“AUSTRALIA’S AUTOMOTIVE MANUFACTURING INDUSTRY”

A SUBMISSION TO THE PRODUCTIVITY COMMISSION

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Introduction

The automotive industry is of strategic importance to the Australian economy in terms of the investment, jobs, skills, research and development (R&D), innovation and exports it generates. It is Australia's largest manufacturing sector, representing around 6 per cent of total industry value added and employing over 50,000 people. Automotive exports contribute $3.7 billion of revenue to the national economy and account for around 12 per cent of total exports of elaborately transformed manufactures. The future development of Australia's automotive industry is therefore of critical importance to the growth and wellbeing of the manufacturing industry and the Australian economy. Consequently AutoCRC Ltd welcomes the review of the sector by the Productivity Commission.

AutoCRC Ltd is a not-for-profit company established to assist participants in the automotive industry improve their competitiveness through business process improvement and development of novel, internationally relevant technologies.

Consistent with the inquiry terms of reference and the company's mandate, AutoCRC Ltd seeks to comment on the following key issues:

- The importance of the Australian automotive industry.
- Spill-over benefits from automotive to other sectors.
- The Automotive Supplier Excellence Australia (ASEA) support programs and how these improve the long-term profitability, sustainability and productivity of the automotive industry.
- The AutoCRC research programs and how these facilitate the development of innovative vehicle and component technologies by the automotive industry.
- Policy settings to assist automotive supply companies to diversify, embrace innovation and gain access to global supply chains.

The importance of the Australian automotive industry

At this time perhaps no industry is under more pressure than automotive manufacturing, which is important to Australia's economy as it makes a substantial contribution to output, employment, productivity, exports, and hence economic growth. This pressure is not just coming from the high Australian dollar, but also from the evolution of the industry from being a sector which just manufactures vehicles to a sector which manufactures vehicles which must operate within a larger global system. This means that the automotive manufacturing sector will remain a growth engine for knowledge-intensive products and processes. As such, the innovative performance of manufacturing and its associated service industries is also very important to Australia's overall economic prosperity. If the managerial and innovation capacity of manufacturing grows, then the ability of the economy to be innovative also increases.

Over the last 20 years the Australian automotive industry has been progressively exposed to increasing international competition and is now one of the most open markets globally. In recognition of the contribution that automotive manufacturing makes to the Australian economy, successive Australian governments have provided public funding assistance to encourage the industry to invest in plant and equipment and new technology through research and development. Notwithstanding that the present levels of public funding support provided to the Australian industry rank among the lowest on a per capita basis compared with all other automotive manufacturing countries, the industry has responded by investing heavily in the design and manufacture of vehicles and components. Consequently, the locally produced and substantially locally designed 'large-cars' represent value for money in their market segment and contain high levels of local content in systems, components and materials. Development of automotive technology know-how in Australia has occurred within the industry and within Australia's research sector.

The recent announcement by Ford Australia to cease manufacturing operations by 2016 and the decision by the other vehicle producers that from 2016 onwards all vehicles assembled in Australia will have their origins in vehicle platforms designed overseas further exacerbates the challenges facing the industry. For the Australian vehicle producer, this means much less engineering input will be required locally to prepare for local production, and components needed to assemble the vehicle already exist from overseas supply sources at cost levels supported by high production volumes. For the approximately 150 component suppliers currently operating in Australia, it will be more difficult to compete with the already designed and identical components available from existing overseas sources, not least because the cost to

produce the tooling necessary to manufacture any given component in Australia must be amortised over the Australian local production volumes, which generally will be lower than those in the overseas market. While this scenario presents considerable challenges for Australian suppliers, global vehicle platforms (by definition) create opportunities for competitive suppliers to access high volume markets by exporting from Australia, or by forming alliances with overseas based firms to enable them to participate in international markets.

Furthermore, the automotive industry is evolving from one that simply manufactures vehicles to an industry which needs to embrace and respond to the future mobility needs of the broader community. Companies such as BMW and Hyundai-Kia have mission statements such as:

> ***"The BMW Group is the world's leading provider of premium products and premium services for individual mobility."***
>
> ***"Hyundai-Kia will become a trusted lifetime partner of our customers, we will bring a new perspective to automobiles through innovative mobility solutions based on human-centric, eco-friendly technologies and service."***

Efficient, sustainable transport of people and goods is essential for our prosperity and well-being. However, as more and more vehicles hit the road, maintaining this mobility is one of the biggest challenges facing road users, businesses, the government and ultimately motor vehicle producers and component manufacturers. Part of this challenge consists of increasing road-traffic safety and reducing fuel consumption in order to lower harmful emissions and move towards a sustainable economy. The challenge is how to better integrate motor vehicles in a broader mobility system. This is as an opportunity for Australia.

The Automotive Australia 2020 Technology Roadmap (AA2020) recognises this opportunity and advocates four themes that offer prospects for Australian companies to participate in global value chains, and present areas of focus for government and industry investment. These four themes: Vehicle Electrification, Gaseous Fuels, Light-weighting and Data and Communication Systems build on our local strengths and position our industry for the evolving global opportunities. AutoCRC is focusing on the first three AA2020 Technology Roadmap themes in its current research program. This program is already addressing many aspects of vehicle technology which will be important enablers for the Australian automotive industry to play a significant role in future automotive smart mobility. For example, the requirement to reduce CO_2 emissions can be approached by making lighter vehicles, using hybrid powertrains and

developing smart aerodynamic solutions, all of which are encompassed by the roaddmap and AutoCRC's research programs.

Spill-over benefits from automotive to other sectors

The importance of car and component manufacturers to the domestic economy is magnified by the complex linkages the sector has with other industries such as metal and plastic product fabrication, chemicals, petroleum and coal products, and other non-manufacturing sectors such as finance, insurance, property and other business services.

A key feature of the automotive industry is the leadership role it plays in the broader Australian manufacturing sector in terms of technology uptake – both in relation to products and processes, and in human capital development. AutoCRC has the opportunity to work with many companies across the industry and to observe these spill-over benefits first-hand. The main benefits come from the following areas:

- Efficient manufacturing processes, such as just-in-time and lean manufacturing being adopted as the benchmark in other manufacturing and service sectors;
- Lean product development and stage gate processes being adopted across the manufacturing industry as the standard for new product development;
- Design engineering;
- Quality systems;
- Supply chain management processes and systems;
- Diffusion of new technologies;
- Transfer of skilled staff.

Two detailed case studies which illustrate spill-over effects are shown at Appendices One (SMR Technologies) and Two (UniSA) respectively. Further examples are summarised in Table One below.

Company	Spill-over Benefit	Industry Sectors to Benefit
SMR Technologies	Automotive Technologies used in other sectors Exporter	Defence, Aerospace
CME Composites	Automotive Technologies and processes used in other sectors Exporter	Confectionary, Construction, Rail
Hella Australia	Automotive Technologies and processes used in other sectors Exporter	Mining, Infrastructure
Diver Industries	Automotive Technologies and processes used in other sectors Exporter	Transport, Aftermarket, Marine, Racing
Futuris Australia	Automotive Technologies and processes used in other sectors Exporter	Construction, Infrastructure, Rail
Redarc	Automotive Technologies and processes used in other sectors	Defence, Recreational Vehicles, Marine
GM Holden	Automotive Technologies and processes used in other plants Exporter	Processes and technologies spread across many other manufacturing sections such as, Food, Defence, Marine
MtM	Exporter	Motor Vehicles, Transport, Water

Company	Spill-over Benefit	Industry Sectors to Benefit
Mackay Rubber	Automotive Technologies and processes used in other sectors	Defence, Rail, Industrial, Aftermarket
CBI	Automotive Technologies and processes used in other plants Exporter	Rail, Mining, Defence
Venture	Automotive Technologies and processes used in other sectors	Water, FMCG, Construction, Leisure, Agriculture, Packaging
Backwell IXL	Automotive Technologies and processes used in other sectors	Solar, Appliances, Mining
Dolphin	Automotive Technologies and processes used in other sectors	Defence, Gaming

Table One: Examples of Spill-Over Effects from the Automotive Industry

Achievements of Automotive Supplier Excellence Australia (ASEA) Support Programs and its Importance to the Automotive Industry

Since 2007 AutoCRC, through the ASEA division, has assisted over 120 automotive companies to improve their business processes, to embrace innovation and to implement strategies to sustain and grow their businesses. ASEA has completed over 250 comprehensive company assessments, providing feedback across 11 competencies and 53 metrics, identifying gaps to global best practice, and providing a prioritised set of tailored improvement plans to each company, detailing projects they can undertake to improve their competitiveness and their sustainability.

The result from helping those companies implement more than 350 improvement plans has been exceptional, with average improvements in competency outcomes across a 4 year period such as:

- A **45% improvement** in the cost structures and analysis tools,
- A **39% improvement** in financial systems and practices,
- A **19% improvement** in management and leadership,
- A **23% improvement** in supply chain integration, and
- A **16% improvement** in people and performance.

Individual company improvements have been far more significant, and outcomes from projects have changed the nature of how many businesses operate.

An independent study conducted by Deloitte between 2008 and 2012 on companies that had undergone ASEA benchmark assessments found that on average, savings opportunities of **$2.4m per company** over a three year period were identified. A more detailed overview of the ASEA programs, the ASEA products and ASEA results is provided at Appendix One.

A key part of the ASEA program has been the close working relationship developed through the ASEA Steering Group, consisting of representatives from each car company, federal and state governments, the industry association and the component manufacturers, and chaired by AutoCRC. This Group has been instrumental in providing alignment of improvement activities with companies, and ensuring the benefits from government funding are maximised.

