

ADVANCE QUEENSLAND

Jobs now, jobs for the future



Queensland Advanced Manufacturing 10-Year Roadmap

Discussion paper for consultation
February 2016

The Department of State Development

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Written submissions should be forwarded to AMRoadmap@dsg.qld.gov.au by 24 March 2016



Purpose

In 2015 the Queensland Government announced it would invest \$180 million in the Advance Queensland program, a comprehensive suite of reforms that will diversify the economy and create the knowledge-based jobs now and into the future. As part of this program a number of industry roadmaps are to be developed in consultation with industry.



This discussion paper has been developed in response to the government’s decision to place a strategic focus on selected industry sectors. Advanced manufacturing is one of these sectors.

The government will develop a 10-Year Advanced Manufacturing Roadmap (AM Roadmap), with the support of a newly established Industry and Manufacturing Advisory Group (IMAG), to guide the development of the sector. The IMAG will provide the government

with high level industry advice on strategic matters in building and promoting the sector in Queensland.

This discussion paper explores the current environment in relation to advanced manufacturing, the key attributes of advanced manufacturing businesses and the key opportunities and challenges in the sector. It is seeking stakeholders’ input on the key issues and actions for consideration in the development of the AM Roadmap.

Vision

The Queensland Government is focused on ensuring the state’s advanced manufacturing businesses capitalise on opportunities in manufacturing sectors such as defence, renewable energy, marine, aviation, medical equipment and pharmaceuticals and mining equipment and technology services to generate the jobs of the future, including high value, highly-skilled jobs.

While there has been a decline in manufacturing in the state over the last 15 years and there are numerous challenges to be addressed, there is a strong and resilient core of manufacturing businesses that are succeeding in

the current environment. Many of these businesses are transitioning to, or operating in, the advanced manufacturing sector and they will provide the highly paid, stable jobs of the future.

The government’s proposed vision for the sector is:

Queensland will be an internationally recognised centre for advanced manufacturing with niche manufacturing technologies, products, services and solutions that are innovative, sustainable and embedded in local and global supply chains.



What is advanced manufacturing?

Advanced manufacturing incorporates niche market products and a range of activities from design and research and development (R&D), to production, distribution and after-sales services. It focuses not only on products but also on value-adding across the entire value chain and includes:

- ▶ collaborative R&D and design-led thinking
- ▶ innovative business models and effective supply chain capabilities
- ▶ the effective use of disruptive technologies and systems and cutting-edge materials
- ▶ a focus on customisation and exports
- ▶ world-best practices and processes
- ▶ new ways to manufacture existing products and the manufacture of new products, and
- ▶ the provision of high value-added services and innovative solutions.



Some of the technologies that will support advances in manufacturing include:¹

Advanced robotics—next-generation robots could be mobile and autonomous in their environment, with the ability to interact with their environment and achieve outcomes without programming of all procedures.

Nanoelectronics—semiconductors have been one of the key enabling technologies of the information technology revolution. The technology has driven ongoing improvements in price and

performance of computers, phones and other communication equipment.

Materials by design—materials that endure in extreme temperatures, lightweight composites and new electronic and functional materials have in the past enabled advances in transportation, electronics and aerospace.

Biomanufacturing—researchers are developing new tools to enable them to readily engineer biological systems, with widespread applications for energy, medicine, and electronics.

Queensland manufacturing's contribution to the economy

In 2014–15 manufacturing contributed around \$20.3 billion to the Queensland economy. Over the past decade, Queensland manufacturing has increased its share of national industry gross value added from 15.8 per cent in 2003–04 to 19.7 per cent in 2014–15 (in current

prices). However while Queensland manufacturing contributes strongly to the state's output, it has decreased its share of output from 11.9 per cent in June 1990 to 7.1 per cent in June 2015 (current prices).

