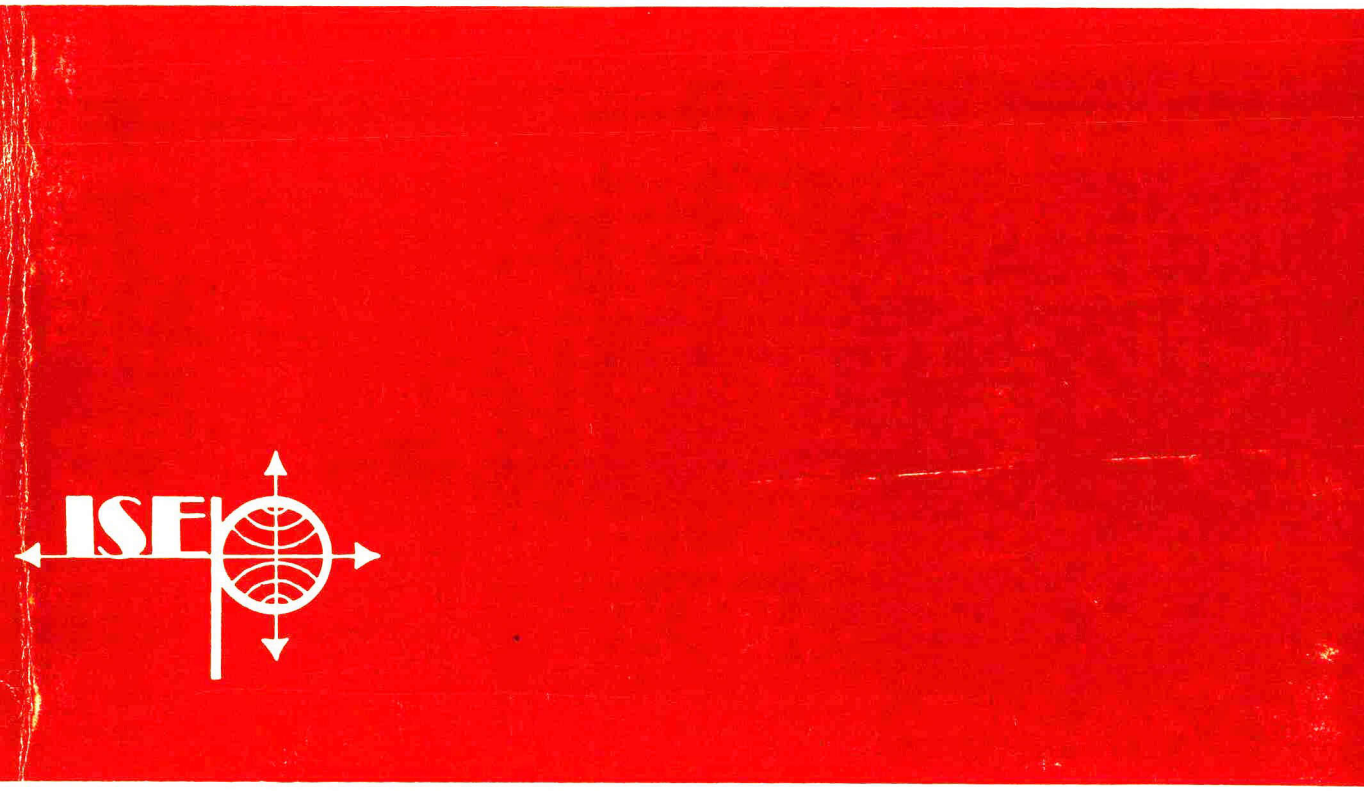
EDUCATIONAL PLANNING



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EDUCATIONAL PLANNING

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The Journal will print articles on the theory and practice of educational planning, case histories, and articles from related specialties (economics of education, sociology of education, demography, town planning, institutional research, operations research, educational research, and applied mathematics) which are of interest to educational planners.

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BEYOND THE CARNEGIE COMMISSION REPORTS: AN ADMINISTRATOR'S VIEW

In 1967, the Carnegie Commission on Higher Education was established by the Carnegie Foundation for the Advancement of Teaching. According to Dr. Clark Kerr, its chairman, the goal of the Commission was to explore the needs and contributions of higher education to the nation's social concerns and purposes. In this paper we shall summarize some major messages of the Commission's reports, react to select recommendations, and suggest alternative perspectives on five areas of concern.

The Commission's twenty-one reports[1] provide sophisticated and thorough analyses of many issues that will remain of importance to higher education to the end of the century. Collectively they comprise a wide ranging investigation of one of the largest enterprises of our society. The two final publications, *Priorities for Action: Final Report of the Carnegie Commission on Higher Education* and *A Digest of Reports of the Carnegie Commission on Higher Education* summarize their conclusions and recommendations. In general, these reports may be characterized as descriptive, predictive and prescriptive. They try to assist the reader to identify trends and avoid crises. They suggest measures to increase the probability of favourable developments and to decrease the probability of unfavourable consequences.

Reaction to them depends to some extent upon the concerns of the reader as defined by the nature of the institution with which he is affiliated; clearly the needs, goals and environment of a community college, for example, differ from those of a comprehensive state-owned institution, a private liberal arts college, or a major private research university. When judging the usefulness of the reports to university administrators, three additional criteria should be noted: (1) The pertinence of the issues and recommendations discussed by the reports to the actual problems that confront administrators. Some reports may prove helpful; others, though interesting and perceptive, are of limited direct utility. (2) The urgency of the issues to administrators. Of the many topics explored by the Commission, financial issues are perhaps the most critical; issues such as solvency, a balanced budget, and salary increments are of great immediacy at most institutions. (3) Whether resolution of the problems actually rests with administrators. Many problems affecting universities (such as the state of the economy, the inflationary rate, birth and enrollment patterns, and levels of state and federal funding) depend for their solution upon factors other than institutional administrative action.

Four questions central to the Commission's effort should be noted: (1) What kinds of challenges and opportunities may institutions of higher education expect in coming decades? (2) What action can and should be taken in response to these? (3) Which actions should be carried out by federal or state governments, faculty, administrators, or other agents? (4) What kinds of contingency planning may be undertaken by institutions to

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allow for flexibility in accommodating to future problems – problems that at present cannot be accurately identified, or will be produced by events beyond the control of the institution.

Although no brief summary can encompass the twenty-one reports, repeat their conclusions, or capture the flavour of their treatment of hundreds of issues, by a review of the *Final Report* we can provide a general idea of their scope and slant.

Having described the current situation and assessed the needs and aspirations of the educational community, as well as present and projected societal requirements, the Commission identified an agenda for action. First, priorities must be set and purposes clarified. Continuing attention must be focused on enhancing quality and diversity, advancing social justice, encouraging change, achieving more effective governance, expanding state and federal funding, and using available resources more efficiently. Particular issues they identified as requiring further study were: student unrest, changes in the labour market, collective bargaining, women's liberation movements, and the nature of the post-secondary age group. The Commission also suggested the roles for each of the principal actors involved in effecting the recommended changes.

The *Final Report* pointed out that certain predictions and recommendations, advanced in the earlier reports, had to be reconsidered in the light of subsequent developments and observations. In discussing enrollment patterns, the Commission concluded that, given the predictions that the 1980s would be a period of slow growth, its previous suggestion that hundreds of community and comprehensive colleges be created by 1980 ought to be reexamined. It recommended conservatism in planning for institution expansion advising colleges to make full use instead of existing facilities by expanding services to part-time and mid-career students.

The Commission also expressed concern over changing attitudes among participants in higher education. Faculty and students alike increasingly appear to be committed to a doctrine of political involvement in the conduct of academic life. Interest in the "affective and sensate" is widespread, as is a refusal to enter into competition, within or without the university.

A third development which the Commission had reconsidered by the time it produced the *Final Report* was "affirmative action", the challenge of absorbing women and minorities into student bodies and faculties. Currently, progress is being slowed by stable or falling revenues and enrollments. The Commission emphasized that planning for the future of higher education must be on a contingent basis, subject to constant revision.

Who should do what?

One means of briefly summarizing the Carnegie Commission's findings is to review some of its charges to the principal actors in the "system" of higher education. In its opinion the U.S. federal government should provide half the total governmental support allocated to higher education. For student aid this should include Basic Educational Opportunity Grants, a federal doctoral fellowship program, and a National Student Loan Bank. The NSLB would provide loans repayable over a period up to forty years, at a rate depending upon income earned. Direct aid to institutions should be provided through cost of education supplements of $500 to undergraduate students qualifying for federal support, and up to $5000 for federal doctoral fellows.

It also recommended that federal funding support research and development in instructional technology through the establishment of seven regional learning technology centres. These would be subsidized for their first ten years of operation. Also, under the Commission's proposed Urban Grants Program, centres would be established at ten institutions to facilitate a "comprehensive urban commitment" on the part of the host universities. Each of these would receive $10 million in federal funds over the ten years.

The most fundamental change in national educational policy which the Commission suggested was that every citizen be entitled to two years of post-secondary education.

State governments were to be assigned responsibility for establishing coordinating agencies with authority to approve or disapprove new institutions, branch campuses, centres and doctoral degree programs. They were urged to avoid the spread of doctoral programs to institutions not currently offering them, discourage the development of new doctoral fields, and eliminate costly or low quality doctoral programs. They should encourage differentiation of roles among the campuses of a system. Due to the expected decline in demand for public school teachers, teacher education programs should be consolidated at those campuses which have high quality programs.

In the opinion of the Commission state governments should not exert authority over administrative actions or the budgets of educational institutions, except for *ex post facto* audit and review. No state should newly establish a single governing board for all the institutions within its system. It held that the fundamental responsibility of the state is to ensure equal opportunity of access to higher education. States which have a low proportion of high school graduates going on to college should expand the number through increased funding. The health of traditionally black institutions must be ensured by the state. Necessary support must be offered to private institutions, and transfer opportunities to four-year institutions must be facilitated for community college graduates.

The Commission assigned the following responsibilities to the faculty of institutions of higher education: They should exercise restraint in advocating the development of new degree programs, especially at the doctoral level; cooperate in eliminating the smaller and more expensive programs; be amenable to both inter- and intra-university consolidation efforts. They should advance new instructional technology and develop programmed materials. They should be imaginative in the use of off-campus facilities and the provision of independent study opportunities. They should undertake periodic reviews of course content to reduce duplication. They should demonstrate enlightened self interest by improving student-faculty ratios. The Commission pointed out that current median student-faculty ratios range from 18 to 22:1 in public and from 12 to 22:1 in private institutions, depending on the nature of the school and its degree programs. If possible, ratios below these medians should be eliminated to reduce costs, and faculty cooperation should enable equitable teaching loads and class sizes to be maintained.

