MicroManufacturing

THE MAKINGS OF A BOOM

POWERED BY resilient futures

The Possibility for Industry, Education and Government

MicroManufacturing is a fast-emerging industry sector that has the potential to revolutionise manufacturing in Australia. As with other industries that have emerged, engaging and empowering a movement requires understanding and aligning on essential aspects of the change.

The purpose of this document is to outline for leaders some of those key factors in sectors critical to ensuring the successful development of MicroManufacturing – industry, education and government.

Our research and thinking over the past five years has informed the views in this document and we look forward to gathering feedback to further shape a collaborative understanding as to the possibility of MicroManufacturing in Australia.

Larry Quick I Managing Director I Resilient Futures

For more information:

Email: larry.quick@resilientfutures.com

Mobile: +61 414 886 742

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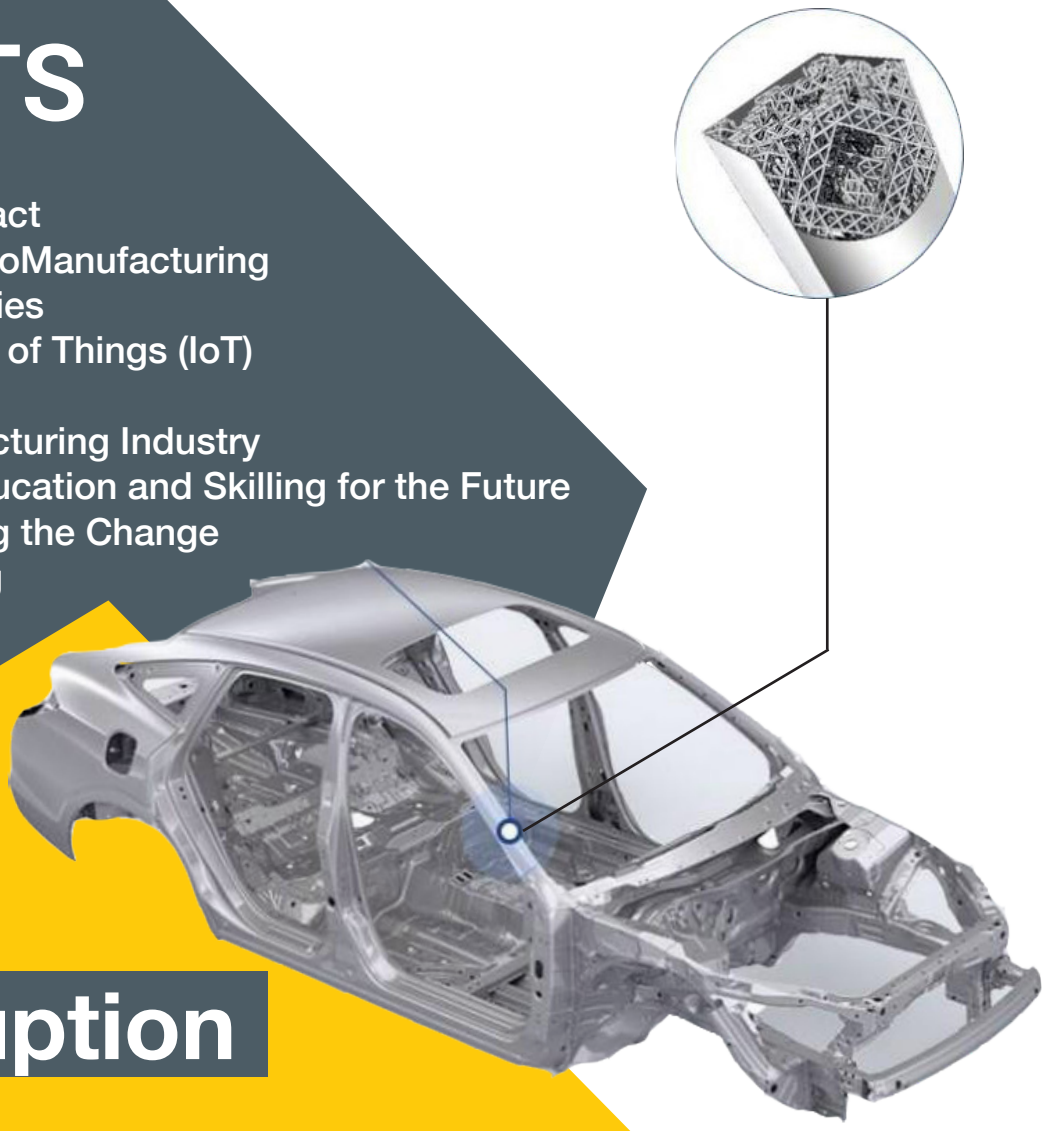


