

MANUFACTURING 4.0 CRACKING THE CODE FOR WESTERN SYDNEY

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FOREWORD

The Committee is delighted that the first report researched and written as part of our new Western Sydney University PhD internship program is about Western Sydney as a future stronghold of advanced manufacturing for our city.

We have long said that the future of Sydney would be determined by the West but even the Committee had not understood fully that might mean Western Sydney would be where much of the future-looking economy would be built. This paper, Manufacturing 4.0, demands through its evidence and advocacy that we look at a key strand of our city's new economy as a Western Sydney strength and catalyst for innovation across Sydney.

Cracking the Code is written and based on extensive research in the region by Inu Rana. Inu is currently undertaking a Doctorate in Business, focused on the Western Sydney Manufacturing industry.

The Committee has said that 'if only Sydney knew what Sydney knows'. We have also stressed that cities collaborate to compete. On the basis of the compelling research in Cracking the Code, Sydney now knows that we have a significant advanced manufacturing opportunity and that like the broader knowledge economy of which it is part, it is growing strongly in Western Sydney. That research was possible only because of the collaboration between the CFS and WSU. This is but the first of the outputs from our collaboration. Sydney will be both better and better informed because of it. We look forward to many more reports of this importance.

TIM WILLIAMS CEO Committee for Sydney

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INTRODUCTION

A renewal of manufacturing is under way in advanced societies. So profound is this process that it has been termed 'The Fourth Industrial Revolution' or more recently 'Industry 4.0'. Whatever the terminology, it speaks to something real that is happening in what we have come to think of as postindustrial societies. And it is happening here in Sydney, not least in its fast-growing and changing West. It has historically been the manufacturing stronghold of Sydney: can it be again in this new world of smart manufacturing of advanced robotics and artificial intelligence, of 3D printing and augmented reality and of data analytics and the Internet of Things (IoT)?

'Manufacturing 4.0: Cracking the Code for Western Sydney' provides both an overview of what the revolution in manufacturing means but also a guide to how its potential can be further developed in this key area for Sydney's future. Globally, we are beginning to see how the entire production life cycle can be transformed with intelligent tools. We are also seeing that early adopters are forging their way to competitive advantage with many examples of the 'near-shoring' of modern manufacturing processes as contrasted with the offshoring seen in previous decades. Cities have been at the heart of this shift which forms part of the wider 're-urbanisation of the economy' taking place in the knowledge economy. This reminds us that manufacturing 4.0, with its deployment of cutting edge software, data analytics, network technologies and the Cloud, is indeed as much a part of the future knowledge economy of Sydney as fintech. 'Smart Cities' do advanced manufacturing and in the most successful cities, the one reinforces the other.

Sydney has a great opportunity to lead Australia into this next manufacturing revolution. A number of key factors come together here – though we have to be ready to exploit them for their fullest potential. One fact is the massive investment on infrastructure Sydney is now experiencing whose scale is unprecedented and gives Sydney a credible claim to indeed be the world's 'infrastructure capital'. With the right strategy and approach to public procurement, that provides an extraordinary opportunity for the design and deployment of the Internet of Things and for Sydney to become a leader in the region in building smart infrastructure. Reinforcing this potential is Sydney's big and growing capacity in technology and digital innovation, and the creative and design talent under-pinning it, which has made Sydney the nation's tech start-up and fintech capital.

The fact that our world class universities are heavily invested in the innovation agenda is another key success factor as is the support for that agenda by both the Federal and State governments. However, what our universities and the state government share most closely is a commitment to develop the eco-system for innovation in their own city and to do so in collaboration with each other and the private sector in Sydney. Recent examples of this partnership working - which everywhere is precondition for a city's success in an era in which cities collaborate to compete - have been the sponsoring of the various industry and university-based Knowledge Hubs by the NSW Government, the inauguration of Jobs NSW as a public-private initiative, and also the designation of certain areas of Sydney by the Greater Sydney Commission, which itself has an economic mandate and role, as 'collaboration areas'. These are where universities and hospitals or 'Eds and Meds' as they are called, are anchor institutions for area transformation and the creation of what have been termed 'innovation districts'.

WSU is playing a key role in the continued development of Western Sydney and particularly its innovation capacity through research, SME capacity building, skills promotion and the creation of spaces and facilities. The dynamism of both the institution and the region reinforces eachother. With the region already housing almost half of Sydney's population and two thirds of all future growth but experiencing an employment gap with the acute need to attract more knowledge jobs, Western Sydney's economic success matters not just to Sydney but to the state and indeed the nation. The key message of *Manufacturing 4.0*, which itself is a product of a unique collaboration between the Committee and WSU, is that the region, home already to significant manufacturing capacity and an emerging digital economy, can play a key role in Sydney's Fourth Industrial Revolution. The caveat is that this won't happen without a coordinated approach from the public, private and university sectors. This jointly sponsored research and report, sets out some of the core elements of cracking the code so that Sydney's West and its forward looking companies can realise the region's fullest potential in the era of Industry 4.0.

In Australia, manufacturing contributes around \$100 billion to the Australian Gross Domestic Product (GDP), that's 6.05% of total GDP, exports A\$96.1 billion of goods, and employs 856,000 people, annually. Western Sydney is Australia's third largest economy, covering 85% of Sydney' area, producing 31% of its GRP, and containing 47% of its population. Western Sydney is one of the fastest growing economies in Australia. Having been traditionally strong in manufacturing, Western Sydney still has manufacturing as the region's major industry sector that contributes up to 16% of GRP, maintaining its position as the biggest employer in the region.

With a set of new initiatives designed for Western Sydney manufacturing, supported and strategised by the Western Sydney University's Innovation Corridor strategy¹, the region will see unprecedented growth, supporting local businesses and creating local knowledge jobs.

The Western Sydney Innovation Corridor



Following the arc of the 'Outer Sydney Orbital', the Corridor links the region's currently diffused and developing innovation entities into an interconnected span of knowledge-driven commercial hubs. The effect is the creation of a consolidated, yet diverse attractor of international and domestic investment that supports sustainable and future-focussed economic activity and employment. The Corridor links the NSW Government's designated North-West and South-West Growth Centres, integrating the Western Sydney Employment Area, the Sydney Science Park and Badgery's Creek Airport Precinct, while linking together Penrith and Campbelltown-Macarthur Regional City Centres.

¹ McNeil, D 2015, Innovation corridor, Western Sydney University. http://www.westernsydney.edu.au/__data/assets/pdf_file/0010/970867/ Innovation_Corridor_-_Discussion_Paper.pdf>

STATE OF MANUFACTURING IN WESTERN SYDNEY

THE CURRENT CONTEXT OF MANUFACTURING IN AUSTRALIA

Australian manufacturing, like manufacturing in other developed countries, has an important multiplier effect on the economy through its influence of infrastructure, job creation, export earnings, and its impact on other sectors².

Similar to other developed nations, the Australian manufacturing sector is in a state of transition and in current times is heavily challenged by high operating costs, shrinking margins and rapidly evolving technologies. The pressure to keep up to date is tremendous and the pressure to maintain competitiveness in global markets is even greater. Another important characteristic of Australian manufacturing is that the sector is primarily made up of small firms, with 87% employing less than 19 employees³. A very small percentage of these firms are engaged in exports; many others have potential to operate on a global scale but are currently not serving global markets. Recent figures, however, show that the manufacturing sector is in decline, with the sector's decline in sales and service income being \$7.9b, or approximately 2 percent⁴ over the 2014/15 year. And notably, manufacturing, previously the second largest employment sector, has slipped to the sixth position⁵. The fact is that the profitability of manufacturing businesses today stands lower than that of all other businesses. While the gross operating profit margin for all businesses has increased from 10.9 to 12.7 per cent between 2001-02 and 2013-14, that of manufacturing businesses has fallen from 9.5 to 7.8 per cent. This has resulted in a widening gap in profitability between manufacturing and all businesses⁶. This trend is alarming, and many complex reasons are behind this situation.