The Commission reaffirmed that the appointment and tenure of faculty should be based on merit. However, efforts should be made in good faith to attract females and those from minority groups. The criteria for tenure should be made clear at the time of appointment; codes should specify faculty obligations; and fair grievance procedures should be established. Institutional planning should avoid the buildup of an excessive proportion of faculty holding tenure; adjustments in the size of the faculty and in individual assignments should always be possible.

In addition to facilitating the actors named to act in the recommended manner, the Commission felt that university administrators bear a special responsibility for mission definition and planning: They should provide incentives to faculty to advance the use of instructional technology. They should establish admission policies that not only ensure adequate enrollment, but also serve equal opportunity objectives producing student bodies of diverse backgrounds and interests. They should eliminate operational, custodial, and service functions that are not directly tied to academic programs – functions which could be performed by other agencies. They should supplement their instructional staffs with technologists and specialists in learning materials. The hiring of middle managers to assist deans and chairmen should lead to more effective management, releasing faculty from administrative tasks.

For the Commission, long range planning is essential in considering major expenditures and commitments. So an institutional research office capable of providing accurate information on matters related to planning is essential for effective administration. In its opinion the long range capital plans of most institutions should be revised downward. The provision of early retirement or semi-retirement can reduce faculty commitments in selected areas. The hiring of temporary or part-time faculty can permit adjustments in program scale.

Budget flexibility is necessary to the financial health of any institution. The Commission suggested that all expenditure be tied directly to programs (e.g., by charging space costs to departments, and computer costs to user projects or departments). Departmental savings should be encouraged by such incentives as allowing the carryover of savings to future fiscal years. Program integration is often cost-effective. For example, at many institutions science programs conducted by health centres can be merged with other basic science programs within the same institutions at considerable long term savings. At many institutions, year round operation would prove to be financially viable.

Student aid should provide grants to the neediest students, especially during the first two years of study. And a combination of loans, paid work and grants should be made available to the less needy students, particularly during their upper years. The Commission recommended increased expenditure in occupational counselling.

The Commission urged that administrators serve as facilitators. They should encourage faculty and student involvement (on an advisory basis) in budget reduction programs. They should seek opportunities to save by developing cooperative ventures with neighbouring institutions (e.g., share faculty, extend joint use of space, avoid duplication of specialized instruction by establishing consortia).

Although many topics of current interest to administrators were not fully explored by the Commission*, criticism of its effort on such grounds should be restrained. Under its initial charge, its reports were not intended to offer specific guidance to administrators but to reflect on contemporary issues which were having an impact on the educational community at large.

*For example: the need for faculty development, the future financial implications of tenure, the proper public service role of universities, the organization of research activity, the management of federal grants, problems of internal campus communications, of management information systems and program planning budgeting, and the role of student affairs in the revision and preparation of educational curricula.

No single paper could enumerate all the possible comments and criticisms that might be inspired by the hundreds of issues and recommendations contained in the Commission's publications. Five broad concerns are singled out here for discussion: future enrollment and revenue, governmental support and control, some alternative models of what government could do to support higher education, a conceptualization of priorities and planning, and a review of what institutions can do to accommodate to declining resources.

Enrollments and revenues

The report *New Students and New Places* recommended the establishment by 1980 of 175 to 235 new community colleges and 80 to 105 comprehensive colleges. The report *The More Effective Use of Resources* described certain financial realities that make it imperative for higher education to find ways to reduce its rate of increase in costs. The latter reviewed the changes which occurred in higher education over two decades as the revolution of rising expectations in the 1960s (referred to as *trajectory 1*) gave way to a period of disappointed expectations in the 1970s (referred to as *trajectory 2.*) Many of their recommendations on open access and cost reduction are appropriate but both these studies underestimated the scale and impact of decreasing enrollments. The harsh reality is that by 1986, the size of the college age population in the U.S. will have fallen to about 80% of its present size; after 1990, it may well be 70%. This observation is not based on projections, but on tabulations of live births in the United States in recent years. From a peak in 1957-1961 of 4.3 million per year, the number of live births swept downward to 3.6 million in 1966 and about 3.1 million live births per year in 1973-1974. The impact of this decline should soon begin to be felt on enrollments in higher education, particularly in certain areas of the country. The size of the college age population will drop sharply. With the current fertility rate at 1.5 to 1.8 live births per female, the most optimistic hope is for an upswing in the late 1990s, almost 40 years after the peak year of live births, when the offspring of the relatively large group of people born around 1960 reach college age.

In *New Students and New Places,* the Carnegie Commission presented a sophisticated analysis of the factors tending to increase and decrease enrollment. However, its projection that the percentage of the 18-21 age group enrolled in college would rise from 50 percent in 1975 to 72.6 percent in the year 2000[2] is not based on sufficiently persuasive evidence. The factors that influenced the increase in the percentage of the 18-21 age group attending college from 14.5 percent in 1940 to 47.6 percent in 1970 are not likely to be repeated. Postwar prosperity, the G.I. Bill, avoiding the draft, new levels of government support for education and research, the search for equal opportunity, and the nature of the skills required by our technological society contributed to that dramatic rise.

Currently, there are many social and economic factors tending to reduce the desire to attend college: high levels of compensation for non-graduates (such as unionized industrial employees and personnel in service functions), the recognition that traditional undergraduate education is no guarantee of social mobility, economic reward or personal fulfillment. College attendance is less dependent upon race, sex or family economic status, and more on motivation, scholarly achievement, an orientation to long term rather than immediate career orientation, and other less quantifiable benefits than apparently was the case in the past. Commission predictions that graduate enrollment will rise from 10 to 16% of the 22-24 age group during the last quarter of the century[3] may be correct but they need additional study in light of the job market for holders of graduate degrees and the "new mentalities" identified in the *Final Report.*

The factors influencing enrollment in undergraduate and graduate school require constant reassessment. New audiences are developing, including adults, women, and minorities, but for various personal, economic and social reasons, many persons either will not enter post-secondary institutions, or will enroll in short term technical or vocational training. The means by which higher education might enlarge its pool of potential students must be studied. One route lies through service to select segments of the post-secondary group interested in technical or vocational short courses leading to marketable certificates.

On the whole it seems unlikely that the proportion of young people attending college will rise rapidly enough to offset the decline in the college age population expected in the next twenty-five years. Since there is little evidence supporting the assumption that more than 50% of the relevant age groups will attend college, and since by 1986 the traditional college age population is expected to be 80% of its present size, unpleasant conclusions are inevitable.

Universities receive between 10% and 90% of their total revenues from tuition, with the composite average being 30%. The market probably will not allow increases in tuition sufficient to offset the loss of real revenues caused by this enrollment decline.

Although support for higher education and research could increase as fast as the growth in government budgets, and perhaps as fast as the inflationary rate, there seems little reason to expect that government priorities for higher education will change substantially from the support levels of recent years. This being the case, given stable or falling tuition revenues, higher education may well be in financial straits throughout the next two decades. In short, *trajectory 3* for the 1980s implies more serious enrollment and revenue deficiencies than *trajectory 2* of the 1970s.

For some private institutions, the decrease in tuition revenues could mean bankruptcy. Public institutions that depend not only upon significant tuition revenues, but upon state capitation formula subsidies, will adjust with difficulty. Even if they are able to increase tuition rates sufficiently to offset the decrease in tuition revenue caused by enrollment decline, their real state support will decrease as enrollment falls unless legislators raise capitation rates.

For those fortunate public institutions funded by direct subsidy, by appropriations not based on the number of students enrolled, the prospects are better. However, in the face of declining enrollments, any significant increase in their state appropriations cannot be expected, and inflation may continue to decrease their effective dollars.

Governmental support and control

Support of higher education by federal and state governments depends upon current political realities and processes, upon competing demands for funds for other public services. Politics is power, expressed through the allocation of resources and the exercize of authority over institutional activities. Institutions wish to be funded while avoiding loss of autonomy to the agency dispersing the funds. In the United States there is no fully developed, coherent and consistent body of federal policy on education. From state to state, the policy varies. The implementation by legislators, bureaucrats or coordinating bodies of fashionable educational developments often lends a whimsical tone to educational policies. The Carnegie Commission perceived the public interest being served when adequate access to higher education and equal educational opportunity are provided, when

knowledge is advanced, and when major contemporary problems are resolved through the teaching and research activities which are fundamental to institutions of higher education. In the cold, pluralistic political world, however, the public interest is often perceived as limiting the claims on public funds. Many politicians and citizens alike believe that defense, welfare, agriculture and commercial subsidies take priority over educational expenditure.

In recent decades public support of education, for the most part, has been granted in reaction to specific problems. The federal government has funded programs to meet scientific and technical needs, to reduce inequality of educational opportunity, to train health manpower. Although higher education has greatly benefited the support has often been premised on different goals from those commonly espoused by the educational community.

Receipt of federal funds has made institutions vulnerable to federal guidance, guidance which has been neither consistent nor enduring. Health schools have expanded their enrollment as a condition for capitation grants, only to find subsequently that federal support has been delayed or diminished. Graduate programs have been initiated with federal support, language and area studies centres have been expanded, and new financial commitments have been made by institutions, only to be followed by withdrawal of federal funds. Manpower requirements are not accurately predictable, yet revised estimates of public needs by governmental agencies have left institutions without funds to maintain buildings or support faculty and graduate students. The initiative for funding rests with the federal government; the liabilities remain with the institutions.

All too frequently, state support of institutions of higher education has led to rigorous state control, which has not necessarily served objectives which are valued by the educational community. On occasion state regulation has objected to the expression of unpopular ideas and been overly aggressive in dealing with minor issues. For a variety of reasons, institutions have resisted central coordination. The ineptitude of state employees and councils, political interference with the functioning of campuses or with statewide planning efforts, and the sometimes hostile motives and postures of actors on the state scene have not enhanced the reputation of central coordination. In many states, institutions are well aware that state decisions reflect the political climate rather than the needs of education. Political influence may determine the distribution of resources among colleges or campuses and restrict institutional authority to add degrees, develop new programs, or expand enrollment.

Institutions also have been guilty of petty and counterproductive behaviour. Educational imperialism, aggressiveness to neighbouring institutions, ambition to become bigger and more prestigious, neglect of the quality of its teaching so that it may become known for the quality of its research centres, subverting priorities in a chase for federal funds, and unresponsiveness in ensuring non-discriminatory access to study and employment – all these have contributed to state and federal intervention in institutional affairs.

States become persuaded that improved state control of education by regulatory bodies such as the coordinating councils recommended by the Carnegie Commission will expand access to education, improve quality, and lower costs by avoiding waste and duplication. Evidence is mixed as to whether regulation will achieve these goals. Certainly cost-effectiveness, not quality, is now the keystone of state funding; quality has not been a productive argument to gain increased appropriations for some time. However, increased

bureaucratic control often does not avoid waste and duplication, but leads to increased costs for the state and the institutions as well. Obsolete programs may become protected by professional interest groups, state bureaucracies may generate counterpart bureaucracies within the institutions, student-faculty ratios may become inflexible, and any attempt at institutional contraction be vociferously contested by various political constituencies.

