Firstly I'd like to introduce myself to the readers to provide some background of my experience so that my observations and recommendations can be evaluated appropriately. I'm senior lecturer at Deakin University but this submission is my private view and doesn't necessarily reflect the views of the University. Some of the units that I teach include Automotive Product Development, Developing Innovations, Automotive Powertrains, Heat Transfer, etc. I'm also founder and CEO of the start-up company Ino8 Pty Ltd. The aim of the company is the commercialisation of safe and clean automotive innovations that are affordable to everyone. So far the company portfolio includes two patented technologies: the multi award winning OVER7™ waste heat recovery system that reduces fuel consumption by over 7% and the award winning SafeRide™ dynamic stability control for narrow leaning vehicles that enables a new generation of cross over vehicles between bikes and cars that combine the best of both worlds. Before joining Deakin I worked for Ford Motor Company in several management roles in product development, 14 years in Germany and 4 years in Australia. I'm also serving on the board of the non for profit organisation Society of Automotive Engineers – Australasia (SAE-A).

The aim of this submission is to provide insides and specific elements related to my experience from within the German automotive industry when I was a member of various German industry groups and associations.

Executive summary

Important market and regulatory factors are:

1. **CO2 emission regulation / fuel consumption**: Australia lags 30% behind the leading markets of Europe and Japan
2. **Exhaust emission regulations** in Australia lag around 5 years behind Europe and are more comparable to emission limits in China and India
3. **Traffic Congestion** is increasing and a serious issue in all large cities around the world
4. **Vehicle Safety** is important to mitigate the global trend of increasing numbers of traffic related fatalities from currently 1.3 million fatalities per year
5. Cars developed to meet only the **mild Australian climate** can't be exported in many markets. However, the tough and hot Australian environment offers an opportunity for vehicle evaluation and development in compressed product development cycles.
6. **Left- and Right Hand Drive** requirements is another factor that prevented exports of Australian vehicle due to increased cost and complexity
7. **The headquarters and ownership** of all global car companies is outside of Australia which has negative effects on investment decisions, research activities and the transfer of ownership of patent rights
8. **Inventions are rarely made** by Australian car producers. If inventions are made by Australian car makers the rights are transferred to their parent company which files relevant patent applications.
9. **Germany has a worldwide unique patent protection act** that fosters a culture of innovation across the workforce and across employing organisations
10. **Automotive Research in Australia is well below global standard** as evaluated by the Excellence in Research for Australia 2012. Automotive Engineering has the lowest number of researchers amongst all different 15 Engineering disciplines of all Australian higher

education institutions. This is only around 10% of the staffing level compared to other engineering disciplines.

11. **Limited Access to Finance** is the biggest single barrier to innovation for 21% of Australian businesses
12. **New leaning cross-over vehicles** between 2-wheelers and cars are being developed and introduced by many global car manufacturers of cars and motorcycles as well as new start-ups
13. **Expertise related to narrow tilting vehicle is widely available in Australia** through different inventors and enthusiasts
14. **Australia is the home of many world class racing athletes**, and perhaps has the largest number of vehicle racing word champions per citizen.

Proposals for alternative public support mechanisms are as follows:

1. **Introduction of an Invention Protection Act** similar as in Germany with modifications for simplification and improved effectiveness
2. **Tying support mechanisms directly to research** instead of investments for manufacturing and product development to push support upstream the innovation value chain for improved effectiveness and minimisation of cost
3. **Establishing a Venture Capital Fund dedicated to Automotive Innovations** similar as the Renewable Energy Venture Capital Fund or Biotech Fund to reduce starving of innovations in the valley of death of commercialisation
4. **Establishment of an Automotive Research Association** similar to German examples that are aimed at long term pre-competitive collaborative research to establish an Australian research leadership in the Asian region
5. **Establishing a consortium to develop, produce and commercialise the world's first global cross-over vehicle between a car and a motorcycle** that really combines the best of both worlds, similar as the AxcessAustralia projects that generated more than $700 million of new export business for Australia.

NATIONAL AND INTERNATIONAL MARKET AND REGULATORY FACTORS THAT ARE AFFECTING THE AUSTRALIAN AUTOMOTIVE MANUFACTURING INDUSTRY'S INTERNATIONAL COMPETITIVENESS, WORKFORCE PRACTICES AND LONG TERM SUSTAINABILITY

1. CO2 Emission Regulation / Fuel Consumption

Australia's voluntary CO2 emission standard is one of the worst of the world and about 30% higher compared to markets that are leading that field like Japan and Europe (figure 1). The result is that cars that are developed in Japan and Europe are much more efficient and competitive compared to Australian made cars. Consumers that are concerned about their operating costs and/or the environmental impact of their cars buy more efficient cars than the Australian cars.

