

A COST/BENEFIT ANALYSIS OF A PROPOSAL TO CHARGE FOR ACADEMIC COMPUTING AT THE UNIVERSITY OF NEW ENGLAND

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Introduction

In the University of New England (UNE) academic computing is completely separated from administrative computing. Administrative computing is carried out by a unit known as Administrative Data Processing (ADP) on a Hewlett-Packard 3000 computer system. Academic computing comprises a centralised computing facility, the Computer Centre's (CC) main computer is a Digital Equipment Corporation (DEC) 2060 computer, and various smaller computers around the campus. This study deals only with the possibility of charging for use of the DEC 2060 computer, which is currently free to academic staff,² postgraduates and undergraduates (on application by a lecturer) for internally-funded research and teaching. All non-university users and most semi-autonomous university units are charged.

The proposal to introduce real-money charging for academic computing appears to be based on the assumption that it would overcome difficulties currently being experienced. The main difficulties are:

- Heavy usage during peak time (9-5 Monday/Friday during term time) results in access difficulties (not being able to log in to the DEC 2060) and slow response time once logged in.
- Relatively large requests by the Computer Centre for funds to enhance the system, and a belief that without real money charging, there is no satisfactory means of evaluating those requests.

After considering some of the alternative methods of allocating computer capacity, this article examines the methods employed in Australian universities. It then outlines a proposal to introduce real-money charges for computer use at UNE and evaluates this within a cost/benefit framework.¹

Charging Methods³

Three objectives of charging for computing services may be identified:

- The allocation of scarce computing resources amongst users;
- Signalling the need for new investment;
- Obtaining revenue to pay for computing facilities.

The first of these involves consideration of what is termed in economics the optimal allocation of resources in order to maximize a 'social welfare function'. The most common of these functions is based on a theoretical construct known as Pareto optimality, which involves setting the price for a good or service equal to its marginal social cost. If this is done throughout the economy then, under a number of assumptions, the utility of consumers is maximized and resources are optimally allocated. There are a number of practical reasons why prices cannot be easily set equal to marginal social cost. There is also an important theoretical reason, known as the theory of second best. In brief, this theory suggests that unless all goods and services in the economy are priced according to their marginal social cost there is no sound reason for any one good or service to be so priced.⁴ The allocation objective includes several sub-objectives of which the reduction of overall demand and the spreading of demand more evenly are the most important. An obvious way of reducing demand at peak times is to adopt a system of peakload pricing to encourage a spread of use to off-peak times. Such a spread will occur to some extent in any case, since some users will choose off-peak periods to reduce the non-monetary cost involved in waiting.

We turn now to the second objective, that of signalling the need for new capacity. This and the first are, of course, closely linked. If capacity has been reached at the current rate of charging (which may be zero), then capacity may be expanded by the acquisition of more resources or demand may be reduced by increasing the price or by some other method. Further investment is warranted if the value of net social benefits (calculated using the social discount rate) exceeds zero. Otherwise reduction of demand is more appropriate. The difficulties in devising a practical measure of net social benefits are enormous, however, and have not been attempted here.

The third objective of computer charging is to cover the costs of providing computer services. In this section we give this objective less attention than the other two.

We identify four main methods to allocate computer capacity — free, perhaps on a first-come-first-served basis; free, but with priority based on an administrative decision concerning the value of the job; use of notional money charging; use of real money charging. There is considerable scope for variation within these categories. Before discussing the relative merits of these, we will outline the least obvious method, that of notional money units.

In this method, a budget is allocated to users, possibly based on past usage or an administrative decision as to the importance of the work, with each budget unit allowing the purchase of a specific quantity of computer resources. It is possible to encourage better utilization by having, for example, a lower unit charge for off-peak rates. The principal advantages of such a system are that it has the potential to restrain use, it can be operated so as to divert usage away from peak times and overall demand can be controlled. It requires less accounting and administrative controls than a real-money charging system but some such costs are still incurred, along with those associated with the application for, and allocation of, notional money units. The fatal flaw in such a method, in our view, is that there is less incentive for an individual to remain within a budget than in a real-money charging system, unless effective controls are implemented, which in turn add to the cost of operating the system.

