



UNIVERSITY OF
TECHNOLOGY SYDNEY

INSTITUTE FOR SUSTAINABLE FUTURES
AUSTRALIAN INSTITUTE OF REFRIGERATION AIR
CONDITIONING AND HEATING



HVAC&R RESEARCH SUMMIT BRIEF REPORT

2014



Business



Office of
Environment
& Heritage



ABOUT ISF

The Institute for Sustainable Futures (ISF) was established by the University of Technology, Sydney in 1996 to work with industry, government and the community to develop sustainable futures through research and consultancy. Our mission is to create change toward sustainable futures that protect and enhance the environment, human well-being and social equity. We seek to adopt an inter-disciplinary approach to our work and engage our partner organisations in a collaborative process that emphasises strategic decision-making.

For further information visit:

www.isf.uts.edu.au

ABOUT AIRAH

The Australian Institute of Refrigeration Air Conditioning and Heating (AIRAH) is the recognised voice of the Australian air conditioning, refrigeration and heating industry. We aim to minimise the environmental footprint of our vital sector through communication, education and encouraging best practice.

For further information visit:

www.airah.org.au

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1 EXECUTIVE SUMMARY

“How can industry establish and maintain a strong culture of research and development and higher education training in HVAC&R?”

There is a significant need for leadership, a strategic agenda and good communications between industry and researchers. These are the core findings of a “HVAC&R R&D” summit hosted jointly by the Australian Institute of Refrigeration Air Conditioning and Heating (AIRAH) and the Institute for Sustainable Futures at UTS (ISF) to discuss the level and direction of HVAC&R research and development work being undertaken in Australia.

Realisation that there was a need for action in this area arose from a short and informal survey conducted in 2013 by AIRAH on current activity levels within the HVAC&R research space in Australia. Overwhelming responses from researchers and industry stakeholders strongly suggested that AIRAH has an important role to play in this space, to act as a facilitator and bridge between academia and industry. The need for such a bridge was strongly expressed by the 26 invited participants at the summit who were drawn from key researchers in the HVAC&R field, industry experts with an interest in research, and relevant government agencies.

Summit participants agreed on the need for a peak body to provide central coordination for the sector to facilitate solutions to the concerns that were raised. AIRAH was nominated to take the lead to broker connections between industry and research, facilitate research projects, and to build up research in HVAC&R.

A central forum for the sector allows it to speak with one voice, to cooperatively develop a prioritised research agenda, bring credibility, advocate for change, and seek funding. There was a suggestion for a centre of research and education excellence with flagship visibility. The HVAC&R industry formation of PRIME may be a model for what is needed, or the mechanism to progress this.

Improvements are needed in communications within the sector to coordinate knowledge about what research is happening in research organisations, what research is needed by industry, and what anyone else is doing. Better communications would help match availability of internships, research projects and supervisors with students. Universities need to communicate with industry about time constraints, deadlines, research processes and student supervision. A long-term strategic plan from industry would allow researchers to factor industry needs into their planning.

Issues with education in the sector included industry concern that students were not industry-ready on graduation, but the universities have had difficulty recruiting enough interested students to maintain a HVAC&R or building services course. Solutions ranged from building the sector profile to make it more attractive to good students; teaching engineers to think non-linearly; teaching the specialised topics industry needs; to more employment of tertiary educated workers by industry. AIRAH’s new post grad program designed to ready graduates for industry is seen as a helpful development.

Improvements are needed in the knowledge and innovation culture of the sector that influences the circumstances within which action can be taken. Amongst other things, the sector needs motivation to change, research priorities, dissemination of knowledge, and understanding of the



needs of other parts of the sector. It is seen as essential that individuals build relationships with each other in order to establish the partnerships required for better outcomes.

Future conversations will be needed to address issues around sharing and ownership of IP, funding sources and allocation, and independence of contract researchers.

Some possible research topics were raised during the summit, but a more comprehensive research agenda needs to be developed strategically. The ideas that came up were framed around the three aspects of step change improvement in industry; improvements to codes and rules; and commercialisation. Some specific topics suggested include research into integrating behavioural psychology in HVAC&R; developing temperate climate solutions; and the pressing need for solutions to refrigerants being phased out.

Industry was encouraged to engage more closely with education institutions and research organisations through direct involvement, funding, and offering employment. The value that interns bring to industry needs to be more widely understood so that there is better industry support for and uptake of interns. Research organisations could provide resources to industry researchers, and postgraduate students were seen as useful resources to tackle difficult questions.