² Department of Manufacturing, Innovation, Trade, Resources and Energy (2012). Manufacturing Works - A strategy for driving high value manufacturing in South Australia, Government of South Australia, Adelaide.

³ Department of Industry, Innovation and Science (2016). Australian Industry Report 2016. https://industry.gov.au/Office-of-the-Chief-Economist/Publications/ AustralianIndustryReport/assets/Australian-Industry-Report-2016.pdf

⁴ Department of Industry Innovation and Science 2015, Australian industry report, http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/ Documents/AIR2015.pdf>

⁵ Australian Bureau of Statistics 2014, 8155.0 - Australian Industry, Canberra http://www.abs.gov.au/AUSSTATS/abs@.nsf/mf/8155.0

⁶ Department of Parliamentary Services 2014, Performance of manufaturing industry a quick guide http://www.aph.gov.au/About_Parliament/ Parliamentary_Departments/Parliamentary_Library/pubs/rp/rp1415/Quick_ Guides/Manufacturing>

MANUFACTURING IN WESTERN SYDNEY

Manufacturing in Western Sydney is a highly diverse sector and presents a cross-section of manufacturing nationwide. At one end of the spectrum it encompasses traditional activities – low end production – and on the other it includes increasingly complex transformation processes and precision engineering. The manufacturing industries include aerospace, automotive, food and beverage, chemicals, defence, mining, pharmaceuticals, engineering, textiles and more.

Western Sydney manufacturing provides a snapshot of Australian manufacturing and largely reflects the trends that manufacturing is going through on a national scale. Western Sydney, currently producing \$97 billion in Gross Regional Product (GRP), gets up to 16% of its GRP from manufacturing. However, manufacturing in Western Sydney, like overall manufacturing in Australia, is in a state of constant decline from the early 2000s. From 2000-2011 manufacturing, has taken a big fall in industry share of GDP, down 1.5 percentage points. Despite this, as the figures reflect, manufacturing remains a sector of significance, and continues to be the largest employing industry in the GWS region, making up to 15.6% of total employment⁷. And although the industry is in decline in terms of GDP contribution and employment, interestingly in terms of output the sector remains unchanged⁸.

Despite the worrying nature of these statistics, there are demonstrated examples in pockets of the Australian industry, and more widely in parts of the Europe and US, where advanced manufacturing sectors have increased international competitiveness through "end to end" value chain strategies focusing heavily on innovation, effectiveness enhancements, and stronger marketing practices. This rise of high value adding advanced manufacturing coupled with Australia's unique positioning and strength in relation to technical advancement, R&D, SME strength via nimbleness and geographical advantage, have the potential to create new manufacturing spin offs that will be technically advanced and globally competitive. Western Sydney is uniquely positioned to exploit this situation, and taking advantage of emerging technologies and Industry 4.0 transform itself into Australia's innovation capital.

The Western Sydney region could emulate countries that have been able to turn around manufacturing decline by undertaking concrete steps such as having a government industry and research partnership at the centre of manufacturing. An often cited example is Germany's Fraunhofer Society which, with the help of Industry 4.0, has been able to position Germany as a leading global provider of manufacturing technologies despite Germany facing similar labour cost pressures as any other developed nation⁹.



7 Economy ID 2011, Employment by industry - WSROC region economy http://economy.id.com.au/wsroc/employment-census%3E

⁸ Langcake, S., 2016. Conditions in the manufacturing sector. RBA Bulletin, June, pp.27-33.

Manufacturing Engineering 2015, Inside America's bold plan to revive manufacturing, viewed 26th October 2016, http://advancedmanufacturing.org/ inside-americas-bold-plan-revive-manufacturing/

THE CHALLENGES MANUFACTURING IS FACING

The single biggest challenge that manufacturers face in Australia is a very high cost operating environment. In fact Australia currently has one of the highest operating-cost environments for manufacturing across the globe¹⁰. As a very high percentage of Australian businesses are SMEs, the impact is even greater. SMEs face tax compliance costs of more than \$18 billion and the smaller the business, the greater the proportional cost of compliance¹¹. The 2013 Broader Western Sydney Employment Area Economic Issues and Drivers Study states that "The 'high cost' operating environment of NSW, especially in terms of energy and construction costs, will affect its ability to compete for business with other, lower cost States"¹².

In terms of competing globally, Australia's remoteness is a disadvantage too. The geographical distance disadvantage restricting access to major global markets coupled with Australia's limited potential in domestic market has resulted in scale disadvantages for Australia, a low productivity manufacturing environment, a low degree of internationalisation and limited integration into the global value chain¹³.

Thus, manufacturing in Australia has heavily suffered from distance, high production transport and trade costs, and limited opportunity in accessing international markets. The early 2000s brought further challenges for the Australian manufacturing sector including a noticeable productivity slump starting in 2001. This constant need for survival over a long period of time has made Australian businesses risk averse and the strategic focus has narrowed down considerably to 'now' rather than tomorrow. This has further resulted in a strong reluctance towards collaboration, a critical factor in innovation, largely stemming from both the need for immediate survival and fear of competitors¹⁴.

There is a need to recognise the extreme limitations this inward looking approach is placing on Australian manufacturers. There is also a need to appreciate the growing competition in global manufacturing. Australian manufacturers need to develop competitive advantages to compensate the relative disadvantages they face. The long term productivity and competitiveness of Australian manufacturing will stem from innovation, technical leadership, leveraging our long standing reputation for quality and standards, a large and diverse base of SME manufacturing firms that have the potential to engage with technologies at a fast pace.

Australia also needs a consolidated national agenda to push manufacturing to newer heights by leveraging the technological revolution that is shaping the world around us. Tremendous potential lies in Industry 4.0. Investment in Industry 4.0 will be core to unlocking new and emerging opportunities and can transform Australia into a highly networked, integrated technologically advanced and export focussed ecosystem that will be able to provide high value customised products and solutions across the globe.

¹⁰ Green, R. and Roos, G., 2012. Australia's manufacturing future. Adelaide, Australia.

¹¹ Lignier, P., Evans, C. and Tran-Nam, B., 2014. Tangled up in tape: The continuing tax compliance plight of the small and medium enterprise business sector. *Available* at SSRN 2479153.

¹² Department of Planning and Infrastructure 2013, Broader western sydney employment area economic issues and drivers study http://www.planning.nsw. gov.au/Plans-for-Your-Area/Priority-Growth-Areas-and-Precincts/Western-Sydney-Employment-Area/-/media/4923B549162C47DD887D76CA8BDD0920.ashx

¹³ OECD 2015, Australian manufacturing in the global economy. http://www.oecd. org/officialdocuments/publicdisplaydocumentpdf/?cote=DSTI/IND(2012)20/ FINAL&docLanguage=En

¹⁴ CSIRO Futures 2016. Advanced Manufacturing - A Roadmap for unlocking future growth opportunities for Australia.



INDUSTRY 4.0 – THE FOURTH INDUSTRIAL REVOLUTION

By 2030, automation, globalisation and flexibility will change what we do in every industry sector including manufacturing. The underpinning technology of that change in manufacturing will be Industry 4.0. The term Industry 4.0 was coined in Germany. Industry 4.0 was an initiative launched in **Hannover Messe** in 2011, as Industrie 4.0, to digitise manufacturing in Germany. The term caught on and gained widespread popularity and later the concept also came to be known as as the fourth industrial revolution.

The world as we know and experience today has been shaped by three major technological revolutions. The first industrial revolution at the end of 1800, a radical shift from an agrarian economy, introduced mechanical production methods powered by water and steam. The second revolution began in mid 1900 and ushered in an era of mass production, with electricity as a key driver and also gave birth to 'factories'. 1970s saw another period of radical transformation this time with the help of electronics and IT and brought in advanced automation of production processes. Today at our doorstep stands a fourth industrial revolution fuelled by the Internet of Things (IoT), the frame that supports Industry 4.0, and which is going to fundamentally alter the world we live in and dramatically shift the way industries interact with key business components including procurement, processing, and logistics, distribution and consumers.

