

College of Engineering and Computer Science

Strategic plan 2009 - 2014

This strategic plan describes modifications and adjustments to the way in which the College of Engineering and Computer Science is to carry out its business in order to take it from its current position to one of pre-eminence in Australia and the rest of the world. The plan is firmly rooted within the strategic framework by which the University operates as described in 'ANU by 2010'. The plan for this College provides the framework for development of the Engineering and Computer Science schools together with Solar Engineering. Each of these academic units will have their own operational plans which will describe in more detail the actions to be taken to achieve our goals (together with an owner and an implementation date). They are to be updated annually.

In broad terms the College desires to be the best of its type in the world. That is to say that the research led educative work of the College is recognized for its brilliance both by us and by the communities we serve and work with. The College is not large and thus we must compete on quality and hence achieving excellence is to be a main driver leading all that is done. A first step towards achieving this is to have a understanding of how the College stands now. Additionally, it will be necessary to develop clear indicators by which progress can be monitored thence ensuring the College is on track to achieving the aims set out here.

This plan therefore begins the process for achieving excellence in all that we do as judged by ourselves and the international community and sets the agenda going forward. It starts with the current position and goes on to identify the next steps to be taken in 2009 and beyond. It necessarily lacks detail which will emerge from the activities outlined herein which will be expressed in operational plans for each of the cognate areas.

This is a collegiate plan and is guided by the College committees and specialist working parties. It has been formulated by inclusive groupings of staff encompassing as wide a representation from the College as possible and will continue to be developed in this way.

The College now

The ANU College of Engineering and Computer Science offers undergraduate degrees in engineering, information technology and computer science along with masters and doctoral postgraduate programs. The College undertakes pure and applied research in information and communications technologies, energy systems, materials and manufacturing, formal methods and logic, machine learning, computer vision and robotics.

Following a decision taken by the Council of the University in November 2004, the Faculty of Engineering and Information Technology (FEIT) and the Research School of Information Sciences and Engineering (RSISE) were brought together as the Information Sciences and Engineering Institute (ISEI). With the decision to group the academic units of the University into Colleges from 1 January 2006, the Information Sciences and Engineering Institute was renamed the ANU College of Engineering and Computer Science. Much of the formative work that had gone into establishing the Institute fortunately transferred easily to the College model so that the current Plan, particularly in relation to management, administrative and business processes, was well advanced.

The College comprised four academic departments (two each from FEIT and RSISE):

- Department of Computer Science (FEIT)
- Department of Engineering (FEIT)
- Computer Sciences Laboratory (RSISE)
- Department of Information Engineering (RSISE)

It has centralised administration, de-centralised support and a single Directorate. Currently the position of Dean and Director is held by one person. The term 'Convener' is not used in this College.

In the latter part of 2007 a comprehensive review of the academic component of the College was carried out by an independent external panel. Five sub panels were appointed to review the four college departments with an overall review leader appointed to oversee the entire process. The objective was to identify means by which College level performance, activities and planning could be improved. Whilst the College has much to be commended, there is potential to achieve at higher levels on a more consistent basis. There is also an imperative to do this if the College is to be recognized as being the best of its type. However, to achieve the objective it was identified that a stronger collaboration between the four departments was warranted. This process of closer integration is to enable maintenance and strengthening of research performance whilst maintaining high quality teaching programs. A uniting theme was the need to conduct research on a larger scale than that possible within the existing departments. The review panel additionally identified solar engineering as an area of great opportunity for growth with both governments and industry focussing attention on sustainable energy sources. Consequently there was a recommendation to nurture solar engineering as an identifiable research

enterprise to take advantage of forthcoming opportunities. The review panel also made a number of more detailed recommendations most of which have been implemented.