3D printing of parts using 21 different metals in the same job

Disruption and it's Impact

Disruption, in all it's forms – digital and physical technology, automation, economic uncertainty and resulting social upheaval, energy reorientation, climate change and more - are combining to create challenges that can only be met with a strong, cohesive and innovative new approaches to skill building, workforce transition, organisational development, and economic sustainability.

While disruption of this type is not new, what is different today is the speed, scope, scale and systemic nature of rapid change and its impact on people, organisations and economies not yet geared for transformation in this exponential era.

This environment brings with it great risk, and also provides an immense opportunity for industry, tertiary educators, government and communities to join forces to re-skill and re-invent industries that are under threat

The Emergence of MicroManufacturing

The manufacture of physical products through small scale, smart facilities that provide new ways for the masses to design, prototype, make, test, sell and distribute small (but potentially scalable) quantities of smart products and related services.

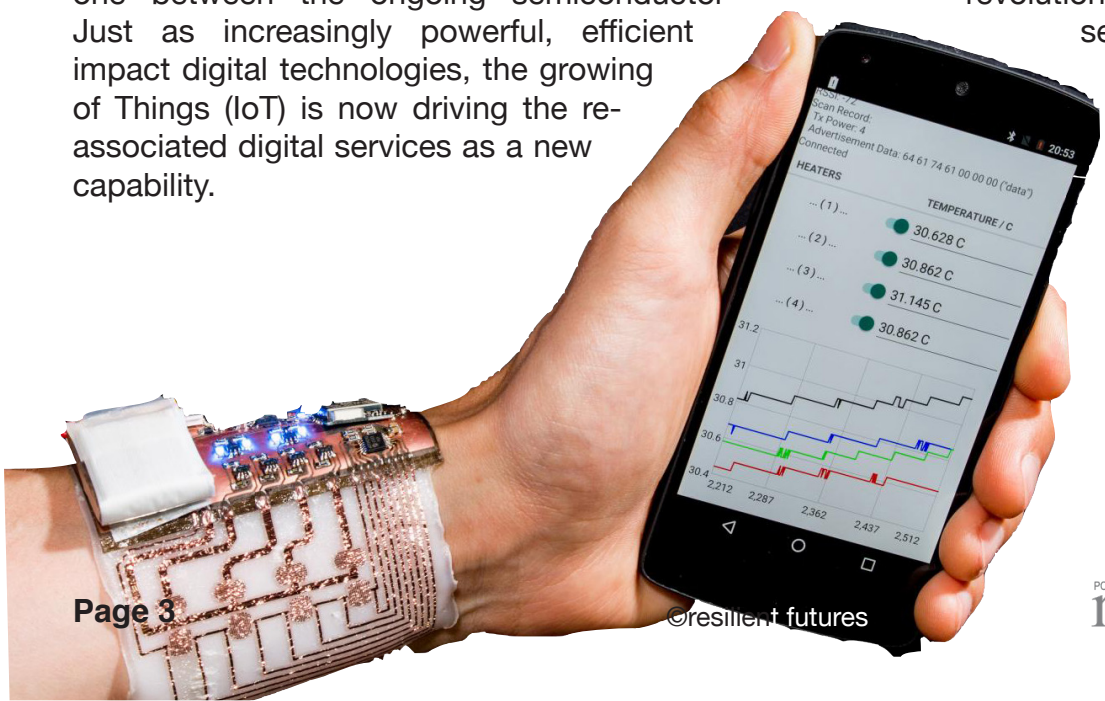
MicroManufacturing has been emerging as a ground-breaking opportunity for some ten years.