In the December quarter 2015,

manufacturing directly employed 169,700 persons in Queensland. Over 88 per cent of manufacturing jobs are full time positions. In terms of total employment, the industry is the seventh largest in the state and despite some strong growth areas, employment in manufacturing

¹President's Council of Advisors on Science and Technology (2011) report to the President on ensuring American leadership in advanced manufacturing, Executive Office of the President, June 2011, p28

is expected to remain flat over the medium term with output growth likely to be driven by productivity improvement. The sector comprised around 9,032 employing businesses at the end of the 2013–14 financial year.

Exports

In 2014–15, manufacturing accounted for \$15.9 billion in international exports, making it one of the largest export industries in Queensland representing over 33.8 per cent of the total value of Queensland’s merchandise exports.

Research and development

Queensland manufacturing spent \$532 million on R&D in 2013–14, accounting for 19.7 per cent of total business R&D in Queensland.

International and national environment

Nations around the world are focussing on manufacturing or manufacturing related businesses to boost economic growth.

The United Kingdom is supporting advanced manufacturing through its High Value Manufacturing Catapult comprising seven centres offering small and medium-sized enterprises (SMEs) access to world-class equipment, expertise and collaborative opportunities to help them turn ideas into commercialisation applications².

Japan boasts robust sectors within its manufacturing industry (vehicle, information technology, electronics, robots, and satellites) and has strengthened intellectual-property rights, and decreased royalty costs to increase entrepreneurship³. It has started programs to increase industry-academic partnerships. South Korea, like Japan, invests heavily in research and development and is a leader in shipbuilding, semiconductors and displays⁴.

A network of government-backed research institutes, the Fraunhofer



Society, has contributed to Germany’s reputation as one of the leading exporters of high-tech manufactured goods even though the country has relatively high wages and is highly regulated. This network, that translates research into innovation for German businesses, is particularly important to the SMEs that figure prominently in the German economy. These companies

are often global players producing locally and selling specialty products that can command premium prices around the world⁵.

In the United States the National Network of Manufacturing Innovation comprising industry, academia, and government partners are leveraging existing resources, collaborating, and co-investing to nurture manufacturing innovation

²<https://hvm.catapult.org.uk/>

³National Policies and Investments - Emerging Global Trends in Advanced Manufacturing, Institute for Defence Analyses, March 2012, pp68-73

⁴ibid

⁵<http://www.wsj.com/articles/behind-germanys-success-story-in-manufacturing-1401473946>

and accelerate commercialisation⁶. In South East Asia, Singapore is investing heavily in manufacturing and particularly in advanced manufacturing technologies to remain competitive with countries in its neighbourhood.

Within Australia, the Australian Government is focussed on revitalising industries that will deliver jobs growth and economic prosperity. Consequently, in 2015 it announced the establishment of a National Innovation and Science Agenda that will invest \$1.1 billion over four years to drive smart ideas that create business growth, local jobs and global success by focussing on culture and capital, talent and skills, collaboration and 'Government as an exemplar'. New initiatives will include tax breaks for early stage