In attempting to evaluate the various methods, we have drawn on Flowerdew and Whitehead's categorization;⁵ in particular, we consider the following to be desirable elements of an allocative system:

- it relates to the user's own valuation of the job;
- it takes into account the costs incurred by other users because of the job in question being undertaken;
- it relates to the costs of running the job;
- it allows the computer centre control over nature of use and overall demand;
- it provides a correct signal as to the desirability of further investment;
- it has low administrative costs;
- it has low information requirements;
- it is equitable between users.

We have tabulated these elements for each main method of allocation and the discussion in this section follows Table 1 quite closely.

TABLE 1: COMPARISON OF ALLOCATION METHODS ACCORDING TO DESIRABLE ELEMENTS

	Relates to user's own valuation of job	Takes account of costs to other users	Relates to computer costs of running job	Allows computer centre control over nature of use and overall demand	Correct signal for investment decisions?	Information required by Computer Centre	Costs of administering the system
Free, eg. First-come, first-served	No	No	No	No	No but this is misleading — see text.	None	Minimal
Free, but based on value of job e.g. priority by job type	Partly	Partly	No	Partly	No, but this is misleading — see text.	Low	Small
Notional money a. general unit cost	Yes	No	Partly	No	No	Considerable to define unit but little ongoing	Setting up costs high, thereafter moderate
b. cost reflecting supply and congestion costs	Yes	Yes	Yes	Yes	Yes	Very large	Very high
Real money a. general unit cost	Yes	No	Partly	No	No	Considerable to set up but little ongoing	Setting up costs high, thereafter moderate
b. cost reflecting supply and congestion costs	Yes	Yes	Yes	Yes	Yes	Very large	Very high

Taking the simplest system (free, first-come-first-served), we see that it takes no account of the user's valuation, costs to other users or costs of running the job. Its advantages are equally clear: administrative costs are minimal and informational requirements are zero. As regards correct signals for investment decisions we have entered a 'no, but...'; we believe a substantially correct signal does occur. Our reasoning derives from Capon and is as follows:

- In a multi-user environment such as exists at UNE, the cost per hour of academic staff time is far in excess of the cost per hour of computer time;
- We assume that staff and students are rational and responsible, and that they will use computing time up to the point where the marginal benefit to them exceeds the cost to them, i.e. the opportunity cost of their time is much more likely to act as the restraint on the amount of computer time used than any charge per unit of computer time.
- Therefore, we believe that a free system does provide a reasonable guide to justifiable usage and therefore a correct signal as regards the desirability of further investment.⁶

As regards equity between users, this method advantages those with low costs and flexibility in work patterns.

The second method, free but with some consideration of the value of the job, allows some account to be taken of user's costs. In return for this, some costs are incurred in administering the system and providing information. A similar argument can be applied regarding signalling investment as for the first method.

The notional money method can be split into two types. The first of these operates on a general unit charge. This does relate to the user's assessment of the value of the job; the costs of setting up the system are high, as are the information requirements but once the system is established these fall to a moderate level. The second method (cost reflecting supply/congestion costs) meets all the desired elements, but incurs substantial administrative and information costs. The major difference between real-money and notional money charging is the possibility that the former may be spent on items other than computing.

Charging, in real or notional money, may vary a great deal in terms of comprehensiveness and

degree e.g. charging for everything with the aim of covering total costs, charging a percentage of costs, at peak times only, for consumables only, charging for some categories of users and not for others etc. There are a variety of means of charging, ranging from a formula-based charge per unit through to a multiple tariff.

Current Practice at Australian Universities

The majority of Australian universities do not charge for computer use, despite implications to the contrary.⁷ Table 2 summarizes procedures at fifteen Australian universities; it indicates that six universities have real or notional charging and nine do not charge.

The Computer Centre at UNE currently maintains a DEC 2060 mainframe computer running under the TOPS-20 operating system with multiprogramming and virtual storage facilities. This handles the majority of the university's academic computing. The DEC 2060 has 1 megaword of primary storage, 1900 megabytes of disk space, and 48 connected terminal ports. Other peripherals consist of two tape drives, a line printer, a number of character printers, a card reader and a plotter. Access to the DEC 2060 (and to a PDP-11/34) is gained via an automatic exchange, the Gandalf. Gandalf is connected to 180 public access and private terminal lines outside the CC.