The long road to Industry 4.0, the digitization of every aspect of business

1800	1900	1970s	2015+	2030+
Industry 1.0	Industry 2.0	Industry 3.0	Industry 4.0	Industry 5.0
The invention of mechanical production	Mass production, with machinesElectronics, IT industrial robpowered by electricity and combustionfor advanced automationcombustion enginesof production 	Electronics, IT, and industrial robotics for advanced	Digital supply chain Smart	Digital Ecosystem Flexible and
powered by water and steam started the first industrial		automation of production processes Electronics and IT (such as computers) and the Internet constitute the beginning of the information age	Digital products, services, and business models Data analytics and action as a core competency	chain networks Virtualized
revolution				processes Virtualized customer interface
				Industry collaboration as a key value driver

At its very core Industry 4.0 is about digital transformation and brings about the convergence of Information Technology (IT) and Operational Technology (OT) which have been disconnected thus far. Globally, there is recognition that Industry 4.0 is a game changer for all and economies are acting fast so as to realise the potential this generates. The German government, as part of its High-Tech Strategy 2020 plan, is pushing to accelerate the adoption of IoT (Internet of Things) by manufacturers under the auspices of Industrie 4.0. The government's economic development agency, Germany Trade and Invest, describes it as a *"strategic initiative to establish Germany as a lead market and provider of advanced manufacturing solutions"*¹⁵. Such is the enthusiasm that Industry 4.0 is generating.

Simply defined, industry 4.0 is the next phase in the digital transformation of manufacturing, leveraging third platform technologies, and innovation catalysts, such as the (Industrial) Internet of Things (IIoT), cloud computing, artificial intelligence, AR & VR, robotics. Industry 4.0 will give rise to connected factories, smart decentralised manufacturing, self-optimising systems, and the digital supply chain¹⁶⁷.

The next wave of innovation will be driven by the Internet of Things. The concept of digitisation involves networking of people and things and the convergence of the real and virtual worlds that is enabled by information technology.

INDUSTRY 4.0 – DRIVING THE NEXT WAVE OF INNOVATION

Digitisation - Operational excellence -Cyber-physical connection

The next wave of innovation will be driven by the Internet of Things. The concept of digitisation involves networking of people and things and the convergence of the real and virtual worlds that is enabled by information technology. This will be the most powerful driver of innovation over the next few decades and will act as the trigger of that next wave¹⁸.

The underlying concept of Industry 4.0 – the connected systems and smart production facilities to generate digital convergence between industry, business and internal functions and processes will bring with it an unprecedented level of optimisation and control in the whole value creation chain over the entire life cycle of products with the help of Cyber-Physical Systems (CPS)¹⁹.

CPSs are simply physical objects with embedded software and computing power and are the enabling technologies behind Industry 4.0 that bring together a fusion of the physical and the virtual worlds, the Internet of Things and the Internet of Services²⁰, and will collectively have a disruptive impact on every aspect of manufacturing companies. In Industry 4.0, more manufactured products will be smart products that they will incorporate self-management capabilities. On the other hand, manufacturing equipment will turn into Cyber-Physical Production Systems (CPPS) - software enhanced machinery, also with their own computing power, leveraging a wide range of embedded sensors and actuators. CPPS will know their state, their capacity and their different configuration options and will be able to take decisions autonomously. And thus, Industry 4.0 form a converged environment bringing together IT and OT.²¹

¹⁸ Kagermann, H., 2015. Change through digitization–Value creation in the age of Industry 4.0. In *Management of permanent change* (pp. 23-45). Springer Fachmedien Wiesbaden.

¹⁹ Möller, D.P., 2016. Digital manufacturing/industry 4.0. In Guide to Computing Fundamentals in Cyber-Physical Systems (pp. 307-375). Springer International Publishing.

http://www.advantech-eautomation.com/media/releases/Industry%204.0.pdf
 Sogeti, 2014. The fourth industrial revolution: things to tighten the link between IT and OT. https://www.fr.sogeti.com/globalassets/global/downloads/reports/ vint-research-3-the-fourth-industrial-revolution

¹⁵ MacDougall, W. 2014. Industrie 4.0: Smart manufacturing for the future. Germany Trade & Invest.

¹⁶ Wee, D., Kelly, R., Cattel, J. and Breunig, M., 2015. Industry 4.0–How to Navigate Digitization of the Manufacturing sector. *McKinsey & Company*, 58.

¹⁷ https://www.gtai.de/GTAI/Content/EN/Invest/_SharedDocs/Downloads/GTAI/ Brochures/Industries/industrie4.0-smart-manufacturing-for-the-future-en.pdf

INDUSTRY 4.0 – ENABLING TECHNOLOGIES

As discussed before, Industry 4.0 leverages third platform technologies to accelerate innovation in factories. According to the Boston Consulting Group there are nine digital industrial technologies at the core of Industry 4.0, namely, advanced robotics, additive manufacturing, augmented reality, simulation, horizontal/vertical integration, Industrial Internet, the cloud, cybersecurity and Big Data and Analytics²².

The initial offerings of Industry 4.0 in manufacturing are automation, process improvement, production optimisation – resulting in overall productivity growth. As industry 4.0 will become the core of manufacturing, new business models will evolve, additional revenue streams will be generated and a new, highly innovative ecosystem will emerge and thrive.

1	ADVANCED ROBOTICS	 Autonomous cooperating industrial robots Numerous integrated sensors and standardised interfaces
2	ADDITIVE MANUFACTURING	 3D Printing; Rapid Prototyping Decentralised 3D Printing facilities for speed, efficiency and Just-in-time
3	AUGMENTED REALITY	 Augmented reality for maintenance, logistics etc. Display of documentation using AR
4	SIMULATION	 Simulation of value networks Optimisation based on real time data
5	HORIZONTAL VERTICAL INTEGRATION	 Cross-company data integration Preconditioning fully automated value chain
6	INDUSTRIAL INTERNET	 Network of machines and products Multidirectional communication between networked objects
7	CLOUD	 Management of data Real time communication for production systems
8	CYBERSECURITY	 Operational networks; open systems High level of networking between intelligent machines, products and systems
9	BIG DATA AND ANALYTICS	 Data mining; data evaluation and application of analytics Real time decision making support; optimisation

Figure: Industry 4.0 - a convergence of technologies - traditional and advanced

22 https://www.zvw.de/media.media.72e472fb-1698-4a15-8858-344351c8902f.original.pdf

WHY INDUSTRY 4.0 IS ESSENTIAL FOR MANUFACTURING

As there will always be demand for goods, the days of manufacturing as a key competitive sector are far from over. Globally advanced countries are making renewed efforts to regain their competitiveness in this sector.

Industry 4.0 at this stage is being viewed by many as the solution for bringing the 'glory days' of manufacturing back. Optimisation and automation through the entire value chain leading to optimum productivity is the benefit that is immediately recognised and attractive to a majority of manufacturers facing cost pressures today. There is significant investment in this area from the firms that are beginning to realise the potential. There are greater benefits to be realised within the overall value chain and speed and accuracy will be just one part. Research undertaken by World Economic Forum reveals that the manufacturing companies are turning to digital technology either to drive down cost or to increase top-line growth by optimising and utilising. Additionally, the creation of alternative revenue streams through new products and services are becoming key drivers for adoption. Today, one of the most widely cited applications of Industry 4.0 is predictive maintenance and remote asset management, changing the way in which equipment is maintained, and generating significant gains from preventing equipment failures or downtime, especially in situations of remote location monitoring. There are, however, additional opportunities that early adopters of the Industrial Internet are pursuing include improving worker productivity, safety and working conditions, and a transformed customer experience.

