International Specialised Skills Institute

Global Recreation Vehicle Production Standards

Vince Panozzo
Higher Education and Skills Group (formerly Skills Victoria)
International TAFE Fellowship

Fellowship funded by the Higher Education and Skills Group, Department of Education and Early Childhood Development, Victorian Government

Victoria
The Place To Be

ISS Institute Inc
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International Specialised Skills Institute

ISS Institute
Level 1
189 Faraday Street
Carlton Vic
AUSTRALIA 3053

T 03 9347 4583
F 03 9348 1474
E info@issinstitute.org.au
W www.issinstitute.org.au

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Executive Summary

Vincent Panozzo, the 2011 Higher Education and Skills Group / International Specialised Skills Institute Overseas Fellow, has undertaken an overseas research program to explore, gain skills, knowledge and a comprehensive understanding in the field of Recreational Vehicle (RV) manufacturing.

The Fellow's focus was to examining the different production techniques, in order to assist local industry groups in using alternative materials and construction processes and remain globally viable.

Caravanning has become extremely popular over recent years, resulting in a spike of Australian organisations manufacturing RV vehicles, however most locally built RV's are still based on the traditional heavy 'c' or 'boxed' section chassis/base frame, with the upper body construction methods of a timber or aluminium frame and cladding which is stapled together. There are also some local manufacturers using fiberglass technology for their wall assemblies.

It is encouraging that we are starting to see an increase use of lighter materials, a direct influence from the European manufacturers, who are using a foam filled process which considerably reduces the vehicle mass weight. These European RV manufacturers incorporate ultra-light weight materials in their designs, without compromising vehicle strength or safety regulations compliance.

Equipped with a comprehensive list of technical areas to explore during this Fellowship to Europe and the UK, the Fellow's objective was to examine the different construction, material and assembly methods.

Technical areas included:

- lightweight materials used in RV manufacturing
- lightweight production processes
- use and location of High Strength Steel (HSS)
- use and location of alloys and composites
- manufacturing bonding, welding, surface finishing and assembly processes
- RV cell construction techniques
- build time reduction processes
- end of life, recycling and waste management programs
- new production equipment
- 'cost to benefit' production processes.

Panozzo discovered that European and UK operations have a firm focus on the growth of the RV industry, by developing quality production capability and the capacity to improve skills for their trade technicians, and at the same time promoting the RV industry to younger people considering a manufacturing career.

The challenge for our Australian RV industry is to explore alternative production processes and materials, up skill the current workers to a national standard and to recognise opportunities in using materials that will produce a lighter, stronger and cheaper product.

The RV industry in Australia has been experiencing skilled staff shortages in manufacturing, service and repair and leadership roles.

Executive Summary

This Fellowship enabled Vincent Panozzo to examine world best practice and bring back to the Australian RV industry the benefits of using advanced vehicle designs, material selection, technician and leadership skills that will place the Australian RV industry in a sound position as part of a global market-place.

European manufacturers have invested heavily in cutting-edge manufacturing equipment, CAD inspired designs which are based on consumer requests and on-board technologies that reflect customer expectations.

The Fellow also focused this study program in exploring successful RV industry training models used in Europe and the UK and the importance of establishing a strong collaborative approach between industry and training organisations that provides the best opportunities in preparing technicians.

The Fellowship findings are assisting industry in implementing change to current products, remain competitive and identify the importance of job specific training to increase business opportunities.

Fellowship International Events

1. Caravan Salon, Dusseldorf, Germany, August 26 to September 4 2011.

The German 'Caravan Salon' expo is an annual global leading event in the area of RV production, showcasing the very latest in RV innovation, designs and componentry. The expo runs for ten days and is referred to by the RV industry as a must attend program for the very latest in innovation, products and design.

Fellowship Visits and Tours

2. UK factory tour No 1 Lunar Caravans – based in Manchester
3. UK factory tour No 2 Swift Caravans – based in the York area
4. UK factory tour No 3 Auto Trail RV – based in the Midlands
5. UK factory tour No 4 AL-KO International – based in Southam
6. Return to Dusseldorf, and factory tours of two German manufacturers: Fendt Caravans and Hymer Caravans.

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Abbreviations/Acronyms

ACE	Automotive Centre of Excellence
ADR	Australian Design Rules
AQF	Australian Qualification Framework
ASA	Auto Skills Australia
ATC	AL-KO Trailer Control
ATM	Aggregate Trailer Mass
ATV	Automotive Training Victoria
CAD	Computer-aided design
CIA	Caravan Industry Association
CNC	Computer Numerical Control
CRVA	Caravan RV & Accommodation Industry of Australia Ltd
CTIAV	Caravan Trade & Industries Association of Victoria
GCM	Gross combination mass
GTM	Gross Trailer Mass
GVM	Gross Vehicle Mass
HESG	Higher Education and Skills Group (originally Skills Victoria)
HSS	High Strength Steel
ISS	Institute International Specialised Skills Institute
KI	Kangan Institute
OH&S	Occupational Health and Safety
RTO	Registered Training Organisation
RV	Recreational Vehicles
RVMAA	Recreational Vehicle Manufactures Association Australia
TAFE	Technical and Further Education
TIG	Tungsten Inert Gas
VACC	Victorian Automotive Chamber of Commerce
VET	Vocational Education and Training system

Definitions

Alternative material

Materials that may be used in RVs to assist in reducing vehicle mass.

Cell construction

The process used in manufacturing sub-assemblies and componentry remotely from RV production line.

Design: Specific definition

CAD inspired design process used in order to simplify RV manufacturing processes, yet retaining customer appeal.

Education and training

Development and implementation of a national training program to increase skill levels of RV personnel.

New techniques

Ideas in alternative construction, fabrication, componentry and assembly techniques.

High strength steels

Used to reduce vehicle mass yet increasing strength to RV vehicle chassis and steel components.

Lightweight

Componentry comprising of FOAM filled wall, floor and cabinetry items.

Skills deficiency

Skill deficiency is where a demand for labour has not been recognised and where accredited courses are not available through Australian higher education institutions. This demand is met where skills and knowledge are acquired on-the-job, gleaned from published material, or from working and/or study overseas. [SKD]

'Directory of Opportunities. Specialised Skills Courses with Italy. Part 1: Veneto Region', ISS Institute 1991

There may be individuals or individual firms that have these capabilities. However, individuals in the main do not share their capabilities, but rather keep the IP to themselves; and over time they retire and pass way. Firms likewise come and go.

Surface finishing

The final finish of the RV surfaces.

Sustainability

The ISS Institute follows the United Nations NGO on sustainability, "*Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs*". [SUS]

Acknowledgements

Vince Panozzo would like to thank the following individuals and organisations who gave generously of their time and their expertise to assist, advise and guide him throughout the Fellowship program.

Awarding Body – International Specialised Skills Institute (ISS Institute)

The International Specialised Skills Institute Inc is an independent, national organisation that for over two decades has worked with Australian governments, industry and education institutions to enable individuals to gain enhanced skills and experience in traditional trades, professions and leading-edge technologies.

