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EXCELLENCE IN COLLABORATIVE R&D

PROFESSOR ASHLEY GOLDSWORTHY

Executive Director B-HERT

EDITORIAL

The purpose of the Business/Higher Education Round Table (B-HERT) is to pursue initiatives that will advance the goals and improve the performance of both business and higher education and training for the benefit of Australian society.

It is a forum where leaders of Australia's business, research and academic communities can examine important issues of mutual interest, to improve the interaction between Australian business and higher education institutions, and to guide the future directions of higher education.

One of the key initiatives being pursued by B-HERT is the need for more extensive and effective collaboration between industry and higher education in Australia in a number of areas.

One of the primary areas in which collaboration needs to be supported and encouraged is that of R&D.

The research carried out in our universities should be of internationally significant quality. There should be a blend of basic research in the pursuit of knowledge and also a strong emphasis on the application of knowledge, innovation and applied research based upon interaction with industry.

Funding for universities' research activities by all levels of government and the private sector has grown as universities increasingly contribute to Australia's research and development needs. These funding streams are earmarked for specific research projects and research infrastructure. Universities cannot simply take the money they earn through these sources and use it to underwrite the provision of university courses for Australian students.

Just as the Government requires that funding it provides for research and for teaching be used for those purposes, income from industry must be used in those specific areas of research for which the funds have been provided by the corporate sponsor, with usually little scope for subsidising 'blue sky' research.

Unfortunately, in Australia the links between the two sectors, particularly in research, lag well behind most major industrialised countries. B-HERT, with its unique membership, is committed to several initiatives to further develop these linkages

Some years ago B-HERT introduced a series of Annual Awards which recognise outstanding achievements in collaboration between business and higher education. The objective is to highlight at a national level the benefits of such collaboration, and by so doing to enhance the links between industry and higher education.

These awards are for OUTSTANDING ACHIEVEMENT IN COLLABORATIVE R&D and OUTSTANDING ACHIEVEMENT IN COLLABORATION IN EDUCATION/TRAINING. They are awarded in a number of different categories.

Collaborative R&D, which is central to B-HERT's Mission, is very well exemplified by the projects entered each year for our Annual Awards. In making the theme for this issue of B-HERT NEWS "Excellence in Collaborative R&D" I could think of no better examples than the winners of some of our Annual Awards. ■

PROFESSOR IAN FRAZER
Director

Centre for Immunology and Cancer Reserach
Princess Alexandra Hospital, Brisbane

Written in conjunction with Dr. Andrew Cuthbertson, R&D Director, CSL Limited.

THE JOY OF (ACADEMIC) INTERCOURSE

A Case Study of a successful R&D collaboration between Academia and Industry

(Written from an academic perspective.)

Members of the Centre for Immunology and Cancer Research, a research centre at the University of Queensland, sat round a table with staff from the Research Division of the then Commonwealth Serum Laboratories in 1990, as a result of contact between two scientists interested in developing a better understanding of the immunology of papillomavirus associated cancer. From this meeting, CSL decided to support a developing research program at CICR on cervical cancer vaccines, though neither party knew at the time that they were letting themselves in for a collaboration which has now lasted for over 12 years, or where it would lead. At the time of the initial agreement there wasn't a specific product in mind, though it was expected that the collaboration might lead to a therapeutic vaccine for cervical cancer. CICR felt that CSL's interests in the area, and their expertise in vaccine production and marketing, should synergise with CICR's interest and developing expertise in the immunology of Papillomavirus, and might lead to something of use to both parties. The collaboration lead in due course to CSL licensing IP which forms the basis of the current candidate Papillomavirus prophylactic vaccine. CSL subsequently licensed this to Merck, and the vaccine is currently undergoing late stage clinical trials around the world. The 12 year collaboration has also lead to the development of a candidate vaccine to treat existing Papillomavirus infection and its clinical consequences. The prophylactic vaccine was an unexpected spin-off from the program to develop a therapeutic vaccine, which is now also undergoing clinical testing.

What makes the collaboration work?

There was early recognition by both parties that each would need the help of the other to develop a successful vaccine for treatment of HPV associated cancer. Therapeutic vaccines were an unknown quantity in 1990, and remain so in 2002, and new products, particularly those associated with an element of risk, don't get on the market unless a commercial partner takes an interest. On the other hand, for a commercial partner to acquire in-depth expertise in a potential product before it's clear that there is a product to develop is a considerable drain on resources. Thus, collaboration was essential for the goals of both parties, and the art was to make it work. This was achieved formally by a collaborative research agreement negotiated through Uniquest. However the true determinants of success didn't lie in the paperwork, but in recognition that a successful collaboration required each party to recognise the potential contributions of the other. CSL provided expertise in experimentation and production of vaccines, in marketing and distribution of successful vaccines, and in research and development of Australian grown products. CICR understood the basic science underlying immunotherapy, and the connection between Papillomavirus and cervical cancer. Both teams had research scientists with relevant interests and track record, and CICR had models with which to test

vaccines, and access through research collaborations to the key research groups working within the area world-wide. It also had clinical contacts through whom specimens could be obtained and from whom expert advice about product evaluation and utility could be obtained. Both had a desire to succeed and both brought significant resources and skills to the table. CICR already had funding for development of cervical cancer vaccines from Government and charitable sources, and could leverage extra funding based on industry collaborations - an approach more easily adopted in 2002 than 1990, but still of use even then. Mostly, the agreement worked because the people involved got on with the job of making it work, through personal contact, regular meetings, phone and email.

Challenges for the Research Collaboration

Over the 12 years of collaboration, both CSL and CICR have changed their structure and their corporate goals. CSL has changed from a Government instrumentality to an incorporated entity and then to a public company. In the process, the company has redefined its primary goals and has increasingly looked outwards from an Australian to an international market. CICR has grown from a small research division of a University department, working almost exclusively on Papillomavirus vaccines, to multi-laboratory University level research centre with interests in many areas besides cervical cancer. The research funding environment has changed, with more focus on commercialisation of research, and the tax environment for commercialisation of research has become less favourable. Thus, a collaboration which was founded in one environment has been required to evolve along new pathways to meet the changing environments encountered along the way.

A broad goal for the collaboration was initially an advantage to both parties, as it allowed exploration of new areas as they arose. Clarification of intellectual property issues was sometimes done after the event, and while no immediate down-side has occurred from this rather unconventional approach to intellectual property protection, the legacy of early informal agreements has created areas of uncertainty for both parties, as the two organisations have grown and diversified. Nevertheless the therapeutic vaccine project has flourished, deriving funding from the Australian Research Council, the Comet scheme, the Start grants scheme and other sources of conjoint funding. Considerable value has been added for both parties in the development of expertise not directly related to the project, but applicable in the broader field of vaccines and immunotherapy. The research plan evolved from open ended to product focussed agreements, and eventually included contract research in specific areas of mutual interest, which were nevertheless planned in large measure conjointly by the relevant scientists and project managers. Flexibility and communication have been the hallmarks of the collaboration and each have contributed substantially to its success.

Tips for the future:

A natural tendency for each party to a collaboration to feel that their expectations from the collaboration are different is exacerbated when the organisations have different and changing goals and priorities. Commercial enterprises are answerable to shareholders who expect profit in return for investment and growth commensurate with the effort put into research. Public enterprises such as Universities and research institutes expect academic freedom, while their staff expect a right to publish and follow the science where it leads. Nowadays, universities also expect the right to profit from intellectual capital and intellectual property developed in their laboratories, preferable unfettered by prior research and development agreements which are not immediately applicable to the new intellectual property developed. Thus, to keep a collaborative relationship working well over time, the aims and boundaries of the research program need to be reviewed conjointly on a regular basis.

No collaborative research program lasts forever. A particular project may fall off the agenda because it becomes commercially unviable, even if successful, or because it doesn't meet requirements for commercialisation in the first place. However, a research program envisaged in academia does not automatically lose merit because of either of these problems. Therefore, a clear exit strategy is required to allow each party to recognise progress and continue in agreement, or alternatively to realise that the program is heading in a new direction, and make a clean break, leaving neither party encumbered by residue from the agreement which would impede their future research and development programs.

If agreements are entered into with the intent to move both parties forward, then both will benefit, and it is important for each party to understand at the outset where the benefits lie and what each party expects if everything goes well, and also if everything goes badly. Planning for failure is a strategy not much encouraged in business or in academic life, but an R&D plan which doesn't include failure as one possible outcome is going to lead to friction at best, and a souring of interest in similar collaborations at worst. Both parties need to give a firm commitment to what they are doing, both intellectually and practically, and if this is done in the full understanding that each party needs the other, and the valuable contributions that the other can bring to the project, then the collaboration is likely to be as successful as the science allows. ■

Winner (Vaccines to Prevent and Treat Cervical Cancer) – 1999 B-HERT Award for Outstanding Achievement in Collaborative R&D (turnover more than $50m per annum and in-train for more than three years)

PROFESSOR MILES MOODY

Queensland University of Technology and Director, Voxson Limited

VOXSON ROCKS ON:

A MODEL FOR UNIVERSITY/ INDUSTRY MARRIAGE?