During the past three years, ASEA has also conducted 15 Industry Forums, where companies participating in improvement activities have shared the knowledge they gained with their peers, government and customers. Likewise during this same period, ASEA has also conducted 14 best practice visits, where companies demonstrate to their peers how they are implementing global best practices.

From the work undertaken with the companies over the last three years, the most common and most significant issues identified were in the areas of:

- global sourcing and the development of marketing strategies,
- management and leadership, and
- people and performance.

These findings are consistent with the investigative work conducted by Professor Roy Green et al in a 2009 study entitled, “Management Matters in Australia – just how productive are we?”

The importance of these findings is that more needs to be done in these vital areas if Australian automotive component manufacturers are to survive the next three years of challenges and uncertainties. The success of the ASEA engagement methodology and the outstanding results and outcomes of its programs strongly suggests an obvious mechanism for further developing the capability and sustainability of the Australian automotive component sector.
A recent analysis of companies that have participated in multiple assessments has revealed that companies that have a culture of continuous improvement, and focus on implementing improvement projects will continue to improve. The assessment data gathered by ASEA has proven that this focus does not just help companies to become more globally competitive, but can shift an entire industry sector.

This is demonstrated in Table Two below, where the automotive supplier industry sector is skewed to the right as companies continue to implement improvement projects over longer periods, and participate in additional assessments to measure their competitiveness.

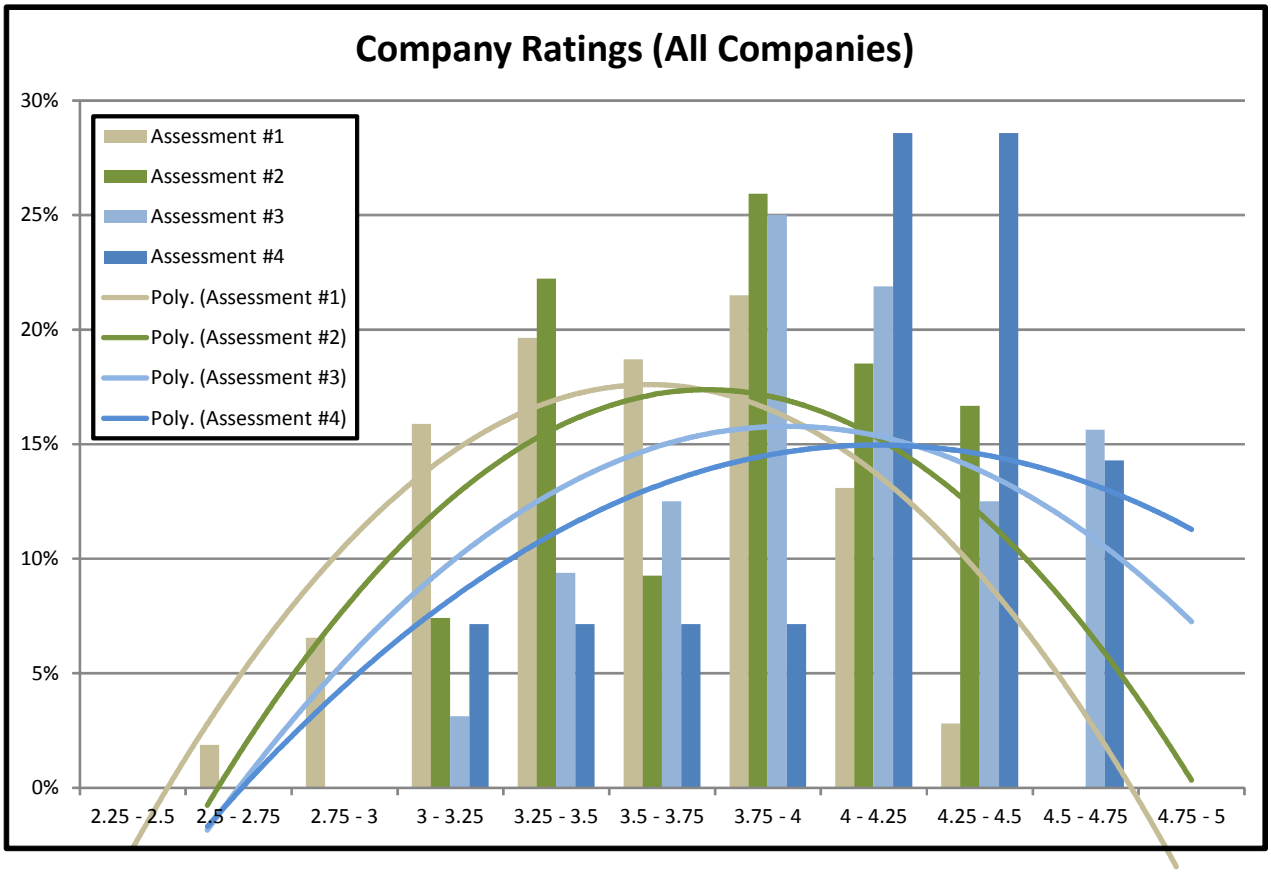


Table Two: Company Ratings

Achievements of the AutoCRC Research Programs and its Importance to the Automotive Industry

Established in 2005, AutoCRC has transformed the way the Australian automotive industry innovates and collaborates. It has cultivated strategic international linkages, completed 80 projects resulting in significant new knowledge and commercial impacts and led the creation in 2010 of the *Automotive Australia 2020* Technology Roadmap (Roadmap) which was endorsed by industry, federal and state governments, and the Automotive Industry Innovation Council.

Funded for an additional five years in 2012, the AutoCRC is charged with managing a research program, building a portfolio with a total value of $100m, including $46m in cash. This significant concentration of funding and capability provides a platform for the Australian automotive industry to collaborate internationally and create the innovation it needs to reap the full benefits of other federal and state government assistance programs.

AutoCRC's research program reflects the commercial imperative for decisive action by the Australian industry to exploit the opportunities offered by international markets as identified in the Roadmap. The program presents significant opportunities for SMEs to deploy their specialist skills to participate in the research collaborations, especially in the implementation process.

Research Achievements – Technology Take-up by Industry

AutoCRC has created and commercialised a number of new technologies with its industry partners, including:

- Patented Friction Stir Blind Riveting (FSBR) system has been shipped to the US and is undergoing development tests in **GM Holden North America**
- Low Global Warming Impact air-conditioning system data used by **Air International** to bid for overseas work
- **SMR** development of a powerfold product concept for potential inclusion in their near side view mirror products
- Licensing of electroactive formulations for coatings to **Du Pont** for use in building construction displays
- **SMR** Patented coating technology for the production of low-cost, durable plastic mirrors (a facility has been constructed in South Australia to produce these initially for Ford and for the export market)
- Production of prototype actuator systems and latches, undergoing feasibility testing in **Futuris**, targeted for EV manufacturers.

- Development of superior quality magnesium alloy engine mounts, shortly to undergo vehicle testing at **GM Holden**
- Production of mild hybrid prototype vehicle which was demonstrated to car manufacturers and licenced to **GM Holden**
- Creation of an implementation plan for Electric Vehicles in Australia, used by Mitsubishi when planning to import iMIEV EVs to Australia
- Prototype built of a 50kw output generator that produces clean, cost-effective electricity and reduces pollution. This technology resulted in the creation of a new company (**gTET**) developing higher capacity generators to sell to broader market
- Knowledge contained in a crash data database provides recommendations to **carmakers** in use of child restraints and protection for older drivers
- Development of an Australian speech database for voice commands, licensed to third party **Nuance**
- Algorithm for voice recognition with noise filtering on a single chip patented by **GM Holden**
- Production of an ergonomic human machine interface and energy management interface now in use in **GM Holden** Australian Statesman and Caprice police vehicles in the US market
- Development of a Wireless Communication Standards Framework, resulting in the creation of the **Australian Dedicated Short Range Communication** (AusDSRC) cluster and the allocation of radio spectrum dedicated to communication for vehicle safety
- A significantly enhanced database of crash information for **GM Holden** to understand better the safety of vehicles and make future design improvements
- Guidelines produced for **GM Holden** on cross-regional factors influencing safety, usability and acceptance for China, a key export market
- Production of a set of design guidelines and procedures evaluating variables in seating design that affect comfort and the subsequent production of a test rig to validate the guidelines in **Futuris**
- Improved road/rail safety system using Dedicated Short Range Communication (DSRC). Tested in vehicles and rural and metropolitan trains by the **Public Transport Victoria, Metro and V-Line, and now QRL**
- Production of data for understanding ergonomic requirements in future products destined for the Chinese market for **Ford**
- A database of human motion licensed to **GM Holden** and integrated into their vehicle design software that enables engineers to better design for the needs of a broad range of drivers.

A detailed overview of the AutoCRC Research Programs is shown at Appendix Two.

Recommended Policy Settings to Maximise the Long-Term Viability of Australian Automotive Component Manufacturers

The prospects for Australia's automotive component manufacturers will depend largely on their ability to survive in a high cost environment. This will almost certainly require them to increase their emphasis on adding value to their products and diversifying their business models so as to become and remain internationally competitive and gain access to higher volume markets. This will require action and change from all parties; the businesses themselves, industry bodies, government, and the research sector. Two responses in particular are key to addressing these challenges and are also central to the role and purpose of AutoCRC. They are: the continued investment in research and development of new technology in automotive and non-automotive product areas, and, ensuring international competitiveness is achieved in all aspects of the suppliers' businesses. Beyond 2016 Australia's automotive manufacturing SME's must possess the technological capability, business acumen, strategies, systems, global sourcing and marketing plans, to succeed on the world stage. Customer value creation and technological advantage will be the vital pre-requisites for success.