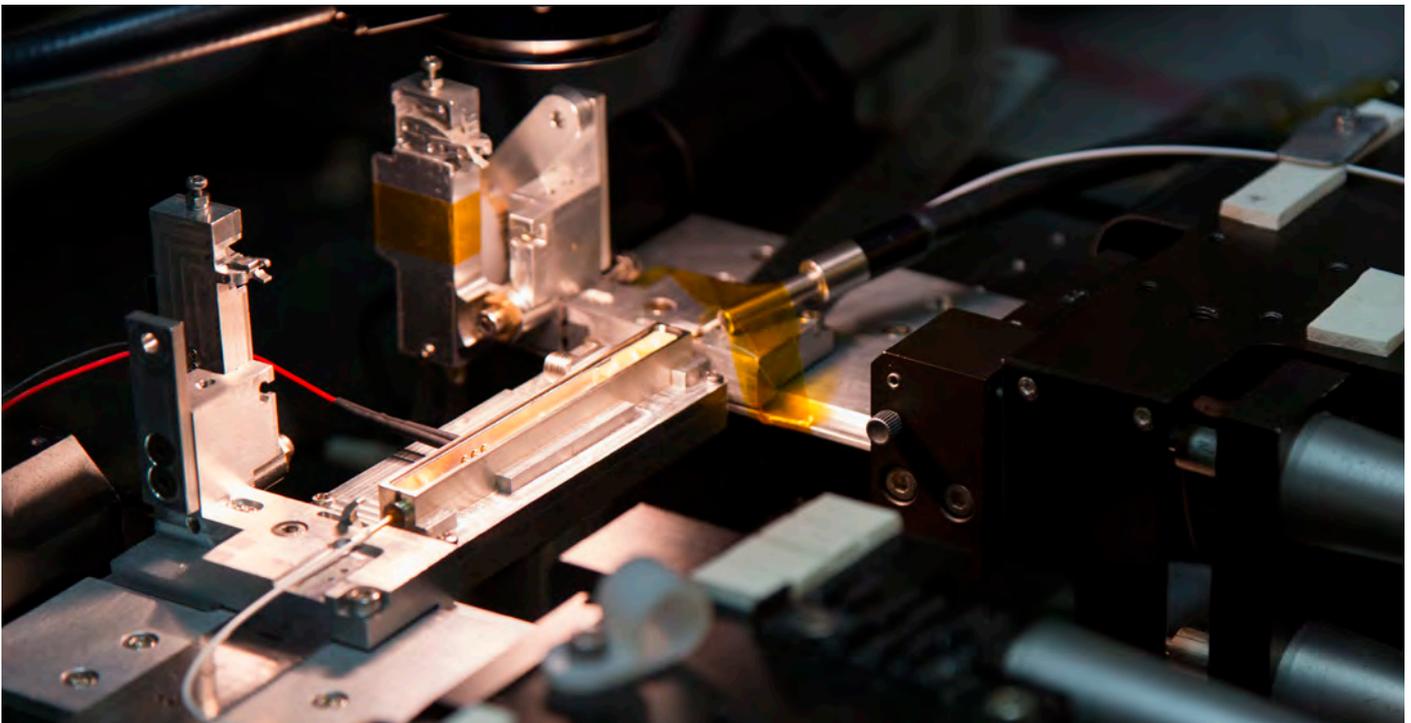
investors in innovative start-ups where investors will receive a 20 per cent non-refundable tax offset based on the amount of their investment. In addition to the capital gains tax exemption there will also be a 10 per cent non-refundable tax offset for capital invested in new Early Stage Venture Capital Limited Partnerships (ESVCLPs), and the cap on committed capital will increase from \$100 million to \$200 million for new ESVCLPs.⁷

These initiatives complement existing programs and agreements supporting advanced manufacturing including the:

- ▶ Innovative Manufacturing Cooperative Research Centre—established to develop and support 'manufacturing

innovation' in Australia across a range of key growth sectors

- ▶ Advanced Manufacturing Growth Centre—established to place science at the centre of industry policy and increase business, industry and research collaboration
- ▶ Free Trade Agreements and the major reforms to anti-dumping laws to further protect manufacturers from cheap imports, and
- ▶ an R&D Tax Incentive program—providing tax relief of almost \$3 billion to more than 13,000 innovative Australian companies.



⁶<http://manufacturing.gov/nnmi.html>

⁷<http://innovation.gov.au/page/national-innovation-and-science-agenda-report>

Opportunities and challenges

To accelerate the shift to advanced manufacturing in Queensland over the next decade the state’s manufacturing industry will need to reposition itself to address emerging challenges and take advantage of the significant opportunities that will shape Queensland’s future.