MicroManufacturing—to be distinguished from the manufacturing of tiny components—is a form of manufacturing that doesn't rely on economies of scale. It entails the design (likely collaborative), rapid prototyping, product testing, and manufacture of small (but potentially scalable) batches of physical products (which give rise to associated digital services) through small-scale, smart facilities. It is an incredibly agile industry that removes many of the barriers to participation that exist within traditional manufacturing.

As with the digital revolution, the emergence of MicroManufacturing is opening the door to new kinds of start-ups while also creating avenues for innovation within existing small, medium and large-sized manufacturers. For example, in recent years TechShop Global, a network of sophisticated "maker-spaces" that provide training and low-barrier access to smart tools and technologies, assisted General Electric in rapidly training 5,000 new engineering employees. It is also assisting Ford to establish eight facilities to rapid prototyping and problem solving. And, the financial service start-up Square began its life in a TechShop in Menlo Park, California.

With this new model gaining traction, a rapid change in the competitive landscape for larger, more traditional manufacturers is imminent.

Finally, the relationship between the Internet of Things (IoT) and MicroManufacturing parallels the one between the ongoing semiconductor revolution and digital technologies. Just as increasingly powerful, efficient semiconductors continue to impact digital technologies, the growing momentum of the Internet of Things (IoT) is now driving the re-imagining of products and associated digital services as a new force in cyber-physical capability.



Small and Smart Facilities

The equipment and facilities that underpin the emergence of MicroManufacturing can be best described as Advanced Makerspaces.

Makerspaces provide people with the opportunity to find a like-minded community, learn new skills, prototype and productise their ideas and potentially launch new businesses.

An Advanced Makerspace takes this concept to a whole new level of sophistication. These spaces:

- Enable access to the latest equipment,
- Provide purposefully designed and laid-out facilities,
- Fuel the creativity that emerges through diverse collaborations of people, knowledge and experience,
- Provide intensive, effective and appropriate training and support, and
- Foster opportunities for innovation for both start-ups and existing manufacturers – large and small.

An Advanced Makerspace sets the foundation for a whole new way of thinking and working in manufacturing and creates a previously missing link between a new product idea and the pathway to mass-manufacturing.

A typical Advanced Makerspace provides open access to a range of equipment, as well as training and services for all manner of users, including large corporate enterprises, SME manufacturers, start-ups, students, teachers, tradespeople, inventors, and anyone wanting to 'have a go' at creating something for themselves or their organisation.

The Internet of Things (IoT) is a network linking physical objects with connective capabilities (e.g. devices, buildings, and machines with sensors) allowing them to share data without human mediation. Kevin Ashton, who coined the term "Internet of Things", explains this computing concept thusly:

Leveraging the Internet of Things (IOT)

> *If we had computers that knew everything there was to know about things– using data they gathered without any help from us– we would be able to track and count everything, and greatly reduce waste, loss and cost. We would know when things needed replacing, repairing or recalling, and whether they were fresh or past their best.*

IoT has the potential to re-invigorate the manufacturing sector as a whole. In terms of MicroManufacturing, it could provide SME manufacturers and start-ups with the agility to create and prosper from new markets and niches in which larger manufacturers are unable or un-willing to compete.

Re-imagining Products

IMAGINE...