At the heart of the ISS Institute are our Fellows. Under the **Overseas Applied Research Fellowship Program** the Fellows travel overseas. Upon their return, they are required to pass on what they have learnt by:

1. Preparing a detailed report for distribution to government departments, industry and educational institutions.
2. Recommending improvements to accredited educational courses.
3. Delivering training activities including workshops, conferences and forums.

Over 200 Australians have received Fellowships, across many industry sectors. In addition, recognised experts from overseas conduct training activities and events. To date, 22 leaders in their field have shared their expertise in Australia.

According to Skills Australia's 'Australian Workforce Futures: A National Workforce Development Strategy 2010':

> Australia requires a highly skilled population to maintain and improve our economic position in the face of increasing global competition, and to have the skills to adapt to the introduction of new technology and rapid change.
>
> International and Australian research indicates we need a deeper level of skills than currently exists in the Australian labour market to lift productivity. We need a workforce in which more people have skills, but also multiple and higher level skills and qualifications. Deepening skills across all occupations is crucial to achieving long-term productivity growth. It also reflects the recent trend for jobs to become more complex and the consequent increased demand for higher level skills. This trend is projected to continue regardless of whether we experience strong or weak economic growth in the future. Future environmental challenges will also create demand for more sustainability related skills across a range of industries and occupations.

In this context, the ISS Institute works with Fellows, industry and government to identify specific skills in Australia that require enhancing, where accredited courses are not available through Australian higher education institutions or other Registered Training Organisations. The Fellows' overseas experience sees them broadening and deepening their own professional practice, which they then share with their peers, industry and government upon their return. This is the focus of the ISS Institute's work.

For further information on our Fellows and our work see http://www.issinstitute.org.au.

Fellowship Sponsor

The Victorian Government, Higher Education and Skills Group (HESG) formerly Skills Victoria, is responsible for the administration and the coordination of programs for the provision of training and further education, adult community education and employment services in Victoria, and is a valued sponsor of the ISS Institute. The Fellow would like to thank them for providing funding support for this Fellowship.

Employer Support

A specific acknowledgement is extended to Kangan Institute, in allowing and supporting the Fellow's application and enabling him to participate in the Skills Victoria / ISS Institute Overseas Fellowship program.

In doing so KI, permitted Panozzo to undertake travel to Germany and the UK in order to conduct a detailed study program for the RV manufacturing industry and its associated suppliers.

Supporters

The following individuals, organisations and associations have supported this submission and the development of the Fellowship.

Mr Ray Griffiths	CEO/ Director, Kangan Institute, Melbourne
Mr Phil Murphy	Manager, Industry Liaison, Kangan Institute, Melbourne
Miss Cassie Smith	Previous, Auto body trades manager, Kangan Institute, Melbourne
Mr Colin Young	Previous, Executive Officer/Industry engineer, RVMAA, Melbourne
Mr Ben Binns	Director, Winnebago Australia
Mr Chris Riley	Training Manager, Jayco Corporation
Mr Sven Mannfolf	Managing director, ALKO International
Mr Rob Lucas	CEO, CIA Caravan Industry association
Mr Stuart Lamont	CEO, CRVA Caravan, RV & Accommodation Industry of Australia Ltd
Mr Greg Walsh	Previous, Executive manager, Automotive Training Victoria
Mr Geoff Gwilym	CEO, Auto Skills Australia
Mr Peter Miller	Training Package Manager, Auto Skills Australia
Mr David Duncan	CEO, Recreational Vehicle Manufacturers Association of Australia, RVMAA
Mr Jeremy Irvine	Previous CEO, ISS Institute
MS Bella Irlict AO	CEO, ISS Institute
Mr Ken Greenhill	Fellowship Adviser, ISS Institute

Panozzo also extends his gratitude to the following International organisations for their support during this Fellowship:

- Hobby caravans Germany
- Lunar caravans Limited England
- Swift Caravans Limited England
- Auto cruise motorhomes England
- Fendt caravan Germany
- Hymer AG Germany
- AL-KO Kober Limited England
- Eura Mobile Germany.

Employer Support

Panozzo thanks Kangan Institute for their support.

The support was from all levels of management and fellow staff members within the School of Automotive, located at the ACE, Docklands, Victoria Australia.

Mentors:

- Workplace: Miss Cassie Smith, Previous, Automotive Manager, Kangan Institute
- Industry: Mr Colin Young, Previous, Executive Officer, RVMAA
- Industry: Mr Rob Funder, Technical Manager, ALKO International
- Report writing: Mr Wayne Walter, Business Development, Kangan Institute.

Organisations Impacted by the Fellowship

Government

Currently not one Victorian TAFE Institute is offering a Certificate III in RV manufacturing, resulting in the industry employing low or semi-skilled workers within their organisations.

This Fellowship provided an opportunity for Higher Education and Skills Group to ensure that an appropriate training program for the RV manufacturing industry can be developed.

Due to the lack of skilled workers, the absence of a recognised TAFE program, and no Registered Training Organisation (RTO) offering a training program, the RV industry is only offering a basic 'in house' training program to their employees, with little or no alignment to a national AQF qualification.

The RV Industry

The peak industry body, Recreational Vehicle Manufactures Association Australia (RVMAA) and its members will benefit from this study Fellowship, in the areas listed above. The RVMAA and its industry partners have identified a need to develop an industry specific training program which reflects the 'skills sets' required in the production of Caravan, campers and motor homes.

The industry nationally is experiencing a skilled staff shortage as well as the added pressure of increasing number of imported RVs, which are at times cheaper and often lighter in construction than our local product. The local manufacturers will need to equip themselves with fresh ideas and technology in order to remain competitive in what is now a global RV market place.

Acknowledgements

This Fellowship provided the necessary information in order to assist in the development of an education and training program, which will address the skill deficiencies identified in this report, and may influence Australian manufacturers to rethink RV designs, material selection construction processes and staff training.

This detailed report listing all gathered information and ideas is available to Government, education providers and industry associations and private enterprises.

Professional Associations

- Recreational Vehicle Manufactures Association Australia (RVMAA)
- Victorian Automotive Chamber of Commerce (VACC)
- Higher Education and Skills Group (HESG)
- ISS Institute
- RV manufacturers
- Automotive Training Victoria (ATV) - (ceased operations August 2012)
- Caravan Trade & Industries Association of Victoria (CTIAV)
- Caravan Industry association (CIA)
- Caravan RV & Accommodation Industry of Australia Ltd (CRVA).

Education and Training

- Kangan Institute (KI)
- Higher Education and Skills Group (HESG)
- Automotive Centre of Excellence (ACE)
- Jayco Corporation
- Winnebago Australia
- Automotive Training Victoria
- Auto Skills Australia (ASA)

Community

- Recreational users groups
- RV components suppliers
- Caravan Industry association (CIA)
- RVMAA
- RV manufacturers.