For some time now, Federal and State Governments have introduced various schemes designed to encourage business, universities and government research agencies to collaborate in research and development, with the aim of bringing together the commercial acumen and vision of business leaders and the intellectual capital of researchers for the generation of real wealth for Australia. This is a laudable program and one which is enjoying considerable success in many fields, but there are some other successful collaborations which have not had the advantage of the funding which these grants offer. Together with my students, our involvement with one company has proved exciting and challenging and has shown that universities certainly can assist in bringing mass products to market, without the need for government assistance.

The bringing of an idea from first feasibility to a finished product is not much different from raising a child from conception to adulthood. The conception is fun (and doesn't last long), the up-bringing is expensive (and extremely time consuming) and the outcome can range from bad to good depending on many uncontrollable factors along the way. The Cooperative Research Centre (CRC) Program acts like a 'rich uncle/aunt' in this process, in that it supplies a funding base for infrastructure and research effort which many Australian companies have found it hard to provide themselves. This is particularly difficult in the hi-tech domain of Information and Communications Technology (ICT), where systems and software are becoming increasingly complex, test regimes incredibly stringent due to global standardization and international competition strong due to the size of market. Over the years, Australia has not had a particularly good record of development leading to commercialisation of high technology, evident from the fact that virtually none of the top 100 Australian companies is in the business of producing hi-tech products for the ICT market [1].

The Top 100 is dominated by finance, service and retail 'industries'.

In order to get into the business of consumer product development, many small companies are still having to 'go it alone', a bit like a single parent, often with dire consequences but sometimes with great success.

Those who have done it know that development of state-of-the-art products involves a great deal of research, but most government research funding bodies do not appear to recognize this. At present, the proportion of CRC's devoted to ICT is only 10% (7 out of 71) [2], so access by small companies to assistance from this area is limited. Historically, the lack of large Australian companies and an industry body to represent ITC product development has probably been a large contributing factor to the relatively small number of CRC's in this area.

In 1999, Voxson Limited, together with the Queensland University of Technology (QUT), won a B-HERT award for Outstanding Achievement in Collaborative R&D for the development of Australia's only home-grown GSM mobile phone. Since then, significant advances in the design have generated a range of products now ready for the market. This article describes this marriage of industry and academia and addresses some of the lessons learned in achieving such a goal in the Australian context.

Voxson International (as it was formerly called) was Australia's leading producer of audio equipment until it switched to the highly profitable area of analogue mobile communications in the late 1980's. Designs were contracted and phones were manufactured in Australia until the Federal Government suddenly announced that an MoU had been signed with CEPT in Europe to introduce the digital GSM standard, resulting in the phasing out of all analogue networks by 1997. Voxson was forced to close down its analogue phone business and commence new designs for a system which was still in the development phase and for which new standards were emerging monthly – a challenge even for the large multi-national companies addressing this market.

Voxson had been engaging undergraduate students and graduates from QUT to gain experience and work in communications technology as part of a joint effort to improve the level of teaching and knowledge in this growing area. The newness of the technology and the boom in labour markets overseas made it difficult to attract electronic engineers with established expertise in digital communications, while IT graduates did not have the hardware knowledge required to design mobile phones. Voxson decided to invest in a significant increase in its engineering team, mainly from Brisbane universities and to support post-graduate students in researching technologies which would later impact on the industry, such as Bluetooth, GPS and CAN-Bus.

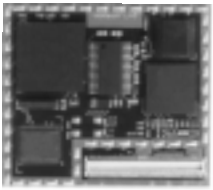
After five years of effort and over $30M of investment in engineering manpower, test systems, components, manufacturing technology and IP licences, Voxson Limited (as it is now known, after an Initial Public Offer occurred in 1999 to assist in funding this development) has produced its third generation of digital mobile phones. The present enabling device

is one of the world's smallest GSM/GPRS 'Engines', a card the size of a large postage stamp, which can form the basis of not only mobile phones but also wireless interconnection for applications such as tracking, Internet services and asset management.

What are the lessons to be learned for anyone contemplating such developments?

Lesson 1 – We can do it

It is clear that small Australian companies can compete with the large multinationals in developing the latest technologies, provided they form strategic partnerships with the right organizations. Voxson relies on a number of companies (here and overseas) to provide the company with base technologies, such as the microchips used in the physical implementation, the base level software embedded in the microchips and the manufacturing plants producing the final products. At a very early stage, it was recognized that the development of microchips with the necessary complexity and the underlying base level software was impossible to achieve in Australia in a time frame which would be commercially viable. An initial attempt to find a manufacturing facility in Australia was also unsuccessful due to the level of technology required to produce 8-layer printed circuit boards required to implement the smallest GSM circuit in the world. Voxson's strategic direction was to own the software and hardware designs which take these basic components and turn them into flexible products, as well as to control the processes on which the quality and functionality of the final product depends.



Voxson Limited, with the help of Queensland University of Technology academics, has developed one of the smallest mobile phone engines in the world.

Lesson 2 – Don't try to go it alone

It is not possible to have all the expertise resident in-house if a company wishes to keep its overheads under control. Particularly in the development of emerging technologies, it is useful (or perhaps essential) to have a strategic partnership with key personnel in one or more universities, where projects can be carried out in an environment which thrives on being at the forefront of new standards being set. In the case of Bluetooth wireless interconnection, wireless GPS applications and speech recognition for control of mobile devices, a valuable liaison with the university has been made through the support of a professorial academic position and by employing specific staff within the company who can be responsible for corresponding areas, strengthening and maintaining the relationship.

Lesson 3 – Don't underestimate the task

Voxson realized from the outset that conversion of its simpler analogue technology to the new and highly complex digital technology would not be an easy task. The mere size of the standards documents was an indication of the amount of effort and learning which would be required and the increasing control of compliance with what is now a global standard meant a corresponding increase in level of quality control in the design team. Despite considerable experience with previous projects however, there is no doubt that the amount of complexity in developing a product which can compete in quality, functionality and design with the world's leaders has cost more time and money than was ever initially envisaged. If more examples of this kind of development are to emerge in Australia, assistance from government in rethinking grants and tax concessions will be necessary to lower the burden of infrastructure set-up cost and R&D staff expense.

Lesson 4 – Get the culture right

The change to an R&D organization when this development was commenced meant a significant change in the culture of the company itself. It went from a predominantly contracting and sales operation to a predominantly engineering organization, but one in which the engineers must concentrate not only on engineering, but also on sales and marketing. Without this awareness, the products being developed would not be competitive or timely to market. Without this commercial culture, development of consumer products is set for failure.

The outcome

Voxson has now brought its children from conception to adulthood. The pain has been considerable but the outcome is positive. The products which Voxson is now finally bringing to the market are equal to the world's best and cover an area in which only a handful of world manufactures have been able to achieve. Despite the pictures of gloom and doom predicted in the press concerning ICT markets, the growth in non-telephony applications of the technology is predicted to be huge, with Voxson in a position to be able to capitalize on this market.

Voxson and QUT will continue to strengthen their marriage and produce new children to the benefit of both organizations and their staff and students (and of course the bottom line). ■

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Winner (Innovative Design and Development of Australia's only Digital Cellular Telephone) – 1999 B-HERT Award for Outstanding Achievement in Collaborative R&D (turnover less than $50m per annum and in-train for more than three years)

NOVOGEN COLLABORATION WITH UNIVERSITY OF SYDNEY

Novogen Limited is a publicly listed Australian pharmaceutical company recognised as a world leader in novel therapeutics based on isoflavone technology.

Isoflavones are plant hormones which have the capacity to modify a broad spectrum of human health outcomes. The company now markets internationally a range of dietary supplements containing isoflavone extracts, but a pharmaceutical R&D programme is running in parallel. Synthetic proprietary compounds designed on the isoflavone scaffold are being generated by Novogen chemists and the company now has a library of compounds in development as prescription drugs for anti-cancer, anti-inflammatory and cardiovascular therapeutics.

Novogen is committed to a vigorous and extensive R&D program and although a substantial in-house research effort has been established, the company has recognised the wealth of talent available by collaboration with Australian universities. Although a history of successful collaboration with many research institutions has been established, a close association has been forged with the University of Sydney. In addition to a number of project collaborations with University researchers, the company has an agreement with the University by which a Novogen Research Institute has been established to conduct preclinical screening of novel compounds. This collaboration provides for laboratory space and use of facilities within the University for Novogen scientists to work on campus to enjoy the benefits of an academic environment. For the University, in addition to the funds attracted by this agreement, the exposure to a corporate research group enables a better understanding of the value drivers which determine industry research policies as well as exciting new opportunities for research collaboration, access to novel compounds and involvement in projects exploring novel mechanisms for modulating cell biology. Both synthesis and bioanalysis of these compounds is highly specialised, and Novogen is the only company in Australia, and probably in the world, which can provide access to these capabilities. Visits by University staff to the company premises are encouraged and research presentations are invited to help keep even the non-scientific staff within the company abreast of R&D developments in relevant areas and to provide them with insights into the

These compounds have been found to have potent biological effects from anti-cancer properties, to cardiovascular activities, immunostimulatory and anti-inflamatory effects.