The figure below shows the key reasons that are driving early adoption of industry 4.0 amongst businesses²³.



How important are the following benefits in driving businesses to adopt the Industrial Internet?

23 World Economic Forum, 2015. Industrial Internet of Things: Unleashing the Potential of Connected Products and Services http://reports.weforum.org/industrial-internet-of-things/general-findings/ 2-1-the-state-of-the-market/#view/fn-3

HOW INDUSTRY 4.0 WILL TRANSFORM MANUFACTURING COMPANIES AND THE SECTOR

The blueprint for adoption of Industry 4.0 across a company, and across the whole of the manufacturing sector is essentially a progression from technology adoption and integration through to business and industry optimisation, with several distinct stages in between. Industry 4.0 is an integrated vision which is a bit more than automation in factories. The vision for Industry 4.0 is business transformation, business model regeneration and optimisation.

It is a staged approach whereby the early stages set the foundations for later stages and the business as whole is addressed while the technology is infused within the business and gains realised at each stage. Additionally, there is value generation at each stage for the industry sector, with each stage building upon the next one creating additional value and a progression from data to information to knowledge to wisdom and further action leading to optimisation.

CASE STUDY: RESMED

ResMed is a medical technology company founded in Australia that employs about 5,000 employees worldwide, operating in 100 countries and has manufacturing facilities in France, Singapore and the US, and Australia. Achieving revenues of \$1.7 billion USD in the year 2014-15, ResMed has captured approximately 40% of the global market for sleep-aid devices.

ResMed has many ground-breaking technologies and products to its credit, including AirMini the world's smallest CPAC device. In addition to the standard sleep apnea treating products and devices, ResMed has made a foray into the service side of things with development testing and data connection services such as ApneaLink Air and myAir which help doctors and patients track the progress of sleep problems in real time. With the help of integrated sensors, monitoring technology and data analytics the treatment can be monitored by the relay of information in between its testing and treatment devices. Keeping R&D as a core differentiator, the company invested over 140 million in research during 2015, and continues to proactively acquire new expertise and explore new territories, with its latest purchase in 2016 being Inova Labs Inc, a provider of innovative oxygen therapy products.







SMART FACTORY CASE STUDY – SIEMENS ELECTRONIC WORKS

With employees wearing blue coveralls walking noiselessly across the spotless white and blue marble patterned PVC floors, chest high blue and grey machine cabinets lined with a row of monitors constantly updating and displaying data and indicator lamps flashing red and green lights – this factory of the future has a bright illuminated look that reminds one of modern operating theatres one sees in movies. It is the Siemens (IW 1000/34) Electronic Works facility in Amberg, Germany^{24 25}.

The facility initially opened in 1989, produces Simatic programmable logic controls (PLCs).

PLCs are used to automate machines and equipment in order to save time and money and increase product quality. They control ski lifts and the on-board systems of cruise ships as well as industrial manufacturing processes in sectors from automobile production to pharmaceuticals.

The Amberg Electronics Plant is an advanced example of Siemens' Digital Enterprise Platform – a production environment that is likely to become standard a decade from now. The products control their own manufacturing processes, and align the next set of production steps automatically. This system are the early steps toward the adoption of Industry 4.0. Already, the endless variables and a complex supply chain make this production process is a step too far from the capabilities of a traditional manufacturing facility. The speed and output are far too advanced with one Simatic control unit produced every second, and twelve million PLCs produced per year. According to a Gartner Industry Research study conducted on the plant in 2010, the Amberg factory only records about 15 defects per million, has a 99% reliability rate and 100% traceability across the line.

Production is largely automated. Machines and cmputers handle 75 percent of the value chain on their own; the rest of the work is facilitated by people. As the employee places the initial component (a bare circuit board) on a production, the manufacturing process begins and automation takes over for the length of the product manufacturing process. Although production in Amberg is highly automated, the human factor is critical and factory workers ultimately make the decisions. Technicians monitor the entire value chain from the workplace. Apart from the monitoring and critical decision making, the Amberg facility relies on people for the development and design of products, production planning, and the handling of unexpected incidents.

²⁴ https://www.siemens.com/innovation/en/home/pictures-of-the-future/industryand-automation/digital-factories-defects-a-vanishing-species.html

²⁵ https://www.siemens.com/press/en/presspicture/?press=/en/presspicture/2015/ corporate/2015-02-Amberg/im2015020439coen.htm

PROGRESSION OF INDUSTRY 4.0 THROUGH THE ARCHITECTURE OF THE COMPANY – CREATING THE 'SMART FACTORY' OF THE FUTURE

STAGE1

Technology integration in the business - with IoT platform integration. This is the first step towards data mining. The upgrade of technology and systems provides the framework upon which the future stages are built. The aim at this stage is to develop a capability to see what is happening across the business by gathering and analysing data via sensors, monitors and embedded systems.

STAGE 2

Data management - which typically involves data integration from across the organisation leading to the creation of big data infrastructure, and data configuration & validation. Having the ability to gather mass data and use analytical tools to derive valuable knowledge helps the business progress to the next stage where data facilitates decision making in the business.

STAGE 3

Advanced analytics - the stage where the companies are able to predict based on patterns emerging from the data. This is the stage where artificial intelligence (AI) is perfected and optimised.

STAGE 4

Digital interface – which brings the businesses to the advanced stage of human machine interaction. The integrated operator machine data and the ability to both visualise and analyse production in real-time gives the businesses the capability to put analytics to use and implement changes as needed leading to continuous realtime improvement across the value chain.

STAGE 5

Business optimisation – the stage which connects the preceding stages to strategy and vision of the business at the same time achieving and maintaining optimum operations leading to reconfiguration of the business model.

INDUSTRY 4.0 – GLOBAL CONTEXT: INDUSTRY 4.0 INITIATIVES AND EVOLUTIONS AROUND THE WORLD

INDUSTRY 4.0 – GLOBAL SCENARIO

IoT, the key enabler of Industry 4.0 initiative, was declared by Gartner in 2014 as a key emerging technology in the context of consumer applications. It is now becoming clear that the industrial application of the IoT is even greater than realised before, and has the potential to totally transform our living, our experiences and our economy.

The Industrial Internet or Industry 4.0 will transform many industries, including manufacturing. It will also transform other key industries and will redefine the work environment including the jobs of the future. All this is predicted when Industrial Internet of Things (Ilot) is still at a very nascent stage much like the internet of 1990s. Industry is therefore still coming to grips with it, with a vast majority of businesses not fully understanding the emerging business models and long term implications to their industries. At this stage there is more apprehension than enthusiasm. Nevertheless, the adoption of Industry 4.0 is accelerating, facilitated by both government and industry driven initiatives, and business led activities, across the world. At the fore front of government initiatives is undoubtedly Industrie 4.0 in Germany which is a multi-year strategic initiative that brings together leaders from the public and private sectors, as well as from academia, to create a comprehensive vision and action plan for applying digital technologies to the German industrial sector. The principal players are the German Federal Government—through the Ministry of Education and Research and the Ministry of Economy and Research; the academic world, through the Fraunhofer Institute, the national academy of science and engineering, the German Center of Research for Artificial Intelligence; and the private business world led by the three associations—BITCOM, VDMA and ZVEI. For the most part, Industry 4.0's main actors are primarily institutional.

On the other hand, an equally strong initiative is the Industrial Internet Consortium (IIC), which was formed in 2014 with the support of GE, AT&T, Cisco, Intel and IBM. The IIC is a non-profit organization that aims to provide resources, ideas, pilot projects, and activities about IIoT technologies. With the IIC, the approach is predominantly business-oriented. The consortium has nearly 200 members today, which are mostly private companies and some academic institutions, in 12 different countries including emerging economies such as India, China and established economies such as Germany. There are other consortia driving and supporting IoT including the AllSeen Alliance and Open Interconnect Consortium (OIC). While AllSeen and OIC focus on devicelevel connectivity, the goal of the IIC is to accelerate the adoption and deployment of Industrial Internet applications through technology test-beds, use cases and requirements development.