Three key areas that would benefit from continued (or additional) government support are:

- **Diversification**. Diversification in this context refers to expansion of business into new products, new processes, new market segments or new industry sectors. In the face of volatile demand from the local vehicle producer's business diversity is becoming a critical requirement for resilience and survival of automotive suppliers. And yet AutoCRC's experience suggests that diversification is a particularly difficult and challenging process for most manufacturers. Therefore we believe it will be important to develop further programs to encourage and support component manufacturers to diversify their businesses. AutoCRC acknowledges the current diversification programs available to the Australian automotive sector, such as the Automotive New Markets Initiative (ANMI) which comprises the Automotive New Markets Program and the Business Capability Support Program (BCSP) and a range of programs available under Enterprise Connect. However, given the importance that diversification will play over the next three to four years to the survival of the industry, AutoCRC recommends that more be done.

- **RECOMMENDATION ONE: Implement an additional three years of the Automotive Supply Chain Development Program** as this program is the essential building block for companies to prepare for diversification.

- **RECOMMENDATION TWO: Expand the BCSP by adding an additional $3m** in funding for the period 2014-2016.

- **RECOMMENDATION THREE: Require companies to complete a BCSP initiative** in order to become eligible to apply for "export" type funding under other programs (for example: ANMI and Export Marketing Development Grant (EMDG)).

- **Innovation and Collaboration**. AutoCRC acknowledges the current innovation and collaboration programs and initiatives currently in place, such as the CRC program, ARC grants, the Automotive Transformation Scheme (ATS), the Automotive New Markets Program, the Manufacturing Centre of Excellence (META) and Enterprise Connect (Researchers in Business program). In addition to these programs the AutoCRC recommends the following:

  - **RECOMMENDATION FOUR: A formal review and update of the AA2020 Technology Road Map** to ensure that proposed policy settings for innovation and collaboration are aligned with the future technology needs of the industry.

  - **RECOMMENDATION FIVE: Continuing levels of support for R&D in the ATS.**

  - **RECOMMENDATION SIX: Additional incentives for companies to partner with overseas companies and organisations around technology innovation.**

  - **RECOMMENDATION SEVEN: Revise rules around using in-kind contributions to allow automotive SMEs to contribute in-kind in lieu of cash contributions.**

  - **RECOMMENDATION EIGHT: Provide AutoCRC greater flexibility within its Commonwealth milestones to undertake research that will assist automotive component manufacturers to survive over the next three years.**

- **Access to Global Markets.** AutoCRC acknowledges the global access type programs currently in place at the Federal and State levels, such as Austrade initiatives, State government trade offices and the EMDG and Export Finance & Insurance Corporation (EFIC) programs. AutoCRC further recommends:

  - **RECOMMENDATION NINE: Encouraging the participation of Australian Automotive component manufacturers to enter global supply chains through the re-introduction of the Global Opportunities (GO) program.**

  - **RECOMMENDATION TEN: Increasing the tooling grant under the ATS.**

  - **RECOMMENDATION ELEVEN: Requiring all ATS recipients to report on the specific details on activities they have undertaken to enter global markets and supply chains.**

Appendix One

A WORLD FIRST FROM SOUTH AUSTRALIA'S SMR AUTOMOTIVE

South Australians, and indeed all Australians, can be justifiably proud of the SMR Automotive thin film coating project.

It is a story of visionary outlook, technical and business acumen, hard work, and a magnificently fruitful partnership between an Australian manufacturer and university, underscored by the funding, facilitation and support role played by AutoCRC.

It is also about bringing a product from concept stage to full production, and producing revenue not just for South Australia but the broader national economy.

The project has, furthermore, seen the conversion of innovative science into a unique, world's first, high value product.

It will also likely produce spill-overs into other sectors, opening the window to wider economic benefits in jobs, sales and broader business opportunities.

Located in Lonsdale, South Australia, SMR is the only Australian manufacturer of rear-view mirror systems.

Employing more than 500 people, it supplies all three domestic car makers and is a major exporter, with some three quarters of its production finding markets in the United States, Asia and Europe.

It is part of the international specialist Smavardhan Motherson Reflectec (SMR) group whose operations span 14 countries, producing a range of sophisticated products including exterior and interior mirrors, lighting and mirror adjustment systems, indicators and blind spot detectors.

The thin film coating project brought into focus the following challenge.

How to design and manufacture a world class, 21st century plastic mirror for motor vehicles which was lightweight and strong, and which could be used in a number of applications.

Cue Australian inventiveness, ingenuity and determination, fostered and enabled by AutoCRC.

As SMR project manager Dr Scott Edwards says, "We saw pretty early on the need for AutoCRC to assist us with our research and development priorities.

"SMR in France had been working on a plastic mirror project but they were having some difficulties in easily accessing the required external - that is to say outside the organisation - technical capabilities to bring this to fruition.

"In all, the product took three years to develop and production of the mirrors commenced in mid-2012," Dr Edwards says.

Because the reflector is plastic, it can be moulded into more complex three dimensional shapes, creating a whole new world of available design formats. As the specially coated mirrors are integrated, they are lighter and mean that the overall unit has fewer parts. Being plastic, they are also safer, for a plastic mirror is shatterproof, except under the most extreme circumstances.

"The mirrors are now being used on the new Ford 250 Super Duty Truck sold in the United States.

"We are making around 50,000 of these mirrors a month and the contract has a life of a further two years.

"AutoCRC played a very important role in providing funding and assisting with the linkages to the UniSA," Dr Edwards says.

He says that development of such a product is a highly technical, time consuming and costly endeavour, requiring very sophisticated research and development input.

"At the time, SMR in Australia didn't have the coating expertise necessary for this application.

"It was natural that we turned to the University of South Australia's Mawson Institute to help us develop the new thin film coating technology.

"SMR already had a good relationship with UniSA, through other funding measures and projects.

"One of the best things we did was to put SMR people actually at the university as secondments.

"So, in 2009, we had two engineers take leave from this organisation, to be actually employed by the university, to develop the product out there.

"Not only were we able to embed our people in the project but were also able to get them trained at the same time.

"From a knowledge management viewpoint it was quite fantastic in terms of our people bringing skills back with them into SMR once they finished the project.

"This has been a wonderful transference of knowledge and knowhow from the tertiary sector into industry – and this will be a lasting benefit for us.

"This project with its advanced technology has potentially created more jobs within SMR design and manufacturing. And it is sustainable employment.

"AutoCRC has brought about the circumstances for us to do this. It has been the enabler," Dr Edwards says.

"The biggest benefit is we're able to basically access Australian core capability that we didn't have. We needed coating expertise specifically for this application.

"To bring this coating expertise in-house we would have had to spend many millions of dollars, to acquire the prohibitively expensive equipment and buy in the development staff.

"This is easier said than done, and frankly would have made the project burdened with too many difficulties.

"We were, however, able to go to the university and access their facilities, imbed our own people, create our own capability in that area, and, most importantly, create a project at low cost.

"To justify the expense of creating another area of technical expertise outside your own core business would be a job unto itself.

"This is risk minimisation, when it comes down to it. With the help of AutoCRC, we've been to do this research and development at low risk.

"Apart from providing funding, AutoCRC's role was to monitor and watch over the project, in essence to ensure the ongoing success of the relationship between the two organisations," Dr Edwards says.

Collaborations between industry and universities can fall apart due to different cultures and operating ethos.

AutoCRC's CEO Jim Walker explains, "CRC's not only scout out opportunities, and then seek to create the happy marriage. But they also work to ensure that the marriage doesn't end in divorce. Because a lot of companies don't quite fully understand how universities work. And universities, on occasion, don't quite understand how companies work."

SMR is now seeking markets for the new innovative film coating technology across new product technologies.

This is where the spill over effect comes in.

"SMR is using the expanded knowledge and intellectual property generated by this project to springboard us into new product opportunities," Dr Edwards says.

"The focus has been to expand opportunities within the current automotive market.

"The UniSA thin film coating project has further strengthened our capabilities and enhanced our overall strategy. So that we can create even more value for customers, and separate us even further from our competitors.

"Also in the auto industry, the coating technology is being developed for use in prestige car interiors, where a premium is placed on style, aesthetics and new age latest development technology.

"The car industry is always looking for more exciting surfaces and ways to distinguish their vehicle from competitors. Premium cars, of course, have a lot of metal finishes.

"We are now developing, with European car companies, new exciting coatings and finishes for the interior of prestige cars.

"These are highly differentiated premium finishes using metallic surfaces and coatings, like brushed aluminium or steel.

"These products look like metal, but have all the advantages of plastic. Such as light weight, safety enhancements, flexibility in moulding design, functionality, etc.

"This is but one example of the spill-over benefits of the development of the film coating technology with UniSA and AutoCRC.

"This light weight plastic mirror project has gifted SMR a core capability in this exciting new coating technology. We now have, in-house, technical people who have spent three years at UniSA. I've got two coating engineers I wouldn't have had three years ago.

"As well, the model for this type of research and development is being repeated, with further secondments of SMR staff to universities occurring, to produce equally successful project outcomes," Dr Edwards says.

Appendix Two

THE UNIVERSITY OF SOUTH AUSTRALIA'S MAWSON INSTITUTE GROWS A WORLD-CLASS RESEARCH AND DEVELOPMENT CAPABILITY, ASSISTED BY AUTOCRC

South Australia's universities have a well-earned and coveted world class reputation in such fields as science, the law, medicine and the arts.