PROFESSOR ALAN J HUSBAND

Professor of Veterinary Pathology, University of Sydney

Research Director, Novogen Ltd.

scientific discovery process. This provides an important perspective for the implementation of commercialisation strategies.

Within this collaborative arrangement novel compounds generated by Novogen have been systematically screened for a range of biological activities. These compounds have been found to have potent biological effects from anti-cancer properties, to cardiovascular activities, immunostimulatory and anti-inflammatory effects. Promising lead compounds can then be manufactured by Novogen to internationally approved pharmaceutical standards, for use in further biological and clinical testing by collaborating units within the University of Sydney and elsewhere. One of the most exciting and tangible outcomes from the collaboration to date has been the successful screening of an anti-cancer agent, phenoxodiol, which was shown to reduce prostate cancer mass in animal models by as much as 80% compared to controls. The drug is now in Phase I/II human clinical trials for the treatment of prostate cancer and leukaemia, and trials in ovarian and renal cancer are also planned.

The relationship between Novogen and the University of Sydney has continued to strengthen since the collaboration commenced in 1995. The major University investigator who pioneered the collaboration, Professor Alan Husband, originally worked as a consultant to the company but in 1999 was invited to take up a position as Research Director for the company while still retaining a fractional University appointment. The Novogen Research Institute consists currently of four scientists and three research support staff from Novogen working onsite at the University. This agreement has enabled an expansion of collaborative opportunities and there are now four additional research projects involving University academic staff, as well as six clinical projects conducted at affiliated University teaching hospitals. This has also provided an opportunity for training of postgraduate students to enable them to obtain a dual exposure to strong academic research but in the context of a commercial programme. To date, three PhD students and two Masters students have worked on Novogen projects and one, who successfully completed a PhD degree in 1999, took up a permanent position as an R&D scientist with the company. The Institute has a management committee consisting of University and company personnel to agree on use of resources and direction of the experimental program.

Whenever academic and commercial interests impact on each other a major cultural realignment occurs. Whereas university academic staff have traditionally valued academic freedom, pursuit of personal research interests and often a disregard for the commercial potential of their intellectual endeavours, research within the commercial and industrial sector has been equally constrained by short sighted desires to make maximum profits from minimum inputs. With respect to industrial R&D there has been a hesitation to become involved in speculative projects or to invest funds without a clear view of the commercial outcomes. In Universities the opposite has applied, with a traditional failure to evaluate the true cost of research and to fully exploit the benefits of its successful commercialisation.

This project has enabled a cultural convergence of these apparently competing interests and both parties have experienced significant challenges to their traditional values which have triggered a harmonization of ideologies. This has ensured that innovative scientific endeavour is not compromised by short-term commercial demands but that successful outcomes are vigorously exploited for commercial benefit. The dual role of the Institute Director as both a University academic and the company Research Director has ensured a strong and vital collaboration. The University partners have learned to respect the need for confidentiality, the need for close cooperation with the company management team, the need for detailed reporting and the need to be available for public comment when appropriate. The company's realignment has enabled it to see the value of a balance between "blue sky" research and targeted research, the benefits of sponsoring and encouraging scientific presentations, congresses and conferences and the need to maintain the scientific enthusiasm of its R&D team by providing a sympathetic audience for new ideas. Most importantly it has learned to tolerate the ambiguity presented by the unpredictable nature of scientific discovery in a climate of intense financial accountability.

Whenever academic and commercial interests impact on each other a major cultural realignment occurs...

The benefits to the University academic staff involved and to the Departmental research profile and finances, has aroused considerable interest as a model of effective industry partnership arrangement. In collaboration with University and other partners, success in grants from the R&D START Grants Scheme has totalled over $10 million in the past 3 years. The company has also successfully partnered University staff in ARC SPIRT grants totalling over $500,000 and has made direct cash contributions to research within the University of over $2 million annually.

The programme has also provided ground breaking experience in enabling the partners to reach an agreed position on handling of intellectual property, appropriate recognition of University input, issues of confidentiality while preserving the rights to publish for academic staff, and the rights to submit theses for research students. ■

Winner (Pharmaceuticals Based on Isoflavones and their Human Phenolic Hormone Derivatives) – 2000 B-HERT Award for Outstanding Achievement in Collaborative R&D (turnover less than $50m per annum and in-train for more than three years)

UTS-MICROMEDICAL COLLABORATION ON VENTRASSIST ARTIFICIAL HEART

DR PETER A WATTERSON

Faculty of Engineering
University of Technology, Sydney (UTS)

Introduction

The VentrAssist "artificial heart" project has been an engrossing research collaboration between UTS and MicroMedical Industries, now joined by several other institutions. The collaboration commenced in 1996 when Dr John Woodard of MicroMedical approached the late great Professor Vic Ramsden of UTS seeking an electric motor to drive a rotary blood pump.

An application for an ARC (Australian Research Council) Collaborative Grant was successful and brainstorming sessions started in early 1997.

This article outlines the device that has evolved from the collaboration, then reports some of the benefits and difficulties encountered.

The product

The principal outcome of the collaboration is the VentrAssist "artificial heart", more precisely VAD (Ventricular Assist Device), to save the lives of people with congestive heart failure. The device is a rotary pump that will take blood from the apex of the left ventricle and deliver it to the aorta at higher pressure. The high speed of rotation of the spinning impeller enables a much smaller pump volume than the pulsatile pumps that have been in clinical use. It can thus be used in all patients including children, unlike existing devices. Around 30 research groups worldwide have been developing such rotary pumps, and several have recently commenced human trials.

What distinguishes the VentrAssist VAD from others being developed is its method of suspending the impeller of the pump. While other pumps use contact pivot bearings, which rub, or magnetic suspension, requiring sensor feedback, the VentrAssist pump uses hydrodynamic suspension, which is passive and therefore failsafe. The impeller blades have been made thick and with tapered edges, so that once spinning, the impeller glides on blood fluid bearings. Magnets are incorporated in the blades enabling the impeller to be driven around by magnetic fields from currents in wire coils placed about the pump body. Thus whereas most pumps have a separate impeller and motor with a shaft in between and seals to keep the fluid from the motor and its bearings, the VentrAssist pump is of a new form, with motor, pump and suspension functions all incorporated into the impeller. The company website [1] has more details including an "exploded" drawing, showing how few parts there are (compared to, for example, a drill).

With no wear on the one moving part, the impeller, the pump promises to be long lasting and reliable – which is what a recipient would like, given the difficulties of replacing the implanted pump! Testing has shown that the pump has low haemolysis levels and can be operated without anti-coagulants, thanks to its smooth internal flowlines. Blood enters the pump on its axis, where most pumps would have a shaft, then flows out between the impeller blades. The pump has performed very well in animal trials – a sheep unknowingly pregnant on implantation gave birth to a healthy lamb. Human clinical trials are about to commence.

Collaboration history

Initially, in 1997, UTS was more heavily involved in the project with up to eight staff playing a role. Prototypes in plastic housings confirmed that the hydrodynamic suspension indeed worked. MicroMedical, aided by an R&D Start grant, then commenced its serious investment in the design from 1998. It established the VentrAssist Division and laboratory in Chatswood, and steadily took over development, manufacture and testing of the design. VentrAssist co-opted two UTS staff to lead strands of its research program, eventually employing one of them. Meanwhile, UTS fine-tuned its sensorless current switching algorithm (which converts DC battery currents to AC motor currents), and designed and built a pulse magnetiser specifically for the magnets in the VentrAssist impeller.

UTS's involvement dropped back with the expiry of the ARC grant at the end of 1999, but staff have acted periodically as consultants on electromagnetic matters, PCB (printed circuit board) development, and pump fluid dynamics. A PhD student is presently based at VentrAssist.

VentrAssist is expanding further, with staff numbers currently around 45, after raising $20 million through share placements to bring the 'artificial heart' to the market [2].

Benefits

Apart from the satisfaction of making something worthwhile, there have been more subtle benefits from the research collaboration. The imperative of reliability has taught researchers to seek the simplest solutions to difficult problems. Optimised use of the best materials has created a window of performance opportunity, a biocompatible pump of sufficiently high efficiency and longevity and sufficiently low blood damage. Operation without sensors in the pump has been achieved, and UTS has proceeded to develop such sensorless motor techniques in other devices.

The demands of regulatory authority approval have required extra diligence by researchers in their documentation of all work, in formal laboratory journals. Part and drawing numbers are used to ensure that all test results are linked to details of the components with which they were obtained. Regular back-ups of electronic data are made.

Difficulties

Conditions of funding sources have imposed various difficulties. The ARC grant (like current ARC Linkage Project grants) did not fund "Chief" and "Partner" investigators and funded other salaries at direct payroll cost. In contrast to these salary factors of 0 times or 1.3 times, consulting research is supposed to be charged out at around 3 times salary. Such bare bones funding inevitably limits the time commitment of senior researchers, especially those funded through research.

Share market capital raising brought other pressures. The Stock Exchange expects project timelines to be met and announcements to occur on anticipated dates. While academics would prefer publication through peer-reviewed journals (taking a year or two), it is fairer for shareholders to be promptly and simultaneously informed of the project's progress, through succinct media releases.