AIRAH has the invitation to progress the concept of a central forum or organisation. Various suggested mechanisms and communication paths to address identified needs are within the reach of AIRAH to undertake or facilitate. These included targeted events; sessions within other events; collating and circulating lists of resources, opportunities and activities; and hosting and publishing information.

The summit exhibited the goodwill, energy and enthusiasm to connect and to cooperate such that the conversation has every chance of continuing. Participants were keen for real action to occur, with concrete suggestions for the sector to start on.



2 INTRODUCTION

In 2013 the Australian Institute of Refrigeration Air Conditioning and Heating (AIRAH) conducted a short and informal survey on current activity levels within the HVAC&R research space in Australia. Overwhelming responses from researchers and industry stakeholders strongly suggested that AIRAH has an important role to play in this space, to act as a facilitator and bridge between academia and industry.

There are several reasons why a frank and open discussion on current and proposed research activities in the HVAC&R field were seen to be beneficial, to both researchers and industry stakeholders. It would:

- Improve connections between industry stakeholders and researchers
- Reduce duplication of effort by different researchers.
- Address fragmented processes for research dissemination.
- Enable industry participation in research to be better understood and encouraged.
- Enable a clear understanding of industry needs, as a basis for collaborative research on which industry stands to benefit greatly.

Summit

Accordingly AIRAH, in partnership with the Institute for Sustainable Futures, held a joint “HVAC&R R&D” summit to discuss the level and direction of HVAC&R research and development work being undertaken in Australia. The summit theme aligned well with AIRAH’s strategic aims, the *Future of HVAC* conference aims and the objectives identified under the PRIME initiative, as well as representing an appropriate response to the 2013 AIRAH Research Survey.

“How can industry establish and maintain a strong culture of research and development and higher education training in HVAC&R?”

The summit was held on the afternoon of Tuesday 15th July 2014 at the Aerial Function Centre on the Ultimo campus of University of Technology Sydney. The date was selected to coordinate with the AIRAH *Future of HVAC* conference being held in Sydney on the following two days. Findings from the summit were reported to the conference on Thursday 17th July 2014.

Attendance was by invitation, with numbers limited to ensure that an open and intimate conversation could be achieved. The 26 people who attended represented key researchers in the HVAC&R field, industry experts with an interest in research, and relevant government agencies.

The summit was hosted jointly by AIRAH and ISF. Phil Wilkinson, CEO, represented AIRAH. Kerry Wilmot, Research Principal from ISF, facilitated the activities. Teresa Cotsinis from AIRAH received participants and took notes of proceedings.

Purpose

The purpose of the summit was identified in advance as to:

- Identify the key HVAC&R industry research needs, and investigate the potential to match these to research capacities and funding sources.





- Consider whether the focus should be on fundamental research, applied research or both.
- Facilitate collaboration between researchers and industry, and between 'researchers in different contexts and institutions.
- Consider the role of VET/TAFE in the HVAC&R research field.
- Discuss ways to better disseminate the results of research to industry practitioners.
- Discuss the key messages that should be delivered to government from the HVAC&R research space.

Format

The summit was a 4 hour workshop style event. The activities were designed to promote introductions between participants. Drinks were offered for an hour following the summit to allow conversations to continue and to consolidate networking.

The agenda is included here in an appendix.

Good Collaboration

The summit started with stories from the participants of good research collaborations between research and industry. Common characteristics of a good outcome included:

Projects where all participants are engaged, involved and sharing.

Open innovation where companies share findings, results and/or IP

Students are supervised in industry – good collaboration gives students industry understanding, and industry gets the benefit of research

Commercial products developed together with universities.



3 SUMMIT THEMES

Themes

Several key themes emerged from the conversations:

- Leadership and unity
- Communication
- Education
- Knowledge and culture
- Time
- Commercial issues

The following sections indicate the concerns and suggestions that were expressed at the summit, grouped under these headings.

Leadership & unity

Leadership

Leadership was identified as a significant need. The industry is currently fragmented with no central organisation or coordination and an enormous gap between industry and research. Without a forum for communication the industry doesn't know where to look for research information, even when it is keen to find out what is being done or to get involved. A peak body providing centralised coordination can facilitate solutions to these concerns.

Single body, one voice, common agenda

There was general agreement that the industry needs to work as a single body. If it speaks with a common voice to represent its requirements there is a better chance of being heard and having its recommendations acted upon. A united voice can advocate for changes, such as, for example, supportive legislation for industry improvements. There was a suggestion to form a consortium, a central forum that could be a mechanism to get all parts of the industry talking together.