Within the Thin Film Coatings Group of the University of South Australia's Mawson Institute, this reputation for excellence and innovation is reaching new heights, with the assistance of AutoCRC.

Associate Professor Peter Murphy and his team have worked with the Australian arm of international group SMR Automotive on a unique thin film coating technology for plastic automotive rear view mirrors. This technology has now transitioned from laboratory based R&D through to a commercial product that is now being sold in the international market place.

As a result, this project has provided a unique opportunity for the research group to take its enhanced skills to the Australian market and the world.

SMR's essentially shatterproof, lightweight mirrors are now being fitted to selected Ford models in the USA.

This is a shining example of AutoCRC assisting an Australian university to work successfully with a local manufacturer, to traverse the challenging, yet richly fulfilling road from concept idea to an unequivocally successful commercial outcome.

But this is just the start of the story.

UniSA has been able to apply these capabilities and skills fostered on the project, to adapt and apply these to undertake research and development for an ever growing range of industries in Australia and overseas.

This has resulted in Professor Murphy being able to develop a research and development capability from modest beginnings to one that now has ten full time staff and 12 research students, with more growth prospects on the horizon.

The investment funding provided by AutoCRC has assisted UniSA to create the substantial research group that is now in place - an impressive team, exceptionally well-equipped to grasp opportunities in their areas of expertise.

"UniSA could see the potential of thin film coatings and its relevance to the manufacturing sector. The support from AutoCRC has undoubtedly contributed to the rapid growth of my research team.", Peter Murphy says.

"The tri-party investment by UniSA, SMR and AutoCRC was the catalyst, the enabler that allowed us to build the substantial group which is currently in place and is now extending its materials science expertise towards other target products.

"We now have a research group that is developing an international reputation and this is evidenced through an ever growing list of overseas based collaborative partners – both from academia and private industry.

"This investment was the building block, the cornerstone, from which we have built this capability. The funding and facilitation role played by AutoCRC has been crucial in this exercise.

"We have now applied our expertise into other industries and have linked up with additional partners as a result of the work we have done with SMR, and assisted by AutoCRC.

"The Thin Film Coatings Group is now working in many different areas, designing, applying and testing the environmental robustness of this thin film coating technology to a range of surfaces in an ever growing number of applications and industry sectors. This has resulted in several commercially valuable patent applications over the past 5 years.

"We are now working on developing ultra-high reflectivity coatings with application in areas of energy efficiency- for example in LED based lighting applications. Using completely different materials and coating designs to the automotive mirror application, this technology is also relevant to the concentrated solar power industry. In this case, reflective mirrors up to 15 metres in diameter are used to harvest solar energy by tracking the sun from sunrise to sunset. In such applications, every 1% increase in the amount of light reflected is crucial in enhancing the efficiency and financial viability of the power generation facility".

"There is a huge market for this, especially in Australia, but also internationally," Peter Murphy says.

As to AutoCRC's role, CEO Jim Walker explains. **"**If UniSA didn't have an industry partner, and they were just doing research essentially off their own bat, it would be, in all probability, that much harder for the research results to be commercialized.

"CRC's aim to establish a happy marriage between business and universities. Once the relationship is established, they work to ensure there is an ongoing fruitful association and successful academic and commercial outcomes. This is a win-win situation where the needs of both partners are met".

"It is clear that the Mawson Institute's Thin Film Coating group has achieved greatly enhanced capabilities from its work with SMR, and this is very gratifying for us at AutoCRC."

Peter Murphy says his research group has achieved impressive growth, thanks to the partnership AutoCRC. Over the past six and a half years, the combined investment by UniSA, SMR and AutoCRC into collaborative projects has been in excess of $7.5 million. When you consider the additional in-kind investments from the partners, as well as the cost of establishing a state of the art advanced manufacturing facility at SMR Automotive in Adelaide, more than

$20 million dollars has been invested by the project partners. This has resulted in the up-skilling of SMR's workforce in addition to the creation of new manufacturing jobs.

"The mutually beneficial relationship between UniSA and SMR is continuing, and indeed has more than three years to run.

"We are still working with SMR on advanced coatings," Peter Murphy says. "But now the brief has been expanded to functional decorative coatings - for cars, instrument panels and the like.

"In the longer term, there are a range of other new potential applications. For instance, in the highly prospective area of easy to clean surfaces.

"Everything you touch you contaminate with finger grease.

"We are now looking at design surfaces that stop the grease transferring from your fingers on to surfaces so that these surfaces will be far easier to clean.

"These have potentially huge commercial applications across many industry sectors.

"The first company to take to the market genuinely easy-to-clean surfaces will have secured a major commercial benefit, and a huge potential selling advantage.

"So this is just one of our longer term strategic development projects."

Peter Murphy is a pragmatist. "It's about delivering outcomes for industry," he says.

"We had to create a reputation for delivering outcomes and we've done that. And now the work is coming to us.

"The big change is that over the past year instead of us having to go and seek out new research opportunities, these are now coming to us.

"We have been able to trade on our enhanced reputation, which has been greatly strengthened by the SMR project and our association with AutoCRC.

"We have gone from having just one external partner to around a dozen currently. And these are all very significant, well established Australian and international businesses.

"The SMR and AutoCRC experience provides overwhelming evidence that research and development is crucial for the automotive industry in Australia," Peter Murphy says. "Our automotive component suppliers need to diversify to become globally relevant, and not be so highly dependent upon the consumption of product by the Australian automotive manufacturers. If we manufacture high value add, in-demand product in Australia, we can continue to play a role in the global automotive industry".

The UniSA and SMR project has allowed the synergies and connection between science and industry to be harnessed, and for real and pragmatic benefits to be identified and developed, and moved to the broad sunlit uplands of commercial life.

Appendix Three

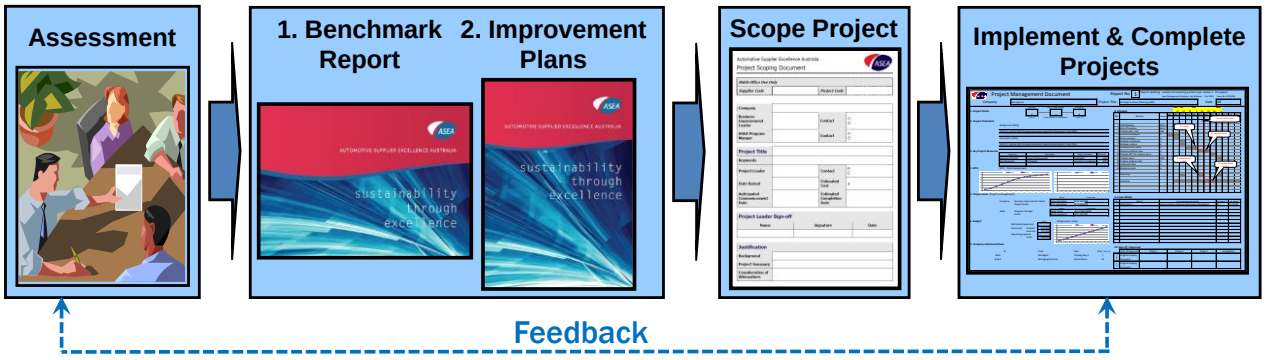
AUTOMOTIVE SUPPLIER EXCELLENCE AUSTRALIA (ASEA) SUPPORT PROGRAMS

In 2007, a need to support the Australian automotive supplier industry to achieve world-class benchmarks for competitiveness and sustainability was recognised, and Automotive Supplier Excellence Australia (ASEA) was established.

Since establishment, ASEA has successfully helped over 120 automotive suppliers by assessing the competency of their companies and/or sites against global best practice benchmarks, identifying gaps, providing a prioritised set of improvement plans to close the gaps, and finally helping them to implement projects to make them more globally competitive, and their businesses more sustainable.

Initially the team at ASEA had a focus on Tier 1 suppliers, but since 2010 has expanded this focus to incorporate the entire supply chain, and Tier 2 &/or 3 suppliers now account for around 25% of participants. Working on the entire supply chain increases sustainability and allows the industry to improve as a whole, rather than just at a Tier 1 level.

Each improvement process commences with an overall and wide-ranging assessment of the Company, which encompasses all of the competencies that should exist within a successful business. The outcome of the assessment identifies the gaps, and provides a prioritised set of Improvement Plans to address and close the gaps.



The assessment provides a set of foundation data for the company, against which subsequent progress can be measured. The Benchmark Report shows them where they are positioned relative to both “average” and “best practice” Australian and global businesses.

To date ASEA has conducted more than 220 Assessments, with some of the more progressive companies having now completed their fourth assessment. These organisations are using the results as input to their strategic planning to guide, expand and improve their businesses. As markets and operating conditions change, ongoing assessments can not only track the results of improvements already made within the company, but can also identify additional improvement opportunities the company can implement.

From the collection of all assessments ASEA can identify on an industry basis where the main gaps exist, and can develop appropriate training and coaching materials, while the consolidation of results from ongoing assessments also indicates how the overall industry is changing and improving.

To maximise the knowledge transferred from the training sessions and to ensure business sustainability, it is essential that all programs incorporate coaching activities. This helps the people involved to maximise the retention of knowledge through immediate implementation, as it is only by "doing" that the training become sustainable. ASEA now has access to more than 50 “certified” coaches/trainers, including many ex-industry executives and specialists, who cover a broad range of competency areas.