Agreement on the share of future profits from exploiting the intellectual property was a lengthy negotiation between UTS and Micromedical. The initial ARC grant contract stipulated equal ownership, but this didn't readily translate to royalty division, since MicroMedical's much higher subsequent investment in the pump development needed to be taken into account.

Conclusions

The collaboration has been of great benefit to both MicroMedical, in jump-starting their VentrAssist blood pump development, and to UTS, in giving us an exciting and worthwhile application to our technical expertise. It has enabled the UTS electrical machines group to add biomedical engineering to their areas of specialisation, which has led to a research contract from another heart assistance firm (Sunshine Heart). And the university has been pleased to use our involvement in the project to attract, inform and inspire students.

Australia does and must create high value products, competitive on the world market. Hopefully, the VentrAssist will become one of them. The Questacon "Our Clever Country" exhibition certainly expects it to, in their introductory remark: "From woomeras to artificial hearts, we've shown the world how inventive we can be" [3]. ■

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Winner (VentrAssist Implantable Rotary Blood Pump) – 2001 B-HERT Award for Outstanding Achievement in Collaborative R&D (small-medium sized companies and project 18 months – 5 years in train)

AUSTRALIAN PHOTONICS CRC:

MAXIMISING THE BENEFITS OF RESEARCH THROUGH COLLABORATION

PROFESSOR MARK SCEATS

CEO

Australian Photonics CRC

ELIZABETH ELENIUS

Communications Manager

Australian Photonics CRC

Background

The Australian Photonics CRC was established in 1992 with ten participants, including four universities, CSIRO and five industry participants; won additional extension program funding in 1997 which brought in an extra eight industry participants, including two of the CRC's early spin-off companies; and was awarded a further seven years of funding in 1999.

Phase two of the CRC has seen some initial participants leave but many more join the Centre, which now has a total of twenty-eight participants, including the Universities of Sydney, NSW, Melbourne, ANU and RMIT, DSTO and 21 companies as core participants including two Australian venture capital companies, Allen & Buckeridge and Macquarie Bank; SMEs, CRC spin-offs, an industry association, AEEMA, which assists industry networking through the Australian Photonics Industry Forum, and innovative Australian and multinational corporations. TAFE NSW is also a core partner, working with the CRC to ensure the skills base for the emerging Australian photonics industry.

The broad goals of the CRC, set by the Commonwealth, are to undertake high quality research and educational programs and to move their outcomes to utilisation for the social and economic benefit of Australia. The Australian Photonics CRC's mission is to grow a new Australian photonics industry through its research, education and commercialisation programs.

Collaborative Culture

The Australian Photonics CRC has a strong record in both inter-university research collaboration and collaboration with industry. For example, in the first phase of the CRC researchers at the University of Sydney, University of NSW and ANU jointed with Siemens to develop optical fibre devices based on multicore fibres. The CRC has a long history of working with TransGrid and ABB on developing a fibre optical electric current sensor, with full-time secondment of industry engineers to the CRC. This technology continues to be refined through field and laboratory trials in Sydney, Sweden and more recently, in the US.

The collaborative nature of the CRC ensures that ideas generated by researchers who may be working in quite long-term, *blue-sky* research, are identified at an early stage as having potential commercial applications. Researchers are not working in isolation from the commercial world and informal discussions can quickly lead to patents, and subsequently licenses, or even new companies. The CRC model also ensures that ideas are not revealed through premature publication in academic journals. It is interesting to note that in its 10 years of operations, no publication has been refused for submission (after amendments), yet the CRC has over 100 patent families under prosecution and has over1000 refereed publications. This has required the development of culture that carefully balances the need for publications against the commercial imperatives.

Most CRC research projects involve inter-university/ industry collaboration which results in substantial interdisciplinary and cultural cross fertilisation across geographic boundaries. Facilities are shared ensuring that the CRC resources provide a greater benefit than the sum of its parts.

The CRC has developed an effective model for working with industry in terms of managing the intellectual property arising from collaboration. Research projects fall into four categories: Centre projects, funded through the CRC Commonwealth grant where IP ownership is shared in accordance with each participant's equity in the CRC; Collaborative projects where IP ownership is determined through the terms of the project contract and where the IP is made available to other participants as background IP; Applications projects (typically closer to commercialisation) where IP ownership is determined through the terms of the project contract but not made available to others. The CRC resources are used to support ARC funded projects, and these are called Associated Projects to provide the framework for ensuring that the IP is managed, and that there is an appropriate accountability to government.

Technology Transfer

The CRC is an unincorporated joint venture, which has the advantage that the contract allows for entry and exit of participants. However, it is inappropriate for commercialisation. To resolve this, the CRC established Australian Photonics Pty Ltd as its technology licensing and marketing arm. The company is wholly owned by the phase one participants, has an independent board, and maintains a patent portfolio of over 100 patents, and over 60% of these have been licensed to participants and start-up ventures. The CRC has also established a number of separate operating entities that include:

- *The Photonics Institute Pty Ltd* – established through the support of the Commonwealth's Science Lectureships Initiative and the ACT Government to facilitate photonics training in Australia and internationally
- *The Photonics Foundation Limited* – established as a charitable institution to support long-term, high quality, scientific and technological research in photonics; to capture the benefits of research by strengthening links between photonics research and its commercial and other applications; to stimulate a broad education and training experience; and to promote cooperation in photonics research by building centres of photonics research concentration.
- *Redfern Photonics Pty Ltd* – established as the CRC's incubator and seed financing company. It has funded the establishment of seven spin-off companies from the CRC, and has raised over $220 million for investment.
- *The Bandwidth Foundry Pty Ltd* – established with support from the Commonwealth's Major National Research Facilities Program, the NSW Government, and the private sector. It aims to bridge the gap between photonic integrated circuit (PIC) design and PIC manufacturing by creating a manufacturing R&D culture in the Australian photonics industry and academic circles.

Australian Photonics has also been appointed as Management Agent for the CRC, providing financial, contract and patent management for the CRC. It is particularly important to have just one interface with industry in the establishment of research contracts. The early experience of collaborative contract negotiations, sometimes involving up to four lawyers representing multiple parties, resulted in long delays with the research often being completed before the contracts were signed and funding received. The universities now appear more comfortable with Australian Photonics negotiating head contracts, supported by standard back-to-back contracts with the research providers which take account of previously negotiated IP provisions outlined in Technology Licensing Agreements with the institutions.

CRC Commercialisation

Initially, it was thought that the CRC's industry partners would commercialise the research outcomes. It was soon realised that although interested in supporting research, the first phase participants would not be the vehicle through which the CRC would achieve its objective of transforming research to products.

The first spin-off company, Indx was established in 1994, seeded by a modest draw-down of the Commonwealth grant, and sold to a US company eighteen months later for around $10million. JDS Uniphase continues to manufacture products based on CRC technology in Australia. Using the proceeds of the sale of Indx, the CRC then established Redfern Photonics in 1998 as the incubator of start-ups. Redfern Photonics has a stake in a joint venture in China, and another in Germany. The CRC's second spin-off company, now VPIsystems has become the largest photonics design company in the world.

The CRC has generated over 600 new jobs, although job numbers have fallen with the recent downturn in the global photonics market. The role of the CRC is changing once again, as it adapts to the change of the market. Commercialisation activities in the defence, power, automotive and biotechnology sectors will have a higher profile.

Recent Case Study in Collaborative Innovation

CRC researchers from the University of Sydney, Drs Maryanne Large, and Martijn van Eijkelenborg, with Honours students Alex Argyros and Steve Manos, Masters student Joseph Zagari and PhD student Nader Issa have developed a method of manufacturing polymer optical fibres with microscopic air holes running along their entire length. The fibre is an improvement on conventional optical fibres, and offers the prospect of low-cost, low-loss transmission options that may provide the low cost route for providing affordable broadband communication connections to the residential consumer.

The light-guiding mechanism is fundamentally different from conventional polymer optical fibre technology in that it arises from the pattern of channels in the fibre, rather than from variations in the refractive index of the fibre material.

One advantage of polymer microstructured fibre is that it uses a single material rather than two and is therefore easier to make. Polymers also have the advantage of maintaining their structure through the stretching or "drawing" process involved in manufacturing, while glass fibre is prone to collapse or lose its structure. It solves the problem of using complex and expensive chemistry to change the refractive index between the core of the fibre along which light is transmitted, and the cladding which traps the light in the core.

This research breakthrough has been fast tracked to commercialisation by Redfern Polymer Optics Pty Ltd (now RPO), led by CEO, Dr Ian Maxwell. The young researchers, by working in the Australian Photonics CRC environment, quickly realised the commercial potential of their discovery, immediately put in train the patenting procedures established by the CRC's technology marketing company, Australian Photonics Pty Ltd, and held off publishing their results until the IP was protected.

Working through Australian Photonics Pty Ltd, RPO licensed the technology, and supported the further development of the project through a standard R&D contract, enabling the innovation process to proceed at a very much faster pace than is usual through the traditional university contract processes.

The researchers, in cooperation with RPO and the CRC then developed a strategy for publicising their discovery. A paper was accepted for publication in a refereed journal, and featured in New Scientist, coinciding with the paper's publication and presentation at an international conference.

