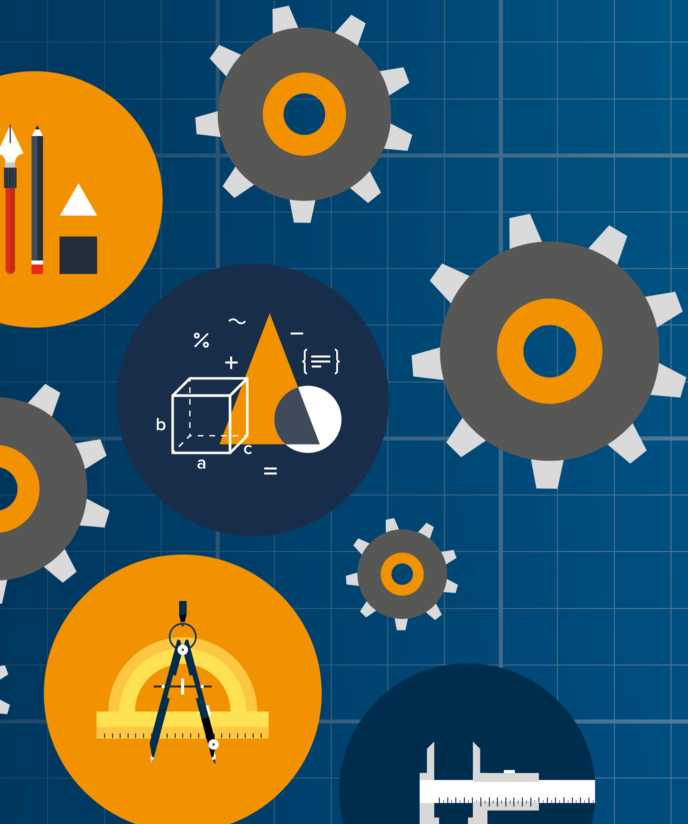
WARMAN®

Design & Build Competition



A history of the Warman Design & Build Competition 1988 - 2015

The Warman Design & Build Competition, now about to enter its twenty-ninth year, is a major event held each year and assists in the development of skilled engineering students. We, the authors, have nurtured it for many years. Alex Churches has been privileged to be involved with the competition from its inception to today and Warren Smith has been the longest serving National Organiser. We hope that you find the history of the competition as interesting as it has been to those of us who have been involved in it.

No history of the competition would be complete without acknowledging the foresight of Engineers Australia as well as the support and sponsorship of Dr Charles Warman and his CH Warman Group followed by Warman International, Weir Warman and now Weir Minerals. We would not have the competition without them.

We would like to thank everyone who has helped us recall the early days of the competition and provided photographs. We would also like to thank everyone who has worked so diligently for so long in running the competition as well as encouraging us over the years and of course the Mechanical College Board for their continuing support of the National Committee on Engineering Design.

We look forward to the future of the competition and increasing the number of universities participating in what is a very important step in developing foundation skills for mechanical engineers.

Alex Churches

DR ALEX CHURCHES AM FIEAust CPEng (Ret)
Chair
National Committee on
Engineering Design (NCED)

W.F. Smith

DR WARREN SMITH
National Supervisor,
Warman Design & Build Competition

ENGINEERS AUSTRALIA

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Published by The Institution of Engineers Australia February 2016

Left and above: Scenes from the Project TRANSFER National Final of the Warman Design & Build Competition, held in the Turbine Hall of Sydney's Powerhouse Museum in September 1995.

Project TRANSFER required students to safely suspend and laterally transfer up to four 0.75kg "radioactive fuel rods" as far as possible. Performance was assessed on the product of the mass transferred and the square of the transfer distance, summed over two attempts. Both overbalancing and lateral stability presented significant design problems.

Carrying the maximum allowable payload of 3kg, the winning team from Curtin University achieved distances of 3.54m and 3.55m using a telescoping tube. The University of Canterbury (NZ) achieved the best single run score on the day (3kg at 3.924 m) with an arched scissor mechanism (shown in photo above) but failed on the second attempt. While most teams used counterbalances, Canterbury employed an unreliable suction cup.

Each year the project context is set on the mythical planet of Gondwana. The Gondwanan background theme in 1995 was created by students at the College of Fine Art at University of New South Wales.

THE GENESIS OF THE WARMAN DESIGN & BUILD COMPETITION

"The Warman", as the competition has come to be known, had its genesis in mid-1987 when John Reizes (now Adjunct Professor at University of New South Wales and University of Technology Sydney), at that time a member of Engineers Australia's Mechanical College Board, suggested setting up an Australia-wide, creative, practical student design competition. John's concept was to broaden the scope of a second-year student design-and-build project Alex Churches had been running in the School of Mechanical and Manufacturing Engineering at the University of New South Wales in Kensington. Alex had inherited the project when he took over the second year design course from Professor Noel Svensson in the early '70s. John, a concept man to his bootstraps and a superb delegator, asked Alex to think about how to implement it.

The basic concept was to offer an outstanding, readymade, annual, creative and competitive hands-on design-and-build project at second-year level to all Australian universities running a broadly "mechanical" course – approximately 24 campuses at that time. The aim was to increase students' experience in creative thinking, practical engineering design and hands-on construction. The Mechanical College Board agreed to the competition being set up provided a long-term sponsor could be found. After the first project had been completed with enthusiasm all round, it was Martin Thomas, at that time Chair of the Mechanical College Board, who suggested that Charles Warman might like to have his name given to the competition, giving it national recognition. While Charles, a naturally modest man, was content to endow the competition and to serve on early judging panels he was initially reluctant to see his name attached in any formal way. Later however, with continuing encouragement and the obvious success of the competition his resistance declined with the name the "Warman Student Design-and-Build Competition" becoming enthusiastically accepted. It was at John Reizes' suggestion that the College Board then establish the National Panel on Engineering Design as a home for the new design-and- build competition. The National Panel was later upgraded to the National Committee on Engineering Design (NCED) which has, from the very beginning, been the group responsible for "the Warman".

THE COMPETITION'S ETHOS

There were of course a number of competing factors to be resolved, not the least of which was the need to catch the interest of both students and campus lecturers. It was also important to generate a project which stimulated creativity, resulting in a 'product' which could be 'manufactured' by students, if necessary on a kitchen table. The format is probably best categorised as 'a proof of concept project'.

The first draft specifications, set out below, have changed very little over the 28 years the Competition has been running:

- Available to second-year students in any Australian (later, Australasian) university campus running a broadly 'mechanical' course (Due to changing course structures, some campuses now run the competition in first year or, in 3+2 courses, even third year.).
- A group project, partly to cope with large student numbers, but also to cater for some otherwise good students who really have little design ability and benefit from the team experience. Group work also reduced cost per student. It was recommended groups be limited to four to minimise 'free loaders'.
- Projects to be suitable for use on any Australian campus with minimal set-up cost.

- Only mechanical energy to be used. This restriction has been relaxed as the use of electric motors and batteries (introduced in 1996) and even micro-controllers and mechatronics (significant use evident since 2006) have become commonplace.
- To emphasise the breadth of design, each project to be designed so that several different conceptual solutions would be competitive.
- At campus level, the focus is on successfully completing the set task, i.e. a project rather than a competition.
- A significant proportion of class marks to be allocated to practical completion of the set task and successful performance of student-designed devices.
- The group with the most successful performance at each campus to be invited to take part in a second-tier competition – a National Final, carrying significant prize money as well as prestige.
- A new project to be created each year – no recycling of projects.

THE FIRST PROJECT

With the basic philosophy in mind, the first project was put together. Project LIFT was to design a rope-climbing machine to raise a payload vertically up a cable to a hovering spacecraft on the mythical Planet Gondwana, where Earth students were imagined to travel for work experience. The standard test rig used is shown in Figure 1. Set as a 'proof of concept' project, the cable was a five metre high length of sash-cord, the payload a table-tennis ball resting unsecured in a shallow plastic saucer. The criterion was shortest time to complete the lift with the table-tennis ball remaining in the saucer.

In the latter part of 1987, Alex Churches travelled to most Australian state capitals and cities with university campuses to sell the concept. Early in 1988, the eighteen interested campuses were provided with a length of standard sash cord, a standard mass to pre-tension the cord, a plastic saucer and a copy of the final project specifications and rules. Lecturers were able to run their campus project either in Session 1 or Session 2, depending on their course structure, which meant the National Final needed to be scheduled as late as possible in Session 2. In practice, the last weekend in September, coinciding with school holidays and most university mid-session breaks, remains a popular choice.

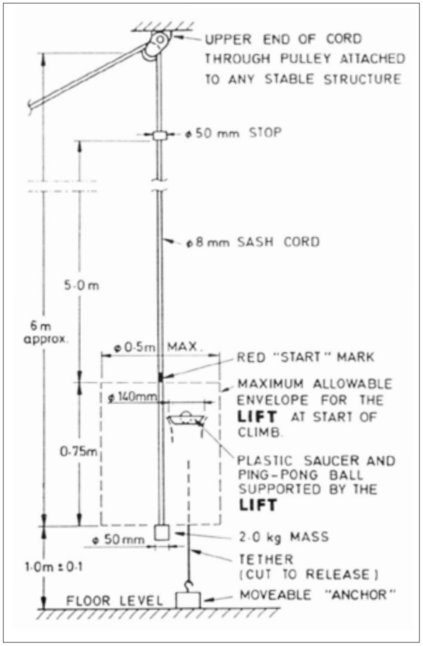

Figure 1: The first project test rig.

THE FIRST NATIONAL FINAL

As part of the first competition, the two members of the best performing team at each campus were funded to attend Engineers Australia's Mech '88 Congress and Exhibition (chaired by Dr Duncan Gilmore, University of Queensland, who was also a Campus Organiser) run in conjunction with Brisbane Expo '88. The visiting students were billeted with students from the University of Queensland.

The Sheraton Hotel, Brisbane, was the Mech '88 venue and the first National Finals were run in the reception area with the rope suspended from the mezzanine level balcony. Engineers Australia's Congress delegates watched the two heats of the event during the morning and afternoon tea breaks. A vivid memory is the consternation amongst the elderly ladies sipping tea in the adjoining café when the Queensland University of Technology students set their device in motion, powered by an extremely noisy geared air motor. The competition was also seen nationally, being covered on multiple national network TV news programs.

Students attended the Congress Dinner held the same evening as the National Finals, where the winners received their prize money ($500, $300 and $200 for first, second and third respectively) before flying home the next day.