State regulation of institutions entails a relationship that works in both directions. When institutions become dependent on state guidance, they, in turn, gain more leverage on agents and decisions of the state, especially through the political process. When used with finesse, this leverage can be of great advantage to institutions. Nevertheless, state regulation often involves the establishment of formal contractual relationships that reduce institutional flexibility, including the freedom to modify programs or implement other cost-effective measures. Whether through guidance from a coordinating council, through obligations entailed by faculty union contracts, or through regulative legislation, the latitude for change may be reduced, not enhanced. Whether strong state coordinating councils would improve quality and reduce costs is a question that requires further study. Alternatives such as regional councils, joint planning efforts among institutions, or advisory councils to encourage dialogue and the sharing of information may, in the long term, prove to be more in the public interest.

In brief, the challenge to higher education is to ensure that government objectives are met in the sense that the public is served without waste or inequity. But institutions have learned to regard state and federal leadership with distrust. The history of unsatisfactory relations between institutions and government suggests that new modes of cooperation are needed. The Carnegie Commission recommended the establishment of strong state coordinating agencies. It might have been more innovative in suggesting different models that would better serve both members of the partnership. Governments and universities have the right to expect better of one another.

What Government could do

Assuming enrollments and tuition revenues do decline, the initial reaction of higher education will be to seek increased state and federal funding. Given the current state of the economy and the changing attitudes about the rewards of a college education, it seems unlikely that sufficient funds will be allocated to fully offset deficits. One obvious alternative would be to identify new kinds of governmental subsidy which combined with existing governmental funding could be effectively directed to relieve the most severe strains on institutional budgets. For example, state aid to private education might help to meet utility costs, building maintenance and renovation, or the provision (on a per student basis) of non-controversial support services. In this way the state could review and approve a significant portion of an institution's budget with minimal interference in its educational programs or regulation of its faculty and their fields of inquiry. Or state support might take the place of a tuition subsidy for state residents attending any public or private institution. Capitation programs have been proposed that could bring tuition within the means of most families and allow the marketplace to determine which institutions gain the greatest state support. To protect the solvency of institutions, "resident tuition augmentation awards" should be funded in advance, and no decreases in the number of awards should exceed ten percent per annum without mutual agreement. Even that level of abrupt withdrawal of state support could be traumatic to the institution.

The Commission recommended that federal support of higher education include Basic Educational Opportunity Grants, a graduate fellowship program, and a National Student Loan Bank. However, support should not be restricted to select fields. Students of their own accord move toward employment opportunities and enroll in graduate or professional fields that are generously rewarded. In addition to funding scholarship programs and continuing traditional support of faculty research projects, the federal government could fund certain academic support functions. Nationally funded regional centres (locally controlled) could, for example, provide hardware, the expertise and operating costs for computers, research libraries, instructional technology centres, and certain kinds of research libraries, instructional technology centres, and certain kinds of research laboratories. All these are vital to institutions of higher education and consume large percentages of their budgets. In this way the federal government can make the tools of education accessible to all institutions without specifying the uses of the tools it provides.

At present universities invest great sums in developing and maintaining computer centres, even though other institutions in the same region are duplicating their efforts. The establishment of several dozen National Computer Centres could result in significant economies for user institutions. Such centres, located on or near major campuses, would be interconnected by a network allowing access to surplus capacity in nearby regions. Thus public and private institutions alike would have access to a wide variety of hardware and software capabilities. Each member institution would pay for terminals. A reasonable amount of computer time could be made available without charge, with an increasing unit rate charged for additional machine time and program services. Representatives from user institutions and the federal government would serve on the centre's executive board to ensure equity and quality of service.

There need be little change in the service to individual faculty members undertaking research projects, or administrators or clerks carrying on the business of the institution. Lines to terminals would simply be a few miles longer. However, each user institution would be saved millions of dollars annually. Computation power would be extended to smaller institutions which have been unable to afford such services. Non-profit agencies and government offices could also be served if sufficient capacity were provided. Computers for non-profit use should become a federally subsidized public utility.

Every major college and university throughout the country feels an obligation to have a comprehensive book purchasing program, even if eighty percent of the materials rarely circulate or are only of interest to a very small proportion of the faculty. A National Research Libraries System could avoid some of the unnecessary duplication of library acquisition and cataloging. Under such a system, books that frequently circulate, as well as special collections of particular interest to an institution, would be retained on individual campuses. Collections with infrequent use would be available upon request by same day delivery service from the regional National Research Library. A certain volume of deliveries would be free, and local boards would determine unit costs of deliveries to institutions whose faculty or students make unusual demands on the system.

Regionally located National Instructional Technology Centres to serve both the public and private sectors of education were proposed by the Carnegie Commission. Their technical experts could contract with university-based faculty to develop courses using media and programmed instruction. They could also facilitate region-wide campus networks for instructional television and programmed materials – providing the studios, support services

and advice. Since many institutions waste large sums on poorly utilized equipment and illconsidered materials, National Instructional Technology Centres seem a worthwhile undertaking.

At present, a large part of the federal funds for research in education are devoted to meeting the high costs of equipment and laboratory facilities, the use of which is confined to the single institution to which the grant was made. Research laboratories frequently require more than half the campus physical plant, utilities and maintenance, but serve only a tiny fraction of the institution's student body and faculty. A significant proportion of the research equipment owned by institutions is used only by individual investigators or the members of their small research teams. Sometimes this is necessary; but in some cases the expensive equipment could be shared with other investigators on the same campus or other institutions in the area.

Another means of making more efficient use of federal research funds granted to higher education would be to establish a large number of National Research Laboratories providing equipment, laboratory facilities and instrument technicians. The federal government could either fund the construction of centrally located facilities or take over existing buildings on university campuses, paying the operational costs, the salaries of instrument technicians, and purchasing and maintaining all standard equipment. If only half of an institution's research facilities and equipment were left under its proprietorship (with the remainder assigned to a nearby National Research Laboratory) the institution could realize substantial operating savings and there would be increased cost-effectiveness of the federal government's investment. Recipients of federal research grants could become fellows of the National Laboratories, assured of access to the equipment and facilities necessary for their projects. Excess instrument time could be made available to junior faculty and graduate students under guidelines established by a local governing board. If sole possession of standard or specialized equipment were required, it could continue to be made available. Whenever sole possession is not required, the travel costs to the local federal laboratories would be more than offset by economies in the use of plant and equipment.

Investigators who currently enjoy sole use of facilities on their own campus might well resist this suggestion. But their inconvenience is preferable to a policy of meeting rising costs by reducing the number of investigators. Cost recovery on research grants is no longer adequate to maintain faculty, graduate students, equipment and buildings without institutional subsidies.

Federal development of these four kinds of national centres would not only lead to major economies in institutional budgets, but also to the more effective utilization of resources. The financial investment involved need not be exorbitant, particularly when compared to the enormous funds now expended *in toto* for personnel, hardware, software, buildings and equipment. The funds freed for institutional use could be directed to offsetting the decline in enrollment revenues and to strengthening program quality. Assiduous local boards and complex operational formulae would be required to ensure proper access and avoid the abuse of the computation centres and research laboratories. But through them the federal government could establish a national research support policy which does not imply control of the missions of recipient institutions.

Overcoming the inertia of both the federal governmentaand institutions to develop more cost-effective forms of government subsidy would not prove easy. However, if the financial situation of institutions of higher education continues to show no improvement, their attitude to innovation may become less conservative. Clearly, a dialogue exploring new models of government subsidy is required.

Priorities and planning

Because the percentage of the GNP spent on higher education cannot continue to increase at the high rate of the 1960s, the Carnegie Commission emphasized the need to set priorities. It commented,

> Purposes are the overall ends of higher education. Priorities relate to those things that most need to be improved, both as to ends and as to means. To some purposes we give a higher current priority than to others, not because they are inherently more important than others, but because more needs to be done and can be done with them at this time than with others. For example, basic research is of the highest importance, but it is more fully advanced at the present time than is the contribution of higher education to equality of opportunity, and so we give the higher priority to equality of opportunity. But in the future, if great progress continues to be made in the direction of greater equality of opportunity and if support of basic research continues to decline, the order might then be reversed.[4]

This approach might best be described as "attentiveness," i.e., in setting priorities, institutions must distinguish between matters that urgently require attention, and matters of equal or greater merit that are already being cared for. It would be inappropriate to conclude that certain schools or programs are of higher priority than others for all time.

In dealing with such subjects as curriculum reform and advancement of social justice, the Commission reports reflect the tension between the traditional values of quality education, the advancement of knowledge and the generation of productive scholars, and competing values of the provision of open access and equal opportunity. Perhaps its greatest challenge was to make recommendations which might improve the traditional functions of education while endorsing new purposes or goals. Maintaining this tension in balance is also a great challenge within an institution as it sets priorities and plans for the future.

A conceptual difficulty in setting priorities can be seen in the Commission report's treatment of post-secondary education as though a "system" of higher education actually exists, instead of thousands of individual institutions, each trying to do its job in terms of some traditional or newly chartered role. The Commission charges institutions to become more innovative and less discriminatory without ceasing to aspire to breakthroughs in research and greater competence in teaching. But no system responds to such exhortations. It is individual institutions which will change or resist change and, in doing so, strain their budgets and develop ambivalence about missions. Each institution must make choices; each must set priorities and plan.

Although the Commission emphasized that in a period of declining resources, the careful definition of priorities is most important, its reports offered little specific guidance on how this might be accomplished. The recommendations were general, covered much territory, and often were expressed in sweeping terms. Still, in defense of the Commission it

must be admitted that giving practical specific advice on the setting of priorities is extremely difficult. Universities are diverse; they are constituted of highly specialized professionals often having quite parochial interests; consensus achieved from within is almost impossible except on the most general terms.

Boards of trustees wish to offer leadership but few are educators and they rarely can devote sufficient time to the institution to gain an understanding of how to proceed. Both students and administrators wish to have the faculty teach more and better; this provides a common factor in defining priorities. But faculty usually derive rewards through research and publications, and identify strongly with the national concerns of their disciplines. Gaining consensus for a redefinition of priorities in favour of teaching does not readily emerge from such an environment.

During the past two decades, institutions of higher education have learned to regard growth and expansion as the status quo and they have developed rules and strategies to govern growth, and the rewards of growth are manifest. They lack the mechanisms to govern in "steady state" conditions or in contraction. The rewards for steady state or contraction management are slim; administrators receive neither fame nor satisfaction by merely maintaining a balanced budget.