Throughout 2008 the College has been implementing many of the review recommendations and this has already started to show impact. The College has also been taking a more considered position with regards the most appropriate structure for going forward. A number of models have been postulated and subsequently refined to a preferred option via the executive committee. After wider consultation, the preferred option is to be adopted and commences 1/1/2009. Hence the College will change to comprise two academic units together with a separate unit for Solar Energy research. This change will be accomplished by combining the Department of Computer Science with the Computer Sciences Laboratory and combining the Departments of Engineering and Information Engineering. All Solar Energy engineering will be grouped together separately. This means that the Research school will be embedded in the Faculty units but is to remain as an identifiable brand and auditable entity. The resulting academic units will be:

- The School of Engineering
- The School of Computer Science
- Solar Engineering

The schools will be responsible for delivery of education and research. By bringing the four departments together the objectives set by the review panel can be readily achieved. It provides both a means for enhanced collaboration and opportunity for increased scale. Further, the academic units will be comprised of research groups. Research groups are loose collections of academics working in broadly similar areas. They create a mentoring environment in which early career academics and PhD researchers can be nurtured. They also offer a ready means by which academics can collaborate and prosecute research on a group basis thus facilitating larger scale research.

However, whilst the review was extremely helpful in identifying some areas for improvement it didn't really provide a comprehensive and detailed health check of the Colleges current position. This is necessary as it provides the base from which the College is to move forward and the bench-mark against which progress can be judged. Thus the first key activity forming part of this strategic plan is to collect the necessary information enabling a clear and detailed picture of the College to be formed. This is to be accomplished via 'Academic profiles'. Academic profiles capture the activity and performance of an academic across the previous five years against obvious criteria such as, publications, impact, citations, teaching, academic service, membership of professional bodies, prizes, awards, advice to government and industry, collaboration, income etc. These will be used to assist individuals in meeting their career aspirations and to understand the strengths and weaknesses of the College. Collectively they will represent the recent achievements of the College.

The College environment

The College wide environment is one of change and it will inevitably be a major influence and constraint on how the College can operate in the future. In the simplest terms the recurrent component of the cost make up of the College is reducing as a proportion of College income. Total College income is increasing quite sharply (roughly at 10% per annum and increasing). The proportion of income from grant and non-grant sources (other government, contract research etc) is driving this increase. This provides opportunity for re-balancing the cost make-up of the College with the aim of generating increased levels

of discretionary funds. The high proportion of non-recurrent income also means that a comprehensive understanding of potential liabilities is needed together with a properly articulated and understood risk mitigation strategy. This is to be developed as a matter of urgency.

The College has also entered into commercialization arrangements that have not been entirely successful. These include both contract research and IP exploitation. Contract research will continue to be a valuable source of income allowing expansion of research. It is therefore imperative that we have (i) better processes for identifying and prosecuting opportunities, (ii) clear local policy on terms and conditions that allow normal university business to be carried out and (iii) better processes for monitoring and tracking progress on active contracts. This will form part of the new knowledge transfer area as discussed later in this document.

The College has a strong research culture in many of its areas and this is to be extended to encompass the entirety of the College. Teaching is also a strength and the College is fortunate to have a dedicated team of highly professional educators. There are considerable opportunities for capitalizing on this in partnership with other Universities. This can take many forms but specific examples include the engineering hubs and spokes diversity project now to be funded by the federal government. It is planned to sign collaborative partnerships with BIT, NUST and Tsinghua universities in China that will expand student choice and provide resource flexibility. The student population is ever changing in the way it expects to interact with educative delivery. Technology advancements are providing new methods for the delivery of education. The educative environment will continue to be carefully monitored and adjustments will be made when clear benefits are elucidated.

The gender balance in the discipline of Engineering and Computer science is notoriously poor and this is reflected in both student and academic populations in the College. Further, at the most senior academic levels there are no positions held by women in the College. Whilst recognizing this as a considerable challenge the College is firmly wedded to the concept of re-balancing and has a very active affirmative action group. This group will now report its recommendations directly to the executive hence offering a route to implementation that is currently absent. Currently, whenever a vacancy arises, the respective School determines whether it is to be filled by a female candidate. The College is to consider this position and examine whether or not, in the first instance, all positions should be advertised as women only, unless there is an overriding case for not doing so. To date the women only posts have yielded a high number of good quality candidates and three appointments have been made. Retention and progression of female academics will also be reviewed.