Not only have CRC researchers come up with a significant discovery, but the processes and structures established by Australian Photonics CRC have enabled it to be fast tracked to commercialisation. In addition, the co-location of CRC spin-off companies with the research group has raised the awareness of researchers to the commercial potential of their discoveries at a very early stage.

The Future

The CRC is currently experiencing some funding challenges, as a consequence of the dramatic global market downturn. But the downturn also creates opportunities. When the market boom was on, the CRC lost around 50% of its key researchers to industry both in Australia and overseas. However, a number of these early innovators are now back in the CRC driving the development of the new technologies which will place the Australian photonics industry in a strong competitive position to be one of the five photonics "hot spots" in the world. ■

Winner (Photonics Research at the Australian Photonics CRC) – 2000 B-HERT Award for Outstanding Achievement in Collaborative R&D involving a CRC

THE COLLABORATION THAT DEVELOPED THE FLAME FOR THE SYDNEY OLYMPIC TORCH

GUS NATHAN
Dept of Mechanical Engineering, University of Adelaide

The University of Adelaide has a long-standing collaboration with FCT Combustion, of which the design of the fuel and combustion system for the Relay Torch of the Sydney Olympic Games is the best-known example.

The collaboration began informally in 1991 with the joint development of the "Gyro-Therm" burner and has developed into a strong and ongoing partnership. The collaboration was formalised in 1993 with the signing of a licensing agreement for the Gyro-Therm technology. The cash-flow from this agreement provides an important contribution to the ongoing development of the technology and provides technical support to the commercialisation. In this partnership, The University of Adelaide provides research expertise, testing facilities and product development while FCT provides project management, engineering and marketing. These complimentary skills, and shared skills in problem solving and design, allow the partnership to provide specialised services to industries throughout the world. For the Sydney 2000 Olympic Games the partners jointly designed and commissioned both the combustion systems for the torches and community cauldrons used in the torch relay before the Games, and also the main cauldron flame at Stadium Australia which presided over the Games.

Together the partners seek to provide ongoing environmentally responsible energy, combustion and emissions control solutions for industry and the community, through the development of new technology and the provision of professional services. They also seek to provide ongoing training for young engineers to enhance the skill base available within the sector. They specialise in one-off designs and the solving of unique combustion-related problems.

The Gyro-Therm technology typically provides simultaneously around a 50% reduction in NOx emissions and an increase in output and/or fuel efficiency of 5% in rotary kilns while also improving product quality. The combined value of these benefits is easily worth US$1m p.a. in many large cement kilns so that the pay-back can be as short as 3 months. The technology results from an extensive research and development program. Since 1994 FCT Combustion has contributed some $2.8m to the R&D program and has installed 26 commercial gas-fired combustion systems employing the Gyro-Therm technology. This has greatly assisted the University of Adelaide in its capacity to attract other research funding totalling $3.4m for related R&D programs.

Until late last year, the Gyro-Therm burners had only been applied in gas-fired plants. However an important step forward in the partnership occurred in October 2001 with the first installation of the technology in a pulverised fuel kiln in the USA. The success of this installation confirmed that benefits comparable with those firing natural gas can also be achieved with pulverised fuels. Since most cement kilns world-wide fire pulverised coal, this greatly increases the potential penetration of the burner into the industry. This successful installation of the solid-fuel burner is the culmination of a 7 year targeted research and development program including a range of pilot scale trials. The partners are now planning further pilot-scale trials to fast-track the penetration of the Gyro-Therm technology into coal-fired kilns and are seeking new partners to join them in this process.

The Sydney 2000 relay torch exemplifies the "cradle-to-grave" environmental design philosophy. The Sydney fuel and combustion system achieved a reduction in the net greenhouse warming potential (GWP) associated with fuel and flame to about one third of that from the 1996 Atlanta torch. In addition, all components of the torch are recyclable except the paint! The number of flameouts in the Sydney relay was around 1%, and an order of magnitude less than that of previous Games in Atlanta and Nagano. Of these, most of the flameouts were due to simple procedural errors. The high flame stability was due largely to the use of a patented combustor, developed by the team, which provides a stable flame independent of wind direction and speed. The combustion system proved to be reliable in all extreme weather conditions - wind, rain, storms and snow. With only one minor burn injury in the longest relay in Olympic history and 14,000 participants, it is also the safest relay yet. The torch also set a new standard in weight, being about half the weight of its predecessor. The design has also combined existing technologies from other fields in a new way to create a simple yet robust fuel delivery system employing a "liquid draw" from the fuel canister. This new system achieves a flame of constant size throughout the run for the first time in Olympic history. It also improves safety by preventing "flaring" when the torch is inverted. The collaboration was awarded the Engineering Excellence Award (2000) in Innovation by the Institution of Engineers Australia (IEAust), S.A. Division.

The flame at Stadium Australia, also designed by the partners, is possibly the most photographed flame ever. Its success can be judged by the words of artistic designer, Michael Scott-Mitchell: "the flame shape and appearance are precisely as I wanted". The director of the Opening Ceremony, Ric Birch, described it as "everything we had imagined". The flame lit perfectly and remained alight throughout the games. The main technical challenge was to achieve a tall, upright candle-shaped flame in still and windy conditions – something not achieved by any system on public record. High luminosity and minimum environmental impact were also required and met. The first criteria was achieved by the use of aerodynamic modelling, both of the stadium itself, and of the cauldron. The modelling of the stadium led to a slight relocation of the cauldron (by about 10m) to avoid the worst effects of nearby structures. Aerodynamic modelling of the cauldron was then used in designing an air-flow system capable of maintaining the candle-shaped flame in the presence of wind. The modelling also allowed the development of a minor aesthetic modification to the shape of the cauldron which greatly increased the ability to make the flame to stand upright, while reducing fan power and noise. The combustor itself was also developed through an extensive testing program. The final combustion system combined in an original way the patented Gyro-Therm technology (described above) and conventional fuel jets surrounded by a curtain of high velocity air.

Adelaide University's Turbulence Energy and Combustion (TEC) Group comprises 11 research staff and 20 postgraduate students. FCT Combustion has 14 permanent staff. Staff and students are drawn from the two organisations as required for each specific commercial and/or research and development (R&D) projects. Presently about half of each of the two groups is involved directly in collaborative programs but all members of both groups were involved in the design of the Sydney 2000 Olympic Torch. ■

Winner (Joint Development of the Gyro-Therm Burner) – 2001 B-HERT Award for Outstanding Achievement in Collaborative R&D (small-medium sized companies and project more than 5 years in train)

INTERNATIONAL RESEARCH TEAM HEADS NORTH TO ALASKA

DAVID GOELDNER
Communications Coordinator JKMRC
University of Queensland

An international research team from universities in Australia and Canada has just headed to the

Alaskan wilderness to investigate and enhance the practical use of 'froth and bubbles' at a remote mine site.

The research campaign, sponsored by the world's biggest zinc producer Teck Cominco, is serious business aimed at making money and advancing science.

The focus is on froth flotation, a process used to separate valuable mineral from the unwanted gangue waste material after mining.

Campaign team members Marco Vera and Kym Runge of the University of Queensland's Julius Kruttschnitt Mineral Research Centre said a lot of effort had gone into the research program being undertaken in Alaska.

The campaign is part of the international JKMRC-AMIRA P9 project – the world's longest running mineral processing research project – and the more recent P541A project involving the Ian Wark Research Institute at the University of South Australia and the JKMRC.

The team will conduct their research from June to August 2002 at Teck Cominco's Red Dog mine, located inside the Arctic circle in northern Alaska.

Mr Vera said the team of ten researchers from three universities, including McGill University's mineral processing group from Montreal, would take more than a thousand samples of lead-zinc product during the research period.

The sampling would be timed in such a way so as not to disrupt Teck Cominco's ongoing mineral extraction and processing at the mine.

He said the campaign demonstrated university collaboration working effectively in an industrial setting aimed at achieving the concomitant benefits of adding value to a mining operation – in this case the Red Dog mine – as well as developing the skills and knowledge of postgraduate researchers.

"Essentially the three institutions coming together are bringing with them their own areas of specialisation dealing with one key aspect of mineral processing – that being the froth flotation process."

These areas of specialisation include the JKMRC's flotation circuit modelling and simulation, Ian Wark Research Institute's surface chemistry, and McGill University's development of sensors to measure gas dispersion in flotation cells.

Kym Runge said the Red Dog campaign follows a similar exercise at Northparkes mine in New South Wales during August 2001, which also involved participation from McGill University's mineral processing group.

She said the Northparkes' experience helped the Australian and Canadian teams get to know each other's 'stylistic' approaches to applied research.

"It's always difficult having many people on site, but we got to appreciate each other's skills," Kym said. "Each team member had something special to bring to the project that we alone at the JKMRC would not have had."

Marco Vera said the experience gained at Northparkes helped put the much larger Red Dog campaign together.

"Our Gantt chart might look simple, but it will be a major task to coordinate all of these people on site," he said. "We are going to be in such an isolated location that we can't really afford to go there and be impromptu."

According to Kym Runge, who is a previous visitor to Red Dog, the mine is so remote that straying too far from base runs the unwary the real risk of being eaten by a bear.