The Industrial Internet has also attracted significant venture capital, with an estimated \$1.5 billion in 2014²⁶. Venture capital funding for the Industrial Internet has poured in in primarily from large corporate venture funds including GE Ventures, Siemens Venture Capital, Cisco Investments, Qualcomm Ventures and Intel Capital²⁷. Siemens had launched a new \$100 million "Industry of the Future Fund" to fund early-stage start-ups in industrial automation and other digital technologies²⁸ in 2014. GE announced a partnership with big data incubator Frost Data Capital to create Frost I3, with a vision to fund and incubate 30 Industrial Internet technology start-ups in the three years²⁹³⁰.

Beyond the major investment by the federal government and German manufacturers, Industrie 4.0 has also attracted technology companies. Microsoft announced that it would open a new IoT and AI Insider Lab in Munich³¹, Cisco has openBerlin, which focuses on "co-innovation [and] rapid prototyping" with a focus on manufacturing, logistics and transportation³². Similarly, IBM's \$200 million "collaboratory" allows external companies to work in collaboration with IoTfocused IBM workforce³³.

The German companies, already leading the world in engineering and technological advancement, are adopting Industry 4.0 proactively and demonstrating early adoption benefits.

CASE STUDY: FESTO AG & CO. KG

Festo is a leading international supplier of automation technology for factory and process automation. A globally oriented and independently run family business based in Esslingen, the company has established itself as a performance leader in the sector, and has unrivalled competence in the field of pneumatics.

The company provides pneumatics and electric drive technologies factory and process automation to more than 300,000 customers in 200 industry sectors across the world. Keeping R&D and innovation at the core of business, Festo together with partners from science and industry, is conducting research into new solutions for merging modern information and communication technologies classical industrial production processes. This is a deliberate effort to be a path leader towards the emerging trend of individualised products in small quantities. Festo recognises that they will requires technologies that are able to continuously adapt to changing production conditions and are proactively investing in developing capabilities in this area.

Festo recognises intelligent components which organise themselves and process requests from high level control systems as the basis for tomorrow's production systems and is actively developing the precision engineering and microsystem technologies in order to realise fully networked overall systems. Fester also invests significantly into researching solutions which will allow the human workforce to directly interact with new machine and robot technologies, as the new order of the manufacturing world will be.

- 26 http://reports.weforum.org/industrial-internet-of-things/general-findings/2-1the-state-of-the-market/
- 27 Cisco, 2014 IoT World Forum. http://www.iotwf.com
- 28 Siemens press release. "Siemens launches new venture capital fund". February 17, 2014. http://www.siemens.com/press/ en/pressrelease/?press=/en/ pressrelease/2014/financial-services/ sfs201402002.htm
- 29 Griffith, Erin. "GE will create 30 big data startups alongside an Orange County incubator". Fortune, June 25, 2014. http://fortune.com/2014/06/25/generalelectric-frost-data-capital-big-data-startups.
- 30 http://www.frostdatacapital.com/news/2016/8/11/gefrosti3
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- 32 http://enterpriseiotinsights.com/20170407/channels/news/microsoft-ciscoibm-german-iot-tag17
- 33 https://newsroom.cisco.com/press-release-content?articleId=1489518

INDUSTRY 4.0-AUSTRALIAN CONTEXT

Australia's manufacturing output is contracting. The engagement between businesses, Universities and research institutions is one of the lowest in the OECD. Similarly, Committee for Sydney research from *Joining the Top Table?* notes that Sydney has dropped in rankings across R&D and Innovation, relative to other Global Cities³⁴.

More significantly, Australia has dropped in the 2014-15 global competitiveness rankings to 22 out of 144 economies and while the performance is better in certain areas, Australia's performance in technological innovation and business sophistication is even weaker, at 26 out of 144 countries³⁵. Technological innovation and business sophistication are the key drivers of competitiveness for advanced economies, according to the World Economic Forum Report. It further points out that although there are economic gains from improving both dynamic and static factors of competitiveness, and they work together reinforcing each other, yet they affect different economies in different ways. In the case of Australia, in the long run the most critical will be technological innovation, given Australia's potential and aspiration to be an innovationdriven economy³⁶.

The opening of the market to allow a continuous of capital, goods, and knowledge is essential for innovation. Participation in global value chains (GVCs) increases the size of markets, facilitates the spread of knowledge, technological exchange, creates new knowledge and accelerates innovation, thereby positively affecting economic growth³⁷. Despite obvious innovation gains to be made through participation in GVCs, Australia's participation in global value chains is below the OECD median³⁸. In the 2014 Australian Innovation System Report it is noted that compared with other OECD countries, Australia has low levels of trade, low participation in global value chains, low international collaboration on innovation, low proportions of researchers in business, and low collaboration on innovation between the research and industry sectors³⁹.

AUSTRALIA'S OPPORTUNITY TO PARTICIPATE IN GLOBAL VALUE CHAIN (GVC)

³⁴ Department of Industry Innovation and Science 2016. Australian Industry Report, 2016 https://industry.gov.au/Office-of-the-Chief-Economist/Publications/ AustralianIndustryReport/assets/Australian-Industry-Report-2016.pdf

World Economic Forum, 2014. The Global Competitiveness Report 2014-2015 http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2014-15.pdf
 World Economic Forum, 2016, The Global Competitiveness Report 2015-2016

http://reports.weforum.org/global-competitiveness-report-2015-2016/

³⁷ OECD 2015, The Innovation Imperative', Organisation for Economic Cooperation and Development, Paris. http://www.oecd.org/publications/the-innovationimperative-9789264239814-en.htm.

³⁸ OECD 2013, 'Global Value Chains: Australia', Productivity' Organisation for Economic Cooperation and Development, Paris.

³⁹ Industry 2014, Australian Innovation System Report, Department of Industry, Canberra http://www.industry.gov.au/Office-of-the-Chief-Economist/ Publications/Pages/Australian-Innovation-System.aspx.

Australian innovation-active business

The ratio of innovation-active businesses that reported increases in performance was:



COMPARED TO NON-INNOVATION-ACTIVE BUSINESSES

Source: ABS (2016) Selected characteristics of Australian businesses, 2014-15, cat no. 8167.0

There are consistent findings that innovation-active businesses outperform non-innovation-active businesses on a range of measures. Innovation-active businesses in Australia make up 45 per cent of all employing businesses but contribute over 60 per cent of sales and employment. Compared to non-innovation-active businesses they are 40 per cent more likely to increase income and profitability, twice as likely to export, and two-to-three times more likely to report increased productivity, employment and training. The figure above summarises how innovation impacts a business in relation to performance, productivity, profitability and other factors⁴⁰⁴.

Thus, there is a clear case for Australia to innovate, grow its manufacturing sector and become part of GVC utilising Industry 4.0.

Globally, industry 4.0 will bring long-term gains in efficiency and productivity with diminished costs. Physical products and services, will be augmented and enhanced with digital capabilities and that will increase their value and life. Assets will be more durable and resilient, while data and analytics will transform how they are maintained. New forms of collaboration will be required and there will be increased collaboration between the customers and businesses. This rapidly changing landscape will transform the business models and as such the organisational forms will have to be rethought including talent, culture and the way businesses will make money and do business.

Already we are seeing increasing servitisation, new business models emerging, and products becoming assets that can be connected to the internet brining in remote monitoring and predictive maintenance at reduced costs. This is helping companies to better understand how assets are used, to predict when they need maintenance and to sharpen the total cost of ownership models. By knowing when faults can be avoided or their impact minimized, and with a better understanding of risk and financial exposure, companies can establish service-based contracts with service-level agreements based on reliable data. Thus, Industry 4.0 is being deemed as a game changer and a transformation that hasn't been experienced before.