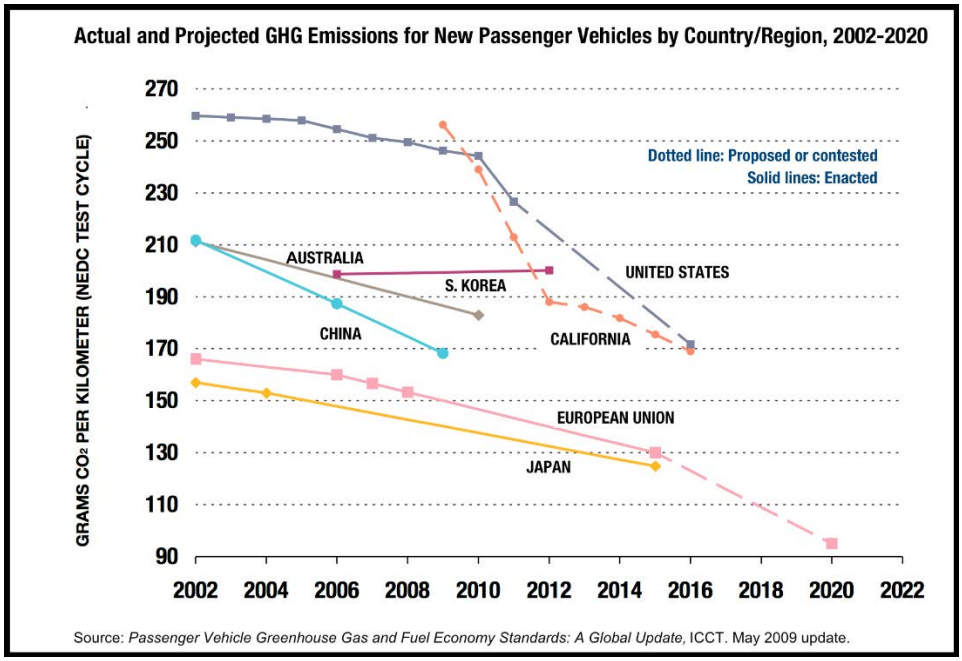


Figure 1 Global CO2 standards /1/

The executive managers within the Australian car manufacturers that have been responsible for the fuel consumption targets of their cars haven't been sensitive to the importance of fuel economy and CO2 emissions for a long time as they simply don't need to pay for their fuel. During a Ford management meeting I proposed to lead by example and to get rid of the free fuel cards for management instead of removing the option of a free wedding car for all employees, the rest of the team applauded strongly but the American CEO at the time replied that this was a hollow view.

2. Exhaust Emission Regulations

Even though Australia has adopted the European emissions regulations, the introduction of the new standards typically lags 5 years behind Europe and therefore the emissions performance of the Australian cars is more comparable to the cars produced in countries like China or India. One of the key reasons why Australia is lagging so far behind Europe is the lobbying of the Australian car manufacturers. For example the introduction of the Euro 4 standard for cars with petrol engines was delayed by 2 years compared to Diesel engines because Ford lobbied that it would fit better in their product cycle plans.

However, when Ford started to look for export markets for their Territory they figured out that they couldn't export it to the UK because it didn't meet the European emission standard.

3. Traffic Congestion

SAE paper 2011-28-0001 summarises some interesting trends related to traffic congestions /2/:

Parking in major cities is becoming more and more difficult and the prices to park a car is also continually growing. These factors are in influencing customer's preference to smaller cars, which are also easier to manoeuvre in parking garages. Increased traffic congestion is a direct consequence of the growing vehicle fleet and the increased distance travelled per vehicle. "In 2003 - 2004 alone,

the passenger vehicle fleet on Australia's roads increased by three percent or around 260,000 extra vehicles nationally" /3/. This is in line with the OECD who "have prepared projections which indicate that, between 1990 and 2030, there will be an increase of 79 per cent in kilometres travelled by all vehicles within the OECD countries, and a rise of 312 per cent for countries outside the OECD (OECD 1996)" /4/. This indicates that this is a trend that will prevail for a longer time and the traffic congestion problem likely to continue to grow.

However, the average car occupancy for journeys to work is only 1.2 according to Public Transport User Organisation (PTUO) /5/, and in the US it is the same even considering all times usage /6/. Bearing in mind that most families have two cars where one at least is only used for commuting, a vehicle with only two seats would be sufficient to solve the needs of at least of 50% of passenger car drivers. This means that most of the existing passenger cars are absolutely oversized compared to the needs of their users.

What is even more concerning is that most of that traffic growth is actually predicted for cities. Today "urban areas already account for 50% of the world's population, but 80% of the world's wealth". "By 2030, urban areas are projected to account for 60% of the population and greater than 80% of the wealth "/7/. This is going to paralyse many mega cities so that the advantages of individual transportation with motor vehicles will diminish rapidly. The average speed in the Greater Tokyo Area is already down to 15km/h reported in 2008 /8/.