A forum that could develop a clear, common agenda that brings together understanding and activities in industry and research, would set a direction for future research that industry can implement. A common agenda and collaboration will bring credibility, and is needed to source research funding. It becomes the basis for industry representations for policy and legislative change, and for broader support for initiatives. A cooperative agreement on the research priorities would improve chances of commercial success.

Flagship visibility and champions

The industry needs a new model, perhaps a centre of research and education excellence with flag ship visibility. Identifying champions will give direction and focus to research needs and activities.

The HVAC&R industry formation of PRIME is a good example of what can be done, and how to bring attention and support into the industry. It may be a model for what is needed, or the mechanism to progress this.

An example of the benefits that could be reaped from this unified approach was given as California, where legislation is working to get energy efficient homes by 2020. It was speculated



that the political situation in Australia might be experiencing pressures from certain sectors that make this unlikely here.

Communication

It was clear that there is an information disconnect, with industry not knowing about research that is happening, researchers not knowing the pressing problems for industry, and nobody really knowing much about what others are doing within their own area.

Clearly, communications within the sector need to be improved.

Match-making

A coordinated way to match research capabilities with research needs within this sector is being asked for:

- What research is being done?
- What research is needed by industry?
- What internships are available; which students are looking for placements?
- Which students are looking for research projects or supervision?
- What research projects are available?

Infrastructure

There were suggestions to improve infrastructure for information dissemination, with various mechanisms suggested such as:

- A research portal
- Accessible lists of the match-making needs and availabilities
- Articles in industry publications to engage the different areas of research and industry with each other's work
- An Australian HVAC&R research conference as a facilitator for these interactions.



Education

Industry-ready

The summit participants spent some time discussing issues in education. There was a sense that students were not industry-ready when they graduated, and maybe mechanical engineering is not the best starting place. It was suggested that the HVAC&R industry is competing with mining for students' attention and the good graduates. The industry doesn't have the profile or appeal to attract enough good students.

Specialised knowledge

Industry needs its workforce to have specialised knowledge in subjects like industrial refrigeration; holistic systems understanding e.g. whole building/architecture; thermal basics, and thermal performance of buildings. In the past, public service engineering cadetships offered the training and mentoring that bridged the gap between qualification and industry-readiness.

Attracting students

On the other side, the universities have found HVAC&R and building services courses don't attract enough students. They need to demonstrate a business case to establish a new course, and it is not there at the moment.

Suggestions to solve this included:

- Offering a specialised combined course between the institutions;
- Establishing a centre of research excellence to build the profile and attractiveness of the subject.

Post-grad programs

AIRAH has developed an innovative post grad program that is designed for recent graduates to ready them for industry.

Industry employment

Another concern is that graduates and higher degree students stay in institutions and industry does not get the benefit of their expertise. Industry needs to employ more of these people, and to value the qualifications and what they offer. It was pointed out that some companies don't employ anyone with tertiary education.

Knowledge and Culture

Leadership and communication

Concerns that were expressed around knowledge and culture are partly addressed by efforts to bring leadership into the sector; and relate strongly to the need for better communications.

Relationship building

Relationship building on the part of individuals is essential to establishing the partnerships that will really solve the problems.

The summit discussed the need to:

- Create an innovation culture in industry
- Address the perception that energy is cheap, which is blocking motivation to change



- Establish research priorities
- Seek out other parts of the sector and enquire about what it needs
 - Align industry and public sector R&D
 - Find the right project
- Provide feedback to each other
- Disseminate the knowledge
- Breakdown the silos in consulting
- Generate political will
- Make HVAC & R a more interesting subject for engagement at all levels.



Time

Although not dwelt upon, it was noted that there is a conflict of time frames between industry needs and academic process.

Industry sometimes has an urgency that can't be accommodated by universities because industry has a short term view rather than an entrepreneurial spirit. If industry could generate a longer term picture through an industry plan, researchers can be better prepared to help.

Where industry can't wait the 3-4 years of a PhD thesis, the 18 months to 2 years of an honours or masters thesis may be better suited.

Industry needs to be aware of timetables for university programs, and universities can do better to inform industry of their situation.