The College in five years and how to get there

The strategic goal for the College is to raise overall performance to at least that of the best equivalents in Australia, to compete favourably on an international basis and to do so within five years. The core business of the College is research and teaching and naturally plans focus on these. Additionally, our role within society and our value to society are important measures of both the excellence of our outputs and their relevance and hence need to be a part of our strategic thinking. Lastly, the delivery of the core business of any university is directly affected by College administration and support which therefore needs to be highly cost-effective. Thus the four areas of Research, Education, Knowledge Transfer and Support form the key pillars of this plan. To augment the work of our committees, working parties were set up to directly address the question of how we can improve in each of these four areas. The working party findings were presented at the College retreat and modified by the ensuing discussion they have additionally been used to directly inform this plan. Each of these four areas are taken in turn

Research

(a) Research environment

In order to carry out leading research of the highest quality it is necessary to have a culture of research excellence in all parts of the College. Whilst the research culture within the College is generally good, there is scope for improvement. This is not something that can be changed instantly but there is a strong desire in the College to embark on this path and it is accepted as necessary to meet our strategic goal. Specifically areas identified for attention are:

- A role of the Dean, Director Research and Heads of School/Unit is to deliberately foster and nurture a culture of research excellence.
- Research groups should focus on quality and that existing groups be upgraded to IAS groups when they meet criteria of internationally recognised excellence.
- Research planning is carried out at the group level (as well as by the research committee)
- Equivalent research institutes are studied and where appropriate used to inform best practice.
- Teaching loads need careful management to ensure greater opportunity for research and external engagement.
- All appointments are to be made against clearly articulated strategic plans.
- All researchers should be nurtured and have the opportunity for appropriate mentoring by senior colleagues.
- External research income will become increasingly important to sustain the research vigor of our programs.
- There should be careful and strategically planned engagement with only the best collaborators
- There should be only one PhD progression path.
- The quality and quantity of PhD researchers should be increased.

Where activities span the College they will be addressed by the College through the committees and the offices of the Dean. However, most of these areas will be addressed within the schools/unit where greatest impact is to be had. A key component will be to invest resources to achieve specific outcomes as identified in school/academic unit plans. Academic profiles will be used to inform the success of improvements in the research culture.

(b) Research directions

The college has a number of research strands that are and will continue to be followed. These also provide the basis for the formation of research groups. The strands are;

- Materials and Manufacturing
- Complex systems and Control
- Applied Signal Processing
- Computer Vision and Robotics
- Solar Engineering

- Algorithms and Data
- Human Centred Computing Software-Intensive Systems Engineering
- Engineering Artificial Intelligence

Currently the College has two major theme areas spanning individual research strands. These are Solar Engineering and Information and Computing Technology (ICT). ICT has long been a central research activity. A significant component of this research is carried out in close Collaboration with NICTA. The working of this arrangement is under review in order to have more effective joint planning of research by which the two organizations are able to seamlessly span the entirety of basic research through to wealth creation. This will allow for greater research gearing from the relationship for both basic research and commercialization. Solar Engineering is undergoing an extremely strong up-surge in (funded) interest. Additionally, the government is committed to spending \$100M on the Australian Solar Institute (ASI) and the College has, after invitation, submitted a bid together with CSIRO and UNSW. This bid has been successful and hence will grow Solar research at ANU very significantly. A complication around this research theme is the requirement for fabrication and experimentation facilities that are both costly to procure and maintain. The current mix of funding sources does not make for a very stable situation. This is to be reviewed in early 2009 with the objective of exploring more stable business models or strategies for achieving this. The ASI will be factored into this review but is currently due to last only three years making the position beyond that period somewhat unclear.

The research committee, under the stewardship of the College Director of Research, recognizes that these two major research themes will continue to be vibrant and fertile topics for the foreseeable future. In both cases the strategy is to carry out the highest quality programs, producing reputation enhancing research outputs and simultaneously engaging in knowledge transfer so that there is appropriate opportunity for playing a role in commercial exploitation and wealth generation.

In addition, all College research will be reviewed so that there is evidential assurance that themes being pursued are on an upward trajectory in terms of impact and importance. New areas for the College will be examined by the research committee. For example, Systems bio-engineering has been identified as a potential theme for the College to more explicitly develop. A fact finding tour of leading bio-engineering laboratories in the US has commenced and will be used to inform the deliberations of the research committee. Other topics such as e research, green car, security and role in national flagship projects such as the Square Kilometer Array (SKA) will also be examined. The output of this review will set the strategic direction and goals for research at an overall College level. The school/unit plans will layout how individual areas will achieve these goals and identify the resources required. By building the results of this analysis into the school plans it will enable a clearly understood articulation of what is needed in the way of investment and how this investment might be targeted (grants, research contracts etc).