Experience on the DEC 2060 suggests a gross imbalance of temporal usage. Very high load factors and poor response times are typical from 8.30 am to 6.00 pm weekdays whereas late at night and early mornings are almost unused. The periods 7.30 to 8.30 in the morning and 6 to 10 in the evening as well as weekends are being more heavily used now than at any time in the past. It is worthwhile noting the minimal usage of batch jobs. It appears that the major problem here is lack of knowledge on the part of the users.

Description of a Real-Money System for charging for use of the DEC 2060 computer

Charging method

Users will be charged for CPU time used, terminal connect time, disk storage use and paper used. The rate charged for connect and CPU time varies according to type of user, time of day/week and usage mode (timesharing or batch).

At present consultancy services are relatively informal and are not charged for. Similarly, a limited data entry service is available at no charge. All engineering/maintenance services are charged for. Departments purchase terminals out of their own equipment grants, pay Telecom to carry out the necessary internal wiring and pay the Computer Centre a one-time connection fee for connection to the Gandalf. It is envisaged that these arrangements will continue.

Information to be provided by users

Users will register with the Computer Centre in the

usual way to obtain a user-name and password. They will also need to obtain at least one account number; many users will need more than one account.

Staff members will need to estimate funds needed to meet computing charges in each of the accounts for which they are responsible. The amounts for research projects will be included in requests for internal research grants or research funding applications to outside bodies. These requests would be for real money. Postgraduate research students would direct their estimates of computing funds needs to their heads of department for review and inclusion in a departmental request. These requests would be for real money. The amounts required for course development and operation will have to be reviewed at departmental level and consolidated by the department into a budget request. These requests would be for notional money.

Information to be provided to users

The charging database will contain details of cumulative usage (and charges) for CPU time, connect time, disk space and paper used for each user account. This will be automatically updated and will be available for online enquiry by users. Each month (or fortnight if considered desirable) reports will be prepared from the above database summarising monthly (or fortnightly) and cumulative year-to-date usage and charges for each account and will be sent to users/departments.

Dealing with users who cannot pay

This is a critical area in any real money charging system. There are many ways of approaching this aspect which would vary widely in effectiveness, equity and ease/cost of operation.

In the system as described it is assumed that the Computer Centre is not concerned with, nor does it keep a record of, the funds allocated to a particular user. Therefore, they will not cancel the registration of any user for 'financial' reasons unless instructed to by either the Bursar, in respect of the accounts of individual academics or academic departments or, a head of department, in respect of the accounts of individual students.

Evaluation

In the original report, the system just described was examined with respect to its technical, legal, schedule, operational and economic feasibilities. Here we concentrate solely upon a cost-benefit or cost-effectiveness evaluation. The question is whether the benefits to be derived from the system outweigh the costs in time, money and other resources required to implement and operate it.

Our approach is to summarise first the direct costs (see Table 3) which will result from the adoption of the system and then to summarise the direct benefits. Indirect benefits and costs are also discussed.

TABLE 2
COMPUTER CHARGING PROCEDURES IN AUSTRALIAN UNIVERSITIES⁸

Real money charging Western Australia ^b Queensland, Griffith Melbourne ^b	
Notional money charging Monash Tasmania	Real money charging introduced 1976; replaced in 1977 by notional money charging. Under review with the likelihood of reverting to real money charging.
No charging Adelaide A.N.U. Deakin Flinders James Cook Macquarie Murdoch Newcastle New England	Notional money charging 1969-72, then abandoned. Real money charging levied c. 1965-66, then abandoned.

Notes: a. Information was not received from the following universities: New South Wales, La Trobe, Sydney and Wollongong. According to Goldschlager and Payne, La Trobe does not charge and the others have notional money charging.⁸

b. We assume here that money allocated for computing use in these universities is not tied to computing. If, as indeed seems more likely, it is available for computer use only, these should move into the notional money category.

No attempt is made to distinguish between cash costs and resource costs, but it is assumed that in the areas under consideration there are no significant slack resources. The fundamental resource cost is staff time used in developing, implementing and operating the system; the fundamental resource benefit is the saving in time for users as a result of better access and response time.