The simplicity of the design of the rope-climbing machine shown in Figure 2 helped to make it a clear winner of the 1988 National Final. A major factor was the use of a steel helical torsion spring mounted around the axle, feeding torque directly onto the drive wheel, rather than the rubber bands used in tension by many students. Later projects have generally been required to perform a series of tasks or stages and have resulted in devices of increasing complexity. The leader of the 1988 winning team, Andrew Thomas (pictured at right) from University of New South Wales, went on to a career in engineering design. Twenty five years later, he demonstrated his device again (pictured far right) during the running of Project SILVER which included a rope climbing element in acknowledgement of the very first competition.

EARLY FUNDING

Shortly after the first National Final, Charles Warman (who later received an Honorary DSc from University of New South Wales) was informed of the success of the competition and volunteered funding to ensure its continuation. If memory serves correctly, the funding cost in 1988 was around $7,000 per annum. At that stage, the Competition adopted the title "The Warman Student Design & Build Competition" which, in various shortened versions, has been retained to the present day.

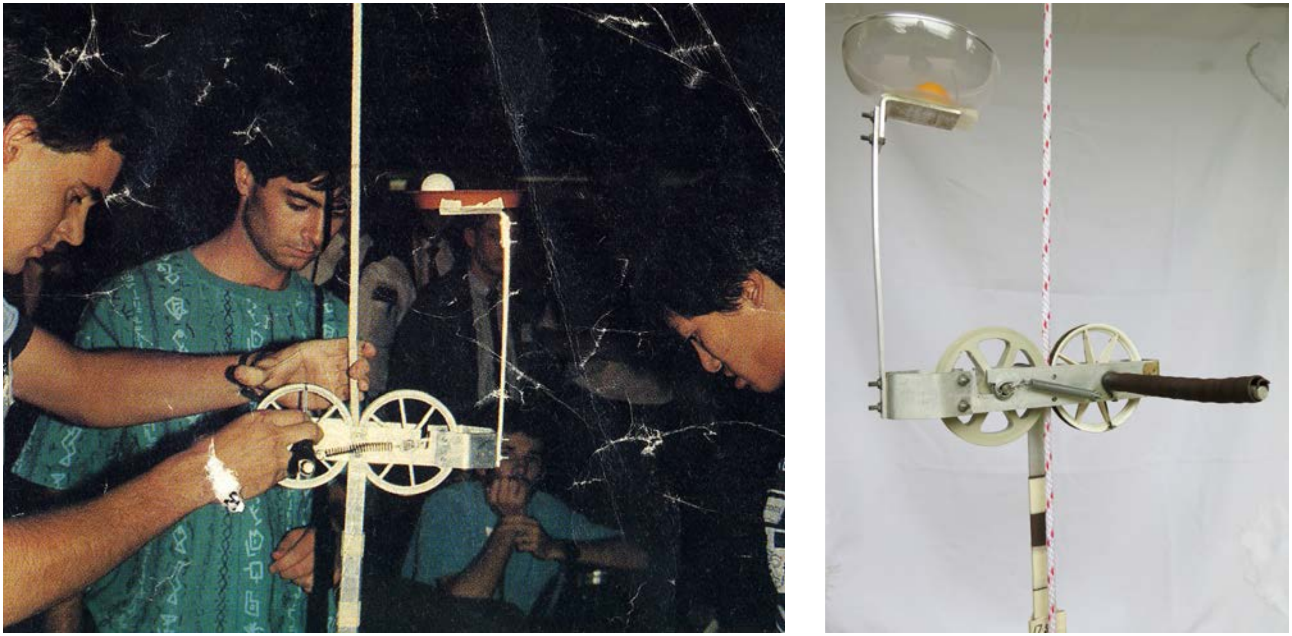

Figure 2: The first National Final winning team and device.

THE WARMAN TROPHY

In 1989 Engineers Australia, through NCED, commissioned the design and manufacture of a bronze casting to be known as the Warman Trophy. Details of the sculptor who designed and cast the trophy are no longer available, apart from an inscription 'ea 89' on the base of the casting. It was intended to award the mechanically-themed trophy shown in Figure 3 to the school of the winning student team, to be displayed in a prominent location for one year. The aim was to strengthen university links with the competition. In later years, it was found more appropriate to award the trophy to the student team, although still with the idea it would be prominently displayed in the school. The wooden plinth seen in the left image in Figure 3 is double the height of the original, as in the top image, to make room for inscriptions of the 28 winning campuses to date.

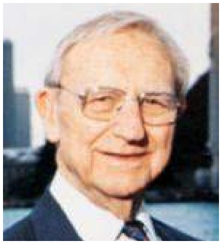

Figure 3: The Warman Trophy (left), designed and cast in 1989 and in the hands of Alex Churches and Charles Warman (top) Charles Warman (right).

THE WARMAN ORGANISATION

Charles Warman began his working life as a draftsman for a gold mine in Kalgoorlie, Western Australia. Noticing that there were improvements to be made to the 'humble' slurry pump, he set about revolutionising the technology.

By 1938, Charles had made several key improvements to slurry pump design and held several patents on his ideas. Some of the improvements included simplifying the seal so it required little maintenance, and introducing an easily replaceable rubber liner.

Charles Warman's C H Warman Pump Group was founded in 1938[1]. He continued to revise and improve slurry pump design, releasing new generations of the Warman® pump in 1950 and 1962. By this time, Warman® pumps accounted for approximately 90 percent of the Western Australian market. In the late 1950's, Charles moved the company to New South Wales and constructed a new foundry, marketing and research facility in Artarmon. In the late 1960's, his main international operations were sold to a large Australian public company trading as Warman International Ltd. Charles had retained the C H Warman Pump Group and continued to manufacture and market Warman products, mainly in Africa. By the end of the century, Warman® pumps were being manufactured all over the world.

In 1999 the international pump business was purchased by The Weir Group PLC, trading as Weir Warman and, in 2008, The Weir Group PLC acquired the C H Warman Pump Group, continuing to trade as Weir Warman. Weir Warman later became Weir Minerals and continues to operate one of their world-wide large slurry pump design and manufacturing organisations in Artarmon. This centre supplies slurry-pumping equipment to many large mining and industrial ventures worldwide. A Weir Minerals timeline is provided in Figure 4.

After some years as sole sponsor, Charles Warman reached an agreement for the C H Warman Pump Group and Warman International Ltd to share equally in sponsoring the competition. Following Charles' retirement, the C H Warman Pump Group focused their activities on the African market and Warman International Ltd agreed to take up sole sponsorship of the competition. Warman International, followed by Weir Warman and Weir Minerals, have continued their generous sponsorship to the present day. During this time, the cost of the competition has increased significantly, mainly due to the increasing scope of the National Final. Engineers Australia has shared very significantly with 'in kind' contributions to meet the increasing cost.

After some years of retirement in Turramurra, Sydney, Charles died on 11 July 2008. He was posthumously inducted into the Australian Propectors and Miners Hall of Fame on 6 October 2009.

[1] www.weirminerals.com

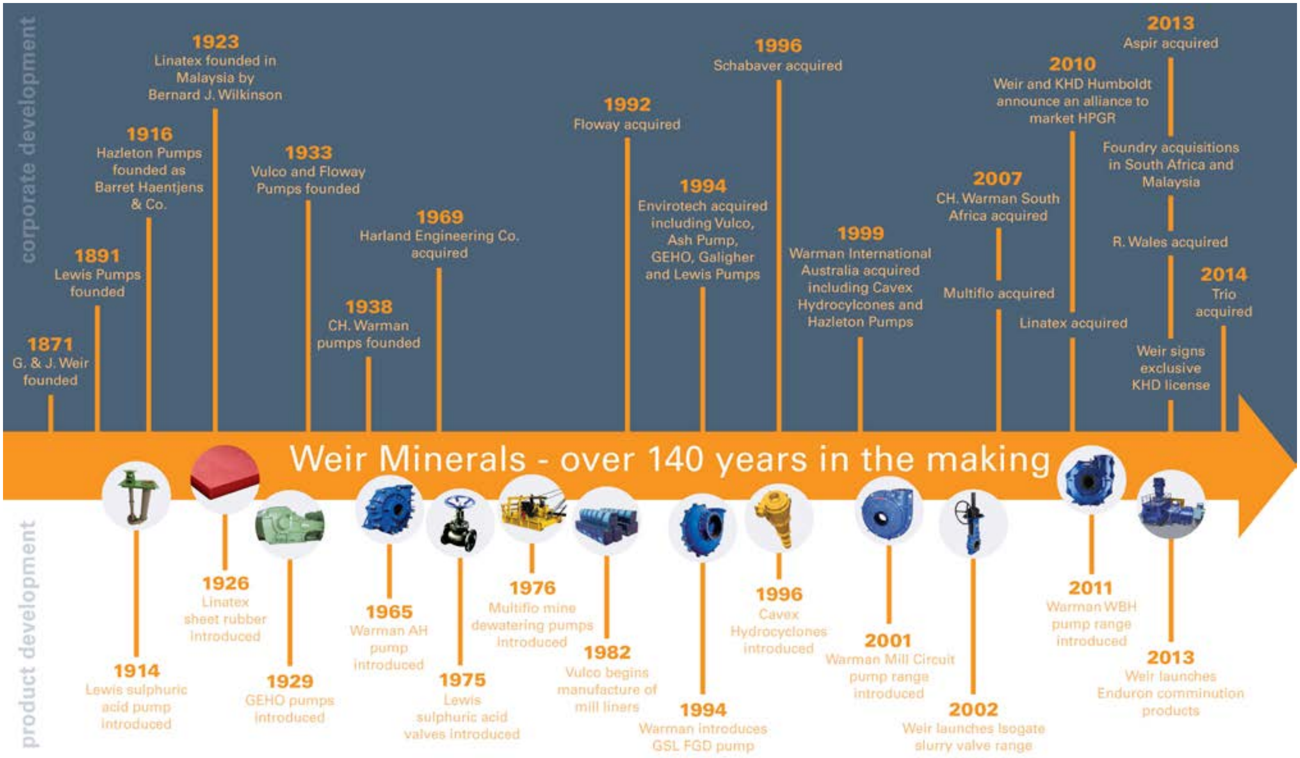

Figure 4: Weir Mineral Timeline highlighting key Warman milestones.

