University Partnerships: sustaining international competitiveness

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Introduction

The economic and cultural success of a nation depends on its universities. Higher education should have the highest priority and it is appropriate that this oration is named after one of Australia's greatest prime ministers and the leading politician of his age. A man of foresight and intellect, it is also natural that Sir Robert Menzies should have been the Chancellor of this University. I am especially honoured to be delivering his oration and I thank most warmly the Chancellor and the Vice-Chancellor for inviting me. Melbourne University is my *alma mater* and I have happy recollections of my time here. I came in 1956 when the campus had many fewer buildings than it has now, and there was no other university in Melbourne. When I was last in this hall, I was here to sit an examination. Who says that life does not improve with age?

In 1960, the year I began my Cambridge studies, and just a few yards from what were to be my college rooms, Robert Menzies received an honorary degree in the Senate-House, from the Vice-Chancellor. The orator spoke movingly of Menzies' statesmanship, humanity, and wartime leadership. Whatever life-plan I had then, nowhere in it was the prospect that I would one day be a Vice-Chancellor, nor that I would be here today to speak in Menzies' memory. I thoroughly enjoyed myself here, despite the examinations, but it never even occurred to me that I would become an academic and indeed I spent the first 20 years of my career working for IBM in the United States.

When I started thinking about this oration, I assumed that I would deal in full with several of the subjects that are preoccupying vice-chancellors today; funding, assessment, access, governance, the Internet, and partnerships with industry and other universities. But I soon realised that this would be impossible. Each of the topics would require too much time, or would be too frustrating or irritating to talk about at any length. So I decided to limit myself to a few remarks about the first five and then to concentrate on the final topic, the need for universities to establish partnerships to keep up with science and technology.

Funding

The funding of universities has become so complex that it should be the sole topic of an oration. It is clear that more money is needed, especially for salaries. The competition for the world's leading academics is increasingly international and most of us are losing out to our US competitors. Salaries in the UK are generally about three times lower and I believe yours are no better. When it comes to finding the extra money there are a vast number of alternatives, particularly within state-funded systems. The key question is whether or not students should contribute, and if so, how much and by what

mechanisms can we protect those with limited resources. You are ahead of us in this debate and we look to your methods of implementation as possible models for any system we might implement in the UK. There is little I could say on this subject that would be of interest other than to tell you that the topic is now being debated nationally and that many of us feel strongly that the government contribution should not be reduced as a consequence of money provided by students, rather that it should be increased.

Assessment

The maxim, that they who 'pay the piper call the tune' was never truer than it is of the Faustian bargain between universities and their paymasters. Of course the government agencies must assure themselves that public money is well and beneficially spent, but the damage that is being inflicted on universities by the suffocating bureaucracy of government assessment is a matter of escalating concern. We are this year once again 'improving' our methods for assessing the quality of teaching but we still mix up evaluation of process with that of achievement. In other words we are more concerned about the mechanisms for assuring that our teaching is of high quality than we are about actually delivering high quality teaching. We are also finding it very difficult to come up with a system that preserves the individuality of institutions and provides a degree of assessment that reflects an institution's performance.

If it was only teaching that was assessed we would be fortunate. It is also research, finance, admissions, safety, governance, et cetera. An index is needed for the work required to fulfil these assessments so that the trend can be monitored and the breaking point predicted. A particular difficulty with any form of external assessment is that it depresses morale by introducing a sense of mistrust. If an organisation decides to assess itself then there is credibility and commitment to the process. The conclusions will be respected and reacted to by the organisation. When the assessment comes from outside all one can hope for is resignation and a grudging acceptance of the inevitable.

I feel it is time for strong action to be taken and advocate the elimination of the entire external assessment process. Let the market rule. After all, if a university does not maintain its own quality then its students will go elsewhere. There are plenty of competitor universities today everywhere in the world. I call for this revolution but hold out no hope that my cry will be heard within the UK. The counterarguments will flood in centering on the need to scrutinise the spending of public monies and the solution will not be easily found. I see Melbourne University Private as a more realistic and creative move in the direction of independence, at least for some of your activities. I congratulate you on the initiative.