The mine is located 150 kilometres from Kotzebue – an ancient arctic Alaskan town of about 2000 people – and about 50 kilometres from the Bering Strait.

When the strait is frozen over it means it's possible, but highly improbable, to walk to Russia from the mine during winter.

Teck Cominco Research Senior Research Engineer Dr Barun Gorain said his company planned to use the knowledge from the joint AMIRA P9 and P541 campaign to develop a comprehensive model for its new Red Dog VIP flotation circuit.

"The successful modelling of a flotation circuit is only possible when experts in flotation circuit modelling, froth chemistry and cell measurements work together in a plant environment to understand the process from different viewpoints," he said.

"Significant financial benefits will be realised if the models and strategies developed from this campaign can be used to improve plant metallurgical performance."

Dr Gorain said the work would also help Red Dog develop a better flotation operating strategy based on the application of new techniques emanating from the projects.

He said the campaign would provide an opportunity for Red Dog plant personnel to observe new technologies like JKFrothCam and the McGill bubble size and gas velocity measurement devices in action.

"It should help operators to obtain different viewpoints and increase technical awareness leading to quicker implementation of new technologies in the plant," Dr Gorain said.

"Teck Cominco would also like to see the Red Dog campaign contributing to the research team's efforts in advancing the science of flotation."

Ms Runge said the team was in no doubt that their main aim was to help optimise Red Dog's new zinc plant in order to increase revenue.

"At the end of the day, the mining company wants to increase grade and recovery, as well as reduce costs so they can make more money for their shareholders."

But as a senior researcher and PhD candidate herself, Ms Runge says an important net gain from the research team's perspective will be enhanced postgraduate experience.

"These researchers are at the cutting edge in flotation research, at least in modelling, measuring and surface chemistry."

She said the PhD and Masters students involved in the campaign would gain invaluable industrial experience, while working alongside the best in the business of flotation research.

After the campaign is over, each postgraduate will return to their respective universities with enhanced knowledge and new data to add towards the completion of their higher degrees.

The Red Dog campaign will commence after the completion of the AMIRA-JKMRC P9M review meeting in Brisbane, Australia from 3-6 June, 2002. ■

For more Information contact:
Marco Vera: Phone 61-7-33655888
Kym Runge: Phone 61-7-33655888
Professor J-P Franzidis: Phone 61-7-33655893

Teck Cominco contacts:
Dr Barun Gorain: Phone 1-250-3644416,
Fax 1-250-3644400
Dr Andy Stradling: Phone 1-250-3644407,
Fax 1-250-3644400

Teck Cominco (Red Dog) contacts:
Kojovic:Email:toni.kojovic@teckcominco.com
Brigitte Lacouture: Email:
brigitte.lacouture@teckcominco.com

Media contact:
David Goeldner: Phone 61-7-33655848, Email:
d.goeldner@mailbox.uq.edu.au

Winner (JKMRC/AMIRA P9 Project) – 2000 B-HERT Award for Outstanding Achievement in International Collaborative R&D

A team of ten researchers from three universities have come together at Teck Cominco's Red Dog mine, located inside the Arctic circle in northern Alaska, to conduct optimisation studies in froth flotation inside the mine's lead-zinc concentrator.

JKMRC researchers Kym Runge, left, and Marco Vera, look over the team's Gantt chart prior to departure for Alaska from their base in Australia.

Researchers from McGill University and the JKMRC came together in 2001 to work on-site in Australia at Rio Tinto's Northparkes mine. From left are Brigitte Comley, Jorge Torrealba, Cesar Gomez, Kym Runge and Edy Sanwani. The two research institutions have since joined with the Ian Wark Research Institute to investigate froth floatation applications at Teck Cominco's Red Dog mine in Alaska.

CULTIVATING THE SEEDS FOR A NEW ERA IN FARMING

GERALDINE HINTER
Journalist – Science and Research, Marketing and Development Unit
University of South Australia

Australia leads the world with a new generation of precision farming practices that utilise sound waves to control the depth of seed deposited in the soil, laser beams to level the land for cotton, rice and sugar plantations, and satellites for automated control of equipment in the field.

The trend towards larger landholdings, direct drilling of crops, minimum tillage of soil for sustainability, and crops planted between permanent wheel ways on soil that has not been compacted by heavy machinery are among the changes that have led to the development of this new level of farming technology.

At the forefront of these developments is Horwood Bagshaw, the major tillage and seeding machinery supplier in Australia, with the largest market share.

Now with its world class factory, it's hard to believe that this company was placed into receivership in 1987. Bought out by its main shareholder at a time when harvester manufacturing was the company's main focus, a review of Horwood Bagshaw's products revealed that, although not traditionally seeding and tillage manufacturers, these products were the most profitable. Work began to develop a new range of machinery but it wasn't until the current owner, Peter Sweeney, took control in 1997 that research and development came to the fore.

UniSA's expertise in machine design and knowledge of tillage and seeding systems matched the company's need for research and development leadership. Associate Professor John Fielke, Leader of UniSA's Agricultural Machinery Research and Design Centre, was appointed Manager, Research and Development at Horwood Bagshaw in Mannum and spends about half of his time on site in that role.

The University has brought a more objective and more scientific approach to development that has helped to remove inefficiencies and take out some of the guesswork, according to Sweeney.

"By introducing other disciplines, such as UniSA's three-dimensional design programs and finite element analysis to test the stresses and strains, we have been able to improve the quality of our products to a higher level than previously," Sweeney said.

He says the company has a long-term commitment to research and development.

"John brings a refreshing level of knowledge and greater exposure to new developments than might be expected through an internal appointment, as well as the benefits of contacts within the university system," Sweeney said.

"We examine Horwood Bagshaw's ideas and, using our research knowledge and engineering expertise to assess market requirements, make recommendations that point the company in the right direction to successfully implement their ideas," Professor Fielke said.

This teamwork has proved so successful that in just two years the Horwood Bagshaw/UniSA combination achieved national recognition as the 1999 winner of the nation's B-HERT Award for outstanding achievement in collaborative research and development between a university and a company with a turnover of less than $50 million. This was awarded for the design and evaluation of tillage and seeding equipment.

"This machinery includes an electric drive air seeder that utilises satellites to direct the seeder to automatically disperse seed and fertiliser at set rates and controlled depths in the field. A blending system allows separate placement of seed and fertiliser or a

blend of seed and fertiliser at certain depths within the soil, and a metering system ensures uniform and accurate placement into the airstream for distribution evenly into the soil. With the ability to switch itself on and off like a robot, this machine is seen as the forerunner to the driverless tractor and places Australian farmers at the forefront of technology," Professor Fielke said.

"Another major achievement for the quad wheel air seeder has been the steering linkage designed at UniSA. This gives very good tracking ability when following behind a tractor and good flotation over the soil without sinking, reducing soil compaction, despite being the biggest available machine of this type on the Australian market with the largest capacity in the world at 15,000 litres. This increase in capacity, from 8,000 litres, means that farmers don't have to refill bins as often and it expands the range from 3,000 to 15,000 litres. The high capacity seeder has the robustness to withstand the stresses and strains when pulled by larger, more powerful tractors and over the areas that they are covering. Other features include air-warming devices that allow farmers to work in a greater range of conditions and larger tyres for wetter and softer conditions."

The air seeder distributes seed and fertiliser to a tillage machine. When Professor Fielke began his research at Horwood Bagshaw, the company's range of tillage machinery included four models varying in size from six to 14 metres wide.

"We have broadened that range to include about 15 smaller and larger machines, varying in size from just over three metres to a massive 18 metres wide. A major engineering task and achievement has been the ability to incorporate a double fold. This allows the widest machines to fold to a width of about seven metres, making them safer for farmers to transport on roads," Professor Fielke said.

"Because of the complexities of these large engineering projects, few manufacturers produce these wide machines. We have taken the principles of good flotation, using large market-leading size tyres and giving special attention to row spacing and tyre layout so that tyres don't touch cropping areas, as well as incorporating subtle changes that add up to a well performing machine," he said.

Horwood Bagshaw's association with the Agricultural Machinery Research and Design Centre has allowed the company to improve its products and have a greater understanding and knowledge of how they work, giving the company total confidence in its machines.

The Agricultural Machinery Research and Design Centre's professional team is the largest group of Australian university researchers working on agricultural machinery design and development. Its specialised facilities, together with the centre's comprehensive knowledge of world-wide practices, are adding value to agricultural products by helping customers through all stages of machinery development, from basic research and design through to the construction and evaluation of prototype equipment. Financial support is available for some research activities, with several schemes available for collaboration with industry. ■

"Now with its world class factory, it is hard to believe that this company was placed into receivership in 1987."

Winner (Design and Evaluation of Tillage and Seeding Equipment) – 1999 B-HERT Award for Outstanding Achievement in Collaborative R&D (turnover less than $50m per annum and in-train for less than three years)

UniSA's Associate Professor John Fielke (left) with Horwood Bagshaw' General Manager Peter Sweeney (centre) and National Sales Manager Max Stagg, standing with the recently developed Horwood Bagshaw double fold floating hitch Scaribar.