THE NATIONAL FINALS

The format of the National Finals has evolved and expanded over the 28 completed years of the competition. In the early years, it was traditional to run the National Finals as part of an engineering conference in Brisbane, Canberra, Sydney, Gladstone, etc. Later, the National Finals broke their nexus with conferences and were run for some years in universities (including one in Christchurch NZ) before settling for many years in Sydney's Power House Museum (PHM), with students accommodated in low cost motels rather than the billeted accommodation made available for the first National Final in 1988.

The current venue is Sydney's Australian Technology Park (ATP) (see Figures 5 and 6). Being in Sydney, as with the PHM, it has the advantage of allowing students competing at National Finals to tour the Warman/Weir Minerals plant at Artarmon (see Figures 7 - 9). We wish to acknowledge, with much gratitude, the roles of Warman International engineers Allan Wightley and Tony Grzina (depicted in Figure 10) as champions of the competition in its early years and proponents of the annual student tour of the pump manufacturing plant.

The factory tour gives students an opportunity to witness the Australian design and manufacture of a world-class engineering product, while benefiting our sponsor through increased awareness of Weir Minerals and Warman® pumps.

To accommodate the tour, the National Finals have become three-day events with the factory tour on a Friday, practice, scrutineering and design judging on the Saturday and the two competition heats and the presentation dinner on the Sunday.

A significant innovation has been the funding of Campus Organisers to attend the National Finals to network, take part in a forum to discuss engineering design issues generally, share campus experiences of the competition, suggest improvements in light of changes in engineering education, and to help in running the two performance heats.

Opposite page

Figure 5 (top left) : Post competition group photo at the ATP in 2014.

Figure 6 (top right): Students and spectators in the ATP Auditorium in 2014.

Figure 7 (bottom): Gathered on the steps of Weir Minerals during the 2014 student factory tour.


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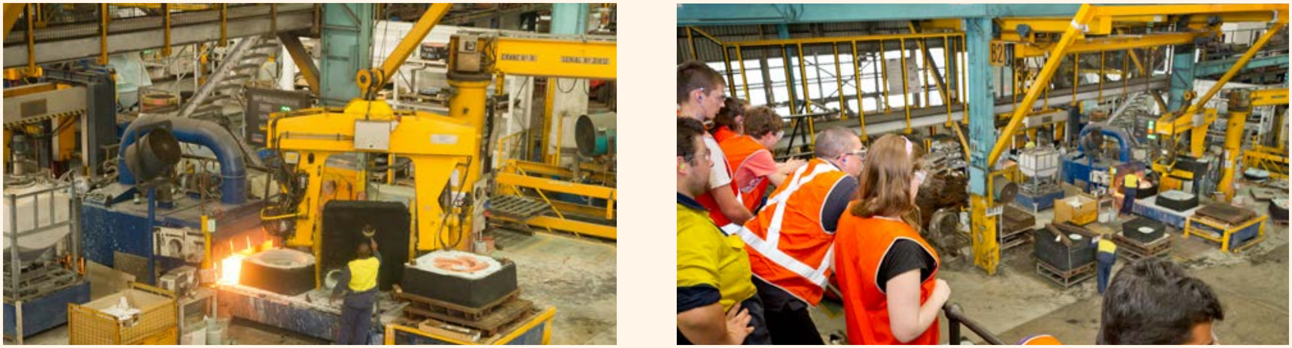


Figure 8: In the Foundry during a student factory tour.

Figure 9: Students with a Warman® Pump during a student factory tour.

Figure 10: Key identities related to the competition gathered in 2012 at the 25th National Final (left to right: Warren Smith, Allan Wightley, Alex Churches, Tony Grzina, John Reizes, Cliff Green).

NATIONAL ORGANISERS

To date, there have been seven National Organisers (listed in Table 1), responsible for creating a fresh project each year, answering campus queries regarding the interpretation of the rules and, in the early years, organising the National Finals.

We are also pleased to acknowledge the significant contributions of the Engineers Australia staff who have made possible the smooth running of the competition.

SELECTED COMPETITION RECORDS

Listed in Tables 1, 2 and 3 are details and statistics of the competition throughout its history. The winning universities, a brief description of each project and the universities that participated in the competition are given. The campuses with significant numbers of National Final victories and podiums are:

- University of Western Australia — 5 wins (11 Podiums)
- University of Auckland (NZ) — 4 wins (8 Podiums)
- University of NSW — 3 wins (9 Podiums)
- University of Canterbury (NZ) — 3 wins (9 Podiums)
- University of Newcastle — 3 wins (8 Podiums)
- University of Adelaide — 2 wins (5 Podiums)
- University of NSW Canberra — 2 wins (5 Podiums)
- University of Queensland — 2 wins (3 Podiums)
- Curtin University — 2 wins (2 Podiums)

On three occasions, 1993, 1997 and 2012, joint winners were declared.

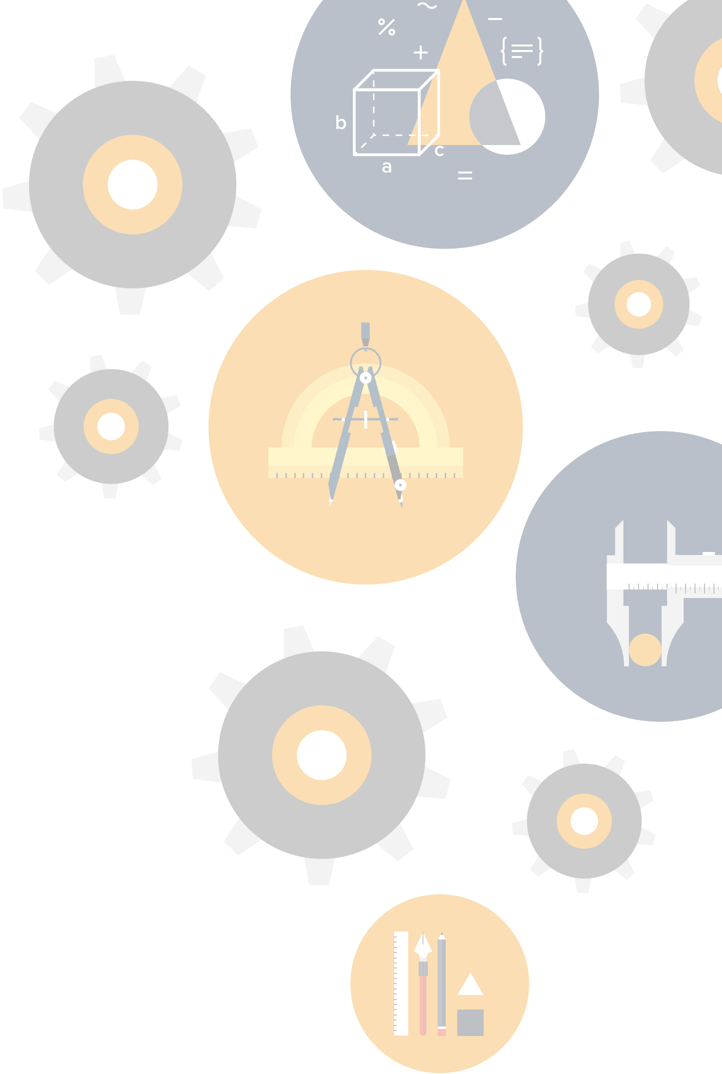


Table 1: Winning universities, project, National Organisers and location of National Final

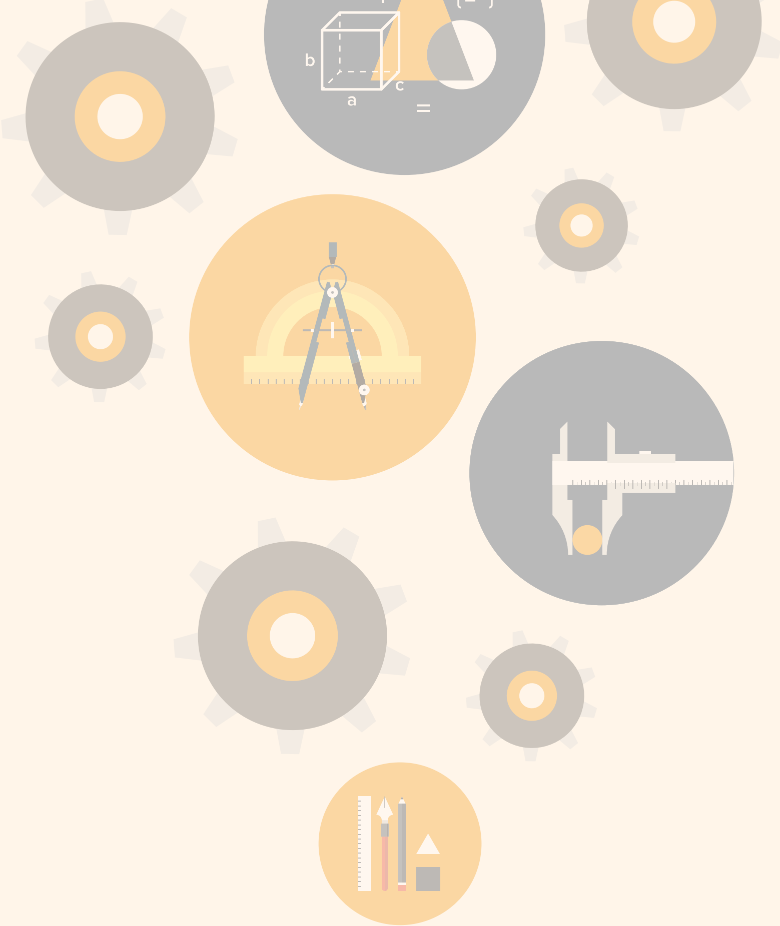
YEAR	WINNING UNIVERSITY	PROJECT	ORGANISERS	LOCATION
1988	University of New South Wales	LIFT	Alex Churches	MECH'88, Sheraton Hotel, Brisbane
1989	James Cook University	DROP	Alex Churches	IEAust National Engineering Conference, Canberra
1990	University of Central Queensland	CART	Alex Churches	IEAust Noise and Vibration Conference, Monash University
1991	University of Technology Sydney	PEP	Doug Wright	MECH'91, Darling Harbour Convention Centre, Sydney
1992	University of New South Wales	SLAM DUNK	Doug Wright	Interdisciplinary Design Conference, Boulevard Hotel, Sydney
1993	Curtin University & University of Western Australia	ELEVATOR	Doug Wright	Australian Aeronautical Conference, Regent Hotel, Melbourne
1994	University of Queensland	SHOWER	Tony Goodwin	Engineering in Agriculture Conference, Christchurch, NZ
1995	Curtin University	TRANSFER	Tony Goodwin	Powerhouse Museum, Sydney
1996	University of Newcastle	CLEANUP	Bruce Field	Bulk Materials Handling Conference, Swinburne University
1997	University of Auckland, University of Adelaide & Queensland University of Technology	ANTIQUES	Bruce Field	Powerhouse Museum, Sydney
1998	University of New South Wales at the Australian Defence Force Academy (University of New South Wales Canberra)	ISLAND HOP	Bruce Field	AAEE "Waves of Change" Conference, Gladstone
1999	University of Auckland	PLUGHOLE	Bruce Field	Powerhouse Museum, Sydney
2000	University of Canterbury	RESCUE	Chris Snook	Queensland Science Centre, Brisbane
2001	University of Queensland	RECYCLE	Chris Snook	Powerhouse Museum, Sydney
2002	University of Western Australia	BALLDROP	Chris Snook	Powerhouse Museum, Sydney
2003	University of Western Australia	ESCAPE	Warren Smith	Powerhouse Museum, Sydney
2004	University of Auckland	PEP	Warren Smith	University of Technology, Sydney
2005	University of Canterbury	SCAD	Warren Smith	Powerhouse Museum, Sydney
2006	University of Auckland	ABC	Warren Smith	Powerhouse Museum, Sydney
2007	University of New South Wales	REACT	Warren Smith	Powerhouse Museum, Sydney
2008	University of Adelaide	READY	Warren Smith	Powerhouse Museum, Sydney
2009	University of Western Australia	BATON	Warren Smith	Powerhouse Museum, Sydney
2010	University of Western Australia	PASS	Warren Smith	Powerhouse Museum, Sydney
2011	University of Newcastle	PnP	Warren Smith	Australian Technology Park, Sydney
2012	University of NSW Canberra & Flinders University	SILVER	Warren Smith	Australian Technology Park, Sydney
2013	University of Canterbury	CROSS	Warren Smith / Craig Wheeler	Australian Technology Park, Sydney
2014	University of Newcastle	ELEVATE	Craig Wheeler / Warren Smith	Australian Technology Park, Sydney
2015	RMIT University	EXTRACT	Craig Wheeler / Warren Smith	Australian Technology Park, Sydney