Open access

The desire to admit the most able students, regardless of background and ability to pay, has long been the wish of responsible universities. Access, as it is now called, has dominated the higher education discussion in the UK this year. The Chancellor of the Exchequer – the Government Treasurer – discovered in May that a student from a northern state school, who had been rejected by Magdalen College, Oxford, had been accepted by Harvard, and declared this to be a scandal. He assumed that she had been rejected because of her 'social class' and because she had not gone to a private school. After literally hundreds of articles in the major newspapers, and as many public speeches on the subject, it has now been established that it was not a scandal, she lost out in fair competition with other highly talented students. It also emerged that leading universities in the UK, in general, have been doing a relatively good job at seeking students from across the social spectrum. Of course, they could always do better.

Access is a subject that greatly interests me and we are working very hard in Cambridge to ensure that it is obvious that we are open to everyone. This does not mean that simply applying will get students a place, or that getting top academic scores secures entry. What it does mean is that there are no secret rules and there is no hidden agenda – we want to attract the brightest students with a genuine desire to learn more about the subjects which interest them most and with an exceptional ability to contribute to society. I am sure that these aims are shared by Australian universities and you may be even more successful in implementing them than we have been because Australia is less inclined to recognise social hierarchies.

Governance

The management, or governance, of universities is another topic that is attracting interest. We in the ancient universities find ourselves in a unique position. The word management is not accepted or even understood and our structures consequently do not fit the accepted norms. For example, it was stated in the Dearing Report, and I pay tribute to that valuable and comprehensive report of my predecessor as a Menzies Orator, that university governing bodies, or councils, should have no more than 20 members. This recommendation had been triggered by the increase in the membership of many university councils to over 50. The governing body in Cambridge, the Regent House, is made up of all of the resident senior members of the university. There are presently over 3000 members, and any ten of them may call for a referendum on matters of significance put to them by the University Council. The Council itself, although elected, has no powers to make major decisions itself. The system works because most of the dons get on with their research and teaching and leave all matters but those involving general principles to the central committees.

The contrast between the ancient universities and those of more recent foundation illuminates the two extremes of the discussion about governance. On the one hand, there is the need to be efficiently managed and to be able to make decisions at a pace that is expected by the rest of the world, and on the other hand there is the need to maintain an environment where scholars have sufficient intellectual freedom to allow them to provide the ethical conscience for society. I offer no answers, but at the moment in Cambridge, we suffer from one of our bodies having power but no responsibility, and the other, responsibility but no power.

The Internet and multimedia

The Internet provides more opportunity for improving and changing the way we teach than anything that has preceded it. I group multimedia display methods with the Internet. Together, they make possible the personalisation of remote teaching in a way that is totally new and the Internet provides access to a greater volume of information than exists in any library in the world. The possibilities are immense and various and I will make no attempt to catalogue them, but I would like to emphasise that the student in the conventional classroom will be as much affected as the distance-learner. Pure Mathematics, and other pencil and paper subjects, are perhaps exceptions. In these cases the blackboard remains the preferred medium for teaching, but for the majority of science and technology subjects, multimedia vastly expands our ability to explain complex subjects. Universities survived and indeed prospered in the course of absorbing the last massive change of this kind, the invention of printing, and I believe that it will do so again.

Partnerships and collaboration

Now to my main topic, that of the role of universities in scientific research and in the conversion of science into technologies that benefit mankind. The relevance of this topic was foreseen by another great Prime Minister, who shared Bob Menzies' interest in higher education. Sir Winston Churchill, although he did not go to university himself, asked that his memorial be a university that would provide leading scientists and engineers for Britain. He recognised that it was scientists and technologists that would determine the success of Great Britain in the decades ahead and he wanted to establish an institution that would produce graduates capable of competing with the graduates of the great universities of the United States. Those involved in realising Sir Winston's wishes decided that this would best be realised in Britain by establishing a new college in Cambridge whose emphasis would be the application of scientific knowledge in the world at large. It is a matter of record that Sir Winston's ideas came from a visit he made to MIT in the post-war years.

It was with especial pleasure, therefore, as a former Master of Churchill College that I became involved a year or two ago in the lengthy negotiations which eventually bore fruit in the collaborative venture between Cambridge and MIT which has been funded with £68 million from the UK Treasury. The funds will support collaborative research, and the establishment of joint undergraduate and graduate courses. The long-range purpose is to effect an exchange of cultures that will benefit the UK economy but more than this it is a landmark in the international collaboration between universities.

While in this part of the oration I am mainly talking about science and technology, I do so in the context of a broad church university. For the six years I was Master of Churchill it was very important to me, even in that college where 70% of the students and fellows were scientists and technologists, that the strength of the arts and humanities was maintained. It is the rich intellectual environment created by mixing the cultures that attracts the most creative minds.