GOVERNMENT SUPPORTS AWARDS

B-HERT is delighted to announce for the fourth successive year that the major sponsor of the 2002 Awards is AusIndustry and the Industry Research and Development Board.

The IR&D Board is an independent statutory body whose purpose is to administer specific Federal Government programs in support of industry-based innovation, and to provide advice to government on national industry-based R&D strategies and priorities. Its broad mission is to increase the level and commercial success of industry-based R&D in Australia.

AusIndustry, the Federal Government's program delivery agency, aims to encourage research and development and innovation within Australia.

See below for details on the 2002 Awards.

B-HERT IS DELIGHTED TO ANNOUNCE THE 2002 AWARDS FOR OUTSTANDING ACHIEVEMENT IN COLLABORATIVE R&D

Purpose

A program of prestigious awards initiated in 1998 to recognise outstanding achievements in collaboration between business and higher education in the field of R&D. The objective of the program is to highlight at a national level the benefits of such collaboration, and enhance links between industry and universities.

Eligibility

The award is made to a program or project involving a collaborative partnership between business and higher education. Therefore, the collaborating organisations nominated for the award must come from business and from higher education. At least one of the collaborating organisations must be a Member of B-HERT.
Each submission must be signed by all participating partners.

Frequency

Awards are made annually and presented at the B-HERT Awards dinner in November each year.
In 2002 the Awards will be for Outstanding Achievement in Collaborative R&D. In 2003 the Awards will be for Outstanding Achievement in Collaboration in Education and Training.

Number and categories of Awards

The first group of Awards are for (a) new initiatives, ie projects or programs in train from 18 months – 5 years, and for (b) established initiatives, ie projects or programs that have been in train for more than five years. These categories are further divided into projects or programs which involve small-medium sized companies and large companies. Small-medium sized companies are less than $100m in sales or less than 500 employees. This provides four Awards.
The second group comprises two special Awards for collaborative R&D:

- Outstanding Achievement in International Collaborative R&D
- Outstanding Achievement in Collaborative R&D involving a Cooperative Research Centre.

An application may be submitted for an Award in one or more Groups, provided it meets the appropriate criteria. However, no application can win more than one Award. Unsuccessful applicants for an Award are eligible to apply for an Award in a later year.

Criteria for Assessment

1. *Innovation* – has the project or program produced new products or services; how innovative is it in its concept or idea, design, delivery or content; what new barriers has it surmounted; what new challenges has it identified?
2. *Strength of Relationship* –

a) what is the extent of involvement of the partners?
b) how has this grown over the life of the project or program?
c) how do the partners work together in a productive partnership? (d) are there obstacles and barriers the partners have had to overcome to make the collaboration work? (e) what other spin-offs have there been from the project or program for participating organisations?

3. *Outreach Inclusion* – has the project or program attracted new participants since its inception; has it become a model for other projects or programs?
4. *National Benefits* – these may be economic, financial, social, educational or community benefits: may include for example, growth in exports, creation of new jobs and so on.
5. *Cultural Impact* – what impact has the project or program had on the cultures of the participating organisations? What changes have occurred in what is done and the way it is done in the participating organisations? What changes have there been in attitudes, behaviour or values in the participants?

PLEASE DESCRIBE HOW THE PROJECT OR PROGRAM PERFORMS ON EACH OF THE FIVE CRITERIA (ONE PAGE FOR EACH CRITERION)

Process

1. Applications for 2002 are now being sought from all Members of B-HERT.
2. Deadline for applications is 16 August 2002.
3. Judging panel is:
   Professor Leon Mann, Pratt Family Chair in Leadership & Decision-Making, Melbourne Business School (Chairman)
   Dr Annabelle Duncan, Chief of Division, Molecular Science, CSIRO
   Dr Bob Frater, AO, Vice-President for Innovation, ResMed Ltd
   Ms Lesley Johnson, Director of Strategic Initiatives, Australian National Training Authority
   Mr Peter Laver, Chairman, Ceramic Fuel Cells Limited
   Dr Jane Munro, Principal & CEO, Firbank Grammar School
   Dr Peter Scaife, Director, Centre for Sustainable Technology, University of Newcastle
4. Evaluations will be completed by 18 October 2002.
5. Awards will be presented by the Hon Dr Brendan Nelson MP, Minister for Education, Science and Training at the B-HERT Awards Dinner on 20 November 2002 in Melbourne.
6. Submissions to be no more than one page on each of the five criteria.

Award for the Best Entrepreneurial Educator of The Year 2002

SPONSORS

B-HERT IS DELIGHTED TO ANNOUNCE FOR THE SECOND SUCCESSIVE YEAR THAT THE MAJOR SPONSOR OF THE BEST ENTREPRENEURIAL EDUCATOR OF THE YEAR AWARD FOR 2002 IS THE AUSTRALIAN TECHNOLOGY NETWORK

Completed submissions for Awards for Outstanding Achievement in Collaborative R&D and Award for Best Entrepreneurial Educator of the Year are to be sent to the Business/Higher Education Round Table at the following address:

Level 5
1 Spring Street
Melbourne Vic 3000
Ph: 03 9654 8824
Fax: 03 9654 8835
Email: bhert@bhert.com

APPLICATION FORMS FOR ALL AWARDS CAN BE OBTAINED BY CONTACTING THE SECRETARIAT OR DOWNLOADING FROM THE B-HERT WEBSITE ON: WWW.BHERT.COM

Purpose
To recognise the importance of education in the process of developing and nurturing entrepreneurs; and to showcase best practice in entrepreneurial education.

Eligibility
Educators of students beyond the age of compulsion from final years of schooling, vocational education, training institutions, universities, employment programs to adult education programs are eligible.

Frequency
Awards are made annually and presented at the B-HERT Awards dinner each year.

Award
The Award will include a Qantas voucher to the value of $3000, valid for 12 months, which is intended to be used by the winner to visit some appropriate overseas institutions.

Criteria for Assessment
1 Effective involvement of industry in the design, implementation and evaluation of entrepreneurial educational activities.
2 Encouragement of students in the practice of entrepreneurship.
3 Is the educator's work a model for others?
4 Demonstrable outcomes of the educator's work – development by students of new products, processes or services.
5 Has the educator's work made a difference to the attitudes, self esteem, behaviour, life chances, values and employment outcomes of their students?

Process
1 Applications for 2002 are now being sought from all eligible applicants. Applications may be submitted by the nominee personally, or by a third party on their behalf (with the nominee's consent).

2. Deadline for applications is 1 October 2002.

3. Judging panel will be chosen from the Board of Directors of the Business/Higher Education Round Table:
- Dr Mark Toner, President, B-HERT
- Professor Ruth Dunkin, Vice-Chancellor, RMIT University
- Professor Denise Bradley AO, Vice-Chancellor, University of South Australia
- Professor Gavin Brown, Vice-Chancellor, University of Sydney
- Mr Russell Cooper, Chief Executive, SITA Environmental Solutions
- Mr Richard Hein, Managing Director, P&O Australia Limited
- Mr David Hind, Managing Director, South Pacific, BOC Gases Australia Limited
- Professor Michael Osborne, Vice-Chancellor, LaTrobe University
- Professor Millicent Poole, Vice-Chancellor, Edith Cowan University
- Mr Rob Stewart, Chairman, Melbourne IT
- Professor Iain Wallace, Vice-Chancellor, Swinburne University of Technology

4 The Award will be presented by the Hon Dr Brendan Nelson MP, Minister for Education, Science and Training, at the annual B-HERT Awards Dinner on 20 November 2002 in Melbourne, along with the Awards for Outstanding Achievement in Collaborative R&D.

5 Submission to be no more than one page of each of the five criteria.

B-HERT Publications

As a unique group of leaders in Australian business, higher education and research organisations, the Business/Higher Education Round Table (B-HERT) sees as part of its responsibility the need to articulate its views on matters of importance germane to its Mission. From time to time B-HERT issues Papers in this context – copies of which are available from the B-HERT Secretariat at a cost of $9.90 (GST incl.) per copy.

Position Paper No. 8 (July 2002) –

Higher Education in Australia – The Global Imperative

This paper is B-HERT's submission to the Nelson Review of Higher Education.

Position Paper No. 7 (January 2002) –

Greater Involvement and Interaction between Industry and Higher Education

This paper looks at the need for a more enhanced partnership between the business community and higher education.

Position Paper No. 6 (August 2001) –

Sharing Administrative Functions at Lower Costs

This paper highlights an innovative approach to achieving savings in administrative activities.

Position Paper No. 5 (June 2001) –

What is Needed to Make Australia a Knowledge-Driven and Learning-Driven Society?

This paper aims to identify major public policy challenges that stem from a proper understanding of the nature of knowledge and learning.

Position Paper No. 4 (February 2001) –

The Critical Importance of Lifelong Learning

This paper aims to establish the significance of lifelong learning in the Australian context. Drawing on analyses of lifelong learning policies and practices in Australia and other OECD countries the paper seeks to identify a number of policy priorities for government, particularly in the areas of lifelong learning, business and higher education.