Table 2: Brief description of projects created and run 1988 – 2000

YEAR	PROJECT	DESCRIPTION	ACRONYM
1988	LIFT	Design and build a device to lift and control a payload 5m up a rope in the shortest time. The payload comprised of a plastic saucer and an unsecured table-tennis ball. The winning device achieved the task in 1.2 seconds and was powered by steel torsion springs, decelerating about 2m from the top as the springs unwound.	"Low-tech Invention Foiling Tryops"
1989	DROP	Design and build a device which is capable of carrying a golf ball up a rope sloping at nominally 45 degrees and having reached the top, manoeuvre to drop the ball as close as possible to a specified target below in the shortest possible time.	"Drop ReActiv8 Onto Processor"
1990	CART	Design and build a mechanically powered device to transport six 375ml cans of "restorative fluid" along a 10m track. The fluid if delivered to Alric, will help the great Gondwanan leader regain his superpowers, and escape from those holding him captive.	"Carry Alric's Restorative Tinnies"
1991	PEP	There is a social event on Gondwana and the humorous East Gondwanans want to surprise the Presiding Engineer by delivering liquid refreshment to him by devices released from the air vents above. Design and construct a device which is released through an aperture at a height of 3m above the floor and delivers a 375ml can of drink to a target 7.5 m from the aperture.	"Potential Energy Propulsion"
1992	SLAM DUNK	Port Dwana on Gondwana, the only shuttle station on the planet, is in dire straits. It has already been evacuated and its imminent destruction by an unstable nuclear reactor threatens to disrupt the economically crucial tourist industry. Design and construct a mechanical device which will convey a golf ball from within the starting envelope on the horizontal track, and drop the ball down the vertical tube.	"Swiftly Lower Alric's Moderator Down to the Unstable Nuclear Kiln"?
1993	ELEVATOR	This year, the problem on Gondwana was terrorists. A small bomb had been placed next to the core of a reactor. If the bomb could be placed over the reactor, all would be well. Design and build a mechanical device which will transport an open can of water from the floor up onto a table and as far as possible from the front edge of the table.	"Evenly Lift the Explosive Vessel And Transport it Over the Reactor"
1994	SHOWER	Gondwanan nuclear plant operators were suffering from radiation exposure. They needed a device to raise their radiation neutralizing agent as high as possible to provide a shower of detoxifying ions. Design and build a mechanical device which will elevate a sealed can with a total mass of 1kg as high as possible from a rest position prior to triggering, to a rest position at the completion of the stroke.	"System to Help Overcome Workers' Exposure to Radiation"
1995	TRANSFER	The Gondwanans had another nuclear reactor problem, this time with removing spent nuclear fuel rods. Design and build a device of no more than 8 kg which suspends a mass representing spent fuel rods and transfers that mass laterally as far as possible.	"To Remove All Nuclear Spent Fuel Efficiently from the Reactor"
1996	CLEANUP	The Gondwanans have been lax in handling nuclear material and have spilled a small quantity of radio-active pellets. Design and build a self contained device to pick up pellets (split peas) and deposit them to another location.	"Collect Lightly and Efficiently All Nuclear Unapproachable Pellets"
1997	ANTIQUES	There has been another radio-isotope disaster on the remote planet of Gondwana! A heavy subterranean gas has leaked into the museum and threatens to destroy priceless antiques. The objective is to transfer a spherical object (a tennis ball) from a "start zone", through an open "window" to a stationary position as close as possible to a defined elevated point.	"And Neutralise The Isotope Quickly Until Entirely Safe"
1998	ISLAND HOP	Severe quakes are dividing the Gondwanan crust and transport between the "islands" being created is needed. Design and build a device which will transport itself and a delicate object (light bulb) from one horizontal platform to another, placed as far away from each other as possible.	"Ingeniously Save Lives And Not Destroy Hopes Or Property"
1999	PLUGHOLE	Gondwana gains power by tapping subterranean gases. Quakes have caused pipelines to rupture and they are venting and need to be capped. The inhabitants want an automatic machine to pass over rough terrain and deal with the most severe leaks that are the most difficult to reach. Design and build a device which will place a circular disc ('the plug') on a defined target area.	"Prevent Leaking Underground Gases Having Overly Lurid Effects"
2000	RESCUE	Design and build a device that could recover a weighted container representing an expeditionary party and deliver it back to home base.	"Retrieve Entire Scientific Crews, Utensils and Equipment"

Table 3: Brief description of projects created and run 2001 - 2015

YEAR	PROJECT	DESCRIPTION	ACRONYM
2001	RECYCLE	The Gondwanans are interested in sustainability. Design and build a device that combines speed and lift in order to make the recycling process work as efficiently as possible.	“Recycling and Energy Conservation of Yelm Compounds using Lightweight Equipment”
2002	BALL-DROP	The Gondwanans want to use a Plasmatron to produce Ozone – a by-product of the reaction. Design and build a device that will deliver fuel in the minimum time and remove the device to a safe location before detonation (and levelling of the terrain).	“Build A Land Levelling Device that will Refuel the Ozone Plasmatron”
2003	ESCAPE	Design a device, which transports a payload representing personnel and equipment along a horizontal tunnel and up a vertical shaft to safety. The shaft had a centre “fireman’s” pole that could be climbed to effect a timed escape.	“Engineer for a Safe and Clandestine Ascent of imPrisoned Expatriates”
2004	PEP	Use the energy of a falling mass to provide energy for a device to travel as far as possible up a track comprising of three inclined planes. The challenge was to design the most efficient device and associated infrastructure that stored and utilised the energy released by the falling mass.	“Potential Energy Propulsion”
2005	SCAD	Transport “citizens” safely across a crevice following a quake, to a significantly safer plain below. Two inclined planes with a gap between them represent the terrain and golf balls sitting on varying height golf tees represent the citizen awaiting transportation.	“Safe Collection And Delivery”
2006	ABC	Design a device to accurately and rapidly distribute seeds along the planet’s highways. Fields for seeding are defined by small fences and fragile trees lining the road are not to be damaged.	“Autonomously Beautify Countryside”
2007	REACT	The Gondwanan Environmental Protection Agency needs help. Design a device that serves to deploy emergency response packs and recover valuable equipment.	“Reliable Effect At Critical Times”
2008	READY	Design, build and prove a prototype device in a laboratory environment that serves to navigate difficult terrain and deploy a response payload.	"Responsible Emergency Aid for Disaster, Year-round"
2009	BATON	Design, build and prove a prototype device in a laboratory environment that serves to automate a baton exchange.	"BATON"
2010	PASS	Design, build and prove a prototype system in a laboratory environment that serves to transport a payload across a disjointed and cambered track modelling the newly forming landscape.	"re-Position with Accuracy, Safety and Security"
2011	PnP	Design, build and prove a prototype system in a laboratory environment that serves to transfer a payload of game balls on the defined track in accordance with the rules. In context, can you design the best system to pick and place product in the form of spherical containers between production and warehousing facilities?	"Pick-n-Place"
2012	SILVER	Design, build and prove a prototype system in a laboratory environment that serves to deliver autonomously a supply package to a balloon based observation facility, using the balloon tether to deliver the supply package.	"Strategically Innovate for Laterally and Vertically Effected Replenishment"
2013	CROSS	Design, build and prove a prototype ground based system in a laboratory environment that serves to transport a payload over a defined terrain which includes negotiating a significant crevasse and some obstacles.	Crevasse Road Outpost Safety System
2014	ELEVATE	Design, build and prove a prototype ground based system in a laboratory environment that serves to transport a payload over a defined terrain which includes negotiating an obstacle of sufficient height.	Emergency Lift and Exchange of Volatile And Toxic E-waste
2015	EXTRACT	Design, build and prove a prototype ground based system in a laboratory environment that serves to extract, transport and relocate a payload over a defined terrain.	Extract, Transport and Relocate Accumulated Treasure



COMPETING CAMPUSES

Details of universities that have competed over the years, together with other data for the competition, may be found in:

Smith, Warren F., "A Pillar of Mechanical Engineering Design Education in Australia: 25 Years of the Warman Design and Build Competition," ASME 2013 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference, American Society of Mechanical Engineers, 2013.