About the Fellow

Name

Vincent Panozzo

Current Employer

Auto Skills Australia, Melbourne, Victoria.

Qualifications

- Trade certificate (panel beater / panel worker), Geelong East Technical School, Australia, 1977
- Overseas Scholarship, Victorian Overseas Foundation Australia, 1978
- Diploma of Technical Teaching, Hawthorn Institute of Education, Australia, 1986
- Front Line Management, Kangan Batman TAFE, Australia, 2009
- TAA 04 Training and Assessment, Kangan Batman TAFE, Australia, 2009.

From 1982 to July 2011, Panozzo was employed as a teacher in the automotive manufacturing, service and repair sector. As a senior educator he had the responsibility to manage, develop and deliver training programs that reflect the ‘skill sets’ required by industry. He was directly engaged in the automotive body-building / engineering, refinishing and RV servicing course development and delivery.

Areas included:

- National trainer for RV service and repair
- On-site delivery and assessment to automotive enterprises
- Automotive manufacturing, bus, truck and trailer
- Manufacturing using composite materials
- Advanced welding
- Advanced automotive panel fabrication
- Engineering design
- Program development.

In the third quarter of 2011, Panozzo retired from Kangan Institute and moved to Auto Skills Australia (ASA). His current title is Training Package Specialist – Auto Body.

His ASA role is National Qualification Writer, for automotive body/automotive manufacturing/automotive sales, parts, administration and management.

Aims of the Fellowship Program

The aim of the Fellowship was to investigate world's best practice in relation to the manufacturing/ service and repair of caravans, campers and motor homes.

Following the Fellow's return from his overseas experience, he has commenced sharing all information with Kangan Institute, an RTO, the RVMAA industry body, plus national RV manufacturers and industry related component suppliers.

The primary areas for investigation were:

- **RV engineering design** - understand the implications of new/advanced design techniques to training programs and Australian Design Rules (ADRs)
- **Exploring lightweight materials** - establish an understanding of different material types, installation locations and the benefits associated in the manufacturing process
- **Alternative material production** - explore the opportunities associated in producing alternative material, material types and the required techniques
- **Use and location of high strength steels** - understand the use/type of high strength steels used in RV manufacturing, design/ development/construction of RV chassis/frames
- **Use and location of alloys and composites** - explore the benefits in utilising alloys and composites in RV manufacturing in order to reduce vehicle mass
- **Exploring the different manufacturing techniques, construction, bonding, welding, assembly and surface finishing** - explore/understand the benefits/impact and implications of construction techniques and finishing process
- **Cell construction techniques** - explore the 'cost to benefit' gained when using a cell construction process in manufacturing
- **Production times** - explore how to reduce production times and maintain quality
- **New techniques and equipment** - investigate new technology and develop contacts in relation to the latest equipment/technology that will assist Australian RV manufacturers
- **Design regulations** - explore global design regulations and the impact of imported vehicles to Australia
- **Education and training** - examine all education and training programs and training materials currently offered by European training Institutes and RV manufacturers
- **Waste and recycling opportunities** - explore/understand the implications of RV manufacturing waste materials and the recycling opportunities within the industry.

The Australian Context

Past history

The caravan industry had a slow and humble start in Australia in the mid 1930s, with very low production numbers and designs that were extremely basic. The RV industry at the time was very much a cottage industry, with hobbyists building caravans using technology and appliances from domestic kitchens, with at times little understanding on vehicle safety standards and regulations. However, caravanning soon become a popular activity for many Australians.

Early construction techniques

The 1930s vehicles were manufactured using a timber trailer base frame and a simple upright timber frame, plywood internal lining and plywood or aluminium flat sheet or simple cladding on the outside. Internal fittings were very simple and only provided a basic mobile bedroom with simple kerosene or methylated spirits stove and little else.

The concept of caravanning appealed to many Australians and it soon become popular and so did the demand from the community to ‘build to order’ larger vehicles incorporating different internal designs and appliances.

Present

The current caravan or RV now offers a vast range of vehicle options ranging from entry level camper trailers costing as little as $5,000 up to fully equipped luxury motor homes costing in excess of $750,000.

Over the past 20 years, the RV industry has enjoyed an increase beyond all expectations, and therefore the need to ensure the industry is correctly regulated has become far more important. The RVMAA monitors RV unit production and its aim is to ensure that all vehicles produced in Australia are fully compliant to current safety standards and regulations, the ADRs.

With an increase in production numbers the RVMAA have also set up an auditing program for manufacturers, ensuring all organisations conform to the industry ‘code of practice’ which incorporates manufacturing, servicing and marketing activities. Also, with the increased demand from the travelling community for caravans, camper trailers and motorhomes, the industry is now experiencing skilled staff shortages in respective production and manufacturing job rolls.

Current construction

Even today there are some RV brands that still manufacture their vehicles using technology that dates back to timber or aluminium frames and cladding stapled to the frame.

Larger manufacturers today, however, are now using a one-piece fibreglass/timber ‘sandwich’ wall construction. The process reduces production time but is still a heavy option, not to mention that if the RV requires a repair due to impact damage, the entire wall may need replacing, which is an expensive operation.

Future

Industry discussions have identified several key areas of importance for future growth in order to increase quality, increase vehicle safety, reduce vehicle mass and remain globally viable:

- The European RV industry has embraced foam filled materials technology in order to reduce the vehicle overall mass. The foam filled construction technology is used in walls, floors, bench tops and some roof sections
- The most common foam filled laminating process uses polystyrene foam which is an inexpensive product; however it also requires timber bracing around the edges, door and window openings. The foam infill is cut to fit perfectly between the pre-coated highly durable power coated aluminium sheeting and the inside pre-finished ply board section
- Carbon fibre is also incorporated into new RV designs and components
- Using high strength steels in chassis designs to reduce weight
- The development of a RV manufacturing specific training qualification
- Training and qualifying service and repair technicians
- The use of cell construction ideas and designs.

RVMAA and KI have developed a twenty two unit national service training program, which is delivered to industry using an e-learning environment. This Fellowship provided an opportunity to build on current industry technology, plus provide fresh ideas that may further enhance industry growth and provide career opportunities within RV manufacturing organisations.

The development of an RV manufacturing industry specific training program will address the vision from industry, RVMAA and Higher Education and Skills Group.

SWOT ANALYSIS

Strengths

- Improve productivity
- Capacity for production growth
- Develop a manufacturing process that is smarter, faster, lighter vehicles
- Increase vehicle safety
- Develop an education and training program
- Unit cost reduction
- Addressing RV industry skills shortage
- Build on existing knowledge base
- Develop new construction and design ideas.

Weaknesses

- Industry reluctant to change current procedures
- Lack of research and development opportunities
- Market pressure to produce more units and unable to release staff for training
- Lack of education and training support
- Lightweight materials too expensive
- ‘State of the art’ equipment too expensive for smaller organisations.

