2016. Australia's future workforce?
[146] Baur, C; Wee, D. McKinsey & Company. (2015). *Manufacturing's next act*.
[147] Schallen, M et al. Bain & Company. (2019). *Beyond Proofs of Concept: Scaling the Industrial IoT.*
[148] Schallen, M et al. Bain & Company. (2019). *Beyond Proofs of Concept: Scaling the Industrial IoT.*
[149] Schallen, M et al. Bain & Company. (2019). *Beyond Proofs of Concept: Scaling the Industrial IoT.*
[150] Schallen, M et al. Bain & Company. (2019). *Beyond Proofs of Concept: Scaling the Industrial IoT.*
[151] Schallen, M et al. Bain & Company. (2019). *Beyond Proofs of Concept: Scaling the Industrial IoT.*
[152] Predii. U.d. Predii Intelligence WhitePaper.
[153] Cipresso, P; Giglioli, I; Raya, M; Riva, G. Frontiers in Psychology. (2018). *The Past, Present, and Future of Virtual and Augmented Reality Research: A Network and Cluster Analysis of the Literature.*
[154] Google. (2019). *Complex assembly, done faster*.
[155] Google. (2019). *Complex assembly, done faster*.
[156] AGCO. (2017). *Augmented Reality on AGCO's Factory Floor.*
[157] AGCO. (2017). *Augmented Reality on AGCO's Factory Floor.*
[158] Postma, S. (2016). *Sysmex Talks Augment Reality to Help Customers Perform Routine Operational Tasks*.
[159] Upskill. (2017). *Upskill Solving the Skills Gap Through AR.*
[160] Department of Industry, Innovation and Science. Australian Government. (2019). *Industry 4.0*.
[161] Jobs Queensland. (2018). *Advancing Manufacturing Skills*.
[162] Jobs Queensland. (2018). *Advancing Manufacturing Skills*.
[163] Jobs Queensland. (2018). *Advancing Manufacturing Skills*.
[164] PwC. (2019). *Transforming Australian Manufacturing: Preparing businesses and workplaces for Industry 4.0*.
[165] PwC. (2019). *Transforming Australian Manufacturing: Preparing businesses and workplaces for Industry 4.0*.
[166] PwC. (2019). *Transforming Australian Manufacturing: Preparing businesses and workplaces for Industry 4.0*.
[167] PwC. (2019). *Transforming Australian Manufacturing: Preparing businesses and workplaces for Industry 4.0*.
[168] Grattan Institute. (2018). *Mapping Australian higher education 2018*.
[169] Jobs Queensland. (2018). *Advancing Manufacturing Skills*.
[170] Jobs Queensland. (2018). *Advancing Manufacturing Skills*.
[171] Jobs Queensland. (2018). *Advancing Manufacturing Skills*.
[172] Jobs Queensland. (2018). *Advancing Manufacturing Skills*.

Contact us

Evan Rawstron
Partner
P: +61 2 9455 9586
E: erawstron@kpmg.com.au

Kate Hawkins
Director
P: +61 2 9335 7039
E: katehawkins@kpmg.com.au

Michelle Baulderstone
Associate Director
P: +61 7 3225 6876
E: mbauldersto1@kpmg.com.au

kpmg.com.au

kpmg.com.au/app