Table 4 (opposite page), reproduced and updated from Warren's paper shows that the maximum number of campuses competing in any year was 24, in 1995. The lowest number of competing campuses was 14, in 1989, 2008 and 2010. The campus of the University of NSW Canberra has run the competition in all 28 years but missed representation at the National Final in 2001. The Universities of Adelaide and Newcastle have also been consistent participants registering involvement in 27 competitions. With 25 attendances at the National Final are the Universities of Adelaide, Newcastle and Western Australia and Monash University.

Figure11: Campus Organisers and NCED members at the 25th National Final.

The average number of participating campuses over the Competition's history has been 17.5 with an estimated total of approximately 42,000 students having experienced the Warman at campus level over that period.

The competition is dependent on a number of things for success, not the least of which is the ongoing work of NCED and the Campus Organisers. Those involved in the project in 2012 and present at the National Final are depicted in Figure 11.

Table 4: Participating at the National Final

	Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
University	Count	18	14	18	18	20	17	22	24	21	21	18	18	16	18	16	18	17	20	16	17	14	17	14	15	16	17	15	15
Australian National University	3								■	■	■																		
Auckland University of Technology	2																									■	■		
Central Queensland University	18		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■									
Charles Darwin University	4																		■	■	■		■						
Curtin University	14	■			■	■	■	■	■		■		■	■	■			■	■	■	■								
Deakin University	2																											■	■
Flinders University	5																								■	■	■	■	■
Griffith University Gold Coast	1																										■		#
James Cook University	21	■	■	■	■	■	■	■	■	■								■	■	■	■	■	■	■	■	■	■	■	■
Massey University, NZ	5							■	■	■	■	■																	
Monash University	25	■		■	■	■	#	■	■	■	■	■	■	■	■	■	#	■	■	■	■	■	■	■	■	■	■	■	■
Monash University - Caulfield	15	■		■		■	■	■	■	■	■	■		■	■	■	■	■	■	Engineering program closed									
Monash University, Malaysia	8												■	#	#	#	■	#	#	#	#	■	■	#	#	■	■	■	■
Queensland University of Technology	16	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■												
RMIT University	23	■		■				■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Swinburne University of Technology	12	■			■	■	■	■	■	■					■	■	■	■	■	■									
University of Adelaide	27	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
University of Auckland, NZ	22						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			■	■	■
University of Ballarat	7												■				■		■		■	■	■		■				
University of Canterbury, NZ	24					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
University of Melbourne	6																							■	■	■	■	■	■
University of Newcastle	27	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
University of New South Wales	25	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	#	■	■	■	■	■		
University of NSW Canberra (ADFA)	27	■	■	■	■	■	■	■	■	■	■	■	■	■	#	■	■	■	■	■	■	■	■	■	■	■	■	■	■
University of Queensland	18	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■				■						
University of South Australia	19	■	■	■	■	■	■	■	■	■	■										■	■	■	■	■	■	■	■	■
University of Southern Queensland	19							■			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■
University of Sydney	7		■	■	■	■			■	■			#	■															
University of Tasmania	18	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■		■	■	■								
University of Technology Sydney	20	■	■	■	■	■		■	■		■	■					■	■	■		■		■	■	■	■	■	■	■
UTS - Singapore	1																	■											
University of Western Australia	25	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■		
University of Wollongong	9	■	■	■	■	■	■	■	■	■																			
Victoria University	12	■	■	■	■	■	■		■	■	■	■		■	■														

#Participated at Campus level but not at the National Final

EDUCATIONAL OUTCOMES

The changes to the Warman specifications over the years have already been mentioned as part of **THE COMPETITION'S ETHOS**. On reflection, it is interesting to consider the changes generally in the first course in mechanical engineering design that have occurred over the past 28 years. For many years, topics such as electrical/electronics and control theory have been part of mechanical engineering degree courses and mechatronics is, in some universities, a recent offshoot of mechanical engineering. But perhaps it has been the growth in electromechanical and mechatronic toys (and the associated access to inexpensive components) that has been a major driver for the changes in the competition task specifications and complexity.

The simplicity of the original (1988) project and the essentially 'mechanical' nature of the winning device have already been illustrated (Figures 1 and 2). Even as late as the 1995 project, the winning curved-scissors mechanism followed a similar mechanical specification. During this 'mechanical' era, it was appropriate to deliver a recurring and well justified comment to students at both campus heats and National Final:

> ***"Now I'll tell you about something that will be a problem to you all your working life. It's about friction – when you want it, there is never enough; when you don't want it, there is always too much!"***

In other words, in the early days, students learnt about mechanical friction in all moving parts, about deflections of shafts under load with associated 'binding' of bearings and about hysteresis in rubber bands, etc, justifying the restriction to mechanical energy. However, by 1996, small electric motors were becoming commonplace in hobby stores and in children's toys and the competition moved with the times. Similarly, by the mid-2000s, many students had become adept with microprocessors and mechatronic principles, so basic microprocessors and associated sensors have been permitted. Overcoming 'friction' is now usually achieved by increasing the battery voltage on the driving motor.

It is expected that the project specifications will need to adapt further as mechanical engineering progresses – but always with an eye on cost per student group[2] and a recognition that a carefully specified project can sometimes be creatively solved by a simple, purely mechanical device. In several recent competitions, simple mechanical machines have won, despite competition from much more complex, microprocessor-controlled devices.

Student surveys of learning benefits of the Warman have been carried out over the years, all showing keen enthusiasm for the competition. In our most recent survey, competitors in the 2015 Warman National Final were asked whether the project and competition contributed to their learning of 14 aspects of managing an engineering project. Fifty-four students responded of sixty-one participating (almost 90% response rate) as shown in Figure 12. If 'some benefit' as well as 'significant benefit' responses are combined, positive responses of over90% have been achieved for 11 of the 14 aspects.

[2] On the majority of campuses, students are required to provide their own funding to build their device – an excellent means of emphasising the importance of cost consideration.

It is also worth noting that the lowest positive response (for 'importance of cost consideration') was 69%. While 'how to work in a group', 'how to carry out a project' and 'importance of organization' all attracted 100% benefit scores (when summing 'significant' and 'some' responses), the highest ranking 'significant' benefit is clearly from gaining 'practical experience of design' (85%). The next highest 'significant' is 'how to work in a group' (80%).

An astute reader might question the validity of the results presented in Figure 12 due to the sample being drawn from a population of the 'best-of-the-best' at the National Final. In 2015, approximately 1950 students participated in the competition at the campus level. However, consolidating all data held from similar surveys conducted in 2015 (National Finalists, 54), 2010 (National Finalists, 44), 2004 (National Finalists and 3 campuses, 328), 2002 (National Campus Survey, 345), 1997 (National Campus Survey, 318), 1993 (UNSW, 87) and 1991 (UNSW, 72) which collectively provide 1248 responses, the picture is very similar, as depicted in Figure 13. There is a slightly different ordering of the impact on learning, with the importance of simple design filtering to be equal at the top. The top percentages have dropped a little but the lowest positive responses are still well above 60%.

It is planned to conduct a comprehensive national survey in 2016.

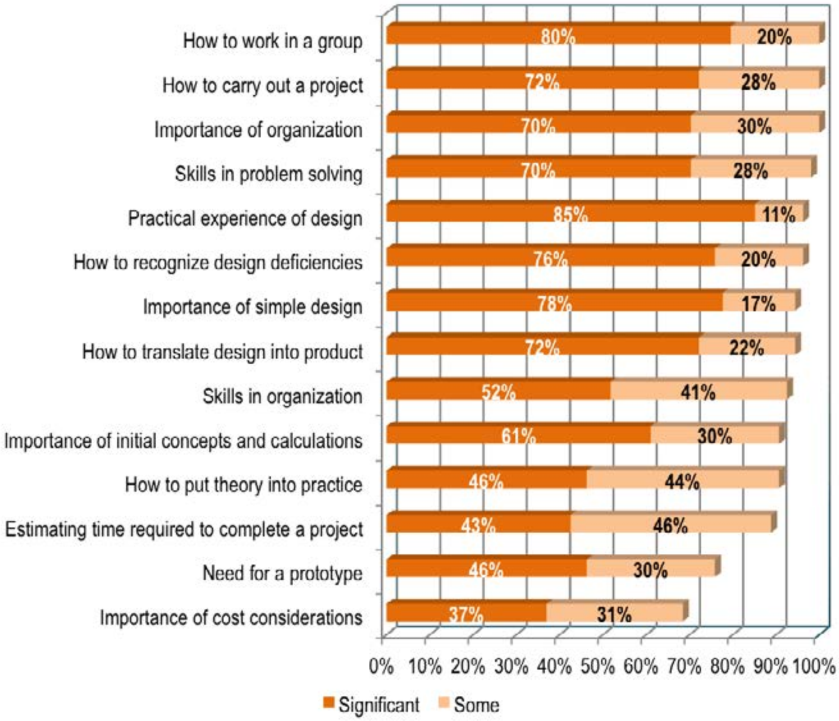


Figure12: Positive student survey responses from the 2015 National Finalists (n = 54) – "To what level did your experience of participation in the Warman contribute to learning in each of the aspects listed?" (responses marked 'little', 'none' or "unable to say" account for the un-plotted remainder)

In essence, the objective of the Warman Competition has been to assist Universities offering Mechanical Engineering programs (broadly defined) to produce more rounded undergraduate student capability. It does this by providing a complete practical exercise requiring creative design, leading to prototype construction, testing, refinement, reconstruction (manufacture) and proof testing. It is no accident that the skills built up in the Warman closely match Engineers Australia's Stage 1 Competencies and that the students perceive these competencies being developed through the Warman project. This coincidence is a powerful argument for the Warman to be considered as part of any undergraduate Mechanical Engineering course. An indication of how closely the Warman Competition relates to the Stage 1 Competencies is given in Table 5.