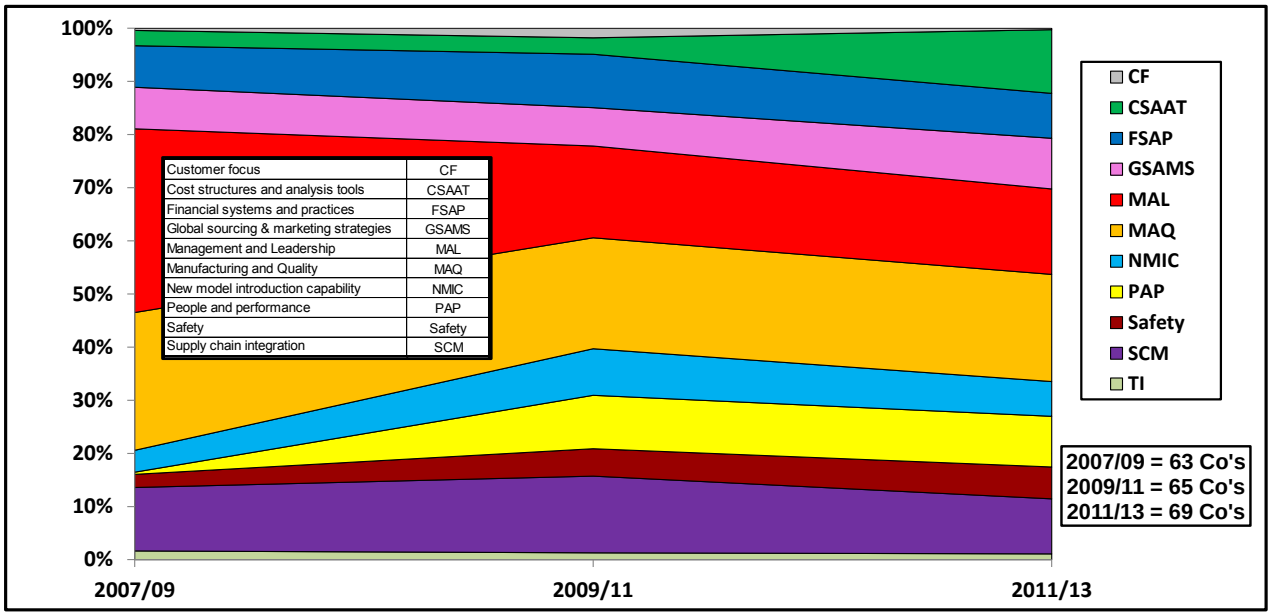
ASEA works to a standardised and disciplined process, which is based on client and stakeholder feedback and has been continually improved and refined. All improvement projects undertaken by ASEA are specified and detailed on a standardised "Scoping Document", signed by all stake holders, and tracked. The effectiveness of each project is assessed using a comprehensive and disciplined process administered through the ASEA Client Managers.

At the end of every project there is a standardised 1-Page “Project Close-out Document" that records and summarises the project, including lessons learnt and future actions. This document is signed by the all people involved.

Finally, a feedback form is sent to the Supplier, asking them to rate the services they received from ASEA, and identify any improvements we can make. This Feedback Form along with the Close-out Document, the Scoping Document and any Reports are filed in both hard and soft copies for future reference and audit purposes.

Throughout the past 6 years, ASEA has collected a huge amount of information about the automotive supply chain, and has written approximately 1,000 improvement plans. Analysis of these plans shows where the key gaps are within the industry at a particular time, and sequential

analyses show the change that has taken place over time. This is illustrated by the following graph showing the distribution of improvement plans by "Competency" at three different times.



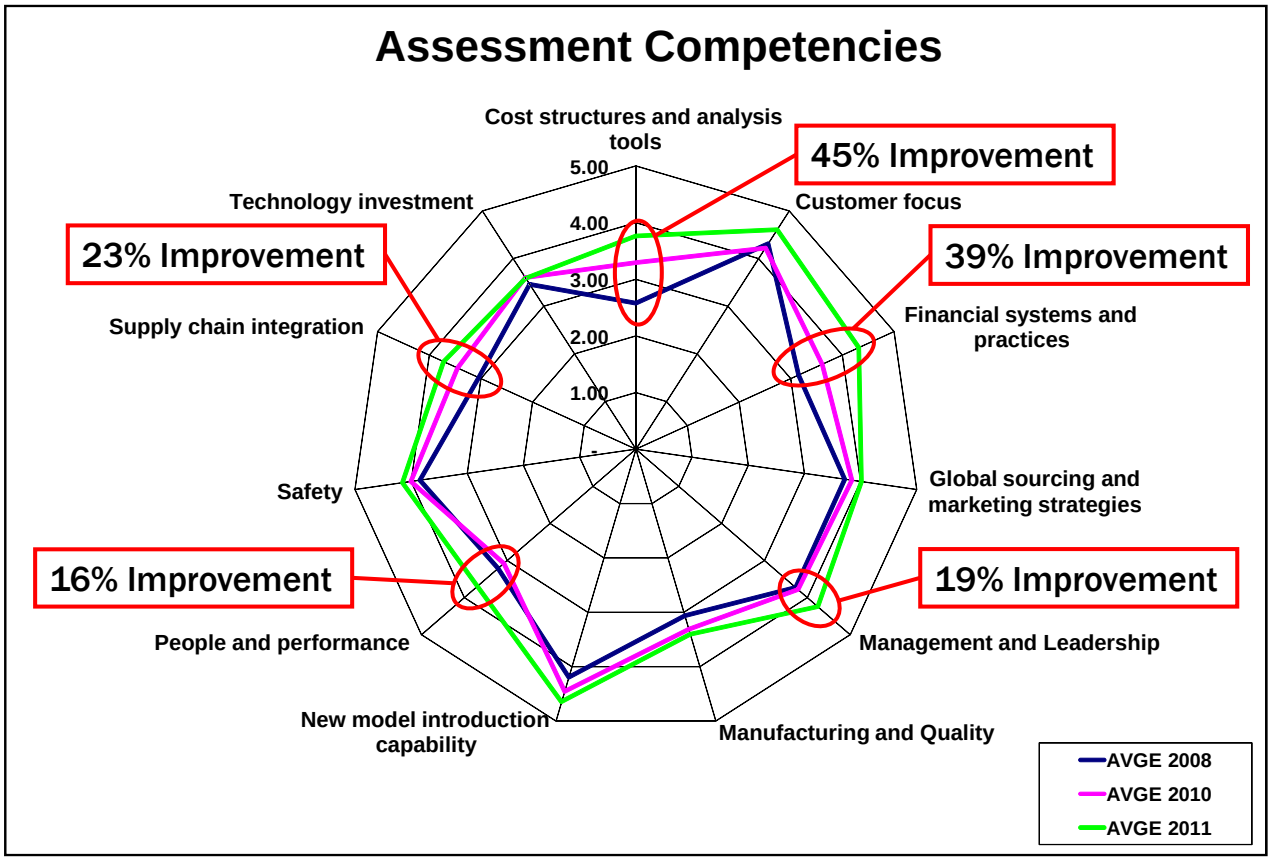
This graph points towards an important role for the "Management and Leadership" (MAL) competency, and further analysis of the assessment data shows a strong correlation between MAL competence and the rates of improvement in other business competences. Unfortunately as can be seen above, MAL is also one of the largest gaps within the automotive supply chain, although improving over time.

Interestingly, the perceived importance of making improvements to MAL competence is not uniform across the industry. Improvements in MAL were given the highest priority by small companies, whereas medium sized companies preferred to focus on "Manufacturing and Quality" (MAQ) and the highest priority for larger Companies and multi-nationals was "Supply Chain"(SC).

A benefit from having conducted identical assessments over many years is that improved performance can be identified and program impact assessed. 29 companies have participated continuously with ASEA since 2007 and have completed at least three assessments.

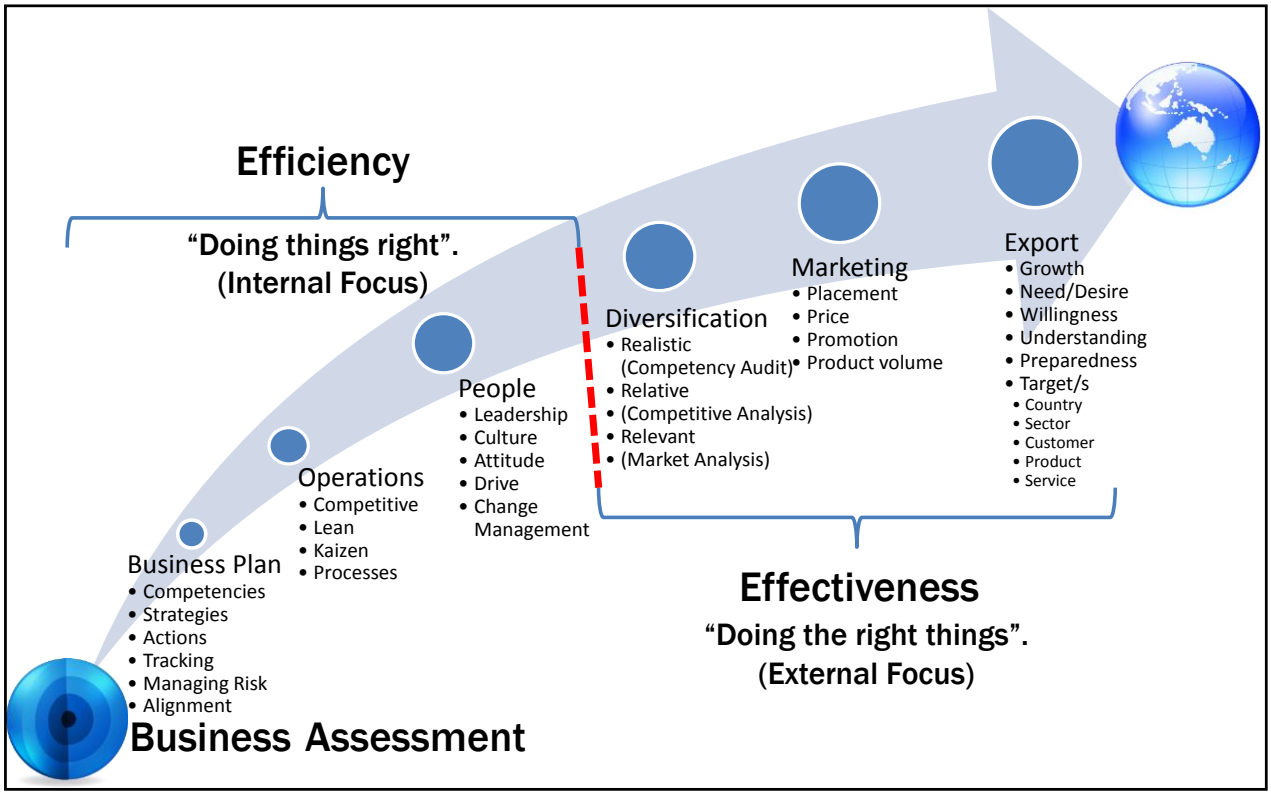
The average results of these 29 Companies is shown below across the 11 key competency areas of any business, and it can clearly be seen that there are significant improvements across many of the competencies. The results of these series of assessments demonstrate clearly that when companies have the desire and culture to implement improvement projects focused on