A further question to be addressed by the research committee is 'what should the nature of engineering and computer science research that is undertaken by a leading university be?'. Engineering is ubiquitous, spanning the whole of society in an endless number of ways. However, like many academic subjects it is more usually carried out in a discrete fashion with the result the societal elements are often

not considered. There is scope to think of engineering and computer science differently and indeed many of the major challenges faced by the world may make this an imperative.

Teaching

Engineering and Computer Science are essentially problem-solving disciplines. They develop the solutions – often not unique – to the technological problems of society. They are creative endeavors, based fundamentally on understanding the nature and scope of a problem, and proposing and synthesising effective solutions. They have at their heart the concept of design; given that each problem is different, the design task regularly involves a component of research to identify and realise a solution.

A natural outcome of the design-orientation and discipline-grounding of engineers and computer scientists is that they are in the position to be effective community leaders, able to contribute to the shaping of society and its physical and information infrastructures. These are attributes and skills identified by industry as being desirable in graduate engineers.

In preparing our graduates to meet these demands our curricula have two broad elements. The first is the domain knowledge relevant to their field of study. That consists of the fundamental principles of the discipline and the advanced knowledge of particular specialisations, in which there is rapid change. In our engineering program, which is unique in Australia, we present our students with a system-wide view of engineering, not focussed on specific disciplines such as electrical or mechanical engineering, but rather as a careful integration of concepts from electrical, mechanical and materials fields, consistent with industry needs for engineers with broad outlooks and skills.

Secondly, we inculcate in our students “a way of thinking” relevant to a problem-solving discipline. We do that through design exercises in which teachers, confident in their own abilities, challenge our students in a manner that engenders in them, in turn, the confidence to be creative even when the problem domain they encounter may be foreign and outside their comfort zone. We emphasise the importance of teamwork in reaching realisable solutions to technological problems and the importance of clear technical communications.

Because of the rapidity of societal and technological change, it is not possible to know the nature of the problems that will confront engineers and computer scientists in the future, and for which solutions are required. It is therefore essential that we graduate professionals who will not be daunted by new concepts and challenges. They need to be comfortable with meeting new, difficult and contemporary material during their time with us. We achieve this goal by carefully exposing them to the research ethos of our staff and presenting them with material at the forefront of knowledge.

Design courses, already a long-standing part of our undergraduate curricula, contain an element of research, because that is the nature of design and synthesis. This aspect continues to be strengthened to make research methods more explicit and to develop in our students the notion that discovery and creation are the hallmarks of graduates able to meet the unknown challenges of the future, in a manner and style different from their peers who have not had exposure to research as an essential element of successful and innovative design.

For our very best students, our methods of instruction include reading groups, small group mentoring and participation in the laboratories of our researchers in which the principles of research are more readily explored and applied.

The Education committee augmented by a working party that reported at the 2008 CECS retreat have been examining how the College can improve in all aspects of teaching. The ensuing discussion at the retreat together with the work of our committees has identified a number of areas for attention in 2009. These are:

- The number of offerings at 3rd and 4th year level in computer science should be reviewed.
- Engineering majors are to be reviewed.
- BIT scope to be reviewed
- Consideration should be given to the development of a computer systems engineering major for the BE course
- There should be a pilot a scheme for industrial internships.
- Revisit the elite degrees to ensure continued success.
- Review and revise **all** graduate course work programs against market led needs to ensure relevance and attractiveness.
- There is a clear need for more rapid re-skilling of the workforce. Hence the College should introduce a new Integrated Graduate Development Program (IGDP), targeting professionals in industry.
- Ensure there are clear guidelines and training so that PhD supervisors are suitably equipped with the necessary skills. A register of qualified supervisors will be introduced.
- Ensure all new teachers have appropriate qualifications and training.
- Provide a support program for staff development in teaching (including mid career).
- Initiate yearly review of course content for all courses.
- Maintain currency of web based course information.
- Streamline student feedback.
- Develop a college policy with regards anonymous marking.
- Offer a student forum with Dean and heads of school
- Consider going to modular teaching.
- Consideration should be given to the variability of grade distribution between courses.