TABLE 3: SUMMARY OF COSTS

System development and implementation		
1. Complete System Design/Specification CC, ADP, Administration and Academic Staff 3 man-months (M-M) @ \$2500 ^a		\$7500
2. Programming and Testing CC and ADP applications programmers 18 M-M @ \$2500		\$45000
3. Documentation and Training CC Staff 3 M-M @ \$1500 ^a Administration and Academic Staff 1 M-M @ \$2500		\$4500 2500
4. Disk Space Occupied 1/5 of an RP07 disk drive costing approximately \$50,000		\$10000
Total of these one-time costs		<u>\$69500</u>
System Operation		
1. Disk Drive Maintenance 1/5 of an RP07 disk drive at \$3500 per annum		\$700
2. 1022 DBMS Royalty 365 hours per annum at US\$15 per hour		\$6000
3. Program Maintenance 2 M-M per year @ \$2500		\$5000
4. User Liaison Officer 6 M-M per year @ \$2500		\$15000
5. Preparation of funds requests ^b 12 M-M per year @ \$2500		\$30000
6. Review of funds requests and monitoring of charges/funds 6 M-M per year @ \$2500		\$15000
Total of these annual costs		<u>\$71700</u>

Notes:

a. These cost estimates are based on most likely durations and costs taking, if anything, a slightly optimistic viewpoint. Staff involved are deemed to fall into two remuneration categories; Senior Staff with an annual cost of \$30,000 (\$2500 per month) and Junior Staff with an annual cost of \$18,000 (\$1500 per month).

b. In 1982 there were approximately 800 staff/post-graduate students and 1500 undergraduate students registered as computer users. It is estimated that the combined time devoted by staff members alone to prepare serious estimates of computer resources required for their research and teaching purposes during the following year would amount to at least the equivalent of twelve man-months.

As to benefits, users will not have the virtually unlimited use of computer time as under the present free system. This should lead to:

- Better access and response time (during peak time) to those users with a 'genuine need/right' as evidenced by their ability to obtain 'real-money' and their preparedness to spend it on computing.

- A reduction of number of users (in peak time) and a reduction in usage by peak time users. An increase in off peak usage would be expected.

- A better measure of 'genuine' usage of the system should result which would aid computer system enhancement decisions.

- Charges for computer usage may be levied on external users more easily.

Excepting possibly for item 4 above, the estimation of values of these benefits would be highly subjective, as is often the case in cost-benefit analysis. We have chosen not to attempt such estimation because, during the course of our study, we have come to the opinion that these benefits could be achieved, to a significant extent, using a variety of simpler and less expensive methods. Thus we now treat the problem as an exercise in cost-effectiveness.

We have also identified certain other effects which a charging system is likely to have but which are indirect and difficult to quantify:

- Loss of external research funds because UNE researchers would be 'more expensive' than researchers from universities where computing is available at no charge or lower charges.

- Potential loss or non-attraction of staff and graduate students whose work is reliant on large amounts of computing.

- Potential for detrimental effect on the research work of existing staff and graduate students. It should be noted that in times of financial stringency many academics are forced to engage in research of a theoretical or computational nature.

- Slowdown in the introduction of computing into courses.

- Loss of momentum in computing generally at UNE when the opposite is true of universities in the main.

- The relationship between users and Computer Centre staff will become more commercial and less in keeping with the ideal of a community of scholars.

- Proliferation of micro and mini computer systems. It should be noted that whereas the above effects are largely negative, this item has considerable positive (e.g. wider range of software, easy accessibility, low initial cost), as well as negative (e.g. incompatibility of hardware and software, duplication of effort, maintenance problems, reduced prospect of scale economies) effects.

Conclusion and Recommendations

Our conclusion is that in a single campus academic institution of relatively small size like the UNE where there is close personal contact between the Computer Centre and its major users, a real-money charging system is not justified. It is not justified because, in an organization such as UNE, the potential benefits to be achieved from a charging system can be achieved by simpler and less expensive means. These will be discussed later in this section.

Our conclusion has been strongly influenced by Capon's 'responsible user approach',⁹ which was used to persuade the University of Adelaide to abandon its notional money charging system in 1972 and return to the free system which exists there today. The following extracts from his paper support this view:

There is no return to most researchers in computing for computing's sake, because little or no knowledge or (for the cynical) publishable material results from such activity. It should then be evident that persons able, and trusted, to do research should have access to computing as needed, as a means to the agreed end.

... the essence of academic research computing is that it needs control only to the extent that its users have less responsible views on the value of knowledge and/or the cost of getting it than prospective controllers. If usage is to be controlled then it is this judgement of the value of knowledge that needs to be examined not the consumption of computing resources.¹⁰

The introduction of a real-money charging system will satisfy the rationing function and will secure funds from external users. For reasons mentioned earlier, however, we believe that existing usage provides an adequate signal as regards the desirability of further investment. Against these benefits

must be weighed the formidable cost of the charging system and the possible negative indirect effects of such a system. In our opinion the anticipated benefits fall substantially short of the anticipated costs.