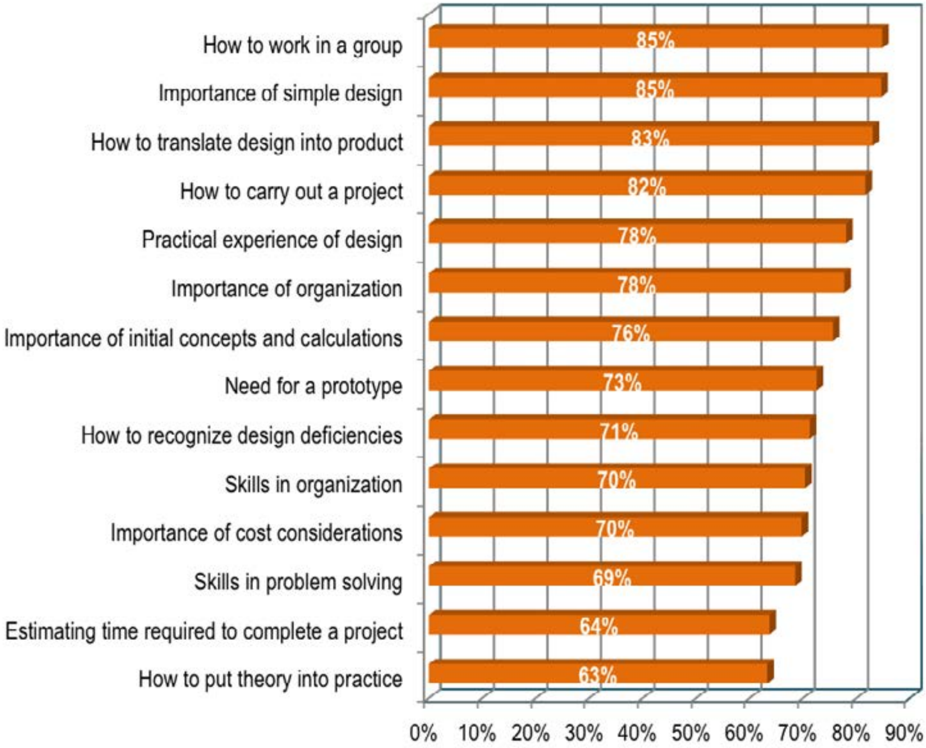


Figure13: Student survey responses of "YES" to "Did your experience of participation in the design and build project result in significant learning in each of the aspects listed?" (n=1248 student responses to surveys conducted in 2015, 2010, 2004, 2002, 1997, 1993 and 1991, responses marked 'little', 'unable to say/unsure/blank' or 'no/none' account for the un-plotted remainder)

Table 5: Engineers Australia's Stage 1 Competencies and How the Warman Competition Builds Capacity in the Elements of Competencies [from (Wheeler and Smith, 2014)]

STAGE 1 COMPETENCY AND ELEMENTS OF COMPETENCY		HOW THE WARMAN COMPETITION BUILDS CAPACITY
1.	**KNOWLEDGE AND SKILL BASE**	
1.1.	Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.	Students apply engineering fundamentals to systematically investigate and analyse a complex engineering problem, with the aim to develop an innovative and practical solution.
1.2.	Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.	Students develop and apply relevant investigation analysis, interpretation, assessment, prediction, evaluation and measurement tools to evaluate the performance of their solutions.
1.3.	In-depth understanding of specialist bodies of knowledge within the engineering discipline.	N/A
1.4.	Discernment of knowledge development and research directions within the engineering discipline.	Students interpret and apply selected research literature to inform their conceptual designs, material selection and methods of construction of their prototype devices.
1.5.	Knowledge of contextual factors impacting the engineering discipline.	N/A
1.6.	Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the specific discipline.	Students apply systematic principles of mechanical engineering design to develop their solutions and gain a real-life understanding of the fundamental principles of engineering project management. Students appreciate the principles of risk management and the health and safety responsibilities of a practical engineering problem during construction, commissioning and operation.
2.	**ENGINEERING APPLICATION ABILITY**	
2.1.	Application of established engineering methods to complex engineering problem solving.	Students learn to partition the set problem into manageable elements for the purpose of analysis and design, and then recombine to develop a functioning solution in the form of a prototype.
2.2.	Fluent application of engineering techniques, tools and resources.	Students apply a wide range of engineering tools for analysis, simulation, visualisation and validation of their designs. These tools are often taught concurrently in the course. Students design and safely conduct experiments, analyse and interpret data, and formulate conclusions in relation to the performance of their prototype systems.
2.3.	Application of systematic engineering synthesis and design processes.	Students proficiently apply technical knowledge and open ended problem solving skills to design various elements of the prototype system to satisfy the competition specifications.
2.4.	Application of systematic approaches to the conduct and management of engineering projects.	Students work in teams to execute a relatively complex engineering project and become aware of the need to plan and quantify performance over the life-cycle of the project.
3.	**PROFESSIONAL AND PERSONAL ATTRIBUTES**	
3.1.	Ethical conduct and professional accountability	Students are expected to behave in a professional manner
3.2.	Effective oral and written communication in professional and lay domains.	Students build capacity in communication with their peers, including comprehending critically and fairly the viewpoints of other team members, and expressing their own information and ideas effectively and succinctly. Courses often include the requirement to submit a written report and oral presentation as part of the project assessment.
3.3.	Creative, innovative and pro-active demeanour.	Since each Warman Competition starts with a clean sheet of paper, creativity and innovation are major issues for students to consider and develop. They are expected to (and do) apply creative approaches to identify and develop alternative concepts and solutions, often from both technical and non-technical viewpoints.
3.4.	Professional use and management of information.	N/A
3.5.	Orderly management of self and professional conduct.	Students are expected to behave in a professional manner
3.6.	Effective team membership and team leadership.	Students are required to work in a team environment of nominally four members. This exposes students to the fundamentals of team dynamics and leadership, learning to earn the trust and confidence of their colleagues, and recognising the value of alternative viewpoints.

THE FUTURE

The life of the Warman Design & Build Competition has seen marked changes in Australia's university system. One of the most significant has been an increasing emphasis on research, with university funding linked to published research papers. The result has been a focus on educating graduates in 'engineering science' to the detriment of 'engineering practice', with practical engineering design the big loser. Whilst NCED believes there is currently pressure through the Engineers Australia Accreditation process to increase the practical engineering content of Australian engineering courses, in 2015 the need for the competition experience is as great as it has ever been.

The Warman has moved with the times. From the specification of a purely mechanical device in its first few years (we were after all dealing with mechanical students) projects are now written to be suitable for inclusion in mechatronics courses, while still not excluding purely mechanical devices. There remains keen interest from the Campus Organisers and the student cohort present at each National Final is as enthusiastic as those in 1988.

With the 2015 project wrapped up, and the 2016 project ready to launch, the immediate future of the competition is secure. In a rapidly changing educational environment, with pressure from increasing course content and changes in engineering technology, the Warman Design & Build Competition needs constant vigilance, ongoing creative input and 'tweaking' if it is to maintain its present useful and educational role. The Mechanical College Board and the NCED are committed to the continuation of the competition as a valued addition to the curriculum of participating universities.

SELECTED PUBLICATIONS BASED ON THE WARMAN DESIGN & BUILD COMPETITION

Wheeler, C. and Smith, W.F. (2014), "Teaching Practical Engineering in Schools and Universities – The Warman Design and Build Competition", Seminar Presentation, EA National Convention, Melbourne, VIC, Australia.

Smith, Warren F. (2013), "A Pillar of Mechanical Engineering Design Education in Australia: 25 Years of the Warman Design and Build Competition," ASME 2013 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference, American Society of Mechanical Engineers.

Smith, W. F. (2008), "Twenty-One Years of the Warman Design and Build Competition," in 19th Annual Conference of the Australasian Association for Engineering Education (AAEE-2008), Yeppoon, QLD, Australia.

Smith, W. F. (2007), "Perspectives of the 'Warman Design and Build Competition'," in International Conference on Design Education (ConnectED-2007), Sydney, NSW, Australia.

Churches, A.E. and Magin, D.J. (2005), "128.61: Student Design-And-Build Projects Revisited". International Conference on Engineering Design ICED 05, Melbourne, VIC, August 15-18, pp 239-40.

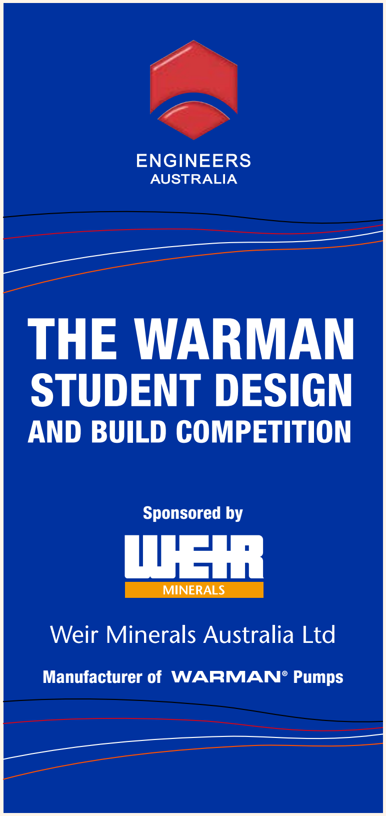
Churches, A.E. and Magin, D.J. (2003), "The Warman Student Design Project and Competition in its mid-teens". Australian Journal of Mechanical Engineering, Vol. 1, No. 1, pp 55-61.

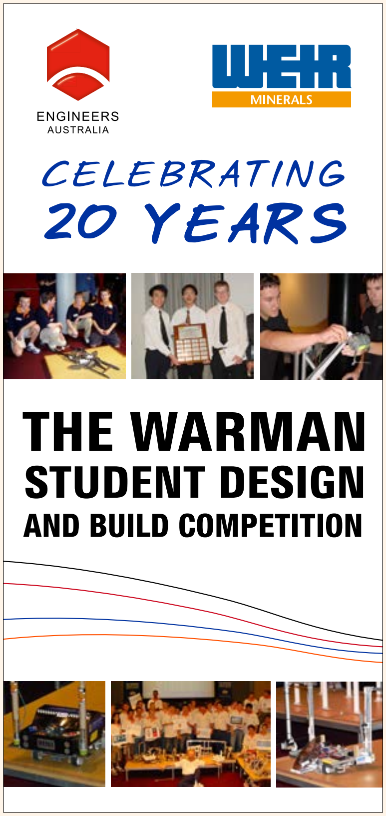
Churches, A. and Magin, D. (1998), "The Warman Student Design Competition: Ten Years On", in Waves of Change Conference, Annual Conference of the Australasian Association for Engineering Education (AAEE), Gladstone, QLD, Australia, 28-30 September.

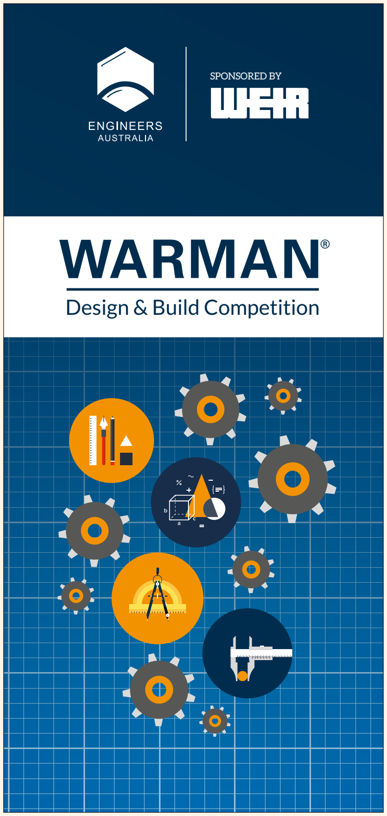
Field, B.W. (1997), "The Australian/New Zealand Warman Design Competition", International Conference on Engineering Design, ICED97, Tampere, Finland, August 19-21, pp 3/419-422.