4. Vehicle Safety

Worldwide every year around 1.3 Million people are killed in traffic accidents, most of them on two wheelers. In Victoria, 17% of road fatalities are riders and passengers of motorcycles, even though they travel much less kilometres than cars /31/. The number of two wheeler fatalities is increasing, in contrast to the continuously reducing number of fatalities of car drivers and passengers. Cars have become much safer through the introduction of various passive and active safety systems like crush zones, seat belts, neck rests, ABS and lately ESC. The wide-ranging introduction of these technologies have been driven mainly through safety ratings tested and published by ANCAP and similar global partner organisations. However, for 2-wheelers only a few of such safety technologies have been introduced and mostly only on very expensive models as no equivalent to ANCAP exists. So safety of 2 wheelers is a critical issue to reduce the road toll in Australia and worldwide and road fatalities and injuries from riders of 2 wheelers are a serious economic loss. The Victoria Police Road Safety Strategy 2013-2018, contains some relevant statistics: "In 2012, 282 people lost their lives on Victorian roads, with serious injuries affecting more than 5,500 people. The economic cost of road trauma per year is estimated to be in the vicinity of three billion dollars. The human cost of road trauma is profound and lifelong" /9/.

5. Climates

Australia's climate is quite mild compared to other regions even though the average temperature over one year and different locations is not too much different from other regions like Europe or North America. However, in Europe, USA, Japan and China cars need to developed to function at temperatures as low as -30°C. That is not the case for probably many Australian made cars. Not only that most of them most likely wouldn't start at such a low temperature, many other systems would not work or perform adequately, the heating system is certainly one of those. The costs of

developing and manufacturing cars that would meet the development targets of these largest car markets would have been much higher and would have made the Australian manufactured cars less competitive in Australia.

However, some elements of Australia's climate are very advantageous for the development of new cars. The summers are consistently very hot, especially in the Northern parts. Because the seasons are shifted by half a year compared to the Northern hemisphere, Australia is a perfect location for hot climate vehicle evaluations. This capability is becoming more important with the trend towards the reduction of development cycles where most car companies only produce one prototype vehicle series anymore compared to typically 3 different prototype series around 20 years ago. The next trend might be to conduct cold and hot climate evaluation concurrently at the same time but by different team members in different parts of the world to further reduce development durations.

Furthermore Australia has a lot of open space with a tough and rugged environment which is ideally suited for the development and evaluation of any type of off-road vehicles.

Another interesting aspect related to the mild climate in Australia is that it is much favourable for electric vehicles compared to colder temperatures. At negative temperatures electric vehicles become much less efficient so that its limited range is reduced much further, by 30% or more depending on the temperature. If the driver wants to use a heater, then the range is reduced even more. So Australia has a natural environment that is more supportive for electric vehicles, hybrid- and plug in hybrid electric vehicles.

6. Left- and Right Hand Drive

Australian cars are designed to have the steering wheel on the right side of the car to be able to be driven on the left side of the road. However, only 30% of the world's countries drive on the left side. Even more importantly the number of cars produced every year with the steering wheel on the right side is much smaller again, as the world's largest car markets including the China, USA, and Europe without the UK drive on the right side. So to make Australian cars capable for exports into these markets even further investments are required for product development and manufacturing.

7. Ownership

Although Australia is only one of around a dozen countries that "have the capability to design and build vehicles from the ground up" /10/, Australia is the only of these countries that does not host at least one headquarter of a global car company. Ford Australia and GM Holden are subsidiaries of companies with a US headquarter and Toyota's headquarter is in Japan. Countries that host at least the headquarter of one global car maker are Japan, China, Germany, India, USA, Italy, South Korea, France, Russia, Malaysia and to a certain degree perhaps the UK and Sweden. That has significant implications not only on investment decisions related to manufacturing but as importantly related to research investment.

In many publications it is not really differentiated between research and development even though there are significant differences between both activities. Most research activities start with some sort of a theory that has not been proven or verified, for example in experiments or in a prove of concept prototype demonstrator. In contrast, product development can only start, once a concept has been proven. The amount of real automotive research that is conducted in Australia is quite

small, as discussed in the sections Automotive Research in Australia and Patents. Product Development is more likely to be conducted after decisions about intentions to implement an invention into production has already been made, but without significant research activities the chances that product development or even manufacturing will follow related to new innovations are very small.

One new exception is the company VMoto that make electric- and petrol scooters and all-terrain vehicles. They have their headquarters in Perth and own and operate 30,000m2 manufacturing facility in Nanjing, China /11/. According to Navigant Research Leaderboard market research report: Electric Scooters VMoto is the world's second strongest electric scooter manufacturer /12/.

8. Patents

The patenting activities of the Australian car manufacturers and higher education institutions is negligible. The 2012 Excellence in Research Australia (ERA) reports only one granted patent family for the review period of 3 years from 2008 until 2010 /13/. For the car manufacturers the picture is not much better. A quick search in AusPat, the search system for Australian patents, revealed the following:

- Ford Motor Company of Australia has currently only 2 pending patent applications and 1 granted patent in Australia
- Ford Global Technologies from the USA holds 8 granted patents
- GM Holden has no patent or patent application
- GM Global Technology Operations has 11 granted patents and 2 applications
- Toyota Motor Corporation Australia Limited has no current patent, they all have lapsed or ceased.
- However, Toyota Jidosha Kabushiki Kaisha, the Japanese parent, currently holds well over 200 Australian patents and patent applications.