Opportunities

- Define new markets
- Research new materials
- Define existing markets better
- Developing a national training program
- Sharing of common production ideas and vehicle components
- Producing smarter vehicles
- Increase production numbers
- Reduce waste and increase recycling
- Facilitates new components and suppliers.

Threats

- Technology gaps within Australia
- Cost of new equipment
- Little or no government funding for training and up skilling of staff.

Identifying the Skills Deficiencies

The Australian RV manufacturing industry is currently experiencing a massive growth in demand as more Australians are buying RVs and exploring the great outdoors. This has resulted in an ever increasing skills shortage across the industry.

The RVMAA has identified that a skill deficiency exists within general manufacturing skills, engineering design and lightweight material selection, not to mention the growing demand from industry for quality production workers. There is a national RV service and repair training program on offer to the industry by the RVMAA and it is recommended to review the manufacturing qualification.

Present Deficiencies

Nationally the RV industry is finding it almost impossible to recruit staff with the required skills to manufacture and or service the growing numbers of caravans, motor homes and campervans that are in our community. The RVMAA represent the manufacturing sector, and would like to develop industry specific training programs that reflect best practice. This has been identified as a direct result of an increasing number in the reported production defects.

RVMAA Vision

‘To achieve 100 percent compliance from Australian manufacturers, and to strive for zero defects.’

Warranty increase

As mentioned previously, RV manufacturers nationally are experiencing an increasing number of vehicle warranty claims, due to construction and assembly techniques. This is of concern to the RVMAA, with an increase in client complaints. The current semi-skilled/ non-qualified workers have only basic in-house training and at times little understanding of the industries ‘code of practice’ and industry standards.

The information gathered from this Fellowship provides an opportunity for the RVMAA to work closely with Higher Education and Skills Group, in developing a training program which will be made available nationally to all RV organisations, in order to up-skill the current work force, reduce warranty claims, increase quality, reduce unit cost, increase production and increase vehicle safety as well as being fully ADR compliant.

Basic Deficiencies

- Industry specific education and training
- Develop confidence within the RV manufacturing sector
- Determine design and quality construction procedures
- Develop a skilled work force.

Applications

- Offer a range of industry specific skills training
- Encourage existing industry organisations to participate in training
- Showcase positive industry outcomes
- Increase productivity and quality.

Operations

- Provide support to all workers in the RV manufacturing networks
- Promote career opportunities to industry and the community
- RVMAA to provide benefits to industry members
- Educate RV manufacturers of possibilities
- Promote benefits to the RV using community.

Occupational Health and Safety (OH&S)

- Ensure all manufacturers comply to OH&S regulations
- Reduce the impact within the manufacturing environment
- Provide a safe working environment.

The International Experience

As highlighted in the Executive Summary, this Fellowship enabled Panozzo to visit the world's foremost RV exhibition, and to visit a number of international RV manufacturers to gain an understanding of the global best practise in RV manufacture, service and repair.

Destinations

Caravan Salon, 26 August to 4 September, 2011

Dusseldorf, Germany

www.caravan-salon.de

Above: Caravan Salon Dusseldorf, Germany

Contacts from the expo

Ms Rachel Nicoud - Sales Director

Company:	Euramax Coated Products
Country:	Netherlands
Product:	Coated aluminium sheeting
Market share:	Suppliers to 90 percent of the global RV manufacturers

Mr Peter Gorenc - Export Sales Manager

Company: Plastoform

Country: Slovenija

Products: Thermoplastic components and body panels

Market share: European leader with global exports

Mr Holger Schulz - International Sales manager

Company: Hobby – Wohnwagenwerk

Country: Germany

Product: Caravans and Motor Homes

Market share: Approximate production of 24,000 units annually

Mr Roberto Kerkoc - Manager

Company: Tecnoform, Spa

Country: Germany

Product: Forming of internal shaped doors

Market share: European leaders in product technology

Mr Pieter Botha - Production Manager

Company: Jurgens Ci p/l

Country: South Africa

Product: Caravan manufacturing

Organisers of the Caravan Salon 2011 reported that this year's event had the largest range of recreational vehicles on display in the world and after walking around venue for several days, the Fellow can only agree.

Dusseldorf is located on the Rhine River, in North-western Germany, with a population of approximately 750,000. Dusseldorf got its name from the small river that runs through the city centre called 'Dussel' and 'Dorf' which is the German for village. The main industry of Dusseldorf is fashion and it is referred to many locals as a 'mini Milano'. Other industry groups include production of Mercedes Benz commercial vehicles and some steel manufacturing.

Dusseldorf hosted the 50th International Caravan Salon 2011, an event that showcased over 600 RV related companies from across Europe, which displayed and presented the very latest caravans, motor homes designs, models and innovations, as well as a vast range of RV related products and components. The showcase set new trends for the European RV industry and give fresh stimuli for the 2012/13 caravanning / vacation season. The Caravan Salon attracted approximately 200,000 caravanning enthusiasts, making it the largest and most successful European caravan expo.

The International Experience

A very interesting and notable aspect of the showcase was that the majority of motor homes on display were compact focused, incorporating a low line roof line design, which without doubt makes an attractive looking vehicle with the added benefits of reducing wind drag and increased fuel efficiency. In the Fellow's opinion there were two stand-out RV manufacturers, HOBBY and FENDI; both are German built with exceptional engineering designs, advanced styling, high production quality and light weight integrated componentry.

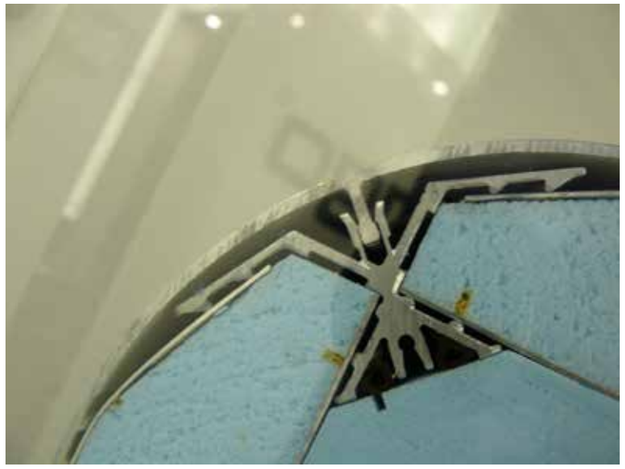
HOBBY offered Panozzo the best 'wow factor' in both the motor home and caravan range. The seamless exterior body styling, black acrylic glass laminated windows which all open using a lean ratchet strut system, purpose made LED rear vehicle lights with integrated grab handles for easy manoeuvrability, options for vertically opening storage access doors, made from (ABS) plastic, slightly recessed roof-line and advanced sealing rubbers eliminate the common problem of RV water leakages and much more.

Left: Hobby caravan front & rear view

Left: Hobby caravan side view

The motor homes range also offered a subtly curved exterior wall assembly whereas the caravans have flat walls; however both are constructed using a combination of CAD inspired ABS plastic moulded sub-assemblies, advanced foam filled sandwich construction for the floor, walls, roof sections, internal bench tops and cabinetry and lightweight aluminium extrusions. The ‘Hobby 600’ motor home also has a fully integrated awning which reduces wind drag and fuel consumption.