addressing their gaps, they can and will continuously improve. It is also interesting to note that the improvements are somewhat "staged".



Initially the greatest improvements were first seen in areas focused on improving internal efficiency such as cost structures, manufacturing, supply chain and financial systems. Following these initial improvements, the focus then moved to people and performance issues such as culture, HR systems, multi-skilling, training, etc.

Based on over 220 assessments of 120 automotive supply companies AutoCRC proposes the one page roadmap below to describe the journey for a typical manufacturing SME in the automotive sector, and most probably in any sector.

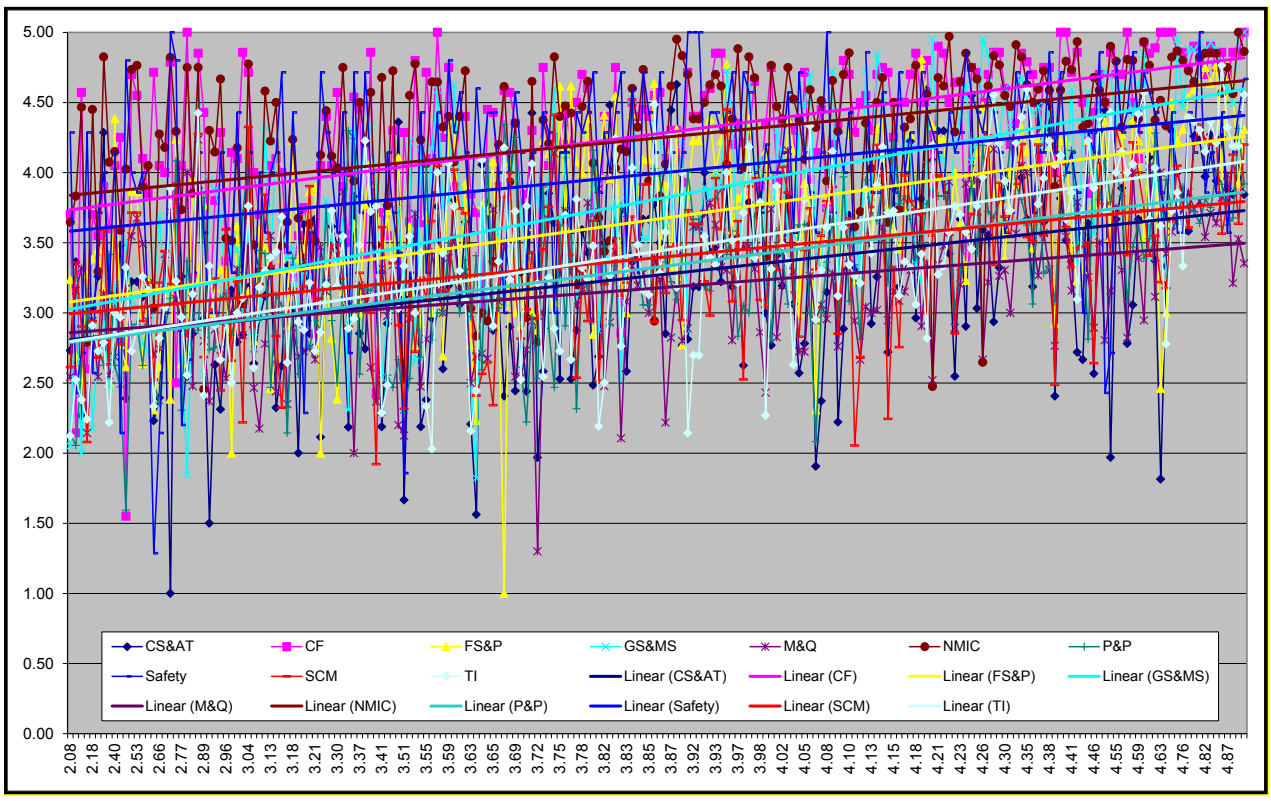


The initial focus of SMEs is on improving the efficiency of their business by "doing things right". This journey usually commences with the development of a 5 year business plan, followed quickly and sometimes simultaneously by an in-depth focus on improving their operational efficiency by implementing lean practices. Unfortunately lean is not sustainable unless the organisational culture is knowledgeable and supportive, so it is quickly followed by focusing on the people including training and HR systems.

Improving efficiency reduces costs and improves competitiveness, and allows them to then focus externally on activities such as diversification and in "doing the right things". However SMEs who have only supplied into the automotive sector and have had captive markets for many years, generally find it very difficult to do this. This step between internal and external focus is HUGE, but it is also an essential part of the growth journey.

Companies that have successfully made this step between efficiency and effectiveness are typically quite entrepreneurial, and received high scores for the MAL Competency. This observation lead to a study using all of the 220+ Company assessments, to assess the effect of MAL on all of the other 10 Competency areas in the assessment.

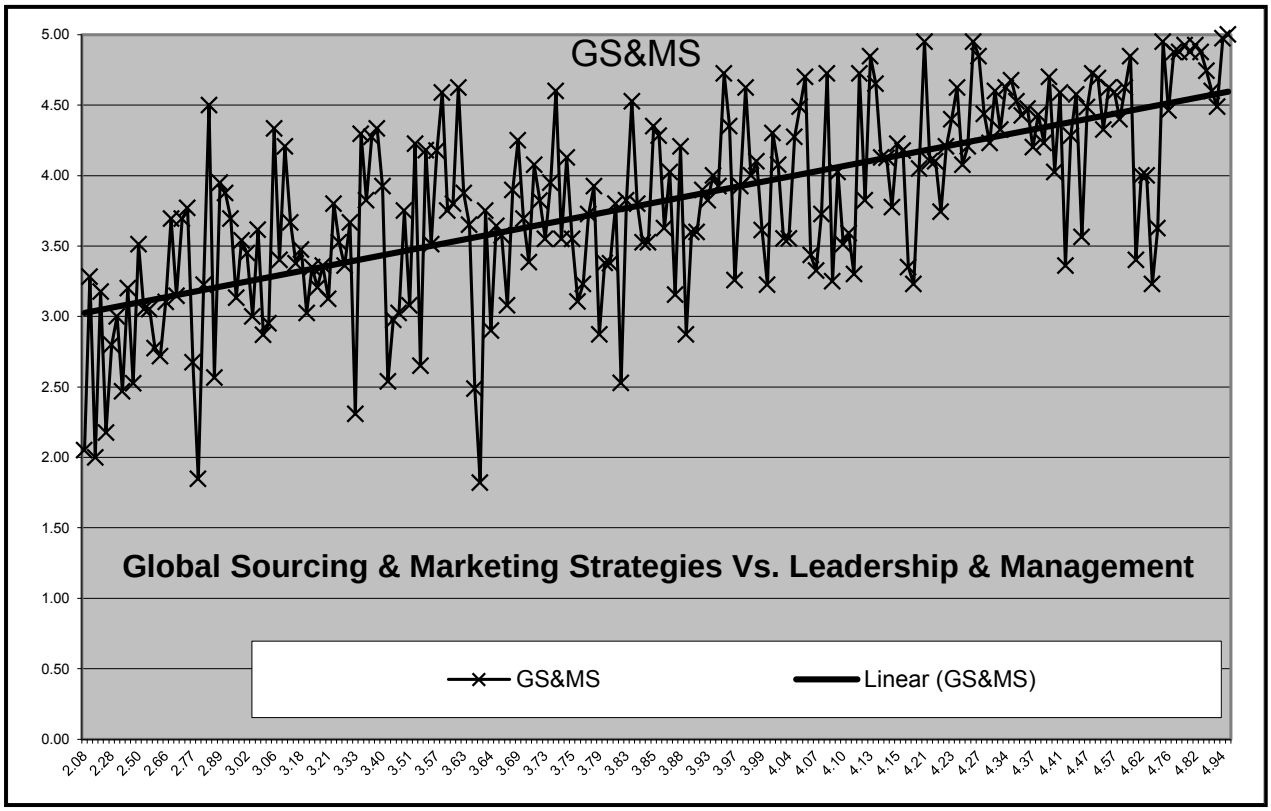
The result was the following very busy graph, with the gradient of the linear "lines of best fit" for each Competency indicating the magnitude of the effect of MAL on each. Using the lines of best fit, it can be clearly seen that the higher the score for MAL, the higher the score for every other Competency within the Company, and the lower the MAL score, the lower the other scores.