A smart WiFi LED bulb with colour-changing hue to help reduce energy consumption while controlling lighting at home. While it connects directly to home WiFi it can also be controlled from anywhere through an app that adjusts colour and brightness, tracks energy consumption, and sets schedules for when it's on.

A wearable appliance that monitors all vital signs, reports directly to a medical service and delivers drugs according to a real-time diagnosis.

An air monitoring device with a smart plug that provides multiple benefits for consumers. The air monitoring aspect of the device tracks toxins and chemicals in the air and then offers a recommendation on how to improve the air quality.

A sensor layer that fits over any mattress and instantly turns a bed into a smart bed. Receive daily sleep reports each morning, use the dual zone warming feature to make the bed extra cozy, connect to almost any WiFi enabled device in your home.

While we may only be starting to imagine what is possible, all of these products and associated digital services are available today.

Now, imagine what will be achievable when the full extent of the Internet of Things is understood, realised and 'plugged-in' to places where people can easily 'make' their ideas a reality.

Re-making the Manufacturing Industry

Alongside their pursuit of the opportunities inherent through Industry 4.0, global organisations like Ford, Siemens, GE, Tesla and Fujitsu are building MicroManufacturing capability into their organisations by activating Advanced Makerspaces. The reasons for their entry into this area are diverse and include:

1. Inspiring new product ideas and innovation
2. Stimulating problem solving through fresh approaches
3. Mixing disciplines to gain novel inputs and outputs (e.g. STEAM)
4. Creating unique design IP
5. Encouraging rapid prototyping and demonstration
6. Enabling small batch manufacturing
7. Fostering fast-to-market product testing and adjustment
8. Responding rapidly to market changes
9. Gaining more value from existing R&D budgets
10. Building new capabilities to meet disruptive change
11. Creating new business models to match the emergence of cyber-physical products and services
12. Being agile to enter and exit fast-changing markets

A critical element in the success of MicroManufacturing comes from connecting the diverse interests and skills that exist within a maker community. In these environments, ideas and information are cross-pollinated in new ways as a diverse group of individuals and experience come together to work on different problems and create new solutions.

For example, the mobile point of sale swipe device Square was invented under precisely these conditions. Square co-founder Jim McKelvey states that while he went to TechShop's original Menlo Park location to prototype the device, it was actually the maker community at TechShop that helped solve many of the problems he hadn't even been aware of when he initially conceived the idea.

Re-thinking Tertiary Education and Skilling for the Future

What are the jobs of the future, and how can they be identified in time to skill the workforce ahead of their emergence? This question is on the minds of nearly every educator in the world.

Answering this question requires firstly acknowledging that tertiary institutions must be 'in the game' and standing alongside their existing industry partners as new industries start to appear. They must be able to understand the changing conditions, sense the opportunities and risks facing industry and co-create the solutions that will build the new capabilities that ensure industry succeeds in a disruptive environment.

In doing so, the benefits for the tertiary sector of a MicroManufacturing focus include:

1. Strong industry connection at a time when many industries are facing severe disruption
2. Leadership in industry training and re-skilling
3. New training offerings that suit new student needs
4. Mainstream micro and modular teaching, learning, and credentialing
5. New ways to engage with students who are seeking meaningful work that fits with their view of the 21st Century
6. New career options for students
7. Incubating start-ups and speed-ups
8. Knowledge and research opportunities in the Internet of Things and 'product as a service'.
9. Horizontal integration and growth of digital and physical innovation through the development of STEAM (science, technology, engineering, arts, and mathematics) capability
10. Product, service, and business model innovation fit for local economic growth

Such potential benefits come at a time when all tertiary education institutions are being challenged by immense change in teaching, learning and the needs of students preparing for the future.

Including MicroManufacturing in strategic planning is now a must for all such institutions.

TechShop and Fujitsu Launch Mobile Makerspace for Student Education

Government Co-leading the Change

In a globalised economy that is significantly disrupting local manufacturing and jobs, at the same time MicroManufacturing is also re-inventing 'grassroots' manufacturing. It promises to build and reorganise local skills, workforces, industries and economies so that they are fit to generate value in the 21st century.