Position Paper No. 3 (April 1999) –

The Case for Additional Investment in Basic Research in Australia

Australia needs to ensure that additional funding is provided within a broader policy framework. Such a framework should ensure maximum returns from this investment through diffusion of knowledge to industry and community, improving the skills level of the workforce, encouraging organisational culture change and collaboration, and promoting competition.

Position Paper No. 2 (October 1998) –

The Development of Cooperative Research Centres

Overall the program has resulted in a strongly positive effect on Australian spending on research and development by government departments, universities, CSIRO and other public R&D agencies and industry.

Discussion Papers:

- How Should Diversity in the Higher Education System be Encouraged?
- The Role of Universities in the Regions

(Refer B-HERT website: www.bhert.com)

B-HERT PAPERS

B-HERT Paper No. 5 (June 2002) –

The Facts – (Higher Education in Australia – today compared with yesterday and the rest of the world)

A compendium of statistics on higher education. Copies are available at $19.95 (GST incl.)

B-HERT *Paper No. 4 (February 2002) –*

The Knowledge-Based Economy: – some Facts and Figures

An update to B-HERT Paper No. 2 which provides some useful and interesting comparative data on Australia's relative global position within the context of the knowledge-based economy.

B-HERT Paper No. 3 (September 1999) –

B-HERT: Survey of Benefits from Commonwealth Government Business Programs

The Report identifies what the respondents saw as the critical issues in R&D support and provides a series of compelling short case studies highlighting the experience of the business community with various government business programs in support of R&D.

B-HERT Paper No. 2 (August 1999) –

The Knowledge-Based Economy: – some Facts and Figures

Provides some useful and interesting comparative data on Australia's relative global position within the context of the knowledge-based economy.

B-HERT Paper No. 1 (June 1999) –

R&D Leadership Training: Direct Contribution to an Enterprise

F.H. Faulding & Co. Ltd is a diversified health and personal care company.

The CSIRO-B-HERT R&D Leadership Program was selected to be the vehicle to assist driving change and improvements in Faulding's development processes.

The team of trained participants has helped reduce total development and technology transfer times by 25-30%.

A significant increase in the number of parallel activities has been achieved with a greater number of projects and product introductions being handled simultaneously.

Without exception all participants realised significant personal outcomes from the course — both in their professional and private lives.

The return on this investment in training in Faulding's case represented a dollar contribution to the bottom line of $1.5 million in the first year.

LEADERSHIP IN INNOVATION COURSE

One of the most exciting initiatives B-HERT is involved in is the unique Leadership in Innovation program.

The program is an intensive three-module live-in training course for prospective R&D managers developed by the CSIRO and the Business/Higher Education Round Table with significant input into the program from BHP, F H Faulding, and the University of Melbourne.

The *Achievement Through Teams – Leadership in Innovation* program involves three residential periods of five days duration (commencing on a Sunday afternoon and finishing Friday lunch time). Module 1 is about Self-Management; Module 2, Team Building; and Module 3, Organisation Culture and the Future of R&D.

The residential courses are held at small, quality conference centres close to capital cities.

The course design is specific to the needs of R&D technical project leaders; brings together participants from across organisations and functions; encourages integration of professional behaviour with personal goals; and encourages leadership through trust, respect for others and generating enthusiasm for a project.

The program is highly responsive to individual and group needs and provides an environment where participants form a strong learning community and ongoing networks.

The cost of the course is $12,000, which includes accommodation and meals, all training, course materials and coaching between modules.

Information: Margaret Redford, Ph: 02 6276 6265 or email: Margaret.Redford@lctd.csiro.au

B-HERT MEETING DATES FOR 2002

Please note the following date for the remaining

B-HERT meeting for 2002:

Wednesday, 20 November 2002 – Melbourne

2.30pm-5pm (inclusive of Annual General Meeting), followed by

Awards dinner at which the Hon Dr Brendan Nelson MP,

Minister for Education, Science and Training, will deliver

the after-dinner address and present the Awards for:

Outstanding Achievement in Collaborative R&D; and

The Best Entrepreneurial Educator of the Year.

SIFE®
STUDENTS IN FREE ENTERPRISE

'SIFE STUDENTS ROLL UP THEIR SLEEVES'

Further progress has been achieved in the development and growth of the Students in Free Enterprise (SIFE) program that is supported by B-HERT. SIFE students devise and deliver projects that help others in their communities to benefit from the market economy while developing their own leadership, communication and teamwork skills.

The Arnotts SIFE Australia National Competition will be held on Saturday 13 July 2002 and more than 100 students from 16 universities are expected to converge on the Hilton Sydney for a day of intense but friendly rivalry. The competitors represent ANU, Bond, CQU, Edith Cowan, Flinders, Griffith, Macquarie, Melbourne, Murdoch, RMIT, Tasmania, UniSA, UNSW, UQ, USQ and UWS. Observer teams from QUT, USydney and UTS will also attend.

The program will commence with four pools or 'leagues', each of four teams, presenting their portfolios of projects to panels of senior corporate executives in 'parallel' sessions during the morning. The teams chosen as the winners of each pool will advance to a final round during the afternoon. This time, their presentations will be judged by a panel of 24 chief executive officers chaired by Roger Corbett, CEO of Woolworths.

The team chosen as the Qantas SIFE Australia National Champion will win $5,000 and the right to represent Australia at the SIFE World Cup in Amsterdam in September 2002, courtesy of a travel award to be presented by Geoff Dixon, CEO of Qantas.

All members of B-HERT are most welcome to attend any part of the day's activities, which will commence at 9.00 am and continue through until 5.30 pm, to be followed by an Awards Dinner in the evening. For further information or to indicate your attendance, please contact the Executive Director of SIFE Australia, John Thornton on 0417 811877 or by email to sife@sifeaustralia.org.au

MEMBERS OF THE BOARD

Dr Mark Toner
(President)
Company Director

Professor
Denise Bradley AO
Vice-Chancellor
The University of South Australia

Professor Gavin Brown
Vice-Chancellor
The University of Sydney

Mr Russell Cooper
Chief Executive Officer
SITA Environmental Solutions

Professor Ruth Dunkin
Vice-Chancellor
RMIT University

Mr Richard Hein
Managing Director
P&O Australia Limited

Mr David Hind
Managing Director, South Pacific
BOC Gases Australia Limited

Professor Michael Osborne
Vice-Chancellor
La Trobe University

Professor Millicent Poole
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Edith Cowan University

Mr Rob Stewart
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Professor Iain Wallace
Vice-Chancellor Swinburne
University of Technology

Executive Director:
Professor
Ashley Goldsworthy
AO OBE FTSE FCIE

Executive Assistant:
Anne Munday

The purpose of the Business/Higher Education Round Table (B-HERT) is to pursue initiatives that will advance the goals and improve the performance of both business and higher education for the benefit of Australian society.

It is a forum where leaders of Australia's business, research and academic communities can examine important issues of mutual interest, to improve the interaction between Australian business and higher education institutions, and to guide the future directions of higher education.

Mission Statement

In pursuing this mission B-HERT aims to influence public opinion and both government and non-government policy on selected issues of importance.

B-HERT believes that a prerequisite for a more prosperous and equitable society in Australia is a more highly-educated community. In material terms it fosters economic growth and improved living standards – through improved productivity and competitiveness with other countries. In terms of equity, individual Australians should have the opportunity to realise their full social, cultural, political and economic potential.

The membership of B-HERT comprises, by invitation, the chief executives of major Australian corporations and research organisations, and the vice-chancellors of Australian universities.

B-HERT pursues a number of activities through its Working Groups, State Chapters and active alliances with relevant organisations both domestically and internationally. It publishes a regular newsletter (B-HERT NEWS), reporting on its activities and current issues of concern relevant to its Mission.

BUSINESS/HIGHER EDUCATION ROUND TABLE A.C.N. 050 207 942
Shell House, 1 Spring Street, Melbourne Victoria 3000 Phone: 61 3 9654 8824
Fax: 61 3 9654 8835 Email: **bhert@bhert.com** Website: **www.bhert.com**

Entrepreneurial Australia
Future Australia

Outcomes Report

The outcomes of a 2-day event held in Melbourne on 30 & 31 May 2001.

The program was developed from the major issues identified in the Global Entrepreneurship Monitor Australia 2000 (GEM):

- Education
- Lack of Capital
- Regulation & Tax Burden
- Short-Term Outlook
- Australia's perceived Anti-Entrepreneurial Culture

The format was a combination of keynote presentations and panel discussions.

Objectives

The objectives of *Entrepreneurial Australia: Future Australia* were:

- To hear from those who have cleared the hurdles and won the gold
- To hear from those who invest in them
- To hear from those who nurture their minds
- To hear from those who help create the right environment.

And to commit to actions those outcomes that were seen to be crucial to Australia developing an entrepreneurial culture.

YES, I WISH TO ORDER _____COPY/COPIES OF *'Entrepreneurial Australia: Future Australia'* at $11.50 per copy (GST incl.) includes postage & handling

☐ Cheque payable to: Business/Higher Education Round Table Amount: $_____
Level 5, 1 Spring Street, Melbourne Vic 3000
Ph: +61 3 9654 8824 Fax: +61 3 9654 8835
Email: bhert@bhert.com

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