Commercial issues

Issues of intellectual property ownership and funding were only addressed briefly during the summit. This did not appear to be due to a lack of concern or interest, rather that other issues were highlighted and drew the discussion. Enough mention was made to indicate that these will be subjects requiring investigation in future conversations:

- How to manage IP
 - Open innovation – sharing IP compared to keeping IP in-house to protect commercial interests
 - IP transfer
- Funding
 - Australian Research Council (ARC) funding and how it is distributed i.e. the students get the money, industry provides in-kind support
 - How the cost of R&D could be lowered for industry
- Universities could undertake contract research without impacting their independence



4 RESEARCH TOPICS

During the course of the afternoon various research needs and gaps were identified. Generally they were framed around three aspects:

- Where are we now and where do we go?
- Lead to change in codes
- Commercialisation of interesting ideas

The following does not purport to be a comprehensive list of research gaps, but merely a record of research ideas that arose.

- How to create a step change improvement in the industry. What is 50% better than best practice?
- Australia has mostly a temperate climate so we cannot directly apply imported solutions and need temperate climate solutions. This opens prospects for research.
- Integrate tricky behavioural psychology into HVAC&R performance, controls and operations.
- Revisiting rules of thumb
- Impact of latent loads and control
- Components, sizing in particular
- Life cycle analysis

There is some urgency to plan for the phase out of refrigerants, or find replacements. Equipment with a 25 year life span is still being installed using refrigerants that are due to be phased out well before then. The industry needs better awareness of this, and to take responsibility for providing appropriate advice and installation designs. Researchers can help by finding and proving the alternatives.

- Natural refrigerants, low GWP



5 SUGGESTED ACTIONS

The summit was rich in ideas for how to proceed. They have been categorised here in terms of who should take responsibility for actions.

Industry

What industry can do and the benefits for it

Industry has the projects and the applications

Interact with institutions; make connections with researchers.

Get involved in university boards / committees.

Guest lecture

Pay for schooling in subjects that matter to industry i.e. scholarships to cover course fees for particular subjects or courses

Employ tertiary educated staff

Contribute to research in kind:

- Provide equipment to make it happen.
- Provide part time employment
- Provide access to tools, technology and equipment. This brings benefits to the business in creating student and academic know-how of their equipment

Build industry engagement with academics into professional CPD programs

Offer internships

Value of interns:

- They become good employees
- They bring a fresh set of eyes, a completely new way of looking at things
- They bring opportunity to get questions/answers from someone who has time to deal with them
- They bring independent third party validation
- They bring new information
- For the interns there is an opportunity to get prototypes up.
- They may be a useful bridge between industry and research

Industry could undertake its own R&D to answer burning questions; build infrastructure to integrate R&D into industry; or build a relationship with researchers to contract it out.

Commercially

Industry should:

Improve equipment selection at all project scales, look at options and solutions

Take responsibility for information and be able to inform clients



Universities

What universities can do

Work better with industry, explain benefits and how to work together, to act and develop.

Engage industry more fully where they are involved, such as when supervising students

Teach building services engineers need to think differently, non linear

- Start education changes with post-grad students
- Add more electives
- Teach Information Technology; controls & energy management systems in buildings

Provide facilities, resources, computer modelling capabilities for industry research

Use post grad students to answer the odd, tricky questions.

TAFE & technical education could train in new refrigerants

Industry & Research

What can both sides do together

Build closer relationships; engage with each other, be part of that change; create a forum to make this happen

Create better mechanisms for joint management of student projects

Create different ways of thinking, try and change the thinking process, not every problem has a single answer.

AIRAH

AIRAH was nominated to take the lead in many of the solutions that were discussed.

The role for AIRAH

It could take the role of central coordinating body by:

- Brokering connections between industry and research
- Facilitating research projects
- Building up research in HVAC&R

Communications

AIRAH could create the communication paths. Some suggestions were:

- Provide lists of resources
- Collate lists of research projects – underway, proposed and needed
- Host more summits – each state, annually, and/or to brainstorm on particular subjects
- Post research ideas for industry to vote on for feedback and prioritisation
- Host a ‘trade show’ or R&D fair – to showcase who the latest researchers are and what they are working on
- Hold state division events
- Hold forums to discuss potential projects
- Circulate relevant information



Tools

The tools AIRAH could use:

- The AIRAH website, providing links etc
- Publish articles in EcoLibrium to engage different sectors, to engage interest or spread the word
- Host online discussion forums (LinkedIn, Facebook etc)
- Allocate conference sessions – opportunities for researchers to present their work in short formats, similar to the “three minute thesis” university competition, or a Pecha Kucha format.
- Hold events, forums, summits



6 CONCLUSION

There was a lot of goodwill from the summit participants who indicated an eagerness to connect and a willingness to cooperate. Some connections were made during the summit that may lead directly to research collaborations.