These will form core topics for review and action in 2009. The high quality, the dedication and professionalism of teaching in the College is a great asset and the standards set need to be maintained. This is currently being tested due to a steeply increasing undergraduate intake and the large number of courses taught. Student numbers will be managed to meet targets. However, the facilities enabling teaching large numbers are under strain but will be improved thanks to an infrastructure grant. This will add both space and equipment. It also provides for a natural pause point at which the College will take stock of its teaching in terms of capacity, direction and resourcing. In particular the hubs and spokes project will be used to position courses that play into additional domestic and overseas markets as well exploiting the combined strength of collaboration with UniSA.

As identified above, all graduate course work programs will be reviewed. The intent will be to offer only those where there is a sustainable interest and opportunity for revenue generation, whilst being

consistent with the ethos of being research led. The number of individual undergraduate degree programs will also be reviewed.

Knowledge Transfer and Engagement

Knowledge Transfer is an increasingly important component of the College's activities at many levels. The overall aim is to help businesses improve their competitiveness and productivity through better use of the knowledge, technology and skills that reside within the ANU and the College. The College already works with a wide range of industrial partners with considerable success. To date this has been done on something of a scattergun basis and the objective for this new activity is to engage with industry on a more systematic basis. This is especially important as the College desires to increase the proportion of income it receives from industry (and government). This is anticipated as taking many forms from direct contract research to industrially sponsored chairs.

The concept of a dedicated Knowledge Transfer and Engagement activity has been examined by the Dean and Deputy Dean across the latter half of this year. A Knowledge transfer working party, led by the Deputy Dean, was set up to examine 'how to engage more systematically and effectively with Industry and government'. The working party reported their findings at the 2008 College retreat. As a result of the subsequent discussion it was concluded that the following specific activities should commence:

1. Short Term

Business roundtables/lunches: A general forum in which external organizations are invited to lectures/discussion around key areas of their interest.

Schools engagement program: This builds on the existing program of Archimedes day workshops school visits. Wider engagement opportunities exist such as continued involvement in projects such as the outback challenge, F1 in schools initiative etc.

General Market Awareness Program: This will focus on College capability profile-raising through the media and the ANU. It will include production of news items and letters, coordination of the College website and coordination of visit program by external organizations.

Comprehensive Capability Statement: required in order to project the scope and expertise within the College.

2. Medium Term

Innovation Challenge The Opportunity Partnership Program will be used to call for key problems/challenges that need innovative solutions. This can then become an opportunity development project.

Alumni Program A series of alumni events to be held in Canberra and further afield focused on College graduates. These will dovetail with broader University Alumni events and are aimed at create mutually beneficial relationships with our graduates

3. Long Term

Green paper workshops The aim of these is to raise important issues collectively with industry and government partners. Topics might include energy, new materials, sustainability, transport infrastructure etc, manufacturing, pervasive computing etc which draw in large numbers of organizations. The workshops provide a forum to explore major problems and allow our Professors to profess. They are expected to generate a green paper that sets out a community position. These papers form the forerunners of more official positioning papers enabling the community to have a clear understanding of the advantages and disadvantages of differing strategies.

Proof of Concept & Seed Funds: Many ideas are generated by academics and PhD researchers. Often these have the potential to be developed to a point that demonstrates the concept is viable for ongoing funding from external sources. The aim is to consolidate and coordinate a proof of concept fund possibly with ANU Connect Ventures or with the ANU Exchange Innovation & Partnership fund in addition to any College resources.