So besides the fact that there is not a lot of patenting activity through the Australian car manufacturers, this analysis also demonstrates that IP, even if developed in Australia, is transferred to the ownership of the parent company through their own IP subsidiary. Even Ford of Europe typically doesn't file their own patent applications but transfers the IP ownership to the US parent which files the relevant applications in the markets of interest.

9. Patent Rights and Workplace Regulations

Most Australian automobile manufacturers have a clause in their standard employment contracts that all inventions made by the employee belong to the employer, often even including those inventions that are not related to that field where the company operates in. Such a practice can be very counterproductive. If there is no incentive for the employee to disclose an invention there might be many reasons not to disclose an invention, or even worse, not even to think about making an invention. Typical reasons might be the following:

- To be able to disclose a patentable invention an employee firstly must understand or be trained about what is required so that an invention is patentable. Such a training is probably not provided to most employees in Australia, and certainly not for blue-collar workers.

- Making an invention mostly doesn't come through a Eureka event but involves a lot of hard work including extensive literature review and application of creativity technologies, either in a conscious or subconscious way.
- Once the invention is made it has to be articulated and written down, very often this can be a very difficult task for people that are not familiar with that process.
- As an invention is a new compared to existing technologies, it is difficult to assess if it really would be feasible. Inventors might be afraid to be ridiculed, for example if it wouldn't work or by managers or pseudo experts that unfortunately don't know better.
- If a company decides to file an invention, the inventor has to work together with a patent attorney to work out the details and read a lot of documents that are written in a very specific language that could create a lot of discomfort, especially for employees with a low level of education.
- All of these steps involve a lot of extra work that has to be performed on top of the normal duties so why should someone bother about it if the effects might only benefit the employer in a typical timeframe of between 10 to 15 years, or later when the employee most like is not with the company anymore, considering typical churn rates.
- If an employee thinks that the idea has a lot of commercial potential, he might not disclose it, but perhaps resign from the company and decide to commercialise it himself. However, that bares the strong risk to him of not having enough resources or the right resources to commercialise the invention successfully.
- The employee may fear that the invention might end up in a drawer and not getting utilised and therefore wasted.

In contrast, Germany has a regulative approach to create incentives for employees to generate and disclose inventions to their employer. Germany has an employee inventor protection act which is worldwide unique /32/. It includes a couple of very interesting elements:

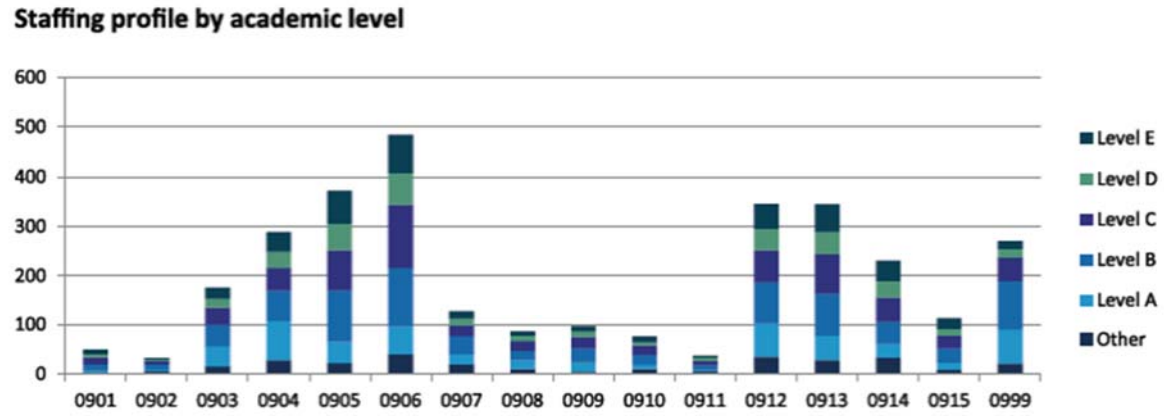
- An inventor is obligated by law to disclose any invention to his employer in writing, if it might have the potential to be utilised in the work area of the employer
- The employer has to decide within 4 month if he wants to utilise the invention, if not it belongs to the employee
- For inventions outside the work area of the employer the inventor needs to offer it to the employer to be used non-exclusively for a reasonable compensation
- The employer has to decide within 3 months if he wants to utilise the offer
- If a patent is utilised, the employer has to be compensated appropriately depending on his responsibilities, position etc. Typical standards for such compensations are available, mainly based on previous court decisions.

So there are strong incentives from 2 sides that pull and push the disclosure of inventions: Employees are pushed to comply with law to disclose invention and they are pulled by financial incentives. The same applies for the employers, they are pushed to compensate the employees and pulled by the need to make a decision to utilise an invention.

10. Automotive Research in Australia

The Excellence in Research for Australia 2012 report (ERA) listed the staffing profile of Australian higher education institutions for all different engineering disciplines /13/. It turned out that Automotive Engineering has the lowest number of researchers amongst all 15 Engineering discipline

with only 2 level E and 3 level D professors compared to 10 times as many in other disciplines like materials, chemical, resources, etc. The sector also receives the lowest rating for research excellence of only 1 out of a maximum possible score of 5 and is described as “The Unit of Evaluation profile is characterised by evidence of performance well below world standard presented by the suite of indicators used for evaluation.” /13/.