Opportunities - general

Opportunities exist for Queensland manufacturing firms to:

- ▶ build on existing competitive advantages and advanced manufacturing niches, particularly whole-of-life service capabilities, to outbid cheaper imported products
- ▶ position themselves to access new domestic and international supply chains and other value-adding market opportunities
- ▶ capitalise on export opportunities—for example by taking advantage of the market for scientific instruments (largely medical) and medicinal and pharmaceutical products—areas that experienced the largest increase in real exports (nationally) from 2002–12⁸
- ▶ apply advanced technologies (such as additive manufacturing, automation, cloud technology and robotics); advanced materials (such as composites and nanotechnology) and advanced practices (business models, social media, innovative solutions and sustainability) within a design-led framework to achieve increased productivity and competitiveness, and
- ▶ foster a manufacturing workforce to utilise highly technical

systems to develop greater interconnectedness with customers and build R&D capacity.

Opportunities - specific

Specific opportunities will arise from, and in:

- ▶ upstream processing building on strengths in Queensland’s resource, forestry and agricultural industries⁹, and
- ▶ niche areas of knowledge-intensive manufacturing including:
 - » mining equipment and technology services
 - » Unmanned Aerial Vehicles driven by government agencies including Defence, the Queensland Police Service and Queensland Departments of Emergency Services, Natural Resources and Mines, and Agriculture and Fisheries, and by commercial operators
 - » medical and scientific equipment
 - » pharmaceuticals
 - » transport equipment including aerospace
 - » advanced materials, and
 - » niche products that use creative design and marketing to establish unique brands and reach new markets such as cosmetics and high value fashion¹⁰.



⁸Prime Minister’s Manufacturing Taskforce, Report of the Non-Government Members, Smarter Manufacturing for Smarter Australia, August 2012, p23

⁹ Prime Minister’s Manufacturing Taskforce, Report of the Non-Government Members,

Smarter Manufacturing for Smarter Australia, August 2012, pp1-3

¹⁰ Ibid., p2



Challenges - general

Transforming the manufacturing industry will be critical in addressing a range of general economic and industry challenges facing the nation. The economic challenges include the winding down of the construction and investment phase of the resource sector, the softening of commodity prices and the closure of the automotive manufacturing sector slated for the end of 2017 with a reported \$29 billion¹¹ impact on the national economy and a potential loss of 200,000 manufacturing jobs of which 30,000 are in Queensland.

The manufacturing industry challenges, which were identified in the Prime Minister's Manufacturing Taskforce 2012 report¹² include:

- ▶ **An uneven number of small firms**—a disproportionate number

of small firms (86 per cent) with many operating in small markets, restricting the industry's ability to lift competitiveness, productivity, job generation and technology adoption among the sector.

- ▶ **Skills shortage**—a shortage of skilled workers, especially in the heavy fabrication and engineering sector, caused by an ageing workforce (the median age of workers is 41 years).
- ▶ **High costs**—rising living and energy costs and weak productivity growth while manufacturing centres in Europe and the USA are growing stronger.
- ▶ **Strong emerging competition**—emergence of China as the competitor to the USA as the world's largest manufacturer leading to reduced margins and

radically disrupted global supply chains while some domestic markets are facing import competition for the first time.

Other issues which have implications for the sector include the:

- ▶ **Accelerating and disruptive impact of technology**—the internet is breaking down barriers to entry and presenting an enormous platform for innovation while at the same time, economic convergence means countries that had, until recently, competed for low cost, low skill jobs are now competing for the most skilled jobs and producing the most advanced products.
- ▶ **Increasing flow of data and people across traditional boundaries**—by 2025, 1.8 billion people around the world will enter

¹¹Closing the Motor Vehicle Industry: The Impact on Australia, Bianca Barbaro, John Spehr and NIEIR, University of Adelaide, 2014.

¹²Prime Minister's Manufacturing Taskforce, Report of the Non-Government Members, Smarter Manufacturing for Smarter Australia, August 2012, p14

the consuming class, nearly all from emerging markets, creating enormous new hubs for consumer demand and global production. Additionally, digitisation is reducing the marginal costs of production and distribution and some goods flows are becoming services flows creating significant new opportunities for innovation and disruption¹³.