Left: Hobby 600 motorhome



Left: Lightweight aluminium extrusion section used in European manufacturing

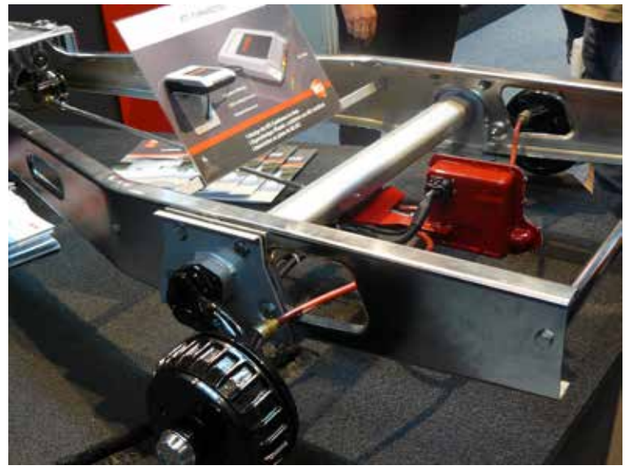
There is however a section of the buying market that believes that size does matter. In this range you can find the ultra-high quality product with the very best of everything including an advanced storage mechanism for the safe transportation of your sports car; all in the interest of remaining mobile when you reach your holiday destination.

Left: Motor home with motor vehicle storage area

RV Safety systems

Towable caravans are becoming lighter and easier to tow, due to the development of advanced handling systems which detects when the caravan is ‘swaying’ from ’side-to-side’ and if the ‘swaying’ is outside the normal safe handling range, the device will slowly activate the caravan’s braking system in order to slow the vehicle and bring the caravan back under control, preventing a possible rollover situation.

This state of the art in safety innovation is produced by AL-KO International, the global leader and major supplier of RV under-carriage components. The AL-KO International produced AL-KO TRAILER COTROLL (ATC), is currently a mechanically activated device. However, AL-KO’s Australian based development centre have also developed an electronic that will reduce response time. This technology should become a standard safety handling system for all RV manufacturers.



Left: AL-KO anti sway system

Caravan mounted tow couplings is another area of best practice on display at Dusseldorf. Tow couplings now offer a 'ball load' indicator, which assists the end user when loading the RV prior to departure. This colour coded visual indicator shows when the coupling is correctly engaged.

The easy to operate coupling has four spring loaded built-in friction pads which grips the tow-ball and reduces movement in both vertical and horizontal directions.

The same coupling also offers an additional indicator for the 'ball to coupling' adjustment and if adjustment is required the coupling colour indicator will again show your safe adjustment range.

Left: AL-KO tow coupling
Below left: 'Dethleffs' Aero
Below middle: 'Fendt' Brilliant
Below right: 'Hobby' 600 motorhome

The vast display halls of the Dusseldorf Caravan Salon offered a one stop expo for everything related to the RV industry, including motor homes, caravans, caravanning accessories, caravanning clubs and associations, banks, insurance, camping and parking holiday regions.

On entry to the expo you were taken back in time with a display of classic caravans, motor homes and cars that reflect the past 50 years of the Caravan Salon and the humble beginnings of the RV industry.

The Caravan Salon committee also provided free entertainment on the two Saturday evenings of the expo. Between 6pm and 8pm visitors were invited to enjoy a relaxing 1960s evening in the massive out-door area, with live music and food made available at 1960s prices to celebrate the Salon's 50th birthday.

ISS Fellow's study tour Objectives

This ISS Institute Fellow explored 'world's best practice' in recreational vehicles manufacturing, including detailed understanding in the areas of:

- Engineering design
- Lightweight materials used in the manufacturing process
- Production / sourcing of alternative materials
- Possible use and location of high strength steels
- Possible use and location of alloys and composites materials

- Different manufacturing techniques, i.e. construction, bonding, welding, assemblies and surface finishing processes
- Cell construction techniques
- Explore how to reduce production times
- Look at different 'design regulations' in relation to ADRs
- Different education and training programs of RV manufacturing
- Material recycling opportunities
- Plus any other quality detail that will assist Australian manufacturing & service/repair.

Outcomes

The Fellow's extensive exposure at the Dusseldorf expo and the four manufacturing visits to England provided the perfect environment in gathering data that will assist Australian manufacturers in engineering designs and materials used. It soon became obvious from the majority of manufacturers on show at the Dusseldorf Salon, that the European trend is focused on reducing vehicle mass; this is achieved with the use of:

- The use of ABS plastics, front, rear walls and trims body panels

Wall assemblies are constructed using foam filled sandwich technique, the external part is from an extremely durable pre-painted aluminium skin sheeting which is then filled with a 'polystyrene' or high quality 'Styrofoam'. This technique eliminates water entry and is the material of choice for many motorhome and caravans manufacturers, the third part-component is finished with a light weight inner timber veneer.

- The use of laminated acrylic glass or polycarbonate window assemblies
- Extremely light weight 'tech-formed' internal doors and cabinetry
- Foam filled RV kitchen work benches
- AL-KO light weight fabricated chassis
- Reduced hinges/locks/mouldings sizes
- Plastic grab handles
- Alloy wheels
- Light weight yet high strength suspension assemblies and components
- Reduced numbers of retaining bolts and screws
- Increased uses of bonding and gluing.

Top left: Foam filled bench tops

Top right: Caravan chassis

Middle: Motorhome chassis

Bottom left: Flush mounted lighting and grab handles (1)

Bottom right: Flush mounted lighting and grab handles (2)

Surface finish options

The European RV industry has a variety of surface finishing options on offer; however in all cases painted aluminium sheeting was used for wall and roof panels, the panels are delivered to the manufacturer in its finished state and then the respective manufacturer will produce the laminated wall, floor or roof sections using the foam filled core process, which is glued and pressed. The sandwich construction process offers an extremely light, yet strong component.

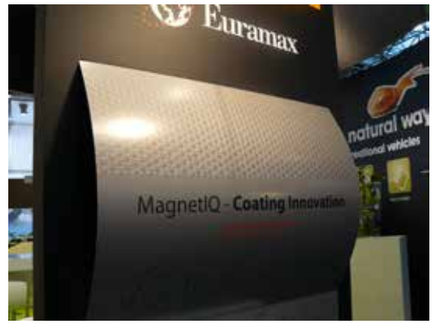
The options are as follows:

Fibre glass sheeting is being phased out by the majority of European manufacturers due to the inherent problem of added weight, expense and surface faults and gel-coat cracks during production. However there are some manufacturers that are investing in new FRP panel production technology. They use a male/female mould plug/press in order to obtain an even FRP thickness and finish.

Carbon fibre film is an attractive option, but it is only used by a few manufacturers, due to its current cost, however results show that it greatly improves surface strength in relation to impact or hail stone damage.