Because the Carnegie Commission reports pre-date the recent sharp rise in inflation, they do not address the subject in depth. However, their recommendations that the federal government provide half the public support of higher education, and that states commit one percent of per capita income to the support of education are appropriate, if modest. They suggest that the cost per student should increase at a rate equal to the increase in the cost of living, plus the general rise in productivity of 2.5 percent. However, if inflation continues to increase the cost of living at a rate of over ten percent per annum, public support for education is unlikely to keep pace. In some states support has declined absolutely as well as in constant dollars. The Commission foresaw the need to economize and make more effective use of resources, but not to the extent which is required of higher education institutions today.

Many institutions that will remain in a steady state or will contract during coming decades, must devise constructive and non-divisive means of accommodation to these conditions otherwise, more painful means will be imposed upon them by banks, state coordinating bodies or other agencies. The literature on the subject of contraction is quite general. Since higher education has had little experience of contracting its activities, sound advice to guide the beleagured dean, planner, or president is in short supply. Now as never before, close cooperation is required of institutional planners, faculty leaders, deans and other administrators. They must generate sound data, ensure proper participation in making the necessary decisions, and implement the decisions successfully. Planning requires that the institution be able to identify the principal determinants of its future – resources, expenditures, loci of decision-making, and enrollment. Institutions not only have great difficulty predicting these elements with accuracy, they have little control over them. Patterns of federal and state funding appear to be in disarray. Some categories of expenditure are rising dramatically in cost, legitimacy and authority in campus decision-making are being challenged by internal and external interest groups. Future enrollment is uncertain. This is the atmosphere in which institutions are expected to plan. The problem is how to do it honestly and openly without generating self-fulfilling prophecies of doom, especially in situations in which only aggressive optimism and leadership can reverse impending events.

In such circumstances, planning must be conceived as a constant process. A plan, once completed, may be of limited value. Most are rendered invalid within a year of completion, as their assumptions are rendered invalid. Enrollment estimates change, new state budgets are released, and programs evolve within the institution – all changing the parameters of the plan and therefore, the value of the plan. The speed with which plans become obsolete is all the more reason to continue relentlessly the process of planning. A flexible approach is mandatory, keeping under control as many variables as possible while gaining as much latitude as possible within each variable. Both qualitative and quantitative factors must be taken into consideration.

What institutions can do

As the Commission pointed out, one of the dangers in periods of budget contraction is that the less traditional, more innovative programs will be sacrificed. Established disciplines and professions have larger interest groups, more tenured faculty, and influential national guilds to protect them. But the temptation to eliminate the newest and most vulnerable programs to balance the budget at the expense of certain advances made in the last decade must be resisted. For example, affirmative action programs will continue to be a necessity in coming years. Instruction in such small courses as the classics, ethnic programs and those of emerging social utility also must be preserved. Likewise, research must be protected. Steps should be taken to "red circle" programs to ensure that they are not cut below certain levels. The problem, of course, is how to distinguish the genuinely innovative from the spurious.

In response, the Commission suggested a number of appropriate economies. Proliferation of course offerings must be avoided; consolidation may be achieved by the gradual phasing out of low enrollment, highly specialized courses. The consolidation of departments and programs may even become necessary. Joint doctoral programs, joint appointment of faculty, the collective support of graduate students by several departments – these may become the mode, with unification of synergistic departments becoming common. (Interdisciplinary studies not only are fashionable, they may prove to be cost-effective as well.)

Two other observations may be of interest to administrators trying to balance a budget with declining resources: First, under these conditions, changes must occur in the reward structures of institutions. For example, knowing that they have an investment in future employment, faculty may accept increases in class size and teaching loads as a condition of salary increases and promotion. Reporting current revenue-producing performance in writing to each faculty member each term could be fruitful, not for purposes of regulation, but as an indication of how an individual work load (however determined) compares to the mean and to the top and bottom quartiles within a school. The younger the faculty member, the more critical the future employment situation will appear; junior faculty may show considerable interest in temporarily increasing class sizes and instructional assignments while awaiting predicted enrollment declines.

Secondly, an institution concerned with tightening its budget should establish an Office of Manpower Development and Planning. Faculty and staff planning must be geared to such questions as: Should early retirement incentive programs be developed? Which vacancies must be filled, and where might program consolidation be effective? How will (and should) faculty staffing patterns appear five years, ten years, fifteen years hence?

What skills and interests do existing faculty have that are not being fully utilized? If certain programs are eliminated, could the faculty be reassigned elsewhere within the institution? What would be the cost of offering sabbatical programs to allow faculty the opportunity to switch specialities? Informed and capable persons, including faculty, should be assigned to work with deans and other administrators to gather the information required to answer such questions. The violation of tenure commitments should be avoided; individual suffering should be minimized. With 70% to 80% of institutional budgets devoted to salaries, monitoring positions and vacancies is essential to the control of future budgets and proper allocation of resources.

Suggestions advanced by the Commission to reduce costs include encouraging the withdrawal of reluctant attenders and introducing shorter time options. However, these and other such steps, in fact, could decrease *revenues* more than expenditures. It could be argued that universities should actively encourage all persons to attend some sort of higher education, especially those adults whose tuition might be paid by government or by employing corporations. The introduction of shorter time options could lower revenues, both through losses in tuition revenues and reductions in capitation grants.

Phasing out the highest cost fields, the ones that are below a critical mass, will be one of the greatest challenges to institution planning. The development of joint programs with other institutions, particularly at the graduate level, in many specialties would permit the reassignment of existing faculty. At some institutions, recently introduced doctoral programs may have to be eliminated. Despite recent efforts to develop comprehensive programs in each and every sub-specialty of a field, there may, in many institutions be merit in providing more general education within the discipline, with emphasis on fewer sub-specialties.

The Commission's conclusion, that universities must cooperate fully with one another to use available resources more effectively has broad implications for positive action to offset declining budgets. Consortia and regional cooperatives for instructional and support services should be considered. Neighbouring institutions that can develop complementary curricular specialties should do so. This would permit the phasing out some redundant positions and allow the merger of some departments. Shared library facilities and computer hardware should become common in future decades, either through federal government support of regional centres, or through cooperative pacts among institutions.

Despite the predicted decline in the size of the college age population, in some regions the community colleges and major campuses of state universities will maintain or even increase their enrollment. The decline will be uneven. Some public institutions will find it necessary to close branch campuses and unify low enrollment programs on centrally located campuses in the more populous centres. Some smaller state owned institutions will either be phased out or changed dramatically in mission. The increased specialization of role of public institutions seems likely.

In the current period of inflation with recession, the following statement of the Carnegie Commission remains apposite; "And there will be some largely unanticipated new developments, as there have been since this Commission first began to meet in 1967. American higher education and American society are in an unusual state of flux .... This planning for the future of higher education should be on a contingent basis, subject to constant reexamination. Such planning will be more useful when based on broad considerations rather than on narrow, quantifiable factors alone. The technocratic planning analysts are bound to be proved wrong".[5]

American higher education, public and private, is too critical a national resource for state and federal government to allow it to decline. States need central planning and coordinating councils, but state support could take forms that will not unreasonably limit the autonomy of the recipient institutions. They must, of course, strive for economies of scale and the sharing of resources, but they will do so more effectively if assisted by innovative modes of federal subsidy. The process of self-examination and reflection which the Carnegie Commission reports exemplify must be continued. Perhaps some of the Commission's recommendations were unduly conservative, asking less of government and institutions than will be required of them in the near future. Still, some institutions of higher education have changed little in recent decades; to them, the reports of the Carnegie Commission must seem revolutionary.

REFERENCES

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B.L. Hansen*

THE BALANCE BETWEEN ECONOMIC EFFICIENCY AND POLITICAL RATIONALITY: A DESCRIPTION OF PLANNING FOR ONTARIO UNIVERSITIES

A reading of the literature on planning in the administrative sciences would show that there are almost as many definitions of planning as authors of the literature. Most differences between definitions are superficial, however. The main substantive difference lies in the degree to which social "good" is explicit or implicit in the planning statement. For example, one definition by a Soviet economist, C.H. Touretzki, is as follows:

> By 'Planning' we mean the fullest and most rational utilization of all work and of all material resources of the community, in the light of a scientific forecast of the trends of economic development and with strict observance of the laws of social development.[1]

Almost all definitions contain references to the future as in the very simple statement "planning is deciding in advance what is to be done."[2]

> The most commonly quoted definition of planning is that given by Yehezke Dror:
> Planning is the process of preparing a set of decisions for action in the future directed at achieving goals by optimal means.[3]

Dror analyses the seven elements of the statement: process, preparation, a set, decisions for action, in the future, achievement of goals, optimal means; and develops primary facets of planning with secondary facets as components of each primary facet. He identifies four primary facets: general environment of the planning process, the subject matter, the planning unit, and the form of the plan. Within each of these primary facets there are secondary facets, a total overall of 23. Reading through this useful listing of the elements of planning and facets of planning design reveals the importance of socio-political-ideological environmental factors, value systems, territorial feelings, organization, status of planning and the planning unit, qualifications of people, in addition to the technical elements of planning such as systems analysis, cost benefit analysis and program budgeting which make up so much of the recent literature on planning.

Some observers have raised warning signals about the preoccupation with *economic* efficiency represented by the technical elements of planning. In a landmark paper questioning this preoccupation and advocating more concern for political rationality Aaron Wildavsky notes the *political* costs of decisions, exchange costs, hostility costs and political power redistribution effects:

> The literature of economics usually treats organizations and institutions as if they were costless entities. The standard procedure is to consider rival alternatives (in consideration of price policy or other criteria), calculate the differences in cost and achievement among them, and show that one is more or less efficient than another. This typical way of thinking is sometimes mis-specified. If the costs of

*Research Director, Council of Ontario Universities. This paper is based on a speech made to the Collogue Sur La Planification Universitaire au Québec, Université Laval, 12 Juin, 1974.

> pursuing a policy are strictly economic and can be calculated directly in the market place, then the procedure should work well. (This is rarely the case.) But if the costs include getting one or another organization to change its policies or procedures, then these costs must also be taken into account. Perhaps there are legal, psychological or other impediments that make it either impossible or difficult for the required changes to be made. Or the changes may require great effort and result in incurring a variety of other costs. In considering a range of alternatives, one is measuring not only efficiency but also the cost of change.[4]

Wildavsky goes on to "emphasize that economic rationality, however laudable in its own sphere, ought not to swallow up political rationality – but will do so, if political rationality continues to lack trained and adept defenders."