FoR code		Level E	Level D	Level C	Level B	Level A	Other	Total
0901	Aerospace Engineering	9.8	6.3	14.1	12.8	4.7	2.2	49.9
0902	Automotive Engineering	2.1	3.2	7.2	11.1	3.6	4.7	31.9
0903	Biomedical Engineering	21.8	19.2	35.8	43.4	41.0	15.4	176.6
0904	Chemical Engineering	39.5	33.1	44.7	64.5	78.4	28.5	288.7
0905	Civil Engineering	66.6	53.8	81.4	105.1	43.3	22.3	372.5
0906	Electrical and Electronic Engineering	75.8	64.0	127.3	120.1	56.2	40.3	483.7
0907	Environmental Engineering	16.8	14.0	21.4	36.9	20.2	19.4	128.7
0908	Food Sciences	8.9	10.6	19.7	18.5	17.9	10.4	86.0
0909	Geomatic Engineering	9.6	11.2	23.7	27.9	19.6	4.3	96.3
0910	Manufacturing Engineering	11.2	7.1	18.8	20.1	8.7	10.2	76.1
0911	Maritime Engineering	3.8	6.2	9.2	9.8	2.4	5.4	36.8
0912	Materials Engineering	49.4	43.8	64.6	85.5	67.6	34.4	345.3
0913	Mechanical Engineering	55.8	45.2	79.5	87.1	49.9	27.7	345.2
0914	Resources Engineering and Extractive Metallurgy	41.4	32.8	51.5	44.5	27.2	33.4	230.8
0915	Interdisciplinary Engineering	20.5	14.1	25.6	29.1	14.3	8.4	112.0
0999	Other Engineering	16.1	17.0	47.4	99.8	69.2	21.0	270.5
Total		449.1	381.6	671.9	816.2	524.2	288.0	3,131.0

Figure 2: Staffing profile of different engineering disciplines /13/

Additional to the lack of automotive research funding, perhaps another reason for that poor performance is that researcher in Australia are measured extensively regarding the publication activity and also how often they are cited by other researchers /13/. Therefore they publish most of their research in relevant scientific journals. These journals are copyright protected so the content can’t be reproduced. Most universities have access to such journals through subscriptions of their libraries. However, for the public it quite expensive to buy these journals or even single articles. But the biggest hurdle to get access is probably more to find such relevant articles as they are not freely available on internet and therefore not indexed by Google etc. Patents and patent applications instead are freely available online for anyone for many countries including Europe, the US and Australia. However, in other countries like Germany the number of publications and citations are much less important than in Australia, granted patents seem to be valued much more as a successful research outcome. Furthermore the ranking of the publication outlet is not so important,

researchers tend to publish their findings more in outlets that are more accessible to the general public.

Moreover, there are also no structures in place that would encourage long term research collaborations between different car manufacturers and suppliers. The main automotive related research program is the Auto CRC with quite limited numbers of industry members. Besides the limited membership numbers another problem with the Corporate Research Centre (CRC) approach is that the duration is limited to a maximum of 15 years even though it is described as a "medium to long-term research program" /14/. Arrangements regarding ownership of the IP developed during this program can vary significantly and mainly depends on the project partners and sponsors of individual projects and not the complete program. This is in contrast to the situation in Germany for example, which has research associations that are established for continued pre-competitive collaborative research and therefore they don't have a maximum duration. A very good example is the Research Association Combustion Engines (FVV) that was established in 1956. Membership includes now 16 OEM's, ca. 120 international suppliers, and about 50 service providers, most of them SME's. "The know-how acquired from the projects is made available to all the members without any restrictions" and "the FVV projects are financed from the annual membership subscriptions and from public subsidies that the Federation of Industrial Research Associations (AiF) gets from the Federal Ministry of Economics and Technology (BMWi)"/15/. The annual membership fee depends on the size of the organisation with a minimum fee of EUR 2,550 for organisations with 250 or less employees. Any member company can make suggestions for research projects in the area of their interest. Decisions about which projects will be supported are made during two annual planning meetings in 6 different sub-groups that are related to different topics. Each company has the same voting power independent of its size and fee.

11. Limited Access to Finance

Support through different governments including Commonwealth and state governments is quite good in Australia compared to international levels. Good examples are Commercialisation Australia, the Victorian Technology Innovation Vouchers, R&D Tax Incentives; and the Export Market Development Program (EMDG).

However, the 2013 CEDA report states that funding constraints were the biggest single barrier to innovation in 2010–11 for 21% of Australian businesses /16/, not only for automotive related companies but across all sectors. It would be interesting to evaluate the same survey by comparing different sectors. For a start-up company it is extremely difficult to access finance to enable the commercialisation of new inventions in the automotive field.