41 ABS (2016) Selected characteristics of Australian businesses, 2014-15, cat no. 8167.0

⁴⁰ Department of Industry Innovation and Science 2016. Australian Innovation System Report (2016) https://industry.gov.au/Office-of-the-Chief-Economist/ Publications/Documents/Australian-Innovation-System/2016-AIS-Report.pdf

HOW IS WESTERN SYDNEY MANUFACTURING FARING?

OPPORTUNITIES CREATED BY INDUSTRY 4.0 IN WESTERN SYDNEY MANUFACTURING SECTOR

Manufacturers of yesterday relied on economies of scale of production to achieve profitability from unit costs. The mass production approach that fuelled manufacturing growth and in turn advanced economies, brought prosperity and wealth to the western world. With manufacturing moving offshore, still driven by controlling and driving down unit cost, the advanced economies that exploited this are beginning to lose their hold on this key sector, Australia being no different. This challenge needs to be urgently addressed. There is increasing noise around the concept of mass customisation - a radical shift in approach towards both production and consumers. The advent of new technologies using Industry 4.0 will allow manufacturers to achieve this dual aim and for the first time the manufacturers will be able to excel in low volume yet high value manufacturing and the manufacturing will see more and more evolved business models.

CSIRO in its 2016 report identifies three distinct opportunity themes to help place Australia on the world map as a manufacturing nation. These are customised high-margin solutions encompassing design capabilities to unique innovative products; sustainable manufacturing brought through business model innovation and sustainable products; and servitisation from creation of additional revenue streams via new solution offerings⁴². Deloitte has estimated that the market of personalised products and services is going to grow exponentially within a short time frame with consumers willing to pay premiums of up to 20% for customised solutions⁴³.

However, in order to fully realise the strategic growth opportunities that this new environment is presenting manufacturers must proactively transform their way of doing business, reconsidering their attitude towards risk and collaboration, investing in newer technologies, embracing the digital and proactively working towards supporting the ecosystem. The encouraging fact is that the contribution of small businesses towards innovation is on the rise. Over 85 per cent of the firms in Australia that are engaging in innovative activity are small businesses⁴⁴. With technology advancement, the opening of global markets facilitated by this progress, and increasing access to technology. smaller firms are finding it easier to adopt technology and become more efficient⁴⁵. Australian firms need to access external sources of information, knowledge, knowhow and technologies, to build their innovative capability and to reach newer markets.

Economic trends in Western Sydney generally reflect the NSW economy trends in particular and overall Australian tends⁴⁶, and manufacturing is the most important industry for 8 of the 12 Local Government Areas (LGAs) in Western Sydney⁴⁷. Western Sydney is well positioned to drive advancements through the sector and open new market segments domestically and internationally.

Finance, Reserve Bank of Aust
 45 Department of Industry Innov.
 42 CSIRO Futures 2016. Advanced Manufacturing - A Roadmap for unlocking future
 43 viewed 26th October 2016, < h

growth opportunities for Australia.
 Deloitte (2015) Press Release: Making it personal - One in three consumers wants personalised products. [Online] http://www2.deloitte.com/uk/en/pages/ pressreleases/articles/one-in-three-consumers-wants-personalised-products.html Accessed 18/10/2016

⁴⁴ Nicholls, S. and Orsmond, D., 2015. The Economic Trends, Challenges and Behaviour of Small Businesses in Australia. Small Business Conditions and Finance, Reserve Bank of Australia, 18.

⁴⁵ Department of Industry Innovation and Science 2014, Australian industry report, viewed 26th October 2016, < http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Industry-Report.pdf

⁴⁶ Department of Premier and Cabinet 2012, Annual report, viewed 26th October 2016, <<u>http://www.dpc.nsw.gov.au/_data/assets/pdf_file/0003/158727/</u> Department_of_Premier_and_Cabinet_Annual_Report_2012-13.pdf>

⁴⁷ Regional Development Australia 2015, Sydney Economic Profile - The Sydney Region.

Challenges faced in adopting Industry 4.0 in Western Sydney Manufacturing Sector

Western Sydney is fast becoming a major focal point for investment, as there is ongoing country-wide dialogue on identifying the potential regions that can be developed to source the next wave of growth and innovation. Economic literature gives us an insight into sustained economic growth and clearly points out that continuous technological progress underpinned by knowledge is the key to transformation.

While Western Sydney is a diverse economy, two industries are of particular significance - manufacturing and wholesale trade. This means as the success of manufacturing goes, so does the success of the Western Sydney economy. At this point in time, the sector is very fragmented, the need for survival is a common sentiment and there is poor collaboration. Only a small percentage of manufacturers are exporting and again a very small percentage are engaging with advanced technologies. The Australian Innovation System Report demonstrates that innovative businesses which collaborate (compared with innovative businesses which do not) are more likely to see increased productivity, are significantly more likely to broaden the range of goods and services offered and create additional revenue streams for the business, and as an outcome are more likely to report increased profitability.

Further, there is consistent evidence that innovationactive businesses outperform non-innovative businesses on a range of measures including productivity and long term sustainability.⁴⁸

MANUFACTURING SECTOR CHALLENGES – WESTERN SYDNEY SYNOPSIS

- Isolated efforts Manufacturing sector is very fragmented, lacking cohesion and works in isolated pockets across Australia. Western Sydney is no different, with isolation being a major challenge in the path of technological advancement of Western Sydney manufacturing companies.
- Focus on costs saving Challenged by rising costs, shrinking margins and contracting market size, the primary focus of Western Sydney manufacturers is on costs saving.
- Poor collaboration There is a very low level of collaboration exisiting amongst the manufacturing sector at present which compunds the problem of isolation amongst the sector.
- A small percentage of manufacturers engaging with advanced technologies – While the larger manufacturing firms are increasingly recognising the significance of 3D printing, robotics and other advanced technologies, the percentage of manufacturers engaging with Internet of Things and emerging technologies is less.
- A small number exporting A very small percentage of all Australian businesses, around 2.5%, are exporting goods or services to other countries. And although manufacturing is the one of the most export-active industries, the other being wholesale, only 11% of manufacturers are engaged in exporting.⁴⁹

CASE STUDY: DRESDEN OPTICS

Dresden defines itself as designers and manufacturers of a modular glasses system. The brain child of GoGet Carshare founder Bruce Jeffreys and designer Jason McDermott, Dresden Optics has brought German approach to a traditional business and is already disrupting the eye wear market in newer ways.

Here's how Dresden defines its system -

- Ultra-durable, lightweight frames in your choice of unlimited colour combos. All made in Australia with recycled and recyclable materials wherever possible.
- Quality lenses, by German company Zeiss.
- Expert eye health care by some of Australia's best optometric
- Fast turnaround customised sets of 10 glasses with interchangeable parts in 10 minutes flat

Dresden is a new startup in the manufacturing space and is keeping manufacturing local by setting up the main production facility in western Sydney, partnering with manufacturing company Astor Industries, previously a car manufacturer.

A true disruptor, Dresden makes and stocks only one frame style, in a range of colour and sizes. Their frames are made from recyclable nylon which can be recycled again and thus as a company, Dresden, promotes suatainable manufacturing with environment as its priority. Dresden describes its mission clearly – "putting the glasses-wearer at the centre of everything", and has put the customer truly at the centre of the business. According to Co-founder Bruce Jeffreys, the business model of a single frame style is a world-first and is driven by servicing patients who might be anxious about the cost of frames.

⁴⁸ OECD, 2010. The OECD innovation strategy: getting a head start on tomorrow http://www.oecd.org/sti/45326349.pdf

⁴⁹ Australian Industry Group 2017 https://cdn.aigroup.com.au/Economic_ Indicators/Fact_Sheets/2017/Exporters_Fact_Sheet_FY2016.pdf

CASE STUDY: ORORA

Orora, a western Sydney subsidiary of packaging giant Amcor, plans to stay competitively ahead in the business of packaging. Orora's main products are as diverse as wine bottles, fruit boxes, cartons, cans, and closures and caps.