In a critique which no doubt reflects a personal bias against the status to which economic rationality has been raised, Ida Hoos suggests that systems analysts interested in promotion and the quick buck have perpetuated a mythology of worth and accomplishment which disappears on close examination.[5] In the purveying of the techniques, systems analysis is made to appear as the logical saviour of our woes, a way of replacing bumbling bureaucracy with efficient management, confusion with technical precision, social disorder with neatness and order, piecemeal fragmentation with wholistic examination. She contends that the systems analysts' self bestowed, mythical and honorific endowment has served as one of the major selling points for application of systems analysis to social problems, along with hard-sell marketing of the appropriateness of space age scientific technological techniques "which have been applied so well in the management of space and defense weapons systems". She goes on to demonstrate that not only will it be difficult to transfer space and weapons systems analysis techniques successfully to the solution of other problems of society and government but they never really worked there either. She documents many examples of cost overruns, inefficiency and economic waste. It appears that the main beneficiaries of the new techniques are consultants in systems analysis and operations research, computer companies, and the technocrats in industry, government and non-profit institutions who rise with the expanding bubbles of information system and planning organizations. Dr. Hoos ends her critique with the following statement:

> Based with some degree of confidence on the empirical evidence, the rebuttal to assertions of defensive support for current systems analysis as the answer to society's problems could state the known truth that, despite the methodological, systematic and systemic pretensions of systems analysis and systems analysts, there is no single method for all problems for all people at all times. There is no cosmic scale solution. The appropriate approach is a function of the particular problem, the particular researcher, and the attendant circumstances. Each analyst must seek out, develop and apply the particular set of tools required for the task at hand. The outcome of his work will probably not be perfect, but he will not feel called upon to rationalize his results or justify his course of action through manipulation of technicalities. Amendments and improvements will occur, if ever, on the real-life scene and not on the shadow screen reflecting the playing out of a scenario. To the oft-iterated counter argument that one should not criticize systems analysis unless one can supply something better, there is an answer – competent research and experimentation, with conceptualization first, technique last, and professional judgement always.

I have dwelt at some length on the general subject of planning and the factors attendant to its most effective use because, in my opinion, whatever success the system of higher

education in Ontario has achieved (by plan, accident, or whatever) it has been achieved largely by the avoidance of doctrinaire approaches to management planning and control. The organizations, value systems, territorial feelings, and planning capabilities of universities and government cannot be ignored if results are the criteria of success. Somehow system planning for Ontario universities seems to have discovered a proper balance between economic and political rationality.

Organization of Government and the system of universities in Ontario

On May 14th, 1974 the formation was announced of a new body to advise the Government on the province's university system, the Ontario Council on University Affairs (OCUA) to replace the old Committee on University Affairs (CUA). The new body was expected to pack greater advisory clout than its predecessor.

Since its inception in the early sixties the advisory buffer body between universities and government in this province has been seen as a vital component of the system – the component that protects university autonomy while insuring system accountability. At various times the buffer body has been ignored, disregarded and bypassed, but overall its record of accomplishment probably stands up well compared to similar bodies. Four of the twelve members of the Committee on University Affairs were academics who more than made up for their minority in number by their contribution to the discussion of issues. CUA's method of operation, which will probably be followed at least temporarily by the new Council, was to review annually the present and planned activities of each university and the system of universities, evaluate them and advise the Minister of the most appropriate actions. In this advisory role the Committee was assisted by staff allocated to it by the Ministry and provided to it by the Council of Ontario Universities* through support of various joint subcommittees. It is in these joint subcommittees the real planning has taken place.

The centralization thrust in public services, which began in the late sixties, recently was given impetus by the reorganization of the Ontario government. Recommendations on government productivity, produced in a series of reports during 1972 and 1973, resulted in, among many other things, the reorganization of the Ministry of Colleges and Universities along lines which separated policy and programming from operating functions and which were aimed to provide for improved interdepartmental communications and program effectiveness.[6] The principal changes from the previous organization were: the formation of an office of policy planning; the creation of three operating divisions (university affairs, college affairs and manpower training, and cultural affairs); and the creation of a common services division. (Figure 1 shows the new organization chart.) Now major decisions in policy and planning are separated from operating decisions within the Ministry and, further, program planning Ministries have been formed for major policy fields such as social development, justice, and environment and resource development. In essence the compartmentalization of planning in one place and operating in another is supported throughout government.

Figure 2 shows the organization of the Council of Ontario Universities (COU). It has a total of forty-three committees and a span of control of forty-three. Having been a management consultant for several years my reaction to this organization chart upon

*The body which *represents* the publicly funded autonomous universities in Ontario.

FIGURE 1 MINISTRY RE-ORGANIZATION CHART

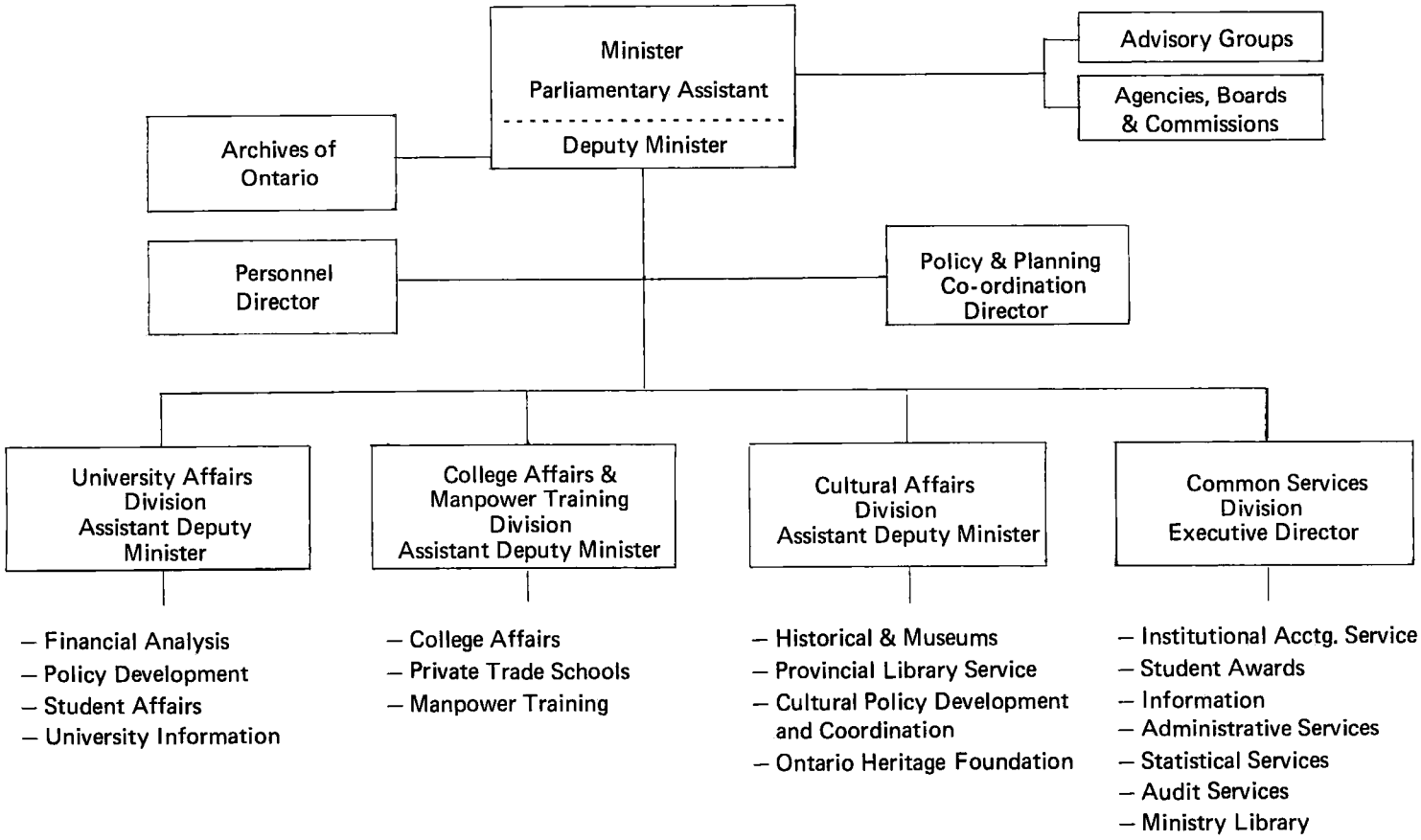
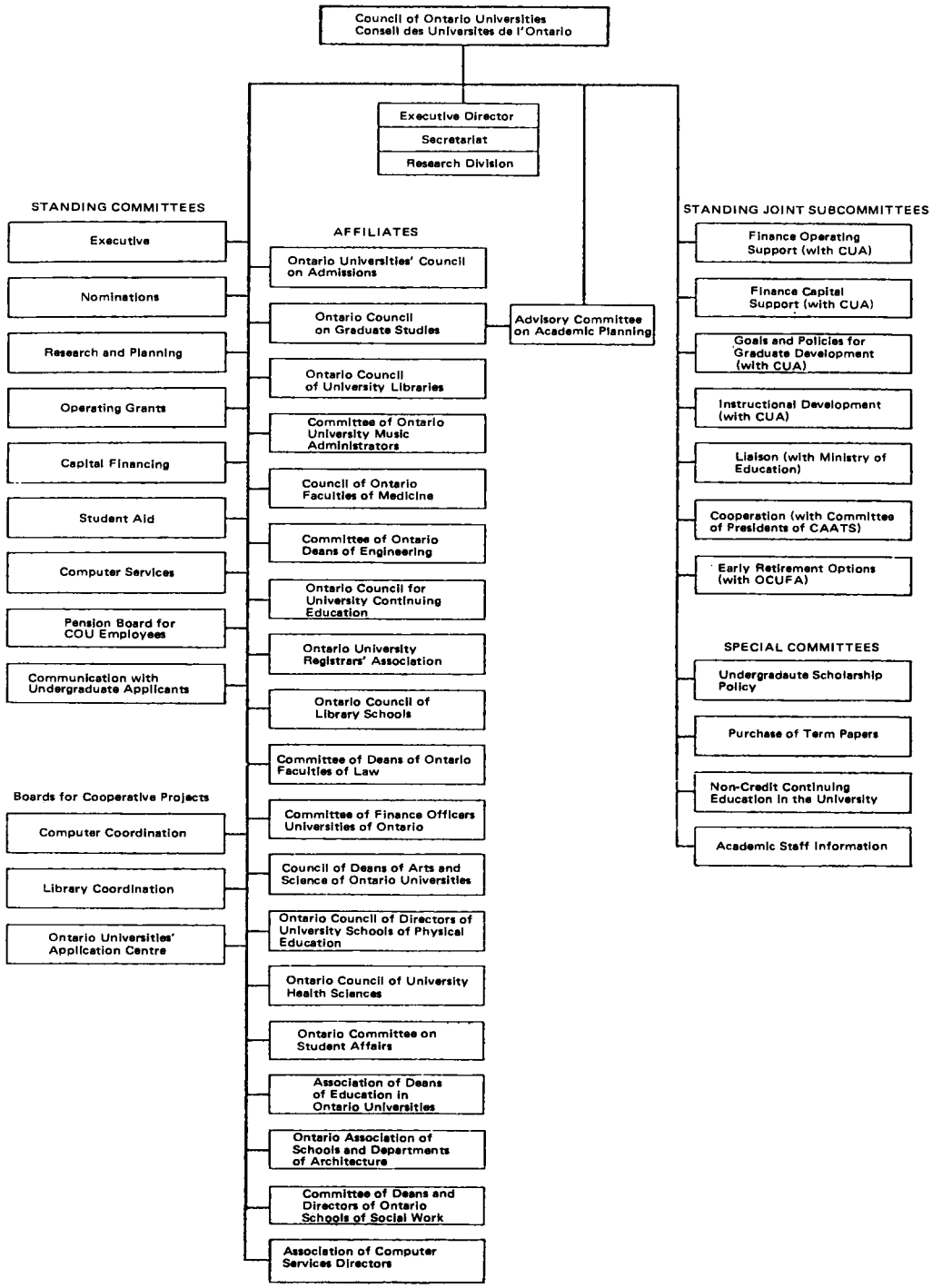


FIGURE 2 ORGANIZATION OF THE COUNCIL OF ONTARIO UNIVERSITIES AT MAY 1, 1974



seeing it for the first time would be to ask, "How do you manage with that kind of organization?" Well, of course, you don't. It is not a management organization. It is an organization for coordination, communication and facilitation. COU is a completely voluntary organization having no foundation in statutes and being held together mainly by the slender but amazingly strong thread of common interest and collective purpose.