In addition, we have recommended that the following alternatives, which are relatively simple and inexpensive, be investigated by the Computer Centre and their implementation, at an early date be considered by the Computer Committee. We believe that these would achieve most of the better access and increased off-peak usage benefits which would follow the introduction of charging yet without most of its costs.

- Restrict the use of some programs to certain times and/or modes.

- Encourage use of batch mode through:
 - (i) Education on its use by the Computer Centre.
 - (ii) Allocating a greater proportion of CPU capacity during peak time to batch jobs.
 - (iii) setting a CPU time limit per session for interactive computing before the user is automatically logged off.

- If the load average reaches a certain level then new log-ins cease until it declines.

- Set log-in limitations for student users (e.g. a maximum of one hour in every three or a maximum of two hours per day in peak time).

- Provide greater access in off-peak times by subsidising more terminals at the residential colleges and having terminals with dial-in capabilities for staff to use at home at night or over weekends.

- Generally providing more education on efficient use of the computing facilities.

There will, almost certainly, be other methods to assist in the achievement of these objectives and we have recommended that the Computer Centre be requested to put forward further suggestions.

References

1. This is a shortened version of a report to the University's Academic Advisory Committee, which asked us to undertake a benefit-cost analysis of the proposal to charge for use of the University's computer. Copies of the longer report are available on request from the authors. At the time of writing (August 1983), no decision had been taken by the University on the recommendations contained in the report. The views contained in this article do not therefore necessarily represent those of the University of New England. There are a number of recent reports which consider charging for computing services in Australian universities and we have been helped in particular by the following:

I.N. Capon, 'Effective Control of Academic Computing', in *Proceedings of the Eighth Australian Computing Conference*, Canberra, 1978, pp 381-391; I. Ellis, *A Real Money Charging System*, Computer Centre, University of New England, 1982; I. Ellis and R.A. Pearce, *A Suggested Charging System for the UNE Computer Centre*, Computer Centre, University of New England, 1981; L. Goldschlager and A.D. Payne, 'Computer Resource Rationing in Universities', in *Proceedings of the Third Australian Computer Science Conference*, 1980, pp 173-184; H.S. Hancock, *Control of Computer Usage*, Computing Laboratory, Macquarie University, 1974; M.P.C. Legg, *Control of Computing Resources: Preliminary Report*, Flinders University Computer Centre, 1976; T.A. Reid, *Discussion Paper on Charging for Computing at U.W.A.*, University of Western Australia, 1982; and University of Queensland, *Report of the Vice-Chancellor's Committee to Review the Provision of Computing Services*, 1980. A major work in favour of pricing is D. Bernard et al *Charging for Computer Services: Principles and Guide-lines*, Petrocelli, New York, 1977. A helpful bibliography has been prepared in Western Australia — Western Australian Computing Centre, *Select Bibliography of books and journals and articles (on computer charging)*, 1982.

2. Staff are requested to include a computing cost, where appropriate, in their requests for outside research funds.
3. We have not attempted to discuss in detail the economic theory behind charging for computer services, which has already been carried out (e.g. A.D.J. Flowerdew and C.M.E. Whitehead, 'Charging for computer facilities in universities', in University of Kent at Canterbury, *Studies in Quantitative Social Science and Management Science Discussion Paper*, 50, 1982). The issues are not, however, unique to computer charging and have been widely discussed in the literature of economics.
4. It should be noted that Flowerdew and Whitehead *op. cit.*, consider that the case for marginal cost pricing for computing is not significantly weakened by non-marginal cost pricing elsewhere.
5. *ibid.*
6. See Capon, *op. cit.* We have couched this in semi-economic terms; alternatively, we could simply have argued that academic staff are responsible. To the extent that there are some who do undertake what proves to be 'wasteful' research using computer capacity, they need help rather than control.
7. See Goldschlager and Payne, *op. cit.*, p.176, and Reid, *op. cit.* p.10.
8. Goldschlager and Payne, *op. cit.* pp 180-181.
9. Capon, *op. cit.*
10. *ibid.*, p. 384.