With advanced production methods and a smart factory with state-of-art machinery to complement the processes Orora has rightly earned recognition in the business magazine as Most Innovative Company.

Operating internationally, the business generates revenue in North America and across Australasia. Dedicated to staying ahead in the increasingly competitive market in a challenging high cost Australian market Orora has committed to invest \$45 million in 2018 towards R&D and innovation.

Producing products such as personalised beer cans for Hollywood director Quentin Tarantino, Orora has a suite of innovative products capturing attention of global market that are being produced at increasingly lowered costs through use of advanced printing techniques, the utilisation of off-coloured glass and specialised industry technologies such as shrink sleeve technique.

THE SMART FACTORY – THE FUTURE OF AUTOMATED MANUFACTURING

The 'smart factory' will see the merging of virtual and physical worlds facilitated through the cyber-physical systems discussed earlier. The production systems embedded with CPSs provide real time quality, speed, resource optimisation and cost advantages. The smart factory also gives the traditional manufacturing an edge by raising the business profitability and productivity significantly, and enabling the business to leverage additional revenue streams by opening the business to newer areas such as servitisation. The CPSs lend real time flexibility to the production systems and that in turn brings radical optimisation.



The smart factory has numerous advantages over conventional manufacturing⁵⁰:

- CPS optimised production units are intelligent units that are able to recognise their field of activity, able to configure options in real time and are also able to communicate with other connected systems to make independent decisions. This brings, speed, accuracy, quality and resource optimisation as discussed above.
- The floor is highly efficient and safer to a much greater degree.
- The production is highly resource efficient and that makes the production process a sustainable environmentally friendly operation
- Facilitates human machine interaction and further opportunities for artificial intelligence.

The smart factory, thus, opens the whole area of 'smart' applications such as smart materials – for resource optimisation; smart grids – for minimising energy consumption and green manufacturing; smart logistics – for optimised logistical operations, and more. The 'smarts' across the whole value chain help build a robust, intelligent, self-sustaining manufacturing infrastructure⁵¹.

⁵⁰ German Trade And Invest, 2014. Smart Factory https://industrie4.0.gtai.de/ INDUSTRIE40/Navigation/EN/Topics/Industrie-40/smart-factory.html

⁵¹ Germany Trade & Invest, 2014. Industrie 4.0 - Smart Manufacturing for the Future. https://industrie4.0.gtai.de/INDUSTRIE40/Navigation/EN/Topics/Industrie-40/ smart-factory.html

INDUSTRY 4.0 ROADMAP FOR WESTERN SYDNEY

INDUSTRY 4.0 - EVOLUTION

The future evolution of Industry 4.0 will likely follow four distinct phases, according to the World Economic Forum⁵².

Phases 1 and 2 represent immediate opportunities that drive near-term adoption, starting with operational efficiency. These activities are happening now, and will likely accelerate in the near future. Phases 3 and 4 include long-term structural changes that are roughly three years away from mainstream adoption. Survey results support the view that the impact of the Industrial Internet is incremental in the near-term but transformative over the long-term. These disruptions will manifest themselves in Phases 3 and 4 in the form of the outcome economy and an integrated human-machine workforce.

The achievement of this vision requires an integrated set of actions, strategic in nature and progressive towards the goal, that a manufacturing business will need to take.



The adoption and impact path of the Industrial Internet

52 http://www3.weforum.org/docs/WEFUSA_IndustrialInternet_Report2015.pdf

INDUSTRY 4.0: ROADMAP FOR WESTERN SYDNEY MANUFACTURERS

Industry 4.0 is finding its way into Australian manufacturing. Australian manufacturing companies are beginning to implement industry 4.0 but in rather ad hoc and isolated ways.

The Western Sydney manufacturing environment is characterised by a large number of small and medium enterprises (SMEs). There is a small pocket of SMEs in western Sydney that produce highly innovative products and supply globally. Industry 4.0 will open new markets for these early adopters of Industry 4.0, nationally and internationally.

For SMEs Industry 4.0 will be of paramount importance. Flexible value chains, personalised products produced at unit costs, drastically reduced production management efforts and faster response to market requirements are some ways industry 4.0 will transform the manufacturing game for SMEs.

It is a defining moment for Australia, however, these are unique times because there will be no single defining event that will take place rather a period of dynamic development that will totally transform the manufacturing environment over a short period of time.

To be a part of this dynamic movement manufacturers need to establish foundation steps. It isn't a single step rather a series of transformative steps that will help manufacturing SMEs embrace Industry 4.0 and capture the opportunities presented. In order these stages are:

- Building digital capabilities across the whole business. Integration of new technologies will be the core to Industry 4.0 adoption. Building digital capabilities as a cross functional capability across the whole business will require centralising digital activity throughout the company, instead of a stand-alone specialised IT department. Traditionally, digital initiatives have been handled as stand-alone projects and are limited to activities within a certain unit or function - so bringing digital capabilities across the organisation would mean integrating the digital strategy with the overall business strategy.
- 2. Bring R&D into the core of business processes Manufacturing is on the cusp of another major revolution fuelled by technology – at a time when technology is rapidly changing. Strategic growth opportunities for Australia's manufacturing sector will be underpinned and supported by innovation, and sustained growth will require significant and proactive research and development investment. Given the preponderance of SMEs in the Western Sydney manufacturing sector, R&D is less central to businesses than in other regions – however it must elevated if we are to capture this opportunity.

3. Actively seek collaboration opportunities across the industry ecosystem

Industry 4.0, while offering exciting opportunities, also brings challenges: initial investment is high, and the realisation of benefits is slow. This brings with it uncertainty around whether significant investment will be successful. These challenges are preventing many Western Sydney manufacturing firms from fully developing and implementing specific plans for integration of Industry 4.0 in their business practices. To help firms recognise the benefits, there is an urgent need to foster the exchange of experience, expertise and resources across the industry sector. Similarly, collaboration can reduce the individual risks of such an investment as the increasingly complex challenges reward a joint and coordinated collaboration effort. Besides broad based cross sector cooperation, the Western Sydney sector needs to develop an integrated and systematic approach towards collaboration, and adopt it as a key value driver for the sector and region.

4. Recognise the nature of data – capture, manage and use data

The Internet of Things and Sensors will enable detection of a vast number of different properties including product attributes, usage patterns and location, which will further enable real time monitoring, diagnostics, tracking and control of various processes, products and systems in a manufacturing environment. This will bring a data explosion and present unprecedented opportunities in the form of data. It will, therefore, become very important to effectively and efficiently channel, mine, and analyse data. There will be challenges in terms of data storage, security and management. It is important to treat and develop data as a central business asset. Simply collecting the data will not be enough - there must be processes for the data to inform practice within the firm - as the Committee for Sydney has written in its #wethecity series, firms must be data-driven and responsive.

5. Build agile IT infrastructure

Building an agile IT architecture can help a business link digitisation to overall strategy. Because of rapid and unknown technological advancements – IT infrastructure needs to be able to respond to a variety of scenarios and support a flexible business strategy.

6. Integrate cybersecurity into core business processes

As data rises in importance and proportion, establishing robust cybersecurity solutions and procedures for manufacturers becomes vital. In the future, to maintain competitiveness and integration within the increasingly complex global value chains, advanced manufacturers will require highly sophisticated and secure ICT systems and digital infrastructure. The great potential of Industry 4.0 lies in data and particularly in maintaining an efficient flow of data, analytics and utilisation of data for optimisation along the entire value chain. Security will need to be embraced as an inherent part of industry 4.0 vision and practice.

KEY IMPLICATIONS & RECOMMENDATIONS

The single biggest opportunity for Australian manufacturing is to increase our technical leadership and improve the distinctive value of our products across the manufacturing industry⁵³. Industry 4.0 will be the answer for this. Adoption of Industry 4.0 will help bring about the rapid R&D environment in Australian factories and make the production innovative and responsive in real time.