There are three Competencies with significantly higher starting values than the other seven, and these happen to be all of the Competencies that Companies have to do. If Companies do not focus on "Safety", "New Model Introduction Capability" (NMIC) and "Customer Focus" (CF), they will not get the business for the next model, so these are the things they must do.

However the Competencies with the highest gradients (and hence the largest influence of MAL) are the ones that Companies don't have to do, but are the ones that can most influence and enable the transition between efficiency and effectiveness. They are "Technology Investment" (TI) and "Global Sourcing and Marketing Strategies" (GSAMS) which are 2 of the critical key enablers for diversification. The most significant of these on moving and leading a Company into diversification is GSAMS, which can be seen below.

It is clear that the diversification activities and focus within the Company is very heavily influenced by the strength of the Management and Leadership team, and the direction they provide. Many of the SMEs understand that the need to diversify using a combination of process, product, service, customer, sector and global diversification options, but they struggle with how and where to start.



It is clear that there are a number of globally competitive Australian automotive supplier companies that are at the upper end of their journey, and are successfully exporting a variety of products to overseas customers. However, there is a much larger number that are still struggling with becoming more efficient, rather than becoming effective. The challenge for the Australian automotive supply sector is to maximise the number of companies able to make that transition. The transition is a particularly difficult task and AutoCRC believes that most companies facing this challenge will require assistance to achieve it.

There are also a number of Companies that have achieved good results in becoming efficient but are struggling with the move into effectiveness, and need support to successfully make the transition.

Appendix Four

AUTOCRC RESEARCH PROGRAMS

Established in 2005 as the CRC for Advanced Automotive Technology (AutoCRC) transformed the way the Australian automotive industry innovates and collaborates. It cultivated strategic international linkages, created the sector-wide supply chain development program *Automotive Supplier Excellence Australia* (ASEA), completed 80 projects resulting in significant new knowledge and commercial impacts and led the creation in 2010 of the *Automotive Australia 2020* Technology Roadmap (Roadmap) which was endorsed by industry, federal and state governments, and the Automotive Industry Innovation Council.

The Australian Governments recognised that innovation is central to ensuring that the automotive industry remains productive and internationally competitive, funding the AA2020CRC program and extending AutoCRC's industry-led cooperative research activity to 2017. AutoCRC is charged with managing a five year research program, building a portfolio with a total value of $100m, including $46m in cash. This significant concentration of funding and capability now provides the platform for the Australian industry to collaborate internationally and create the innovation it needs to reap the full benefits of other federal and state government assistance programs.

The Roadmap involved over 160 organisations and in excess of 2,500 contact hours, and examined the trends, drivers, needs and capabilities of the industry to identify opportunities and obstacles over the short, medium and long term. It identified a series of innovation investment priorities that will enable the Australian industry to internationalize and exploit its core strengths. The Roadmap now frames AutoCRC's research program which is focused on three themes; vehicle electrification, gaseous fuels and lightweight manufacturing.

AutoCRC's research program reflects the commercial imperative for decisive action by the Australian industry to exploit the opportunities offered by international markets. The program presents significant opportunities for SMEs to deploy their specialist skills to participate in the research collaborations, especially in the implementation process.

Achievements – Technology Take-up by Industry

AutoCRC has established a strong platform for collaboration and utilisation, delivering strategic and high quality industry-led innovation to the Australia automotive industry. Examples include

the Roadmap, ASEA, international linkages and the Visionary Research Program. In addition to these strategic initiatives, AutoCRC has created and commercialised a number of new technologies with its industry partners, including:

- Patented Friction Stir Blind Riveting (FSBR) system has been shipped to the US and is undergoing development tests in GM Holden North America
- Low Global Warming Impact air-conditioning system data used by Air International to bid for overseas work
- Over 90% conversion rate from planning to implementation for companies in the ASEA supplier excellence program
- SMR development of a powerfold product concept for potential inclusion in their near side view mirror products
- Licensing of electroactive formulations for coatings to Du Pont for use in building construction displays
- Patented coating technology for the production of low-cost, durable plastic mirrors (a facility has been constructed in South Australia to produce these initially for Ford and for the export market)
- Production of prototype actuator systems and latches, undergoing feasibility testing in Futuris, targeted for EV manufacturers.
- Development of superior quality magnesium alloy engine mounts, shortly to undergo vehicle testing at GM Holden
- Production of mild hybrid prototype vehicle which was demonstrated to car manufacturers and licenced to GM Holden
- Creation of an implementation plan for Electric Vehicles in Australia, used by Mitsubishi when planning to import iMIEV EVs to Australia
- Prototype built of a 50kw output generator that produces clean, cost-effective electricity and reduces pollution. This technology resulted in the creation of a new company (gTET) developing higher capacity generators to sell to broader market
- Knowledge contained in a crash data database provides recommendations to carmakers in use of child restraints and protection for older drivers
- Development of an Australian speech database for voice commands, licensed to third party Nuance
- Algorithm for voice recognition with noise filtering on a single chip patented by GM Holden
- Production of an ergonomic human machine interface and energy management interface now in use in GM Holden Australian Statesman and Caprice police vehicles in the US market

- Development of a Wireless Communication Standards Framework, resulting in the creation of the Australian Dedicated Short Range Communication (AusDSRC) cluster and the allocation of radio spectrum dedicated to communication for vehicle safety
- A significantly enhanced database of crash information for Holden to understand better the safety of vehicles and make future design improvements
- Guidelines produced for GM Holden on cross-regional factors influencing safety, usability and acceptance for China, a key export market
- Production of a set of design guidelines and procedures evaluating variables in seating design that affect comfort and the subsequent production of a test rig to validate the guidelines in Futuris
- Improved road/rail safety system using Dedicated Short Range Communication (DSRC). Tested in vehicles and rural and metropolitan trains by the Public Transport Victoria, Metro and V-Line, and now QRL
- Production of data for understanding ergonomic requirements in future products destined for the Chinese market for Ford
- A database of human motion licensed to GM Holden and integrated into their vehicle design software, that enables engineers to better design for the needs of a broad range of drivers
- Development of a research focused project and knowledge management system licensed to several third party organisations by VPAC, and used by AutoCRC
- web-based project planning and management systems, currently used under licence by five other research organisations
- Seventy (70) AutoCRC postgraduate scholarship holders have completed their studies
- Further thirty (30) students are expected to graduate within five years.

Case Study – GM Holden

GM Holden has invested strongly in technology development through AutoCRC, and at least 14 AutoCRC developed technologies have found their way into the Holden Australian-made local and exported product, either in the vehicle as components, designs and manufacturing processes, or outside the vehicle as infrastructure or safety initiatives. Many of these technologies are also embedded in GM global products.

Case Study - SMR

SMR, in collaboration with University of South Australia and AutoCRC have developed a world first-to-market, light-weight, plastic automotive exterior mirror. This unique product features a

patented multi-layer thin film coating system performance superior to glass, process optimized and implemented in mass production in three years. As such the result is an exemplar of Australian research collaboration and innovation.

This case study reveals unique and wide-ranging benefits for Australian research and industry. The project was a highly effective collaboration between the University of South Australia and SMR Automotive (through AutoCRC), the product required exploration of fundamental science, then translated into a commercial ready product, using an inter-disciplinary project team of materials scientists, physicists, process engineers and mechanical engineers.

The success of the project and the product was such that SMR operations were expanded significantly. A multi-million dollar investment to their facility added four thin film vacuum coating machines, an automated "wash and dip" coater along with a state-of-the-art, quality test centre. The facility has manufacturing capacity for up to 5M mirrors per year. In 2012 SMR commenced exporting plastic mirrors, for Ford North America F-series truck at a rate of 50,000 per month.

The collaboration was so rewarding, SMR renewed its commitment to AutoCRC's research and development model, and is now a major investor in AA2020CRC.

Current R&D Activity

As mentioned previously, AutoCRC's research agenda for 2012-17 has been set by industry and addresses three Roadmap priorities that require complex collaboration, multi-disciplinary research and new human capital:

- **Program 1: Vehicle Electrification** – to position the Australian industry in key elements of the global trend towards electric vehicles (EVs);
- **Program 2: Gaseous Fuels** – to address both technological and social barriers to the uptake of gaseous fuels in cars and trucks; and
- **Program 3: Lightweight *(Sustainable)* Manufacturing** – to make the Australian automotive industry sector cleaner, more efficient and produce greener vehicles and components more competitively.

Vehicle Electrification

The market penetration of EVs is constrained by their relatively limited endurance (i.e. range), the time taken to recharge and initial purchase cost. The Roadmap identified that Australia has a number of competitive advantages that it can capitalise on to play a major role in developing solutions to these issues. Australia is the second largest producer of lithium, has a robust electricity grid, and has globally recognised research strength in energy storage and powertrains.

Program 1 will focus on new and innovative solutions to increase the energy density of battery systems, develop new strategies for rapid charging and develop new, low cost and more energy efficient automotive powertrains. The research will be underpinned and informed by the econometric model for the uptake of alternative fuels developed in Program 2.