With plenty of energy and enthusiasm to harness, the conversation has every chance of continuing to take the ideas further, and to engage more broadly from both industry and research. There were concrete suggestions made during the summit that can be implemented immediately. Others may need a strategic agenda to be established first. Participants were certainly keen for real action to occur.

There was a clear invitation for AIRAH to take leadership on this matter.

Outcomes

Did the summit meet its intended purpose?

Despite good intentions, there was not enough time to examine all the topics, or dive deeply into finding solutions. It is possible that the scattered nature of the conversation reflected the fact that the subject has not been aired before in such a diverse group. Future forums can step off the back of this summit to directly engage with particular areas of concern that have been raised.

- The summit identified some HVAC&R research projects for industry and aired the disconnect felt with researchers and what industry needs in order to be better engaged with research. It matched some industry and researchers, with two clear 'dates' announced from the speed dating round. It didn't get around to addressing funding sources, although difficulties getting funding was touched on a little.
- There was a lot of discussion about the need industry has for applied research. The discussion did not address where the research priorities should lie between fundamental and applied research. This should be a key aspect of the common research agenda that was agreed is needed.
- The summit facilitated connections between the participants, which may lead to collaboration. Some dissatisfaction was expressed with the speed dating round because it was too quick for the conversations that got started. There was enthusiasm for some continuing form of interaction.
- The role of VET/TAFE was only touched on briefly, with respect to education.
- It was agreed that the results of research need to be better disseminated to industry practitioners, and some methods were suggested. This needs further thought, placed in a strategic framework that addresses a common vision for the sector, once agreed.
- The summit did not have time to discuss the key messages that should be delivered to government. The discussion was focussed mostly on what stakeholders could do for themselves and each other. The role of government would arise from a sector vision.



A ATTENDANCE LIST

Attendance list, with affiliation

James Martin	Actron Air
Andrew Pettifer	ARUP
Inga Doemland	Australian National University
Michael Dennis	Australian National University
Edmund Tutty	Bitzer Australia
Reg Binding	Coles
Stephen White	CSIRO
Simon Wild	Cundall
Tristram Travers	Department of Industry
Paul Bannister	Energy Action Projects and Advisory Division (incorporating Exergy)
Lasath Lecamwasam	Engineered Solutions for Building Sustainability
Kristy Harder	Heatcraft
Thomas McIlhatton	Innotech
Michael Calocen	Minus 40
Steve O'Halloran	NSW Office of Environment and Heritage
Dan Granger	NSW Office of Environment and Heritage
Ben Adamson	Refrigeration Engineering
PC Thomas	Team Catalyst
Rosemary Hooke	Unibusiness
Paul Cooper	University of Wollongong
Saeed Mostafavi	UNSW
Ali Shirazi	UNSW
Alistair Sproul	UNSW
Chris Menictas	UNSW
John Dartnall	UTS
Yakov Elgart	Consultant
Phil Wilkinson	AIRAH
Teresa Cotsinis	AIRAH
Kerry Wilmot	Institute for Sustainable Futures, UTS



B AGENDA

Activity	Questions addressed	Time allocation
Introductions Name, organisation, experience/interest in the issue	Who is operating in this space?	10 mins
Summary of the survey findings (Phil Wilkinson)		5 mins
Group Discussion - good experiences of collaboration/engagement	Identify good research that is currently being carried out in the field How is industry engaged in driving research and reporting research outcomes? Positive stimulation of ideas	30 mins
Issues: research gaps, barriers, funding sources - break-out discussion then regroup to report	Industry can help facilitate and participate in research in many ways. Identify and highlight these; Investigate the potential match of research needs to research capacities and funding sources	45 mins
Process and structure - group discussion	Should the focus be on fundamental research, applied research or both? Consider the role of VET/TAFE in the HVAC&R research field	30 mins
Tea break		15 mins
Speed dating: researchers with industry – what each side needs from the other. Looking for matches and agreement, and promoting understanding 4 meetings x 3 minutes each	Industry and research institutions are not well connected. Facilitate improved collaboration between researchers and industry, and between different researchers.	30 mins
Research scoping: develop research ideas. Group discussion to share findings; identify any matches from speed dating session.	Identify key HVAC&R industry research needs.	30 mins
Methods to better disseminate the results of research to industry practitioners - group discussion	Methods for research information dissemination are fragmented. There is no currently central source or portal for HVAC&R research outcomes.	20 mins
Key messages for government - group discussion	Discuss the key messages that should be delivered to government from the HVAC&R research space.	20 mins
Closing thoughts		5 mins
Networking drinks		1 hour