The universities of Ontario are the vital elements in this organization. While COU has a modest administrative structure (about twenty-five full time people and a budget of just over a million dollars) the organization operates through the support of the universities – both through direct financial support and the much larger indirect support rendered by allocation of university personnel to serve on important COU committees and joint COU/CUA subcommittees.

Planning structures

It is fair to say that during the growth years of 1964-70, planning for Ontario Universities was accomplished largely through the Ontario Committee on University Affairs operating in concert with the Committee of Presidents* (later the Council of Ontario Universities), aided by the secretariat services provided by the Department of University Affairs. The Minister made the final decisions, of course, but the advice of the Chairman of CUA was very much in evidence in the decisions that were made. The main planning structures have been the Standing COU/CUA Joint Subcommittees of Finance/Operating Support, Finance/Capital Support, Goals and Policies for Graduate Development and the Advisory Committee on Academic Planning (ACAP). The joint bodies have drawn membership from their parent bodies with the members from the COU side for the first two being drawn from the COU Standing Committee on Operating Grants, Capital Financing. ACAP is a committee of the Ontario Council on Graduate Studies formed for accomplishing the special task of discipline assessment. The functioning of each of these will be discussed briefly in turn in the context of planning.

Planning of operating finance

The operating grants formula for funding Ontario universities was first applied in the 1967-68 budget year. With only a few substantive changes it has been used for allocating operating funds to Ontario universities every year since.[7]

A summary record of how Ontario's universities have fared under this formula is given in Table 1. Enrollment increased by almost 12% per year from 1967-68 to 1973-74; a doubling in seven years. Basic income units, that is weighted enrollment to determine income, increased by approximately the same amount. Basic income unit value, the measure of support for each unit, increased by an average of 5.5% each year. Basic operating income to universities thus increased by an average of about 16% per year. Grants per student increased by about 5.9% per year. Fees per student increased by about 4.6% per year with most of the increase being imposed by government during the 1972-73 year. Though privation could hardly be claimed for the Ontario government's treatment of universities during this entire period, benevolence during early years has been more than offset by financial restraints in later years. This is what is most worrying to universities now and is causing a few of those most hardpressed financially to call for *more* centralized planning and control.

*of universities.

By stretching the imagination it could be claimed that the Ontario operating grants formula was a macro-planning formula for a specific time period. It was developed to enable the Ontario university system to respond to expected growth patterns while protecting the principle of diversity and allowing individual universities to allocate as they wished, the funds provided. The formula itself is not a planning device. In fact, the formula is the antithesis of detailed planning; in the words of the *Formula Manual,* "It has never been intended as a pattern for spending." The Government has maintained financial control by controlling the total operating funds available through the amounts provided for enrollment growth and inflation, by pressures on universities to increase student fees, by selective distribution of special grants to meet special needs, by embargoes on the development of new graduate programs, and by project approval of new capital programs.

While the government has a program of multi-year planning there is little evidence that the result of this planning is more than for the one budget year in question. Given the nature of the political process and the desire of universities to retain authority over internal distribution of funds, planning cannot be anything but short term, adaptive and incremental. And despite their pleading for more lead time and more certain knowledge of operating finance levels for several years in the future, if the trade-off were more government control over the internal distribution of funds (i.e., centralized planning) most universities would opt for the short term approach.

In 1970-71 the average increase in number of basic income units (weighted enrollment) was 11.4% with a range in the fourteen provincially-assisted universities of +5% to +33%. For 1974-75 the average increase was 7.6% with a range of -4% to +11%. It is this simple fact that has intensified demands of some universities for basic changes in the operating grants formula. The universities experiencing little or no growth are bound to seek solutions which protect them against the academic and financial consequences of low, zero, or negative growth. The COU Operating Grants Committee has been working very hard to find revisions to the current formula which will be acceptable both to universities and government. Government appears to want some basic changes in the formula, mainly in the direction of relating program weights more precisely to program costs and providing for accountability to the Management Board for actual and planned expenditures. Most of the universities have learned to live with the formula, are dubious of the value of precise program costing, and do not wish to be pushed prematurely into developing and maintaining costly record keeping and reporting systems for which the prognosis of utility is not very encouraging. They would rather see formula changes which would retain the basic nature of the formula, rationalize the base of calculations in the year of change through the incorporation of one-time adjustment grants for certain institutions, provide for increasing the base according to some factor for inflation, provide some mechanism for cushioning the shock of sudden decreases in enrollment without acting as a disincentive to growth and maintenance of quality, provide additional grants for inescapable problems of small size and geography (preferably through a mini-formula), and require that any other adjustments would have to be on the advice of the Council on University Affairs.[8]

Revision of the operating grants formula and the development of indicators of accountability undoubtedly will be high on the priority list of activities of the new Ontario Council on University Affairs.

TABLE 1 ANALYSIS OF INCREASES TO OPERATING INCOME IN PROVINCIALLY ASSISTED UNIVERSITIES OF ONTARIO 1967-68 THROUGH 1974-75

	1967-68 Actual	1968-69 Actual	1969-70 Actual	1970-71 Actual	1971-72 Actual	1972-73 Actual	1973-74 (Funding based on 1972-73 enrollment)	1974-75 (Funding based on 1973-74 enrollment)
Student [1] (FTE)	80,489	97,086	112,363	126,367 [2]	135,440 [3]	142,032	155,130	168,778
	increase	16,597	15,277	14,004	9,073	6,592	13,103	13,648
	% increase	21%	16%	12%	7%	5%	9%	9%
Basic [4] Income Units	137,533	163,901	194.240	216,372	233,563	247,310	267,840	288,212
	increase	26,368	30,339	22,032	17,191	13,947	20,330	20,372
	% increase	19%	18%	11%	8%	6%	8%	8%
Units per student	1.71	1.69	1.73	1.71	1.72	1.74	1.72	1.70
Unit Value	$ 1320	$ 1450	$ 1657	$ 1650	$ 1730	$ 1765	$ 1825	$ 1955
	$ increase	130	107	93	80	35	60	130
	% increase	10%	7%	6%	5%	2%	3%	7%
Basic Operating Income	$ 182m	128	302	357	404	437	452	524m
	$ increase	56	64	55	47	33	15	72
	incr. units	35	44	34	20	25	0	37
	incr. unit value	21	20	21	17	8	15	35
	% increase	31%	27%	18%	13%	8%	3%	16%
Standard Fees [5]	$ 38m	$ 46m	$ 53m	$ 66m	$ 69m	$ 86m	$ 96m	$ 102m
	$ increase	8	7	13	3	17	10	6
	% increase	21%	15%	24%	4%	24%	11%	6%
Formula Grants	$ 144m	192	249	291	335	351	356	422
	$ increase	48	57	42	44	16	5	66
	% increase	33%	29%	16%	15%	4%	1%	18%
Bilingualism Grants	$ 1.2	1.6	1.9	1.9	2.1	2.2	2.6	2.8
	$ increase	.4	.3	0	.2	.1	.4	.2
	% increase	33%	18%	0	10%	4%	18%	7%
Emerging Grants	$ 6.8	7.8	7.8	7.2	6.4	3.6	4.4	6.2
	$ increase	1.0	0	-.6	-.8	-2.8	.8	1.8
	% increase	14%	0	-7%	-7%	-43%	22%	41%
Other Grants	$ 10m	13.6	4.3	52.9	36.5	34.2	38.0	26.4
	$ increase	3.6	-7.5	48.6	-16.4	-2.3	3.8	-11.6
	% increase	36%	-63%	1130%	-31%	-6%	11%	-30%
Total Grants	$ 162 2	215	263	353	380	391	401	457
	$ increase	53	48	90	27	11	10	56
	% increase	32%	22%	34%	7%	2%	3%	14%
Grants per Student	2,013	2,215	2,341	2,793	2,815	2,754	2,584	2,708
	$ increase	202	126	482	22	-61	-170	124
	% increase	10%	6%	19%	1%	-2%	-6%	5%
Grants per Unit	1,178	1,312	1,345	1,634	1,624	1,577	1,497	1,586
	$ increase	134	42	289	-10	-47	-80	89
	% increase	11%	3%	21%	-1%	-3%	-5%	6%

[1] Student FTE – includes students eligible under the operating grants formula. Does not include Ryerson or OISE for any year. Data obtained from COU – Committee of Finance Officers, Universities of Ontario.

[2] excluding Algoma and Nipissing

[3] excluding Hearst. 1971-72 actual for 10 month fiscal period ending April 30, 1972. Also commencing 1971-72 formula financing was applied to education programs.

[4] Basic income units – number of BIUs times unit value. 1972-73 the equivalency factor for part-time undergraduates was changed to 1:5.5. 1973-74 equivalency factor for part-time undergraduates was changed to 1:5.0.

[5] Student Fees – Fees per student assumed at a value of $472 (1967-68), $474 (1968-69), $472 (1969-70), $474 (1970-71), $484 (1971-72), $570 (1972-73), $607 (1973-74), and $607 (1974-75).

Planning for capital financing

The best way to describe capital planning at this time is to say simply that largely "the freeze continues". The freeze on capital funds was initiated as an immediate governmental response to the stabilization of university enrollment levels. It is paradoxical that excellent work on capital and physical resource planning is being done in Ontario concurrently with the imposition of a capital freeze. Moreover, the government had more persons monitoring capital construction in the year when the budget was less than $20 million than in the years when it was in excess of $110 million.