I was confirmed in my decision to concentrate on collaborations and joint ventures when I read an article by Press and Washburn in the Atlantic Monthly which was distributed to the Melbourne University Council for their consideration. Press and Washburn argue that collaboration with industry puts at risk 'disinterested inquiry' and threatens intellectual freedom. I argue that quite the reverse is the case, provided certain precautions are taken.

Needless to say, the world of research has changed since 1960 when I started my PhD in Cambridge but the problems of providing adequate resources for scientifically based technology research were already apparent. I recall Sir Charles Oatley, my professor, telling me that certain sorts of research were best carried out in industry because the resources required were beyond that of a university. The number of fields where this is the case has increased steadily over the last 40 years so that extensive resources are required in almost all biological- and physical science-based technological research. In my own field of microelectronics, for example, a facility capable of making a state-of-the-art chips, costs more than a billion dollars. So how can university research make a contribution? Before I attempt to answer that question let me go back even further to see how the situation has developed. I will take Cambridge as an example, because I know it better than other places.

Prince Albert, the Prince Consort, became Chancellor of Cambridge in 1847. He was an unusual prince, at least in that age, for he had himself attended university as a serious student, and he was genuinely shocked at what he saw as the frivolousness and irrelevance of English university studies. He also came from a country, Germany, where industry and government were already involved in providing laboratory facilities for universities. He was disturbed by the lack of adequate laboratories in Cambridge and

proceeded to find the means to solve this problem. Ultimately he persuaded the Duke of Devonshire to give the money to build the Cavendish Laboratory. By modern standards these new laboratories were simple and relatively inexpensive but the scientists of the time would not have thought so. The funding of the Cavendish would have been regarded as more significant than the raising of tens of millions today to build a fully-equipped laboratory for biotechnology, or a centre for research on the mobile Internet. But at the same time, the money required to provide the basic infrastructure for research was small. It did not approach the sums required to re-equip today's chemistry laboratories with fume-hoods, or to build animal houses for biomedical research, let alone to provide the fully-equipped clean-rooms needed for information technology devices. In 1897 J J Thomson carried out the experiments in which he discovered the electron with a vacuum pump, a glass bottle with electrodes inserted into it which probably took a glass-blower about a week to produce, a battery, and some galvanometers; relatively simple and inexpensive equipment.

The need for ever more expensive research facilities continued throughout the 20th century with increasing government involvement. In Cambridge, the spinning off of ideas into start-up companies began in the 1890s with the founding of the Cambridge Instrument Company by the Darwin family. In the 1960s the Cambridge Instrument Company developed the first commercial scanning electron microscope which was to become the most widely applied scientific instrument of the second half of the 20th century. It had been developed in the Engineering Department of the University and the Company gave the University a considerable sum of money to support further research.

The scanning electron microscope is a complex instrument but it was possible to build the prototypes within the well-equipped Engineering Department. The physicists here at Melbourne University built accelerators, a cyclotron I particularly remember, in the late 1950s and 1960s which were of similar or greater complexity. But soon after this, apparatus, particularly for particle physics, became too complex and expensive for single institutions to build themselves and collaborative national projects involving governments were essential. Today nations must collaborate as illustrated by the fact that the dream of American particle physicists, the super-collider, proved too large even for the might of the USA.

Particle physics is exceptional in the scale of its projects but most fields of science followed the path of growing complexity and in an increasing number of fields it became essential for scientists to collaborate, certainly within institutions, and frequently between institutions. Steadily the nature of intellectual freedom has changed. The ability of individuals to follow a completely independent path eroded. Of course it was always necessary to follow the intellectual advances of others, but it had not been necessary to agree with others about how one went about one's own work. This is not to say that collaboration is less satisfactory from the point of view of creativity. Today the most exciting advances are made at the intersection between subjects. The ideas come from individuals but emerge in the context of a broad insight that is gained in collaboration with others. The collaboration provides the context.

It is also important to realise that the traditional subject boundaries defined in the 19th century; Chemistry, Physics, Biology, Mathematics etcetera are becoming less and less appropriate. For example, the constraints facing those building tomorrow's communications systems must be resolved by computer scientists, electronic engineers, economists, mathematicians, psychologists and physiologists working together. The interface between Physics and Biology and Biochemistry must be breached if the advances in Genomics and Biotechnology are to be realised. People who can surround their specialist knowledge with a broad understanding of newly related fields that may be based on quite different disciplines, will be the prize winners of tomorrow. Minds that can cope with breadth while at the same time succeeding in depth are needed in this intellectual environment where extreme specialisation is no longer sufficient. And not to

forget computer applications in the humanities such as databases and textual analysis. No less a transformation. It is important that we eliminate the walls that surround traditional university departments. This is happening in Cambridge as I expect it is in Melbourne.