- ▶ Ageing world population—if people were to retire at about the same age as in the past, population ageing would drive further falls in labour force participation rates over coming years placing greater pressure on industries that rely more heavily on labour. At the same time, the more risk adverse elderly population will be less willing to develop new businesses, products or services and this could weigh on productivity growth, and hence on our incomes and economic wellbeing¹⁴.

Challenges - specific

There is a range of challenges impacting on the transition of Queensland’s manufacturing into a more innovative and internationally competitive industry, these include:

Productivity and competitiveness

- ▶ The lack of integration into an Enterprise Resource Planning (ERP) or control system by many SMEs in Queensland’s food industry either because of

cost barriers or the belief that spreadsheet control software will do the work effectively¹⁵.

- ▶ Low levels of participation in global supply chains and a lack of supply chain interoperability that hampers businesses’ participation in supply chains. Supply chain interoperability is important in managing complex information .
- ▶ The low numbers of firms developing into medium-sized, globally-focused firms reducing the industry’s ability to lessen the gap between local business practices and the leading standards of technology, management and design. Small firms’ failure to grow and internationalise can sometimes be attributed to entrepreneurs’ failure to develop an ambitious, strategic and global mindset .
- ▶ Ensuring equity of opportunity for all manufacturing businesses, particularly Indigenous businesses in rural and remote areas.
- ▶ Businesses’ underestimation of the problems associated with a number of elements including outsourcing and offshoring in the areas of inventory management, obsolescence, organisational traumas, reaching quality standards and maintaining in house capabilities .
- ▶ Businesses’ failure to benchmark performance, pre and post



advanced manufacturing technologies’ (AMT) investment, that impacts on their ability to quantify the value of the investment.

- ▶ Staff difficulty in accepting AMT and the reduction in AMTs’ value because businesses are not ready for the AMT.
- ▶ Lack of a favourable community view of manufacturing (and by extension advanced manufacturing).

Innovation, design and technology

- ▶ Business’ difficulties in finding research partners and

¹³Global flows in a digital age: How trade, finance, people, and data connect the world economy, McKinsey Global Institute, April 2014

¹⁴Speech, “Ageing and Australia’s Economic Outlook” Christopher Kent, Assistant Governor (Economic), Reserve Bank of Australia, Address to the Leading Age Services Australia (LASA) National Congress, Adelaide – 20 October 2014

¹⁵Internal document – Survey of Manufacturer’s Use and Integration of Advanced Manufacturing Technologies, July 2010,p2

¹⁶Committee of Economic Development of Australia, Advanced Manufacturing; Beyond the Production Line, April 2014, p103/4

¹⁷Prime Minister’s Manufacturing Taskforce, Report of the Non-Government Members, Smarter Manufacturing for Smarter Australia, August 2012,p49

¹⁸Committee for Economic Development of Australia, Advanced Manufacturing; Beyond the Production Line, April 2014, p.40.

negotiating with public research organisations over intellectual property, and difficulties caused by public research organisations' failure to understand business culture and practices and to appreciate the importance of meeting commercial timeframes¹⁹.

- ▶ Business' failure to adopt ICT enabling technologies impacting adversely on their competitive advantage. Only 19 per cent of SMEs (nationwide) having some form of digital strategy²⁰. Intuitive, simple and easy to use new technologies may address this issue.
- ▶ The lack of suitability of some ICT products for SMEs and the low ICT literacy of SME owners and employees²¹.
- ▶ Poor understanding and knowledge of key enabling technologies (KET) including ICT, photonics, advanced materials,

nanotechnology and industrial biotechnology by manufacturing businesses.