In 1967 on the advice of the Joint Capital Studies Committee, the Committee on University Affairs contracted for a study of the physical resources of Ontario universities. A consulting firm was employed at high cost to conduct a study of space inventories and utilization and to develop a data base that would aid in the establishment of an objective system for distributing capital support among the universities. The principles which, at that time, were thought important in a capital formula were: objectivity and equity, consistent standards, government control over availability of funds, and the incentive for each institution to manage its own resources.

In the fall of 1968 the Committee on University Affairs felt the need for some objective means for determining capital support pending receipt of the consultants' report. (It did not become generally available until 1973 although it had been completed in 1971-72.)[9] Accordingly, a special subcommittee of CUA was put to work to develop an interim capital formula.[10] It is based on enrollment projections with the enrollment weighted according to program. The weights run from one to four and are intended to represent the differential space requirements of programs. Weighted enrollment of the university is then multiplied by a unit factor to derive total space required. A basic allocation inventory for each university was developed from the consultants' inventory of space available as of September 1st, 1969. All capital cash flows after that date were to be determined as the difference between the total space needs according to the formula and the allocation inventory multiplied by the average unit cost of space. The formula also contained a memory feature in that capital entitlements not drawn remain available. Similarly, capital entitlements made available on the basis of projected enrollments not realized would be followed by a corresponding subsequent delay in future funding. Special needs for problems of age, cyclic renewal, etc., were to be provided for outside the formula.

The interim formula was used to determine capital entitlements until the freeze was introduced in 1972. Because it was not satisfied with the consultants' work and the direction that capital financing was taking, COU decided to initiate its own studies leading to the development of physical resource standards useful not only for government capital budgeting but also for universities' internal space planning and capital budgeting. The studies, begun in 1970, culminated in the publication in 1972, '73 and '74 of five COU reports on standards of space, space utilization, unit costs, life costs, and costs of cyclic renewal. They are published as series *Building Blocks, Background Studies on the Development of a Capital Formula for Ontario.*[11] The COU Committee on Capital Financing is continuing its work in this area through ongoing studies of the components of cyclic renewal and their annual unit costs, and the development of a reporting system for annual costs of operating and maintaining Ontario University buildings.

The capital freeze was justified by government on the grounds that while there might be cause for meeting special capital needs of certain universities, the *system* of universities

has surplus space and will have a surplus for the next few years. This judgement, of course is dependent upon the determination of appropriate unit space and cost standards and the allocations inventory. Disputes on the appropriateness of the present space and cost standards (not those of the Building Blocks series) and the accuracy of the allocations inventory have not yet been resolved. It is evident to this observer that, while the capital freeze is justified generally in the public interest, it is also being used by government as a not so subtle way of encouraging the redistribution of new enrollment to the institutions holding surplus space.

Much highly innovative and good work has been done by the COU capital task forces supported by architectural services personnel in the Ministry of Colleges and Universities. The prognosis is encouraging for the development of a capital formula that will serve universities, government and the public interest well in the future.

Planning academic programs

At this time there is much central planning of graduate programs in Ontario, a continuation of a modest beginning in the planning of professional programs and almost no central planning of undergraduate programs. The relative newness of graduate education in Canada was reported in the Sixth Annual Review of the Council of Ontario Universities.[12] For example, in 1967-68, full-time graduate enrollment in Canada was about 19,700. By 1970-71, it had become 29,000, an increase of 47%. Like other statistics for the same period, the growth was concentrated in the first two years of the period (about 19% each year) with a fall-off in Fall 1970 (to 3.7%) and no growth in Fall 1971.

Coincident with this unplanned fall-off was the imposition of a general embargo by government on formula funding of any graduate program that did not have students enrolled before May 1971. Except on special appeal, there would be no funding for a new program until a discipline planning assessment for it had been completed. The agency established to accomplish these discipline assessments under the auspices of the Ontario Council on Graduate Studies (OCGS) and the Joint Subcommittee on Graduate Goals and Policies was the Advisory Committee on Academic Planning (ACAP). A description of the activities of ACAP and procedures for disciplinary planning assessments is contained in the Sixth Annual Review of COU. Suffice to say here that intricate procedures have been established to insure that universities, discipline groups, the Ontario Council on Graduate Studies, and COU all have adequate time to review and comment on the assessment reports as they are made. Also, since only a limited number of discipline planning assessments was considered possible even over a three-year term of study, procedures had to be established for (a) identifying a priority list of disciplines for planning assessments, (b) modifying the embargo restrictions on Masters' programs for the relatively young and growing universities and (c) providing for appeals.[13]

At the time of writing planning assessments of graduate programs had been completed for Library Science (1972), Education, Economics, Geography, Chemistry, Solid Earth Science and Sociology (all in 1973); Anthropology, Political Science, Physical Education, Religious Studies, Planning and Environmental Studies, Physics and Astronomy, History, Biophysics (all in 1974).

The following are our personal impressions of the time consuming, involved process of getting a disciplinary planning assessment through all of the hurdles to the point where the embargo is lifted:

- Despite the bureaucratic mechanisms that have been set up to insure adequate review, the process in the long run will be beneficial to Ontario Universities.
- Established departments in established universities find it difficult to accept a planning assessment which reflects more favourably on a less well-established department in a less prestigious university. The net effect of this is healthy also.
- We have great difficulty in deciding what relative emphasis should be placed on (a) demand for places by students and (b) manpower demand for graduates. Some consultants used for discipline assessments have taken the manpower demand route. This was not satisfactory to the universities because of the unreliability of forecasts for future demand, and because enrollment forecasts mean numbers, numbers must be shared and once they are indicated as numbers to be planned for and shared by universities they will be interpreted by government as quotas. The last thing Ontario universities want government to do is set quotas on enrollments at each university. In general, they support the motto, "Students should vote with their feet". As a result of the great concern for this issue each assessment report features a general introduction which covers planning techniques in the context of discipline planning assessments of graduate programs in Ontario.
- It is difficult to reconcile views about minimum size for quality and the effect of scale on the economy of operation. The pure and applied sciences tend to respond positively to arguments for minimum size and scale economies and for concentrating scarce quality resources rather than spreading them out. The pure social scientists generally are not attracted to such arguments for their disciplines, favouring instead disbursing the resources so that regional, geographical, and other inadequacies may be remedied through interaction of the graduate teacher and his students, few though they may be.
- Authority and power are at issue in the planning relationships between ACAP, OCGS, COU, the discipline groups and the universities. When questions of approval, review, disposition, etc., of a discipline planning assessment are raised, the role and authority of ACAP and its relation to the other agencies is in contention. The Ontario Council on Graduate Studies is a consultative body. COU is also. By statute, universities hold the power to decide what should be taught, by whom, to whom. By its mandate, and responding to pressures from government and the buffer, ACAP treads on these traditional powers and must feel its way very carefully in getting an assessment to the stage where it will be approved by all these agencies. The meetings of COU with ACAP would be good laboratory for showing the necessity for a balance of political and economic rationality.

In the area of assessment of professional programs, the first was a study of engineering completed in December 1970.[14] This report generated a great amount of heat and debate and, while it was considered valuable in many respects, there were still enough important engineering matters at the graduate level to require a discipline planning assessment in the prescribed manner. Studies have been completed for chemical, electrical, metallurgical and materials, mechanical and industrial engineering, and systems design. The report on civil engineering is still in preparation. The planning assessment on architecture has been completed; that for administration, business and management science is still in progress; one is being considered for law.

There is no central planning of undergraduate programs. The government espouses an "open door" policy at the undergraduate level contending that this policy is one of making

sure that there will be a place in *some* undergraduate program at *some* Ontario university for the aspiring student with the necessary prerequisite qualifications. With the recent relatively low level of increase in enrollment demand this has not been a hard policy to follow overall. The problem is more one of insuring that not all student flock to one or two institutions. There are no explicit planning measures to insure this but the capital freeze previously mentioned introduces a form of negative planning. Further, it is possible to stimulate or divert enrollment growth by varying the level of student financial support for scholarship and need. The recent depression in the enrollment levels of those universities with large proportions of enrollments in arts and humanities subjects has introduced something of a scholarship war to attract larger shares of a declining pool of applicants. In response, planning is beginning to take shape in the recent discussions of a special COU committee on undergraduate scholarship awards. At this stage only macro-planning techniques are being considered but if the depression were to continue, pressures for the same kinds of planning measures being used at the graduate level would increase.

Conclusion

The ultimate test of any program, planned or otherwise, is its results. The ultimate test of a planning system, however loosely we define "planning process", is results. Results constitute more than economic efficiency, more than technical elegance. In political systems participants should experience some satisfaction either with the result itself, with their part in achieving such results as there are, or (at least) from the conviction that they have received a fair hearing.

Even such a coordinating system as described here exhibits several of the merits of system planning. The autonomy of the university has been protected but each institution has been made aware of its role in the system of higher education in Ontario and the effect on other institutions of actions which serve only their own self-interest. With the ethos of the "search for excellence", which has enabled the university world to cloak many quite selfish and short sighted policies with noble slogans, this "benefit" of a planning system should not be underestimated. Voluntary constraint and coordination is not always successful but when it fails the offending institution's action is very visible.

It is difficult to demonstrate the benefit of a planning system such as this. How does one measure the chaos, the level of duplication and over-spending which might have taken place during the period of hectic expansion? How does one measure the cut-throat competition for students which might have taken place in the few years of enrollment decline? It might be argued that the Ontario university world has not yet faced a real test period for its voluntary planning system – a long period of sustained enrollment stability with reduced real spending, or even a long period of steady absolute decline in numbers and income.

Nevertheless we would counter with the claim that the basis of institutional freedom, in a system of higher education such as ours, is awareness and responsibility. This planning cooperation and coordination accepts the premise that human organizations are not merely assemblies of sets of interests and activities but they embody value systems. Any system of decision-making and management which fails to take into account these value systems is faulty. The system we have described cannot operate without each institutional member and government being acutely aware of the values and interests of the others. They are equally made aware of their responsibility *to* the others for the effects on group decisions of their particular wishes or needs.

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THE DISTRIBUTION OF GOVERNMENT GRANTS TO UNIVERSITIES: THE ONTARIO EXPERIENCE

The level of public funding received by a university or college is determined by two decision processes: (1) the allocation of government resources to higher education as opposed to other sectors of the economy which are competing for funds, and (2) the distribution of these funds among the institutions in the system, The solution to the first problem is a function of the expressed needs of the higher education sector, the other-than-government sources of funds (such as tuition fees, gifts, and donations), the objectives of government, and its policy priorities. In the distribution among institutions, the prime considerations are their needs and a desire to treat all institutions equitably. This might be accomplished by an institutional budget review process carried out either by government or by an independent agency. Alternatively, it might be accomplished by the establishment of some standard criteria. It is the latter to which this paper is addressed. Can the allocation process be assisted by the use of a predetermined formula rather than deciding upon the distribution of funds in a discretionary manner? The experience of the Province of Ontario in distributing government operating grants to post-secondary institutions by means of a formula might be of interest to planners.