Trying to source funding to commercialise new automotive inventions is like a chicken and egg situation: to be able to access grant programs like Commercialisation Australia matching funding is required on a dollar by dollar basis. The programs are designed so that eventually the funding could come from first contracts or venture capital investments. However, to get a customer contract to build a prove of concept prototype demonstrator is extremely unlikely. For venture capital investment (VC) it is even worse as they also prefer to see first customer contracts and secondly most VC's prefer to invest larger amounts compared to what might be required for an initial prove of concept. Considering that the typical time to market takes between 10 and 15 years after an automotive invention has been made the successful commercialisation of those automotive inventions is very rare in Australia. Other industry sectors with similar long development timeframes

are supported in a much better way. For renewable energy technologies several dedicated funds are available, for example the Renewable Energy Venture Capital Fund (REVC) delivered by the Australian Renewable Energy Agency (ARENA) with a $100 million investment from the Commonwealth that will be matched dollar for dollar by Softbank China Venture Capital, or the US$25 Million investment from the Queensland Government into the Biotech Fund /17/.

12. New leaning cross-over vehicle between 2-wheelers and cars

Many companies have recently discovered that there is an unmet but significant market niche for smaller commuter vehicles that combine the best of both worlds: require less space and are more fuel efficient than a normal car, more like a motorcycle, but are safe and comfortable as a car. There are several categories of such narrow cross over vehicles including concept studies from car manufacturers with car like capabilities, scooters that are already produced with some car like features and further concepts and small scale production vehicles from start-up companies. Some of them will be shown and discussed here a little.

I. Car manufacturer's cross-overs

Latest examples of such cross over vehicles from car manufacturers are the Nissan Landglider, the Toyota i-road or the BMW SIMPLE. However, none of these concepts have been implemented into production yet. One of the main reasons is that the stability control systems that prevent them from tipping over at low speed and when standing without the need to use a foot are very complex and therefore would make these vehicles very expensive. But Toyota recently announced to start limited production of the i-road in 2014 /18/.

Figure 3: Nissan Landglider /19/

Figure 4: Toyota i-road /20/

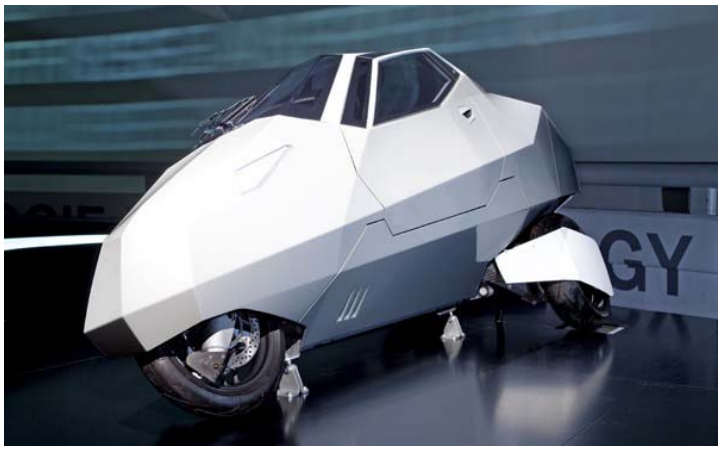


Figure 5: BMW SIMPLE /21/

II. Cross-over Scooters

Some manufacturers of scooters took a different approach in just adding a few more car like features to their scooters so that they provide more protection and can be driven with a car license in many countries. Examples are the BMW C1, the Piaggio MP3 and recently the Yamaha Tricity.

Figure 6: Piaggio MP3 /22/

The Piagio MP3 is one of the best-selling scooter in Europe and even in wetter climates like Germany. This is quite remarkable as the vehicle costs as much as some small cars with 5 seats. The BMW C1 was introduced in 2000 but discontinued shortly after due to some issues that were discussed in a bit more detail in SAE paper 2011-28-0001 /2/. In 2009 BMW showed a new version with electric drive only. Yamaha's Tricity, that will be introduced in 2014, seems to be very similar to the MP3.

Figure 7: BMW C1-E /23/

Figure 8: Yamaha Tricity /24/

III. Start-up cross overs

In addition to established manufacturers of cars and 2-wheelers there are more and more start-ups that are developing and manufacturing similar vehicle compared to those concepts that have been presented by car makers. Some of the most interesting examples are the Swiss Monotracer and the Carver from the Netherlands. The Monotracer has recently won a price of US$ 2.5 Million in the Auto X Prize competition for vehicles with a fuel economy better than 100 miles per gallon. The Carver was introduced in 2007 and was produced until 2009. Pros and cons of the Monotracers predecessor, the Ecomobile and the Carver have also been discussed in SAE 2011-28-0001.

Figure 9: Monotracer /25/

Figure 10: Carver /26/

13. Tilting Expertise

Australia is one of the world's leading countries related to leaning narrow cross over vehicles, mainly driven by independent inventors. Some of the concepts that have been developed were presented during the 2 International Clean Vehicle Conferences at Deakin University in Geelong. The most successful concept so far is the Millennium Motorcycles Tracer from Mike Richardson.

Figure 11: Millenium Motorcycle's Tracer Mark 3 /27/

Since 1997 he developed 3 different versions and one of them actually saved his life when he crashed into a tree if he was sitting in a car or even worse on a motorbike during that crash he most

likely would have died. The main features of his Millennium Tracer involve the mechanical tilting linkage and the related chassis and encapsulating body.