Collaboration and export opportunities

- ▶ Businesses' lack of collaboration within the industry and with national and international businesses. Stronger national networks and global engagement are required to grow advanced manufacturing in the state.
- ▶ Businesses' lack of collaboration with researchers in the development and adoption of AMT. Only six per cent of manufacturing businesses nationwide collaborate with government or research institutions to develop new technologies²².
- ▶ Low integration by businesses into global supply chains.
- ▶ Lack of export orientation displayed by many entrepreneurs in manufacturing.

Skills attraction, retention and development

- ▶ Loss of process-engineering expertise in businesses once manufacturing is outsourced resulting in difficulty undertaking advanced research on next-generation process technologies²³.
- ▶ Skills shortages, especially in heavy fabrication and engineering in Australia (and Queensland)²⁴.
- ▶ Lack of skills in AMT use.

Business costs and regulation

- ▶ Relatively higher operating costs compared with businesses' emerging competitors.
- ▶ Training and time impost in installing and getting AMT investments operational and difficulties in securing the right level of support and service from suppliers. The associated capital and on-going ICT maintenance can also be costly in terms of time and money²⁵.
- ▶ Difficulty in accessing finance to invest in AMT and uncertainty about whether new software will deliver the functionality required.
- ▶ Concerns about customer acceptance of digital designs and the need to factor in the cost²⁶.
- ▶ Hidden costs for businesses associated with transacting data between organisations involved in a common delivery/program incorporates²⁷.



¹⁹Prime Minister's Manufacturing Taskforce, *Report of the Non-Government Members, Smarter Manufacturing for Smarter Australia*, August 2012, p.47

²⁰Sensis Report, *Yellow TM Social Media Report*, 2013

²¹Committee for Economic Development of Australia, *Advanced Manufacturing: Beyond the Production Line*, April 2014, p.42

²²Committee for Economic Development of Australia, *Advanced Manufacturing: Beyond the Production Line*, April 2014, p.88

²³*Ibid.*, p.42

²⁴*Ibid.*, p.102

²⁵Internal document – *Survey of Manufacturer's Use and Integration of Advanced Manufacturing Technologies*, July 2010, p.3

²⁶*Ibid.*, p.3

²⁷Committee for Economic Development of Australia, *Advanced Manufacturing: Beyond the Production Line*, April 2014, p.98

Why an advanced manufacturing roadmap?



Queensland's manufacturing industry is a significant contributor to employment as well as regional and economic growth within the state. However, the identified international and national trends impacting on the industry will require a shift in focus to enable the industry to remain competitive.

The state's manufacturing industry can no longer just make things if it is to become more sophisticated and globally connected. It needs to grow and transform from broad based manufacturing to advanced manufacturing, which includes firms adopting world-best technologies, systems, practices and processes to produce advanced manufactured goods. Innovative businesses need to be producing low-volume, high-value, customised products in a sustainable manner.

More Queensland manufacturing SMEs need to seize the opportunity to supply high-value goods and services into global supply chains and export markets. This will require a greater focus on value-adding along the supply chain and stronger global supply chain integration which will help strengthen manufacturers' international competitiveness.

Queensland's manufacturing industry also needs to build on its reputation as one of the most innovative sectors in the state where SMEs supply high value goods, ranging from rudder pedal kits for Boeing's F/A-18 Super Hornets to microwave products, into global supply chains. By boosting its level of innovation the industry will significantly lift its productivity and competitiveness.

It has been suggested that only 15 per cent of SMEs have realistic prospects for growth²⁸. Encouraging and supporting manufacturing businesses with potential to grow to adopt advanced manufacturing technologies and processes, where appropriate, should deliver economic and environmental benefits to the state.

There is also opportunity to lift the productivity and competitiveness of all manufacturing firms through building the capabilities and capacity, including managerial skills, needed to access global supply chain and other market opportunities.

To support this systemic shift in the sector, it is essential that the state's manufacturing businesses

operate within a supportive business environment that encourages innovation, investment and growth.