Magin, D.J. and Churches, A.E. (1992) "The Warman Student Design Competition: What Do Students Learn?". Trans. Mechanical Engineering, I.E.Aust., Vol. ME17, No. 4, pp 207-212.

Churches, A.E., Boud, D.J. and Smith, E.M. (1986) "An Evaluation of a Design and Build Project in Mechanical Engineering". Int. J. Mech. Eng'g Ed., Vol. 14, No. 1, pp 45-55.

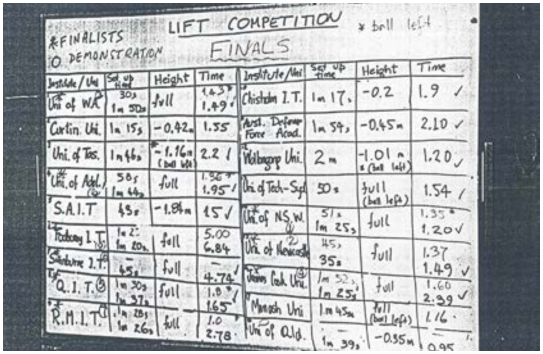




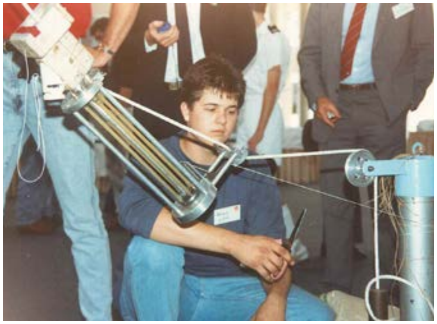


Banners from recent years of the competition.


SELECTED IMAGES FROM THE
COMPETITION ARCHIVES



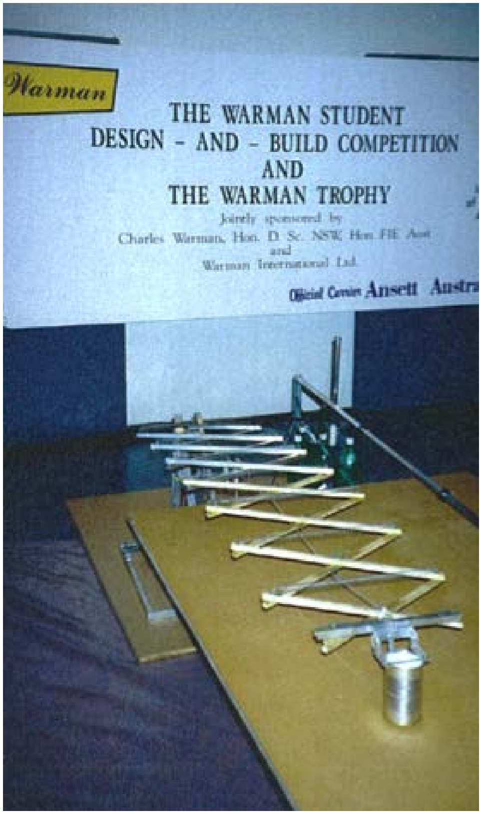
1988 Project LIFT final scoreboard – The University of New South Wales system prevails in Brisbane.



1989 Project DROP – Setting up and awaiting launch instructions in Canberra.

1990 Project CART – University of New South Wales Canberra (at ADFA) local competition teams.

1991 Project PEP – Devices and test rig in the Darling Harbour Convention Centre.



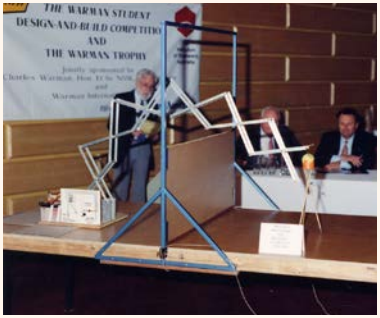
1992 Project SLAM DUNK – University of New South Wales was the first with their hands on "The (new) Trophy" in Sydney at the Interdisciplinary Design Conference (bottom left).

1993 Project ELEVATOR – National Final held in Melbourne.

1994 Project SHOWER – conducted in Christchurch, New Zealand
Devices included telescoping wooden segments (defeated by friction and the rubber bands losing tension), a pneumatic cylinder (which predictably buckled as its height increased) and various scissor mechanisms. Stability was the main issue but the maximum height achieved was over 4m.

1995 Project TRANSFER – National Organiser Tony Goodwin, Rolfe Mische from UNSW, Alex Churches (with microphone) and Kelvin Hundt also from UNSW inspect the winning device (left). Scissor mechanisms were the most popular concept, though Curtin University won with a telescoping tube and another unrolled (right). This was the first of many competitions held at the Powerhouse Museum, Sydney.

1996 Project CLEANUP – Things do not always work as split peas are spread around the room. It was an apt competition, being held in conjunction with the Bulk Materials Handling Conference at Swinburne University.



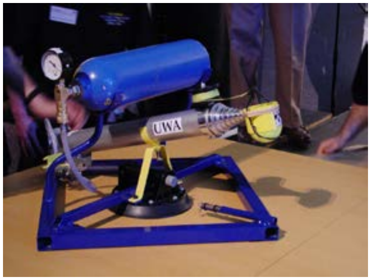
1997 Project ANTIQUES at the Powerhouse Museum, Sydney – Three joint winners were crowned Queensland University of Technology (left) and the University of Adelaide (right) (and Auckland).

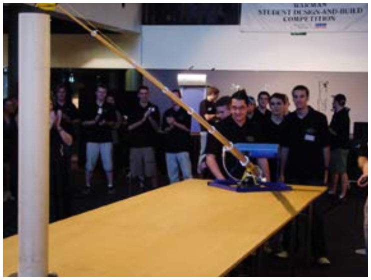
1998 Project Island Hop – The winning team from University of New South Wales Canberra (at ADFA) proved the value of meeting the reliability criteria; landing both attempts while many others trying to go further did not. The scoring algorithm was the sum of the distances achieved from two attempts. Casual attire was also fitting for Gladstone, QLD.

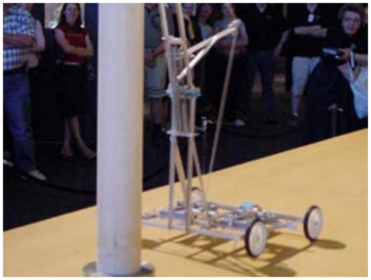
1999 Project PLUGHOLE at the Powerhouse Museum, Sydney – Bruce Field (in blue) perusing the score board with Alex Churches with an ingenious curved scissor mechanism deployed on track (left). The judges (Cliff Green and Tony Grzina) applaud an impressive tow (right).

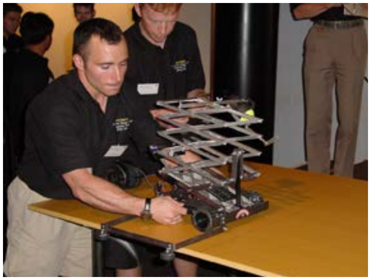
2000 Project RESCUE – Winners, University of Canterbury, had the accuracy and distance required to triumph at the Queensland Science Centre.

2001 Project RECYCLE at the Powerhouse Museum, Sydney – Students await the start signal from Chris Snook (right).
Alex Churches watches a device using tape measures, go up and up and up (left).



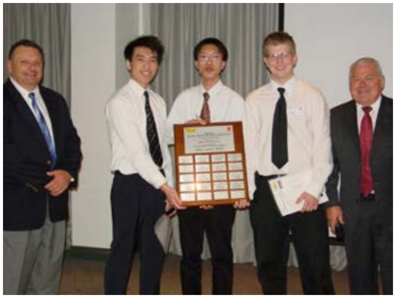






2002 Project BALLDROP at the Powerhouse Museum, Sydney – 10 years on, the project was something of a repeat of 1992's Project SLAM DUNK, but it was won with a very different solution. Shown are the three different concepts used by the three place getters in 2002, University of Western Australia's winning precision device (top).

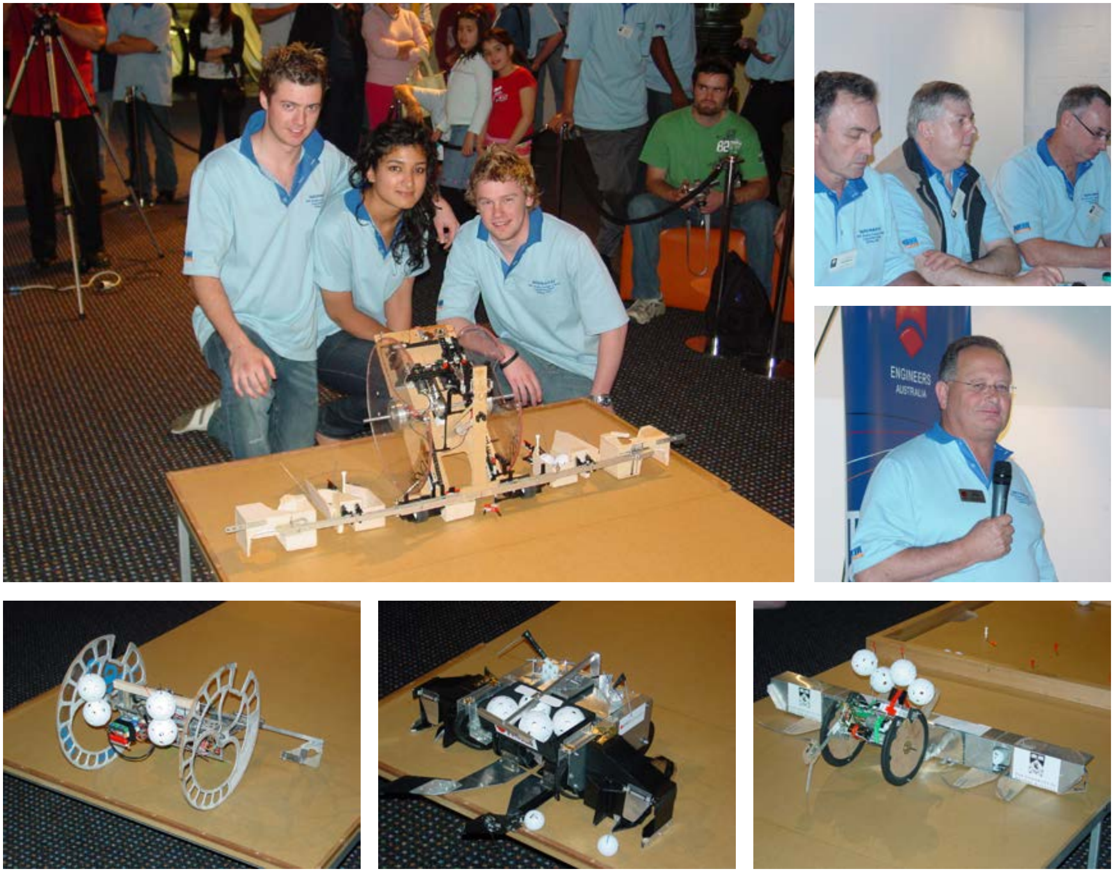
2003 Project ESCAPE at the Powerhouse Museum, Sydney – Images of the track representing an underground mine with the University of Newcastle, (3rd Place) on deck.