This program aims to position Australia as a provider of critical technology in strategic aspects of the global EV market, and to increase the uptake of EVs in Australia. To ensure capture of benefits for Australia, this program will include Australian SMEs CAP-XX (a NSW-based super capacitor manufacturer), Redarc (SA-based power management systems company), Blade EV (Victorian-based EV converter), and ChargePoint (a NSW-based charging service provider). It will also involve international participants GM Holden (Australia and USA), Toyota Australia, DLG Energy (Victoria-based subsidiary of DLG Battery Co, China), MAI (Malaysia) and Baosteel (China's largest steel producer, with a strategic commitment to development of new energy materials). These end-users are committed to working with the research team to enhance the probability of success and providing a clear path to utilisation.

Gaseous Fuels

This program is driven by the cost and supply advantages from Australia's large reserves of natural gas and the potential for reducing carbon emissions. The International Energy Agency is projecting Australia to become the third largest producer of liquefied natural gas in the OECD by 2035. According to the Australian Bureau of Agricultural and Resource Economics, Australia's identified gas reserves are approximately 393 000 PJ - equating to around 180 years supply at current production rates. Both LPG (liquefied petroleum gas) and natural gas release less carbon dioxide per unit of energy than oil and so switching to natural gas offers a relatively quick way to cut emissions with little change to overall transport infrastructure.

The take-up of gaseous fuels is constrained because:

- Infrastructure planning and policy development has been poor and ineffective;
- Consumers find refuelling difficult, slow and inconvenient;
- Storage tanks are difficult to integrate into cars and intrude into the usable spaces; and
- Engine performance can be sub-optimal, especially in conventional retrofits.

This research program will provide deeper understanding and new technical solutions to enhance the consumer refuelling and driving experience, it will address the current limitations of storage tanks to deal effectively with the pressure and temperature extremes associated with natural gas fuels and it will maximise the environmental impact of moving to these cleaner, cheaper and locally abundant fuels.

To ensure the uptake of the research outputs and to capture the benefits to Australia, this research program includes LPG Australia (representing the Australian LPG industry, which is dominated by SMEs). It also includes Australian end-users, SA Department of Premier and Cabinet (strategic interest in increasing the uptake of alternative fuels), Ergon Energy (Queensland-based energy supplier), with additional support from RACQ and RACV (peak motorist associations). It involves international participants MAI (Malaysia) and Sammitr (a Bangkok-based specialist in Natural Gas Vehicle conversion). A number of third parties including BMW are also engaged in project work as a consortium with QUT.

Lightweight (Sustainable) Manufacturing

Program 3 is developing new technologies and scalable manufacturing methods to provide new lightweight components and bodies and new advanced coatings that enhance durability and reduce wastage. Lightweighting was identified in the Roadmap as a critical enabling technology to deliver reduced emissions in conventional vehicles and to drive increased uptake of alternative fuelled vehicles, including EVs. This program will involve extensive Life Cycle Analysis to ensure that the outputs meet the most rigorous international standards to reduce, reuse and recycle materials.

This program has the dual aim to make Australian automotive manufacturing cleaner and leaner. To ensure the uptake of the research outputs and to capture the benefits to Australia, this program includes the Australian SME ACS Australia (Victorian-based composites commercialisation company), Futuris (leading Australian manufacturer of automotive interiors) and SMR (diversified SA-based manufacturer with >20% world market share in exterior mirrors

for cars, commercial vehicles and heavy trucks). The program also involves international participants GM Holden, MAI, Sammitr and Baosteel.

AutoCRC has ramped up its new research program over the past 18 months. At present there are 31 active industry focused projects, with both local and international collaborations. The foci of the current research include;

- significant levels of R&D in advanced battery chemistry, module design and battery management,
- focused research on advanced functional coatings on plastic and other low cost substrates,
- strong industry investment in modeling consumer take-up of energy efficient vehicles and alternative energy for transport, and
- Australian SME engagement in many projects, including working with overseas companies.

With systems, access and research activity in place, AutoCRC is on-track to achieve its Commonwealth-agreed contractual milestones, and economic impact. A survey of current activity shows substantial investment in each program, with local and international industry engagement, with organization size ranging from SME to multinationals, as shown below.

Program 1 Vehicle Electrification

- Breakthrough Battery
  6 projects $4.4m total budget
  Participants: MAI (Malaysia), ARCA (Malaysia), Redarc, UoW, UTS, SUT
- Hybrid and Electric Powertrains
  5 projects, $1.52m total budget
  Participants: GM Holden, Baosteel (China), CNEVRA (China), CSIRO, UoW, UTS, DSDBI

Program 2 Gaseous Fuels

- Take-up of Alternative Energy for Transport
  3 projects, $1.56m total budget
  Participants: MAI (Malaysia), DMITRE, QUT, UniSA, and EPIC consortium
- High Capacity, Fast Fill Storage Solutions
  1 project, $0.5m total budget
  Participants: RMIT

Program 3 Lightweight Sustainable Manufacturing

- Lightweight Structures
  13 projects, $5.6m total budget
  Participants: Sammitr Thailand), VCAMM, MAI (Malaysia), Futuris, CECAP, Multimatic (US), NHK (Jp), Autokeen (Malaysia), SIPRO (Malaysia), Dolphin, Metalsa, Backwell, CSIRO, Deakin, VPAC, SUT, RMIT
- Advanced Coatings
  3 projects, $5.4m total budget
  Participants: SMR, GM Holden, UniSA, VPAC, CSIRO

Education

Education has always been a vital part of AutoCRC's activities and its industry seminar and technical conference program since inception has attracted over 1000 attendees. 70 AutoCRC postgraduate scholarship holders have completed their studies, and a further 30 are expected to graduate within five years; all contributing to AutoCRC's agreed research program milestones. To date, 200 industry student projects have been completed by teams of undergraduate students in participating universities.

AA2020CRC's education and training program is integrated with its research, SME engagement and commercialisation programs. The contractual arrangements for PhD research projects in industry, particularly with Australian SMEs, have been streamlined for ease of access. The student projects are defined and tightly focused on industry needs. This industry-friendly approach promises to substantially increase the innovative capacity of Australian SMEs and enhance their ability to compete in the international supply chain with industry-ready graduates. In addition, these students and the industry participant will link into the very best international research through international exchanges to leading Asian, European and North American universities.

SME R&D Linkages

The Australian automotive supply chain comprises some 200 SMEs. AutoCRC has focused on the industry's SME organisations and has an exceptional record of success in working with SMEs. Its flagship initiative ASEA provides an independent, best-in-class benchmarking and targeted improvement process to the Australian automotive supply chain. ASEA's assessment framework identified a pressing need to increase the innovative capacity of Australian SMEs in the

automotive supply chain and for them to embrace new technology. AutoCRC delivers this capability.

Through its ASEA program network, and core participants the Victorian Centre for Advanced Materials and Manufacturing (VCAMM), and Malaysia Automotive Institute (MAI), AutoCRC has established a pro-active SME engagement process to ensure that, through all R&D projects, benefit to Australia is captured and maximised. This process builds on the ASEA program, itself recognised by a CRC *Star Award* in 2009 for innovation in SME engagement.

Frameworks

AutoCRC has collaboratively developed a comprehensive contractual framework as a solid foundation for industry to work with its researchers. The international automotive industry has specific requirements regarding intellectual property (IP) management, financial and project management controls, and a priority for researchers to hear the "voice of the customer" throughout the project duration. The industry-led philosophy of AutoCRC supports these priorities with its agreements and project management templates, giving AutoCRC a further competitive advantage as a research centre for the industry.

AutoCRC has also experienced many of the challenges and risks associated with international IP licensing and commercialisation and it has applied all of the typical protocols of close control of information flows, embedded technical protections against copying/reverse engineering and careful supply chain management. Many of AutoCRC's staff and Australia-based end-users have extensive experience with establishing joint venture companies and high-quality international manufacturing operations, while retaining Australia as the primary location for IP development.

Furthermore, AutoCRC has engaged prestigious and highly reputable international organisations into the Participant group, and those relationships have all been developed as a result of close government-to-government cooperation (with high level support from Austrade and the Victorian Government in particular). Especially in Asia, the ongoing close bilateral involvement by government is a powerful strategy for risk management and conflict resolution in legal, contractual and IP areas.

AutoCRC has strategically engaged with a significant number of international partners. The Roadmap and AutoCRC vision can only be achieved by connecting Australian researchers and companies (particularly domestic SMEs) with equally ambitious international companies. Complementing its strong Australian industry cohort, AutoCRC has attracted new participants

from Malaysia, China, Thailand and Japan, to ensure that Australian products and know-how created from the AutoCRC outputs are immediately integrated into high growth global supply chains. In this way, the overseas investments in AutoCRC will lead to further investment and more jobs for Australia.

At the industry-project level, the commercialisation of AutoCRC's research outputs is carefully planned through the international supply chains accessible via the participating organisations, and the business opportunities have been quantified and risk-adjusted using the CRC Program Economic Impact Analysis protocol. The key assumptions and estimates of additional investments required to achieve the economic impacts have been rigorously reviewed in conjunction with the Deloitte Automotive and Manufacturing Team (Melbourne) and key end-users.

While the risk profiles and timescales to commercialisation vary across projects, the total portfolio is balanced and the returns on investment show a high degree of consistency. The overall benefit-to-cost ratio for AutoCRC is 2.6:1 and this represents a sound investment for the Commonwealth and the participating organisations. The analysis indicates that AutoCRC research programs and their commercialization will deliver $453 million in economic impact, with a benefit: cost ratio of 2.6:1, and an industry-ready contingent of 225 graduates and PhDs. Furthermore, AutoCRC has the prospect to create over 500 additional jobs and reduce CO_2 emissions by over 14 million tonnes.