The AM Roadmap will complement the Queensland Government's existing policies and programs including:

- ▶ The Industry and Manufacturing Advisory Group, established to provide high level industry advice to government to help grow the manufacturing industry.
- ▶ Jobs Queensland, a key element of Working Queensland, established to advise on current and future skills demand and long-term workforce planning.
- ▶ The \$180 million Advance Queensland, another element of Working Queensland, that provides a comprehensive suite of programs creating the knowledge-based jobs of the future, driving productivity improvements and building on the state's natural advantages.
- ▶ The Queensland Charter for Local Content that provides local firms with full, fair and reasonable opportunities to tender for major Queensland Government projects and procurements.
- ▶ Building Queensland that provides expertise and advice on infrastructure priorities.
- ▶ The establishment of a number of new and emerging sector teams within the Department of State Development to provide focus for the development of priority sectors.

²⁸Prime Minister's Manufacturing Taskforce, Report of the Non-Government Members, *Smarter Manufacturing for Smarter Australia*, August 2012 p.48

A productive, innovative and sustainable advanced manufacturing sector into the future

This shift to advanced manufacturing will manifest itself as smaller, interdependent niche production units across global value chains that capture value through innovation, focus on exporting and operating in geographical or virtual clusters that generate productivity efficiencies and critical mass gains²⁹.

The sector will comprise businesses with strong ICT capacity and expertise—elements critical to advanced manufacturing processes, integrated supply chains and efficient factory operations.

The advanced manufacturing sector will build on technological achievements in advanced automation, intelligent manufacturing, embedded sensors and the linkage of sensors to the internet³⁰.

Businesses will be operating in an environment characterised by the transformation of energy usage, generation and storage as markets move towards renewables and green fuels in an environmentally sustainable economy.

The advanced manufacturing sector will be agile and skilled in adopting sustainable manufacturing practices that reduce inputs, waste and costs while delivering high value products.

The future of an advanced manufacturing sector is best summed up by Frank Wagner, Associate Professor at Queensland University of Technology³¹ who said:

“The manufacturing industry will be a backbone of the overall economy, but it will be a different manufacturing industry. It is not

about mass manufacturing of goods, like cars or fridges or whitegoods. It is going to be of higher value and highly-specialised manufacturing. For example, this is evident in the emergence of connected devices, smart homes, smart environment, assisted technologies for the ageing society, higher value individualised medicine, drugs and devices, bio-fabrication especially to service the ageing society. We want to be healthy but also live a comfortable lifestyle. This gives a lot of opportunity for future modern, high-value, advanced manufacturing, which is different, from the traditional mass-production focused industry.”



²⁹KPMG, *Global Manufacturing Outlook, An Australian Perspective, 2015, p.2*

³⁰John Pollaers, *Chairman, Australian Advanced Manufacturing Council speech at CRC's Australia 2040 event, Parliament House, Canberra, June 2015.*

³¹Frank Wagner, *Associate Professor, Queensland University of Technology in QMI Solutions Edition Three, 2015,p3.*

Have your say/questions

You are invited to provide a submission on the questions listed below by email to AMRoadmap@dsd.qld.gov.au no later than 24 March 2016.

- 1 Do you support the proposed vision? If not, what is your vision for an advanced manufacturing sector in Queensland?
- 2 Are the identified challenges comprehensive? If not, what are the other impediments to the development of an advanced manufacturing sector in Queensland?
- 3 Are the identified opportunities comprehensive? If not, what are the other new markets/opportunities for the state's advanced manufacturing sector?
- 4 What policy settings and actions can the government apply that:
 - a assist existing businesses transition to advanced manufacturing
 - b support the development of new innovative businesses in the advanced manufacturing sector
 - c position businesses to attract capital to commercialise their new technologies or products, and
 - d assist businesses identify and adopt technology to support advanced manufacturing products, processes and systems?
- 5 How can the government effectively market Queensland's capability and capacity in advanced manufacturing?
- 6 How should the success of the Roadmap be measured?
- 7 Any other comments?

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