However, there are a number of challenges that could prevent industries from embracing Industry 4.0 at the pace at which is warranted. These mainly include capability building, security, interoperability, data policies, and education and talent gaps. To overcome these barriers and accelerate the rate of adoption, business, industry and government stakeholders need to take actions, both joint and independent. To ensure that we are prepared and equipped for the future in manufacturing broadly what we need is –

- A nation wide strategy to redesign the approach to manufacturing including the dialogue and narrative
- A new commitment to digitisation, technology adoption, skill building; and
- A promise and plan for the equitable opportunity landscape

As such, the recommendations laid in this report address both business/industry and policy makers. Key actions have been identified for each group and some potential joint actions have also been identified.

FOR BUSINESS

There is a greater need for manufacturing SMEs to proactively gear up to both create and exploit opportunities presented by Industry 4.0 and digitisation.

The foundation steps towards the adoption of Industry 4.0 is a staged approach; from building digital capabilities and bringing R&D into the core of the business, to progressing towards a robust, agile IT infrastructure with integrated cyber security systems. These stages are:

- 1. Building digital capabilities as a cross functional capability across the whole business.
- 2. Bring R&D into the core of business processes
- **3.** Actively seek collaboration opportunities across and in the industry ecosystem
- 4. Recognise the nature of data Capture, mine and manage data
- 5. Build agile IT infrastructure
- 6. Integrate cybersecurity into core business processes

To achieve technical advancement and establish a leadership position in this space, Australian manufacturers should focus on three actions.

First, reorienting the business strategy around Industry 4.0 to bring R&D to the core of the business. This involves robust and ongoing R&D within the business and rather than an ad-hoc approach to R&D, R&D becomes a core enabler of value differentiation.

Second, strategic, active and ongoing collaboration both with research institutions and other potential partners to boost capabilities, share costly investments and deliver complex outcomes. The collaboration can be around project-specific partnerships, or can also involve continual personnel and resource investment etc. to rapidly build on latest ideas.

Third, identifying pathfinder projects that the business has capability to derive 'now' to achieve some early gains and move quickly towards aligning the business with rapid R&D strategy.

53 https://www.amgc.org.au/Attachment?Action=Download&Attachment_id=15

FOR PUBLIC POLICY MAKERS

Lately progress has been made with a more deliberative understanding of Australia's national innovation system. There are improved but still not adequate levels of funding for the various elements of the system and a shift of policy emphasis from supply side concerns such as public research, business R&D and skill development, important though these are, to the demand side of innovation, particularly enterprise absorptive capacity, management capability, public procurement and technology diffusion.

There is more that government and policy makers can do to accelerate the transition of Australian manufacturers to Industry 4.0. The key areas that require immediate attention are –

1. Industry regulations

There is a need to update regulations as Australia ranks fairly high in terms of regulations. For the industry, it will be beneficial if the existing regulations are reviewed and relaxed to allow the industries the flexibility to invest, take risks and innovate. This will also encourage more competition, improved market efficiency and will help uplift the standards and quality industry wide supporting Australia's vision to attain a leadership position.

2. Optimising support for R&D capability and innovation development

Supporting SMEs in innovation development – an initiative similar to ZIM that allows SMEs in Germany to apply for grants for research and development projects in the area of Industrie 4.0.

3. Targeted funding

In Germany, The BMBF is funding nine applied research projects that demonstrate to SMEs in particular how Industrie 4.0 technologies can be integrated in practice. The research projects target:

- the development of tools for economic feasibility studies which allow investment protection and conclusions to be drawn about the future viability of Industrie 4.0 technologies;
- best practices for the SME sector to facilitate adaptation processes based on transferable solutions;
- deployment strategies and recommendations for the implementation of modifications. These are to be provided as handouts, checklists and model procedures that deliver assistance in as concrete a manner as possible.

Similarly, grants could be offered to SMEs to advance innovation and R&D.

4. Strategic linking of infrastructure spending with manufacturing 4.0

The Western Sydney City Deal is focused on increasing infrastructure investment and investment attraction to support the development of Western Sydney region and increasing employment and economic output in the region. It is linked to a \$3.6 billion Western Sydney Infrastructure spending plan. This should include Manufacturing 4.0 as a identified growth industry linked to the development of Western Sydney Airport and Celestino Science Park.

Further to this, a regional Western Sydney Internet of Things strategy for the manufacturing sector should be commissioned to help identify strategic areas of focus as well as challenges.

BUSINESS

- Reorient business
 model
- Start with strategic
 pathfinder projects
- Seek collaboration opportunities

JOINT ACTIONS

- Invest in strategic R&I
- Collaborate on key initiatives
- Accelerate digital reskilling

PUBLIC POLICYMAKERS

- Invest in building up industry 4.0 expertise across industry
- Updating industr regulations

JOINT ACTIONS

There are areas where policy makers, industry and business interact and these intersections could be identified, established and actions undertaken to strengthen these. Stakeholders can come together to:

1. Invest in long-term, strategic R&D

The sector wide adoption of industry 4.0 will require large scale multi stakeholder efforts. The challenges that are being recognised as barriers to mass adoption especially capability building, reskilling, security, data policies, education and talent gaps are complex problems and will require the coming together of academia, industry, government and business. Government led and supported initiatives need to be started in these areas to problem solve these issues.

2. Collaborate on showcase projects

Much benefit could be derived from setting large scale showcase projects to demonstrate technology, its application and benefits and let the industry experience the technology first hand. Similar initiatives in Europe have been instrumental in bringing broader awareness in the industry and driving uptake of technologies.

The proposed Regional Development Australia's Manufacturing Light House project could also be one of such projects that could help bring the industry and government together to enable a coordinated approach towards helping manufacturers by facilitating information exchange and dissemination critical to developing innovation capabilities in the manufacturing sector.⁵⁴

3. Accelerate reskilling of the industry to meet the emerging and changing talent needs

The convergence of physical industries and digital technologies will worsen the widening talent gap among workers with both operational and technological skills. Industry 4.0 will require advanced technological skills and education in newer emerging technologies as well as advanced analytical skills and data. To address the rapidly changing demand in skills and growing demand for digital talent, industries and academia must come together to reshape educational training and implement reskilling programmes with focus on flexibility. Again, government led initiatives should be driven to incentivise and encourage businesses to address these talent gaps.

Adoption of these recommendations will further initiatives to increase employment, in particular the recommendations of the Jobs for NSW report⁵⁵ which included in its recommendations the need to 'nurture our globally competitive growth segments', and 'skill up for the knowledge economy.

⁵⁴ Regional Development Sydney 2017, Sydney's Manufactiring Industry has their say, https://www.rdasydney.org.au/news.asp?pid=135&id=215

⁵⁵ Jobs for NSW 2016, Jobs for the future https://www.jobsfornsw.com.au/_data/ assets/pdf_file/0020/90740/Jobs-for-the-future-full-report-August-2016.pdf

CONCLUSION

Industry 4.0 presents a major opportunity to help Australia regain its position and become one of the emerging leaders in the market providing industry 4.0 solutions and services. In turn, this will open countless new market opportunities thereby strengthening Australian economy.

Western Sydney is uniquely positioned to capitalise on this movement and has the potential to drive the next wave of innovation, productivity and competitiveness to assert itself as a leader in manufacturing advancement. Western Sydney has a unique positioning as it has a concentration of small manufacturing companies that are eager to transform. Currently, many of the disruptive technologies are driven by small innovative companies. The size gives these businesses the advantage of agility, risk taking ability and the ability to quickly evolve and change the business model as they progress.

Work is needed to be done to coordinate efforts to integrate Industry 4.0 into Australian manufacturing, as that will be imperative in opening up the way towards Australia being a global supplier of products and services.



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"I commend the Committee on the role they are playing in intellectual thought leadership for Sydney"

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