SOURCES OF STUDENT DISSENT: LA TROBE UNIVERSITY, 1967-72

BARRY YORK

Student unrest on university campuses in the late 1960s caught social theorists by surprise. Capitalism, after all, was functioning as an efficient economic mechanism and cold war conservatism was winning against socialist alternatives. Moreover, the end of ideology was asserted to have occurred. The campuses were silent. Then, suddenly, in 1964 students at Berkeley University launched their free speech movement. And by 1968, *Time* magazine was speaking of 'the biggest year for students since 1848'.¹ Student uprisings were taking place from Argentina to Yugoslavia.

These movements were often revolutionary in that they sought the overthrow of existing ways-of-life. Nourished by intellectual sources which were traceable to Marxism they were sometimes regarded as dangerous to the very fabric of Western society. Indeed, they tended to function outside of institutional politics.

The problem confronting theorists was how to explain the advent of essentially similar student rebellions, occurring at roughly the same time, throughout the Western world. The student movements of the advanced capitalist societies simply did not fit the existing theoretical models. One of the most perplexing factors relates to what Hannah Arendt has described as their 'almost exclusively moral motives'.² Generally, there was little self-gain for the student in the objectives of student movements. They were, indeed, movements based on 'human subjectivity in this, the era of the scientific and technological revolution'.³

There is, of course, no single master hypothesis. It is necessary to look for the specific concatenation of causes that combined in the post-war period to produce the 1960s phenomenon,⁴ and to locate student movements in their particular geo-political, cultural, and social contexts.

Lewis Feuer, possibly the most influential critic of the late 1960s, is notable for his violation of both methodological tenets. Feuer attributes student rebellion to oedipally-projected politics; that is, the ideological acting out of the sons' subconscious hatred of their fathers.⁵ Feuer, however, fails to account for the fact that not every generation produces a radical core, even though presumably the parricidal urge is constant.⁶ His reliance on student songs and poems as primary sources highlights the second methodological flaw, for it cuts across historical as well as cultural lines. And empirical studies into the familial background of American student activists contradicted Feuer's emphasis on son-father antagonism.⁷

Arthur Koestler suggested that Western youth's rebellion was a by-product of an existential vacuum.⁸ In other words, they were unprecedentedly affluent, but also unprecedentedly unhappy. Roszak and Keniston dealt with the same paradox in speaking, respectively, of youth's 'immiserization' and the contradiction between psychological adulthood and sociological adolescence.⁹

Other popular hypotheses of the time suggested that youth was naturally rebellious. The natural rebel theory, however, failed to account for such phenomenon as the silent generation of the 1950s. Bruno Bettelheim blamed student unrest on the alleged self-hatred arising from permissive child-rearing, liberal schooling, and subsidized university education.¹⁰ Yet are we to believe that all student rebels, from Paris to Tokyo, were so reared?¹¹

Conspiracy theories also assumed a certain vogue, epitomized by Van Maanen who traced all campus unrest to Moscow.¹² Altbach's work, however, indicated the extremely limited nature of international student co-ordination.¹³ Moreover, there is abundant evidence of Soviet opposition to left adventurist students, be they in Prague, Poland, or Paris.¹⁴

Finally, it is worth mentioning the derivative hypothesis; namely, that students here were merely keeping up with the rebellious Joneses 'over there'. Australian student movements certainly adopted some of the terminology and techniques of their American, Japanese, and European counterparts. One could say that they were being sensible in applying tested tactics, and internationalist rather than imitative. However, the copy-cat hypothesis begs the question: why were students rebelling, in so many different places at the same time, in the first place?

A natural starting-point is the universities themselves; or rather, how the new technical and managerial requirements of post-war capitalism affected them. Tertiary education was encouraged to expand rapidly and, nourished by the baby boom, continued to produce society's professionals and skilled workers. A new form of intellectual labour was also required, however, social engineers, such as advertising agents, editors, fashion designers, and market researchers became the technicians of consumption and consent. 'The new developments of capitalism' were indeed making education 'one of the crucial areas of change'.¹⁵

Australia's university planners, cognizant of our second industrial revolution, found themselves caught between two different models. On the one hand stood the Newman ideal: the Alma Mater, knowing her children individually, and lauding 'the cultivation of the intellect as an end for its own sake'.¹⁶ On the other, the American model, epitomized by Clark Kerr's multi-iversity, in which the university became the main plant of a knowledge