Another inventor is Phillip James from Tilting Vehicles Australia. He invented an “automatic counter-steer boost for tilting vehicle” that he filed in 2003 and together with others “wheel arrangements for tilting vehicle”. Similar to Richardson he already build several prove of concept prototypes.

Figure 12: Tilting Vehicles Australia by Phillip James /28/

Simon Williams designed and built a “Deliver E-Trike for Urban Transport” with the aim of replacing the Posty bikes. To be able to understand the needs of typical Posty driver as good as possible he even worked as a Posty for some time. The vehicle was finalist of the Australian Innovation Challenge 2012.

Figure 13: Deliver E-Trike /29/

14. World Class Racing Athletes

Australia has been the "breeding ground" for some of the world's best car drivers and motorbike riders. The latest successful racing car driver is Mark Webber who was one of the top contenders in Formula one racing for the last several years. Australian Motorbike racers have been even more successful, consistently over a long period. In Moto GP road racing Casey Stoner was the latest rider that won 2 Moto GP world championships, the most prestigious category in motorcycle road racing. Previous world champions include Mick Doohan and Wayne Gardner. In Moto Cross / Super Cross Chad Reed is currently probably the world's most successful competitor, winning the US AMA SuperCross series several times. The same applies in Enduro's since Shane Watt's moved to Europe to win the word title in 1997 followed by 4 time world champion Stefan Merriman. The last category relates to extreme sports like Freestyle Moto Cross with Robbie Maddison who won gold at the X-games and holds the motorcycle jumping world record with a distance of over 100 meter. These are just some examples and list can be continued even further. Unfortunately these sports are quite dangerous and probably most of these athletes suffered from quite a few injuries during their careers. So they are very well aware of how you could get injured but also how to prevent an injury through special riding skills.

PROPOSALS FOR ALTERNATIVE PUBLIC SUPPORT MECHANISMS

1. Introduction of an Invention Protection Act

The German Law on Employees' Inventions is unique in the world, even though it was already introduced in 1957 to protect inventions and to support inventors. A similar act should be introduced in Australia to nurture a culture of innovation. Compared to the German act some improvements are suggested:

- A clear guideline should be provided how to share potential profits from an invention between employer and inventor. That is currently a loophole in the German act. Compensation rates are based on previous court decisions and vary a lot across industries and depending on the responsibilities of the inventor within the organisation. One of the world's most generous and simplest example of how inventors can be compensated is Deakin Universities IP policy. It states that the inventors will receive 50% of commercialisation revenue which is the net revenue after the costs of intellectual property protection, commercialisation, marketing and other reasonable expenses.
- The compensation should be independent of the position and responsibilities related to the invention to simplify the process.
- Inventions made in Australia should need to be filed by an Australian entity to ensure that at least some of the revenues generated by the invention will contribute to the Australian economy and can't be transferred free of charge to overseas parent companies, which seems to be the current standard process for car manufacturers.
- It should include an element for training to ensure that employees are trained appropriately about what an invention is and what their obligations and benefits are through the new act.

Such an act would have several advantages for the companies, employees and the Australian economy:

Company Benefits

- More disclosures of inventions

- Increased motivation of workforce
- Provides a clear framework about how to implement an appropriate invention managements system which is especially important for SME's
- Supports the decision making process
- Encourages quick decisions to ensure timely filing of patent applications

Employee Benefits

- Appropriate compensation
- Incentive to invent and innovate
- Provides relevant training

Economic benefits

- The act is easy to introduce as no significant budget expenses are required, in contrast to other industry stimulation programs
- Supports all industries, not only Automotive
- Ensures that revenue generated through Australian inventions will benefit the Australian economy
- Generates further new jobs for patent attorneys and within IP Australia through increased patenting activities
- Will be world-wide unique and leading.

2. Tying Support Mechanisms Directly to Research instead of Investments for Manufacturing and Product Development

Research is the elementary first requirement to enable innovations. Therefore any future support programs should be directly tied to increased research activities. That means in case of programs that provide cash or tax offsets they should be linked to research activities and not to applied product development and manufacturing investments. If current resources and financial support will be shifted upstream of the innovation process, this means that many more projects can be supported. These additional resources are probably be needed once an Invention protection Act will be introduced. Another benefit of such a strategy is that it would also not require an increase in Government spending, instead resources will be used more effectively, potentially it could even have a positive effect on the Governments budget in the short term through reduced spending and for sure in the long term through positive effects on the economy. Again, this does not only relate to the automotive industry but across all sectors.

3. Establishing a Venture Capital Fund dedicated to Automotive Innovations

Automotive innovations require a similar research and product development duration compared to other investment intensive sectors like biotech or renewable energies. Therefore a Venture Capital Fund dedicated to Automotive Innovations should be initiated, similar to the Renewable Energy Venture Capital Fund. Such a fund would also help to attract foreign investors and could result in global suppliers and or OEM's to co-invest in Australian automotive innovations. The funds would perfectly match other Government programs like Commercialisation Australia, R&D Tax incentives and Export Market Development Grants to provide the required matching funding so that the valley of death in the commercialisation process can be crossed without starvation.