Pre-painted aluminium sheeting is without doubt the preferred option with the main RV manufacturers.

'Euromax painted products' is the major supplier to the industry; supplying to 90 percent of the RV market and offers an amazing range of options. The latest technology which is still in the testing phase has iron power mixed in with the highly durable paint; when the paint is applied onto the aluminium



Above: 'Euromax' magnet IQ coating

Above: Euromax Decor carbon design

sheeting in a flat position, the advanced technology uses a magnetic field under the sheet, which, when 'switched on' produces an endless amount of graphic design patterns. In-fact a manufacturer could have their logo/name placed in any location on the sheet as the magnetic field attracts the iron power to that location. Designs are only limited by your imagination.

Concluding Remarks of Dusseldorf Salon

The Dusseldorf Salon Expo is a must for all Australian caravan and motor home manufacturers. The ten day expo is filled with the very latest in engineering designs, materials used and products which make up the European RV industry.

UK manufacturing tour

Findings from UK enterprises

The UK RV industry is also experiencing an exciting growth, and the 2012 caravan season that started in September 2011 had many new models released to the public.

The construction processes are generally the same as other European manufacturers with a strong focus on RV overall light weight construction, due to a smaller size towing vehicle and fuel consumption.

The UK internal styling is slightly different to their European neighbours. The UK product incorporates the lounge area in the front of the caravans, this is so people can park their RV forward facing at respective locations and enjoy the view through the large opening windows, whereas the Europeans tend to use their caravan as a base and prefer to sit outside and enjoy the outdoors.

All organisations visited in the UK use a cell construction process. All internal and external vehicle assemblies are produced using remote production and assembly stations technology.

RV Cabinetry

All internal cabinetry starts life from a CAD inspired drawing. This information is then sent to an automated router cutting table where the light weight veneered timber material sheet is placed on the cutting table, the program then nests all required components on the timber sheet, the cutting process then starts and within minutes the cabinetry components are cut to the highest standard. An operator then places all cut items into an assemble sequence and forwarded to the respective assembly station.

The assembly process begins via a number of stations until all cabinetry components have been completed for each section of the caravan or motor home interior. The chassis used by the UK and European manufacturers is the AL-KO light weight chassis /axle/suspension assemblies, for both caravans and motorhomes.

This light weight chassis/axle/suspension assemble is then fitted to a ‘foam’ filled laminated floor section with a water proof membrane on the underside of the floor panel. The AL-KO chassis is fully adjustable for different caravan and motor home models/sizes.

Lunar Caravans

Left: Lunar Caravans

The construction process at Lunar caravans starts with the floor and chassis assembly in an upside down position, this makes it easier for the operator to install all axles, braking, water tanks undercarriage plumbing lines, inner wheel-wells and alloy wheels.

When the above components have been assembled to the underside of the caravan, all bolts are correctly torqued and marked with a ‘high-vis’ paint, indicating that all fitted components have been correctly fitted and checked. The completed floor and chassis is then turned over and placed on its wheels, at this stage the cell constructed cabinetry is assembled onto the floor, with one assembly team working from the front and another working from the rear, simultaneously the electrical assembly team installs the electrical system, stove, internal lighting and bathroom fittings.

Each assembly station is allowed approximately 20 minutes to complete their respective tasks before moving the caravan to the next station. When all internal cabinetry is completely fitted and tested the vehicle moves to the wall assembly area; the pre-formed walls are lifted and screwed into position, the front and rear ABS plastic or FRP fibre reinforced plastic vehicle panels are then fitted and glued into position, with the cabinetry secured to the wall assembly.

The roof is next to be installed and sealed, roof hatches, satellite dishes and other options items are fitted at this stage, the caravan then moves to a lights connection station and soft trim/seating area and onto the quality testing and inspection station.

All defects are identified and logged into an electronic scanning reporting system which is downloaded to a pre-delivery quality system.

Swift Caravans and Autocruise Motorhomes

Country: England

City: Cottingham, Yorkshire, UK

Event: Tour of Swift Caravans

Country: England

City: Swinton Mexborough, UK

Event: Tour of Auto cruise Motorhomes

Top: the Swift Group
Bottom: Autocruise

‘Swift Caravans’ and ‘Autocruise Motorhomes’ have a slightly different assemble process. They also use the same foam filled construction technology in order to reduce vehicle weight yet retaining overall strength, however when it comes to the assembly of the cabinetry, the wall sections are laid down flat; the ‘cell’ completed cabinetry sections are then fitted onto the wall section and secured together in a flat position. When each side is completed it is then lifted up and fitted onto the floor assembly. This ensures that the operator is working in a comfortable situation and not climbing up and down onto the vehicle chassis when assembling the cabinets.

It is important to note that both assembly techniques seem to work well and the finished products are completed to a very high standard.

Left: assembly of RV internals at LUNAR Caravans & RV's

Welding

It was interesting to discover that the welding processes still used by Australian RV manufacturers in the construction of vehicle chassis has been engineered out of the European and UK production process. The reason given by the different organisations is that the welding process requires highly experienced personnel that at times produce different results.

The European and UK manufacturers have replaced the welding process with high grade plastic connecting systems which are glued and bolted using high tensile graded bolts and locking nuts. This is faster, cleaner, attractive and easier for servicing and repairs when required.

Chassis and axle assemblies

Country: England

City: Southam, Warwickshire, UK

Event: Tour of AL-KO International, world leader of RV component manufacturing

Left: AL-KO International

The chassis of choice by UK and European manufacturers for both caravans and motor homes is the AL-KO light weight chassis which is a pressed section and bolted together with the options for adjustments to suit different RV sizes and models.

The low line axles assembly employ advanced technology which results in a safer vehicle when towed and when equipped with AL-KO's 'ATC - Alko Trailer Control' system provides piece of mind for RV users when towing, as mentioned earlier.

The number of RV 'roll- overs' have reduced in both the UK and Europe, due to the combination of advanced chassis handling devices and caravans towing couplings with safety loading indicators, which offer visual 'ball weight' and 'ball adjustment' parameters.

In Australia currently, there are different caravan suspensions used, the standard is a 'bean axle and spring assembly', this axle/suspension assembly is fitted to a multi cross member chassis which is constructed using a welding process.

This chassis then supports a 12 or 15mm ply flooring, which is fastened using screws and glue. This process could be changed to the 'foam filled' laminated floor section and a lightweight chassis, which will reduce vehicle weight as used by UK and European manufacturers.

Information, Contacts and Providers:

The following is a list of the various contacts the Fellow visited, spoke to, or was referred to by those he visited. It is included to demonstrate the breadth of organisations involved in this industry.