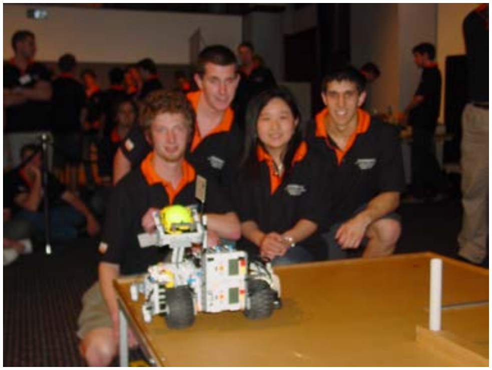
2004 Project PEP in the Engineering Building Atrium at University of Technology, Sydney (left) – University of Auckland, 1st place showing high efficiency (middle) and with Weir's Allan Wightley and Doug Jones at the presentation (right).
Note, for some years the Warman Trophy was replaced by the Warman Shield in order to accommodate the list of winners. The plinth of the Warman Trophy was later increased in height (see Figure 3) to accommodate all names to date.

2005 Project SCAD at the Powerhouse Museum, Sydney – University of Canterbury, 1st place, with some very nice carbon fibre for the downhill run in the Coles Theatre of the Powerhouse Museum.

2006 Project ABC at the Powerhouse Museum, Sydney – Beautifying the country side required seeds to be distributed and trees not to be knocked down, 1st the University of Auckland, 2nd the University of Tasmania and 3rd the University of New South Wales Canberra placed devices (left to right).



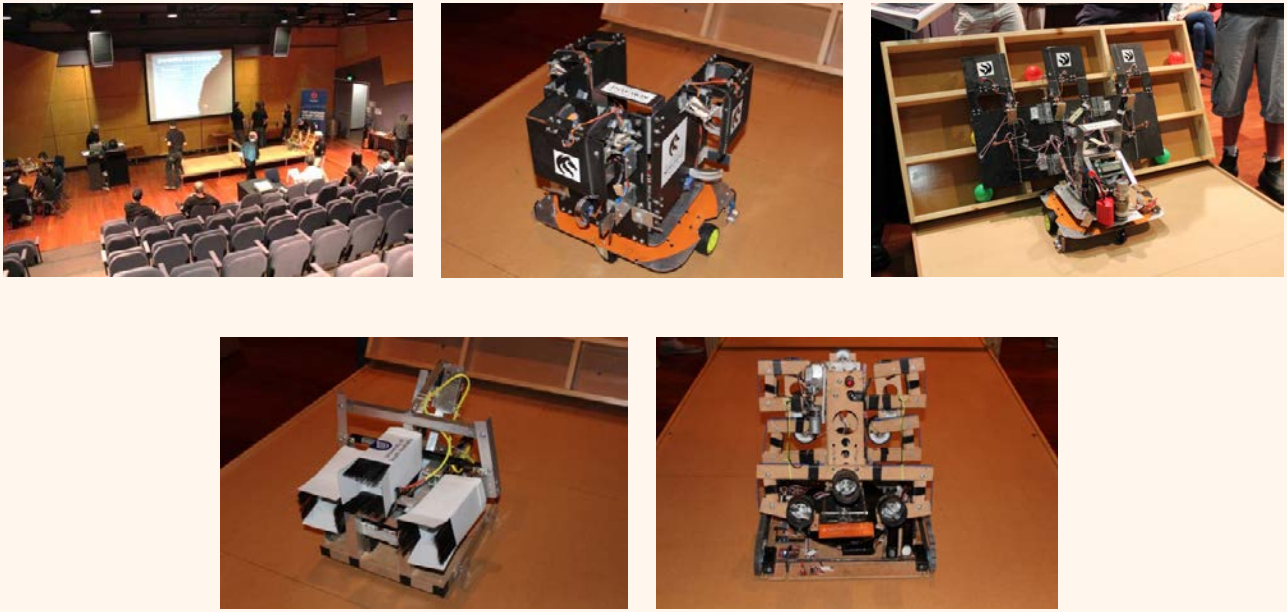
2007 Project REACT was won at the Powerhouse Museum, Sydney by University of New South Wales Canberra (top left) - Warman engineers acting as judges: Geoff Moore, Kevin Burgess, Dave Dawson (top right) and NCED's Cliff Green (middle right) regularly officiated. Assorted devices at the 20th competition (bottom left to right).



2008 Project READY at the Powerhouse Museum, Sydney – University of Adelaide (left) invested in a fully redundant back up system to take the GOLD! 2nd University of New South Wales Canberra (top right) and 3rd University of Canterbury (bottom right).

2009 Project BATON at the Powerhouse Museum, Sydney (left) won by the University of Western Australia (right). The task, to transfer a baton from one vehicle to another, was completed in a staggering run time of 0.89 seconds.

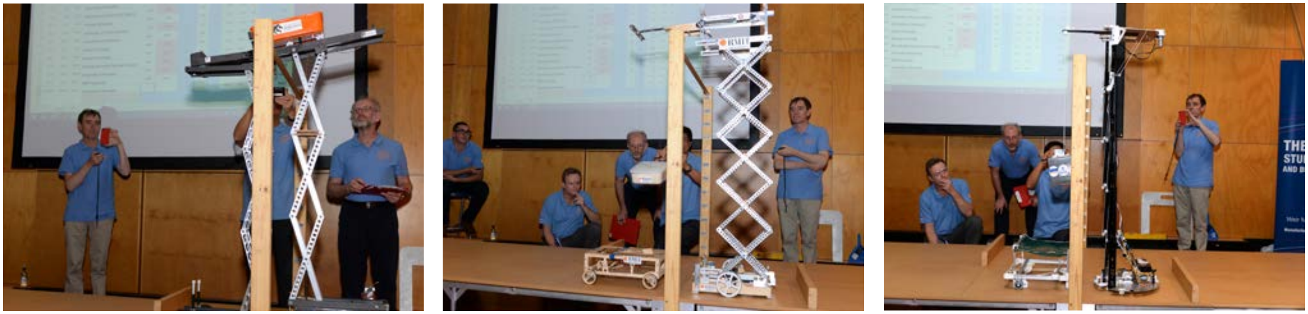
2010 Project PASS – Won again by the University of Western Australia (right) with a lightweight high payload ratio polystyrene based system.



2011 Project PnP – First time at the Australian Technology Park, Sydney (top left), University of Newcastle wins (top middle and right), 2nd University of South Australia (bottom left), 3rd Monash University (bottom right).

2012 Project SILVER, the 25th Anniversary Competition at the Australian Technology Park, Sydney – University of New South Wales Canberra (left) and Flinders University (right) are named joint winners.

2013 Project CROSS at the Australian Technology Park, Sydney –
The top three National Final bridging solutions; 1st University of Canterbury, 2nd University of New South Wales Canberra, 3rd Monash University (left to right).



2014 Project ELEVATE at the Australian Technology Park, Sydney –
The top three National Final solutions (exhibiting significant system differences)
1st University of Newcastle, 2nd RMIT University, 3rd University of Auckland (left to right).

In awarding their prize, the Weir judges made the following comments on the UNSW Canberra device. "There is an elegance to design using a minimum of materials, most of which were readily available, and a concept which can be readily understood and therefore easily maintained. The conservative approach utilised by the UNSW Canberra team showed they were not tempted to over complicate their device. They utilised a relatively simple design with a minimum number of actuators and with repeated use of components. It was apparent they had thought about design choices which would mitigate potential failure modes as well as utilised a design approach which considered the elements that would most contribute to their success. Their design did not contain anything that seemed to be unnecessary and in discussion with the team, it was clear that this had been their goal. UNSW Canberra had first identified what they believed to be an optimum strategy and then executed their design in accordance with this strategy, illustrating a mature design approach.

If the UNSW Canberra teams design had not failed to deposit the sixth ball on their first run (missed by a matter of millimetres) they would have been the clear winners. We believe they deserve recognition for a fast, consistent and reliable machine."

2015 Project Extract - 1st RMIT University (left), 2nd University of Canterbury (middle), 3rd Monash University, Malaysia (right)

Design Award – University of South Australia (left), Weir Judges Award – UNSW Canberra at ADFA (right)

The Mechanical College of Engineers Australia congratulates all who have been a part of the Warman Design & Build Competition through its 28 years. This includes the Weir Group, the National Committee on Engineering Design, Engineers Australia staff and volunteers, and the campus organisers, but most importantly the approximately 40,000 mechanical and mechatronics engineering students who have been a part of the competition at universities around Australasia.

The Board of the Mechanical College recognises the importance that events like the Warman play in the development of our future professional engineers, where practical design experience provides the glue that holds the engineering sciences together, whether students go on to careers as engineering designers or more broadly into other mechanical and mechatronics roles. We encourage all Australian universities to have their students take part, as the competition is an excellent way to develop many of the Stage 1 competencies that are required of graduates entering the engineering workforce.

We look forward to seeing the competition continue to be a part of the learning experience for mechanical and mechatronics students from around the region for many years to come, inspiring the engineering designers of tomorrow.

Dr Michael Lucas FIEAust CPEng NER

Chair
Board of the College of Mechanical Engineering 2015

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