Government support for the creation of accessible and functional facilities, combined with a focussed effort to educate organisations, educational institutions, government agencies and communities as to the benefits, is key for the successful emergence of MicroManufacturing.

Also, government has a role in the organisation and support of inputs (e.g. training, research and development, innovation funding) combined with a focus on outputs (i.e. re-skilling, workforce and economic development). Ultimately, the global impact of MicroManufacturing is imminent, but whether it takes root in specific places or not will depend upon the active coordination of these factors.

Understanding this can assist government in leveraging key economic drivers for overall workforce development, economic agility and growth including:

1. Delivering rapid work readiness and continuous re-alignment for work of the future
2. Reorienting the manufacturing sector to the 21st Century
3. Leveraging, at scale, the emergence of the Internet of Things (IoT)
4. Kick-starting start-ups, scaling-up small and medium operations and accelerating adopters
5. Staying at the forefront of MicroManufacturing and IoT
6. Building purpose back into communities that have lost their 20th Century manufacturing industries

As with the historic emergence and adoption of new industries like agriculture, mining and the Internet, the role that government plays will in co-leading, with industry and education, the push for globally competitive MicroManufacturing capability will be crucial.

A Future for the Making

3D bio-printing of skin

Based on the current global growth of MicroManufacturing and Advanced Makerspaces there is no doubt that a revolution is underway.

Whether or not Australian organisations and Australia can take a meaningful place alongside its global peers through stimulating the growth of these two capabilities and leveraging the future of the Internet of Things, will depend upon whether individual leaders are willing to take up the challenge.

MicroManufacturing is growing fast, however it is also an emergent sector in its early growth phase and needs to be approached with strategic sense that ensures opportunity is pursued in balance with the ability to mitigate risk.

As in all industry revolutions, in their early stages of emergence, the complete picture is unknown and mistakes will be made as innovators clear the way for early and late adopters to follow. Having said this, there are considerations that must be understood when identifying the pathway that best suits local or organisational needs.

Most importantly, we must beware because existing experience tells us that a 'build it and they will come' approach does not work. Many Makerspace start-ups have not been designed to operate in a sustainable way - at the service levels to which they aspire. They have dealt with issues of user engagement, inappropriate business and operating models, missing standards and compliance, loose insurance policies, dysfunctional facility layout and design, poor equipment choices, and ill-funded asset maintenance and replacement considerations for fast evolving equipment technology. Not only has this inhibited their ability to sustain operations, it has also impeded their ability to scale beyond their original form.

Any investment in MicroManufacturing and Advanced Makerspaces must last the journey as this new industry grows and people become accustomed to what it can offer. Just like digital and online – it will take time for the masses to get on board and for those who are well-positioned to make a return on their investment.

The key to taking advantage of the MicroManufacturing opportunity is to understand what is happening and think it through before starting.

SELECTED REFERENCES

Understanding Advanced Makerspaces in less than 10 minutes

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https://www.youtube.com/watch?v=iGgWR5eC_cc

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Hardware Accelerators: Empowering the Race to Market

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Tertiary Education Hosting Advanced Makerspaces

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China Taking a Lead

In 2016 a Wired Magazine series named Shenzhen as The Silicon Valley of Hardware.
Video – Summary - (2 min 30 secs)
https://www.youtube.com/watch?v=hUtUwRRlTKw

RESILIENT **FUTURES**

Resilient Futures' primary focus is on building the capability within organisations to leverage disruption through strategic leadership.

Since 2012, Resilient Futures has been researching the growth of MicroManufacturing and allied Advanced Makerspaces in the USA, Europe, Asia and Australia. This research has been complemented by our strategy work in manufacturing (GM Asia, Holden, Marand), tertiary education (Curtin, ECU, VU) and workforce and economic development (USA).

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