In addition a 'business prosecution plan' will be developed. A key component of this will be the identification and conversion of prospects to fee paying contracts. Once a prospect has been identified it needs managing in a timely and professional manner. The aim would be to focus on large opportunities to the College although this does not exclude assisting and managing smaller projects. Examples include: the Australian Solar Institute (ASI), Square Kilometer Array (SKA), Co-operative Research Centres (CRCs), Centres of Excellence, Green Car Fund, Pre-Competitive Seed Funding, Innovation Challenge, etc. These activities would require close working relationships with potential funding bodies; College based academics, other partners such as CSIRO or other universities. Following implementation of a project operationally, ongoing management of the project and the relationship is necessary. Often the skill base is not in the College with little resource available in the first instance. There is the need to nurture the relationship to a point that it is sustainable within the College and University. It is proposed that a team of project managers would support the development and management of the project ensuring appropriate risk management so that projects are delivered to customers needs

Overall, the aim is to develop a process that allows the opportunity to be assessed in line with strategic goals, financial viability, resource requirements and risk. It is recognized that many opportunities will be identified by individual academics. The aim here is to build long term partnerships with organizations on a more strategic and systematic basis. There is a natural alignment of this work with that of the Alumni office.

Management and Support

Management and support functions play an increasingly important role in a modern university. Highly professional, cost-effective support enables the College to carry out its core business efficiently and can generate capacity and competitive advantage over other universities. The College is fortunate to have dedicated and well managed teams. However, currently the College support is part centralized and part de-centralized and this introduces unnecessary management complexities.

A number of reviews of aspects of College management and support have recently been conducted. In addition a working party was set up to examine 'how to enhance College support'. The working party reported their findings at the 2008 College retreat. As a result of the subsequent discussion it was concluded that the challenge ahead is to modernize by managing a small and presently dispersed support effort to its best effect in order to gain maximum return for the investment in a seamless and effective way. The present structure has led to a considerable blurring of roles and responsibilities and the proposed framework aims to provide clarity for all stakeholders. This is to be achieved by creating working groups tasked with planning and implementing the new structure. Specifically catalogues of services are to be created for each of the six new functional areas that have an enabling focus. They will additionally embrace modern business processes, data integration and reporting as well as staff development. Overall, management and support needs a common focus and sense of purpose and needs to extract maximum value for each support dollar while meeting academic priorities. It is equally important that College management and support acknowledges its role in the greater ANU and hence will be led by the need to interface effectively and seamlessly with other Colleges and ANU central offices. The following improvement areas will be examined.

1 - Structure: The College consolidate administrative and technical support into a single structure that supports the strategic goals of the College. This will include creating a new Development unit to focus on external engagement.

College Administration and Technical Support (CATS)



In order to move to this structure relatively quickly some assumptions have been made

- Support is assumed to include only those general staff positions funded recurrently and are continuing appointments.
- Staff paid on external funds will not be incorporated into this group.

The proposed structure will create flexibility, responsiveness and bring together all support staff into a coordinated and cohesive unit. It offers critical mass dealing with the current atomization, offers backup and improved communications between the operational areas.

2 – Implementation: Establish three implementation groups to determine the details of the support functions bringing the present School based support, facilities and labs, information technology into the structures described above.

3 – Service catalogues: Each functional area to develop a catalogue of services. As part of defining the detailed structures a catalogue of services will be developed for each functional area to further clarify roles and responsibilities

4 – Business process modernization: While preparing functional area service catalogues, business process in each functional area will be reviewed and concept maps for processes developed to define and clarify of roles and responsibility; and assist in identifying determining business critical activities.

5 – Data and information: Improve integration of business data and information to provide more effective and relevant reporting capabilities to assist in providing better understanding of College business functions – establish improved monitoring mechanisms and financial and other outcome target tracking.

6 – People: Establish a coordinated human capital investment program to enhance

- Team building
- Best practice business processes
- Renewal and refreshment of skills

Overall the aim is to update methods and processes and to do so in a way that allows ease of interplay with other Colleges and central services. There is a strong cultural aspect to this change whereby there will be a much closer relationship between academics and administrators. This will need careful nurturing but should be rapidly adopted once the rewards are clear.

Summary

Overall the College has performed well in recent years, undergraduate applications are up, income is up, publications are up, HDRs are steady. Whilst there are aspects of both teaching and research that are exemplary there are also areas that are not performing to capacity and this provides the potential for improvement. The elements of this strategy recognize the changing environment for Australian universities and aim to pro-actively manage our way through this having clear strategic goals to raise our game in all areas. The identified improvements are specifically aimed at ensuring we are competitive at a world class level and lead to a College of which the ANU and ourselves in the College can be justly proud.