4. Establishment of an Automotive Research Association

Analogue to the German example of the Research Association Combustion Engines (FVV) a new Automotive Research Association should be established that should focus on long term pre-competitive collaborative automotive research. This Automotive Research Association should be established without an end date in mind but instead focused on continuous growth. The aim should be to create a leadership in the Asian region with a vision to extend its membership base to the entire Asian region including Japan, China, India, etc. The model has been proven to be very successful in Germany where the association was opened internationally only a few years ago. This resulted in a significant increase in industry members with the result of stronger research performance. Even though the increased international membership, the main research beneficiaries are the 100 German universities and research institutions that conduct the research in contrast to only 6 international research institutions that are part of the network.

5. Establish a Consortium to Develop, Produce and Commercialise the World's First Global Cross-Over Vehicle between a Car and a Motorcycle that Really Combines the Best of Both Worlds

The AxcessAustralia projects from 1998 and 2000 are a good example of a successful similar consortium as it reportedly generated more than $700 million of new export business for Australia.

"The aXcessaustralia low emission vehicle project was based on technologies developed by CSIRO and 80 component manufacturers. The project has been used to help industry in a novel way to show their technological capabilities. It also helps companies learn about new automotive technologies in general. Companies whose traditional business has been to manufacture components designed by carmakers had the opportunity to demonstrate their innovative skills on an example of 'tomorrow's car'." /30/

The difference to the AxcessAustralia projects should be the real intention to produce and commercialise a new generation of ultra-efficient cross over vehicles, in addition to showcasing the capabilities of the Australian automotive industry. Members of such a consortium could be any component supplier, service provider, research institution, vehicle manufacturers, and perhaps also individuals. The company equity should be distributed according to the relevant contributions from each member. The contributions could be in form of cash or in-kind agreed over a pre-defined duration, for example 5 years or so.

Such a new Australian consortium to develop, build and commercialise such a novel small vehicle would address most of the international and national market and regulatory factors that were mentioned before. In addition it could utilise the specialised expertise available in Australia. Examples of the benefits of such a vehicle are:

1. **Lowest possible fuel consumption** compared to other small cars that are only reduced in length. Reducing the width of a vehicle reduces the aerodynamic resistance by reducing the surface cross sectional area and by reducing the drag factor.
2. **Lowest possible weight:** compared to conventional cars no torsional stiffness is required for the body and chassis, so the body and chassis can be made much lighter
3. **Emissions:** In most countries the vehicle will classify as a motorcycle. Motorcycle exhaust emission standards and limits are much more relaxed compared to passenger cars. That means that if the vehicle will be developed to meet the car emission standards of the most important target market, it will be much easier to develop such a vehicle that will also meet

the current motorcycle emission standards all around the world. Furthermore the costs for expensive after-treatment can potentially be minimised.

4. **Vehicle safety performance** will be much better compared to any existing 2-wheelers. However, there is the potential that such a vehicle can also be safer than a car in some situations. The smaller widths for example, will make it more difficult to be involved in frontal or rear impact collisions. And the driver and passengers can always leave or enter the vehicle on the pedestrian side without the hazardous traffic passing by. Just recently the Victorian Police expressed strong interest in such a vehicle for three different reasons:
    a. To improve access to places where the police is needed
    b. To reduce the risk of injuries for Police officers compared to using motorcycles
    c. To reduce road trauma in general considering the fact that 17% of deaths on Victorian roads in 2011 involved motorcycle riders and passengers /31/
5. **Climates**: For a vehicle developed and build in Australia it can be claimed that it was tested under the toughest environmental conditions. The combination of encapsulation with air conditioning and heating provides the same comfort for the passengers as in a car.
6. **Left- and Right Hand Drive** differentiation is not required for such a vehicle that utilises only one half a lane. That significantly reduces the product development effort and manufacturing complexity
7. **Ownership**: The headquarters of the consortium will be based in Australia. Because the Australian Government will be a major shareholder, it won't be possible to relocate the headquarters outside of Australia, similar to other car companies like Volkswagen in Germany.
8. **Patents**: Because such a vehicle has not been commercialised yet, it provides a vast range of opportunities for new patents to protect the consortium from foreign competitors that might want to copy some elements of the vehicle. This ensures that the vehicle will be globally competitive over a very long period.
9. **Tilting expertise** will be essential to enable such a new vehicle. Most car companies that tried to commercialise similar vehicles have failed because of inadequate tilting control systems that were either too complex and too expensive or not failsafe enough. Australia is perfectly suited for this challenge due to existence of a range of relevant enthusiasts and inventors.
10. **World Class Racing Athletes** that are well known around the world could help to promote the vehicle and provide valuable insights during the development.

I'd like to thank the Productivity Commission to provide the opportunity to articulate new insights with fresh eyes. If anyone wants to discuss the issues mentioned I can be contacted under frank.will@deakin.edu.au.

Best Regards,

Dr Frank Will

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