Company: Euramax Coated Products
Country: Netherlands
Product: Coated aluminium sheeting

Company: Plastoform
Country: Slovenija
Products: Thermoplastic components and body panels

Company: Hobby – Wohnwagenwerk
Country: Germany
Product: Caravans and Motor Homes

Company: Tecnoform. Spa
Country: Germany
Product: Forming of internal shaped doors

Company: Eura Mobile
Country: Germany
Product: Caravans and Motor Homes

Company: AL-KO International
Country: Sweden
Product: Component manufacturing

Company: Lunar Caravans Limited
Country: England, Preston
Product: Caravans manufacturing

Company: Swift Caravans Limited
Country: England, Cottingham
Product: Caravans and Motorhomes

Company: Autocruise Limited
Country: England, Swinton Mexborough
Product: Motorhome Manufacturing

Company: AL-KO Kober Limited
Country: England & Australia
Product: Global leader of RV under carriage and chassis component

Company: Trakka
Country: Australia
Product: Motorhome Manufacturing

Company: Motio Development
Country: Germany
Product: CAD Engineering / Designs

Company: Fleetwood Corporation
Country: Australia
Product: RV Manufacturing

Company: Jurgens Ci p/l
Country: South Africa
Product: Caravan manufacturing

Knowledge Transfer: Applying the Outcomes

As mentioned earlier, the RV industry in Australia is experiencing increasing competition from imported brands and skilled labour shortages in both technical and lead roles.

On the Fellow's return from Europe and UK the Fellow brought back a range of alternative production and assembly ideas, showing the benefits of light weight vehicles designs and the advantages of 'foam filled' components and assembly processes, plus the possibilities in developing training programs that provide career options for existing workers, young entrants, technician and lead or management roles, which are directly linked to skills that are applicable to the RV industry.

The findings from this Fellowship will facilitate the development new style RVs that may address the concerns of government by retaining a manufacturing industry and for industry in remaining competitive against imported brands.

If the Fellowship findings are applied; industry will experience increased business opportunities via increased sales, exports, sales and servicing, plus the benefits associated with an RV specific training program that directly relates to industry needs; plus knowing that locally built vehicles are at the very least equal in design and quality to European brands, which will appeal to Australian buyers.

The Fellowship findings from travel to Dusseldorf Caravan Salon in Germany and visits to UK manufacturing sites in August-September 2011 have already been shared via information briefing sessions with Victorian RTOs via forum presentations, plus the Fellow accepted an invitation to be a guest technical speaker at the national conference for the Caravan, RV & Accommodation Industry of Australia, (CRVA) held in Queensland, in March 2012.

During the presentations the fellow addressed the areas of:

- design difference, between current Australian and European examples
- advantages of CAD inspired vehicle designs and plastic moulded sub-assemblies
- per painted aluminium outer surface sheeting
- foam filled 'sandwich' floor, roof and wall construction methods
- utilising LED low voltage lighting systems and storage devises
- tinted laminated polycarbonate windows
- low line and stream-line designed models for both motorhomes and caravans.

This report will provide an understanding to the Australian RV manufacturing sector, on the direction European and UK industry is headed with vehicle design, materials selection, vehicle componentry and production practices.

The main industry driver is customer requests, therefore the latest RV technologies, manufacturing processes and light weight material selection and development, must also be embedded into appropriate training programs and learning material and delivery strategies that will move forward the RV manufacturing community.

The following photos showcase Euro products, 'ABS' panels and lights surrounds.

Left: ABS panel sections

Left: ABS lighting surrounds

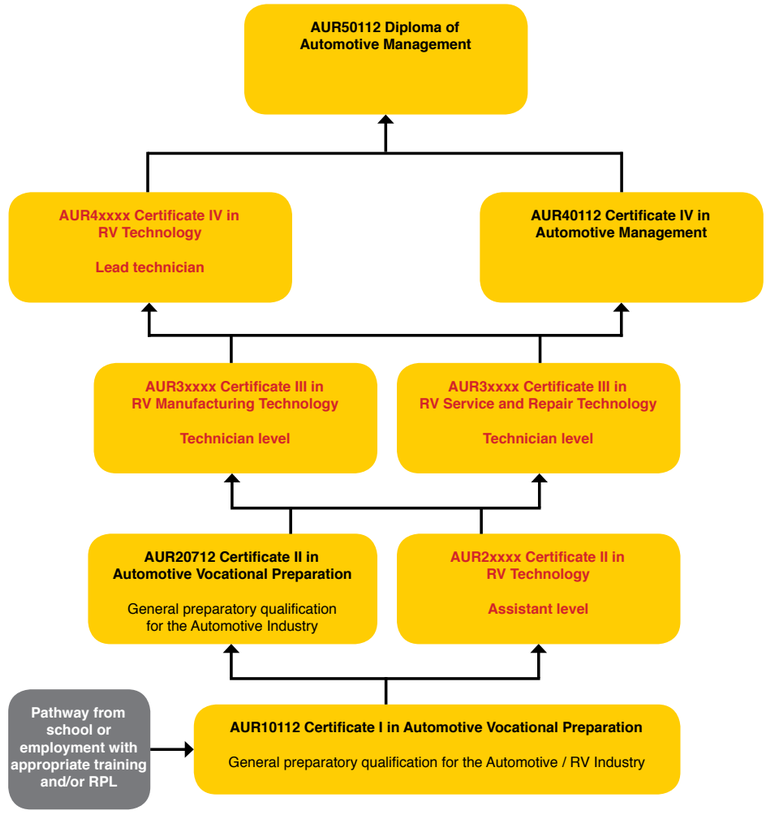
Left: Foam filled RV sections

Recommendations

The following recommendations are made by the Fellow based on findings of his research that indicate:

- Training model covering RV industry specific programs and career pathways
- European and UK RV manufacturing processes
- European and UK material selection.

Example of career option pathways & training programs linked to a National Qualification structure qualification structure:



Government

- Education and training authorities to consider an RV specific training program
- Information within this report will increase the RV manufacturing quality and address government focus on Australian manufacturing, sustainability and environmental and workplace quality standards
- This report will be sent to the automotive Industry Skills Council, for inclusion to their training package improvement register
- The report will likewise be sent to key departments within Department of Innovation, RTOs and training authorities
- Approve funding for the purchase of best practice equipment in training individuals in the RV manufacture industry
- Actively support an industry training program in order to remain internationally competitive.

The majority of RV manufacturers are located in Victoria, therefore it is in the interest of the Victorian government authorities to retain and encourage growth within industry groups and develop strong partnerships between the RV industry, their associations and training organisations that will identify and address required skills for individuals and manufacturers in order to remain internationally competitive.

From the Fellows experience he has compiled a recommended qualification structure for consideration.

Certificate II

Focused on entry level skills; the program will encourage school leavers to consider a career within the RV industry

Units of competence may include:

- WHS (work place health and safety)
- Industry environment regulations
- Working with basic hand and power tools
- Read and use numbers in the workplace
- Follow work instruction
- Work with individuals
- Apply wood working practices
- Assemble RV cabinetry
- Work in a team environment.