I have gone through all of this to establish that there is a need today for interdisciplinary research and for access to large resources. We can accomplish these through the establishment of partnerships.

There are many ways in which these can be realised but before discussing some of the options let me turn more generally to funding options. Universities fund their research from a wide range of sources including their own endowment, government funding councils, defence agencies, overseas governmental research and military agencies, business, industry, media, charities, and individuals.

This broad range is needed to sustain the full breadth of intellectual activity. Much research is purely academic and of little interest to industry or business. It extends human intellect and is fundamental to the culture of universities. It can be supported by endowment and by government and philanthropic sources.

However, research targeted at practicable application, and this includes most areas of science, technology, medicine and much of social science, depends crucially on industrial and business involvement. Industry provides the context for the research and the resources necessary to reach the frontiers. Research that purports to underpin technology must do so in the knowledge of the bounds of the technology and the routes to successful implementation. There is no point in pursuing such science if its implementation will yield devices or technologies that are impractical or excessively expensive.

Industry may support universities by paying for academics to pursue their research, or, better, it may have its own researchers join with the academics to pursue mutual research aims. For universities to maintain intellectual freedom it is necessary in either case for the aims of the industrial supporter to be genuinely the pursuit of research. If the aim is the development of new products or the improvement of existing products then the collaboration should be avoided. Academics have difficulty in participating effectively in schedule-driven development projects. They have to step away from their research regularly to fulfil their teaching commitments. Examining, for example, may occupy them for weeks at a time. Such breaks are intolerable on high technology development projects. But breaks in activity are not detrimental to the pursuit of fundamental research. They may even be beneficial because a new perspective is gained when researchers return after a break.

Regrettably it is not unknown for industry to disguise development projects as research. The difficulty is to discriminate between the two. There is no clear boundary but an industrial collaborator's commitment to research can be tested by their willingness to share, or give up, sole rights to intellectual property and by their willingness to allow rapid publication of results. In the latter case, the delay that a partner can enforce should not exceed three months. Of course there may be cases where it is desirable for the university and an industrial partner to spend longer because jointly they want to protect ideas. Another test is the willingness to allow research students to talk freely amongst themselves no matter who is the collaborator.

As I have suggested, it is best for industrial and university scientists to work jointly rather than just have industry pay for academic research. This ensures that university research concentrates on the most important problems and also encourages industry to take its most interesting and important research and its best people to universities. It avoids the risks that universities waste their time working on problems that have lost

significance and that industry only funds research that it does not consider important enough to work on itself. It also ensures that industry assigns its best people to university collaborations. Academic independence is also better preserved than it is when industry merely funds and monitors the work.

It is clear that it is not easy to set up successful collaborations and it is therefore necessary to be willing to abandon them when they are not successful. The mechanisms for doing this should be set in place at the beginning of the collaboration. Universities can help industry here. More industries fail because they cling to outdated technologies and ideas than because of any other factor. Academics thrive on change and on moving on to new ideas.

The discussion of intellectual freedom must take place in the realisation that complete intellectual independence is rarely achieved. With peer review, for example, there is inevitably an element of control. Independence is frequently lost as peers scratch each others' backs. Peer review is the best of the alternatives for selecting winners in funding competitions but it has its limitations. What is sure is that the opportunities provided by industrial collaboration expand rather than constrain intellectual freedom. The traditional routes are not closed but new routes are opened.

Final thoughts

There are more than enough problems with funding, governance and governmental control, to keep university leaders fully occupied and on the defensive. But to concentrate on problems alone is a mistake. To bask in the comfortable embrace of history is another. Universities should concentrate on the future and explore new ventures. The reason I am back in Melbourne is that I sensed that Melbourne University had adopted just such a forward looking strategy. There has never been a period when the pace of intellectual achievement has been accelerating more rapidly and new ideas more in demand. Collaborations offer an open frontier; between universities and with industry. Industry stands to gain as much, or more, from working with universities as we stand to gain from them. The rules for collaboration must be carefully set, but if we do this, I am convinced that our intellectual independence will be maintained while at the same time we can ensure that the ideas we create will benefit mankind.