Certificate III

Designed for trade technicians, in manufacture or servicing role

Units of competence may include:

- WHS
- Work with industry hand and power tools

- Interpret engineering drawings
- Interpret RV component specification and assembly sheets
- Work with timber RV cabinetry
- Work with foam laminates
- Cell construction principals
- Manufacture RV walls / floors / roof and sub-assemblies
- Work in a team environment
- Work with external ABS plastic and composites
- Use jigs and fixtures
- Introduction to 2D and 3D CAD drawing systems
- Assemble and service chassis components
- Assemble and service RV braking systems
- Assemble and service RV, LPG systems
- Assemble and service RV lighting systems
- Assemble and service RV only 240V power supply
- Apply external surface finishing systems
- Produce foam core sandwich assemblies
- Understanding Australian Design Regulations
- Waste management processes
- Install movable glass/polycarbonate windows/hatches, door assemblies
- Install hinges, locks, gas rams and hardware
- Install soft furnishing and trimmings
- Install RV water systems
- Bonding and sealant processes.

Certificate IV

For individuals who wish to progress to a lead technician / supervisor / manager / trainer

Units of competence may include::

- Workplace leadership
- Workplace training and assessment
- Dealing with customers
- Work quality inspection processes
- Apply CAD engineering drawings

- Management processes
- Production and manufacturing processes
- Material research and development
- Australian Design Regulations
- Alternative material construction options
- Customer relations
- Environmental regulations.

The above certificates levels are suggestions only. However for this to occur, RV manufacturing and associations will be required to invest in a jointly funded training program with industry councils and RTOs. Training must be RV specific, with a strong focus on best practice, incorporating the industry 'codes of practice', 'Australian Design Regulations (ADRs), vehicle designs, lightweight materials, construction concepts and serviceability options.

Industry

The RV industry have for a number of years experienced a bullish local market, however with European and Asian manufacturers entering the local market, the buying market have a range of alternative RV brands that offer reduced vehicle mass, smarter user friendly designs and all at an competitive price.

Our challenge is to equip the Australian RV industry with the knowledge and resources to become highly proficient in production, styling and product quality.

For this to happen the industry must:

- Invest in alternative production technology, to enable international competitiveness
- Invest in research in order to reduce production and component costs, as part of a competitive situation
- Invest into the design of light weight vehicles and parts
- Research into the development of new manufacturing techniques and equipment
- Apply new technology into manufacturing process
- Work with the educational establishments to investigate training programs that address emerging technologies
- Industry and RTOs need to work together to ensure training reflect industry requirements
- Develop partnerships with industry providers and RTOs.

Professional RV associations may need to:

- Develop a pro-active approach in the development of training partnerships between industry and approved RTOs
- Encourage industry, local, state and federal governments to establish partnerships in order to retain a strong RV manufacturing base in Australia
- Assist in the development of job specific training packages, reflecting current and emerging technologies and industry needs.

The RVMAA is committed in assisting all RV manufacturing organisations, as well as assisting the general public in the importance of locally produced vehicles that comply with ADRs. The RV industry nationally employs several thousand people in direct manufacturing, sales and associated related component suppliers.

The CIA with the RVMAA have identified a need for a national manufacturing template in order to ensuring Australian built RV products maintain the highest quality possible. This comprehensive report and international best practice findings is being considered to be part of that template program.

European and UK RV manufacturing processes and training

German based 'HOBBY Caravans and Motor homes', was what I considered to be the Dusseldorf expo leader in engineering design and material innovation.

HOBBY caravans have approximately 1150 staff, with a guarantee apprentice intake of several new students per year. The training program is over a three year time frame with a strong focus on wood working and quality finishing skills. Each trainee undertakes their training within HOBBY's training academy and a national training program.

Mr Holger Schulz, International sales manager for HOBBY said, "The training program ensures that our company D&A is always retained within our quality manufacturing process and product development".

On the Fellow's return he has been assisting the RV industry with presentations on findings and recommendations, including the CRVA National conference, where the Fellow was a guest speaker.

Community shift

The Dusseldorf Caravan Salon was an eye opener with a huge number of people in attendance; more importantly the Fellow noticed a shift in the age demographic of buyers, which was once a holiday option for the older or retired sector of our community.

The Fellow's observation was that a new breed of sub 40 year old buyers was extremely active in not only looking but making acquisitions. However, findings also show that this younger buying market decisions were based firstly on attractive styling, followed by the tow-ability of the RV with a smaller sized vehicle.

The other interesting finding is that the communication technology and other 'products' is a must as standard equipment, i.e. satellite dishes, heaters, IPod connections, air coolers, large refrigerators, large stoves, showers/full bathroom, flat screen TVs, leather trimming.

Where to from here with emerging technology

The global RV industry has the ongoing pressure of rising fuel costs, therefore material selection and vehicle designs are paramount for industry survival. Due to the fuel costs RV customers will explore lighter RV vehicles without comprising on comfort levels. The following suggestions may address some industry concerns.

- Hollow section 'carbon fibre' or 'high density plastic' chassis and components will assist in the weight reduction process, this technology is currently used the bicycle industry and may be an option for the RV industry.
- The use of LED lighting and 'super capacitor' battery storage cell, will also provide low consumption lightweight options, again this technology is under further development for the battery electric vehicle market.
- Self-generation, mini wind driven turbine and solar options, are technologies that currently available.
- End of life and recycling of RV construction materials, again information is available for the process and benefits when selecting and designing the next generation vehicle.

ISS Institute

The ISS Institute is encouraged to provide future Fellowship opportunities in order to investigate construction and advanced materials technologies in the rapidly growing RV manufacturing industry.

References

Endnotes

[SK] *Directory of Opportunities. Specialised Courses with Italy. Part 1: Veneto Region*, ISS Institute, 1991.

[SU] The United Nations Non Government Organisation (NGO) has worked for many years to create a global buy-in on sustainability. Starting with the definition developed in 1987 this organisation is now working on many fronts to ensure that sustainability is understood and adopted by all sectors of Government, Industry, Education and the Community.

Bulletins and brochures used as references

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Plastoform Products

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Eura Mobil

Produced by: Eura Mobil gmbh, Germany, 2011/12

Winterhoff Parts

Produced by: Winterhoff, Breckerfield, Germany, 2011/12

Dow Chemical limited

Produced by: Dow Chemicals, Germany 2011/12

AL-KO International

Produced by: AL-KO International, Australia 2011

Caravan Salon, Dusseldorf

Produced by: Caravan Salon, Germany, 2011

Euramax coating products

Produced by: Euramax, Netherlands and UK, 2011

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- AL-KO International, Australia: www.alko.com.au
- Hobby Caravan- Wohnmobile & Wohnwagen, Germany: www.hobby-caravan.de
- Fendt Caravans, Germany: www.fendt-caravan.com
- Plastoform, Slovenija: www.plastoform.si
- Eura Mobil, Germany: www.euramobil.de
- RVMAA, Recreational Vehicle Manufacturers Association of Australia: www.rvmaa.com.au
- Caravan Industry Associations: www.ciavic.com.au