The Ontario System

The publicly-funded system of higher education in Ontario includes fifteen universities, 22 colleges of applied arts and technology, one degree granting polytechnical institute, the Ontario Institute for Studies in Education (which offers graduate degree programs in education) and the Ontario College of Art. The operating grants formula has been used as the basis for distributing funds to all but the latter, although commencing in 1975-76 the formula will be no longer used for the colleges of applied arts and technology. This article will concentrate on the formula as it has applied to universities.

There is great diversity in the fifteen universities. At one end of the scale is the University of Toronto, a multi-faculty university (over 40 faculties, schools, and institutes) with 29,000 full-time students, approximately 2,700 full-time teaching staff, a full range of professional programs and a large graudate school. At the other extreme is Trent University with one faculty (arts and science), 2,000 full-time students, a handful of graduate students, and approximately 175 full-time teaching staff. In 1974-75 the operating budget of the University of Toronto, exclusive of its two satellite campuses, was over $125 million, while that of Trent was about $7.8 million. In that year the University of Toronto received approximately 22% of provincial formula operating grants, Trent University about 1%, 4 other universities 1-2% each, 3 between 4-6%, 5 between 7-9%, and one about 11%. With such a range of institutions the problem of finding an appropriate formula for funding clearly becomes complex. The University of Toronto's dominant position

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in the system makes it essential that the distribution mechanism be geared to its needs, but every university has special problems – whether they be problems of size, age of buildings, program mix, geographical location, or faculty staffing patterns. To arrive at the common denominator by which funds (over $540 million in 1974-75) can be distributed equitably is not an easy task.

The Formula

Since 1967-68, operating grants to Ontario universities have been distributed by an enrollment-based formula. This has been modified somewhat over the years but is at present essentially the type originally conceived. It has the following format:

$$\text{Provincial Government Grants}_{U,Y} = \sum_{C} \left[\text{Full-time Equivalent Students}_{U,C,Y-1} \times \text{Program Weight}_{C,Y} \right] \times \text{Value of the Basic Income Unit}_{Y}$$

$$- \sum_{C} \left[\text{Full-time Equivalent Students}_{U,C,Y-1} \times \text{Formula Fee}_{C,Y-1} \right]$$

Where U = university Y = academic year c = program category.

The provincial grants to a university are determined by first applying a set of program weights to the previous year's student enrollment to obtain a total number of Basic Income Units (BIUs). These BIUs are multiplied by the dollar value of the BIU specified for that year to determine the Basic Operating Income. From this Basic Operating Income is deducted the total student fees for that university, based on the previous year's enrollment, to arrive at the provincial government grant to the institution. About 98% of the provincial grant is distributed by means of this formula. The remaining 2% is allocated on a discretionary basis to cover special needs deemed not to be covered under the formula weighting system. First, let us look briefly at the components of the formula:

Student Enrollment. The official student enrollment in programs which have approval for formula support, is counted on December 1 of each year (except for trimester programs). There are about 30 undergraduate and 30 graduate programs for which support is given. (No support is given to theological training, for example.) The enrollment data are subject to an official audit. The main change that has taken place in the student enrollment component since the inception of the formula is the introduction of slip-year counting. Now it is the previous year's enrollment which is used for current year funding; prior to 1973-74, it was the current year's enrollment. Since current year enrollment is not finalized until well into the fiscal year, under the current year financing system a university was not sure of its total amount of provincial grant (about 80-85% of its operating revenue) until 3 or 4 months before the end of the fiscal year. This made budgeting extremely difficult.

Weights. The weighting system is a rough measure of the relative cost of academic programs. A weight of 1.0 is given to general degree work in undergraduate arts. The other degree programs are divided into eight categories whose weights imply the relative program cost

with respect to undergraduate arts, e.g. undergraduate engineering is 2.0, law 1.5, master's level graduate programs in humanities and social sciences 3.0, master's level programs in sciences 4.0, all doctoral level programs 6.0. These weights imply no exact cost relationships, although clearly they represent some cost approximations.

Value of the Basic Income Unit. The value of the BIU is determined by government each year on the recommendation of its advisory body, after consultation with the universities. In 1974-75, the value was $1,965. The value clearly relates some estimate of the total number of students of each "value" with the total amount to be allocated to higher education. The setting of this value each year is the government's main control on the total amount of funds to be disbursed to the universities.

Tuition Fees. These are not the actual fees collected from students by each university; fee rates vary from university to university for a given program, although the range of variance in fact is not great. A standard formula fee is set for each program, e.g., undergraduate arts = $585. At one time, these formula fees corresponded to the median fee charged by all universities for the particular program, but this is no longer true. The question of the levels of formula fees is crucial to the determination of provincial government grants. Although the right to set fees has been considered to be that of the universities, recently this has been challenged. For example, the Minister of Colleges and Universities announced that universities must not raise their fees for the 1975-76 academic year.

The main reason for the introduction of formula financing was to provide an objective mechanism for determining each university's share of grants – a mechanism that would provide a basic income for universities while preserving their autonomy. It was based on the following fundamental principles: (1) it is a system for allocating grants to the universities; it does not govern the internal distribution of the funds; (2) a relatively simple pattern of weighted enrollment units is used which only roughly reflects the relative costs of instruction in different programs; (3) in being phased in, it should not produce severe distortion of the income of any institution. The formula was not intended to be a method of assuring that universities would be accountable for their expenditures. Nor was it meant to be a device by which government could "steer" funds. Both of these could be accomplished by other means. The autonomy of the universities is a key to the concept of the formula; autonomy is protected by the formula. Within its total income each institution can (and does) determine its own priorities and funding allocations.

Relationship to costs

Compared with many other funding formulae, the Ontario one is very simple indeed. Many systems in the U.S. have each university or college construct a total budget request by using a set of standard formulae for each of a number of the budget components. These formulae use unit cost data in order to derive the total needs of the university, e.g., a formula for academic salaries might be a function of the projected enrollment and the unit cost of instruction; physical plant costs might be a function of the number of square feet of different types of space and a standard cost per square foot of each type. Obviously this reliance upon unit cost data requires the constant updating of such data so that the formulae provide realistic budget figures. Cost data play only a small part in the Ontario formula. The weights applied to the enrollment in each program category are only meant to roughly reflect *relative* costs. When the weighting system was originally established, to some extent it was based on an analysis of expenditure at one university. However, it was unacceptable

to set the weights at the exact levels indicated by the study, so they were modified to reflect intuitive feelings about relative costs, and to accommodate as closely as possible the pattern of grant distribution in existence when the formula was inaugurated. Since the weights are used for allocation and not for determination of the levels of funding, there is no need to have updated cost data each year. It is only necessary periodically to assess relative costs. This eliminates much administrative work for the universities and for government.

There are other difficulties with a formula which relies upon cost data. Cost data are not real cost data; they are expenditure data. They are not a measure or standard of what it *should* cost to perform certain functions in a university, but simply a record of the amounts allocated to these functions under the individual university's priorities. They vary from institution to institution and from year to year. Attempts to derive standard funding criteria from these data would prove extremely difficult. If applied throughout the system such a "standard" might well prove restrictive. Moreover there are other technical problems involved in deriving even expenditure data by program. The number of arbitrary assumptions that must be made in order to derive expenditures on a program basis casts doubt on the value of the results. For example, the faculty salary expenditure per program will vary greatly, depending on whether faculty salaries are assumed to include payment for research time, private study, etc. and on the particular criteria for allocation to programs (contact hours, student load). Any system for deriving expenditure data by program involves the maintenance and updating of a detailed and costly information base. Because of concern for university autonomy, because of the variance among Ontario universities, and because of the technical problems involved there is unlikely to be a good data base on program expenditures in the near future. The use of the weighting system reflecting rough relative costs bypasses a lot of these problems.

There is one other obvious simplification of the cost structure assumed by the weighting system – the weight is the same for all universities regardless of institution size or degree of excess capacity. In other words, the marginal revenue gained from the addition of one engineering student is the same for the large university and the small university. The marginal revenue is also the average revenue generated by all of the engineering students. However, the marginal cost of the additional engineering student is not the same at all universities. There are economies of scale of university operation but the exact pattern of the cost function can not easily be determined.

Certain costs are fixed costs, *inter alia* parts of the central administration, the physical plant, the library system. Other costs vary with the number and type of program e.g., the high development costs of a new program, the desire of an institution to have a large representation of the more expensive (science, professional, graduate) programs. Many costs do vary with the number of students at the university, but not necessarily in direct proportion. As student population grows there is an increased demand for a larger variety of course offerings. This necessitates the addition of extra teaching faculty which in turn tends to lead to proliferation of the number of course offerings. Some academic, physical plant and administration costs may remain constant for small increases in the size of the student population. However, large increases in student enrollment necessitate jumps in these costs as new teachers are hired, new buildings are built, maintenance costs rise, and registrar's office operations expand. At first appearance, it would seem that costs as a function of student population rise in a non-linear stepped pattern. As the university

expands there will be some economies of scale as it proceeds toward the base of one of the quantum jumps in the cost function. As it expands past the size where such a step occurs on the cost curve there are counteracting diseconomies of scale whose effects would be decreased as the university grows towards the base of the next step. In Ontario variations in average cost are only taken into account for the very small universities, by means of the extra-formula grants. In general, the formula does not consider the marginal costs of adding students.

Since 1967-68 there have been changes to some formula weights, e.g., Medicine, Medical Interns, Social Work. This would indicate a sizeable divergence between the actual relative costs and the relative weights. It is interesting to note that the supporting studies to justify these weight changes used program expenditure data. When applied only to one or two programs, it is doubtful whether this approach is valid. Program expenditure data could be used to justify higher weights in a number of program categories, but since a change in any one weight affects the distribution of funds for all programs in all universities, the proper relative weight could only be adjusted on this basis by looking at expenditure data for all programs.

Overlying all discussion of the relationship of the formula to costs or expenditures is the question of what expenditures the formula revenue is expected to cover. Obviously it includes instruction-related expenditures, with limitations on the formula funds that can be used for student aid. Although not specifically stated, it must also cover expenditures related to research – not those funded out of 'sponsored research' grants, but the overhead expenditures in relation to grants and the internally funded research. It is assumed that funding of this nature is generated by the relatively high weight given to Ph.D. programs. Therefore the universities with small Ph.D. programs do not generate much revenue of this type.

Effects of an enrollment-based formula

Because the formula is based primarily on enrollment, it provides a built-in reward for growth. Not only does higher enrollment result in more grants, but if the additional enrollment is in programs where marginal revenue exceeds marginal cost, the net gain is even greater. During the first few years of formula operation, the total level of student enrollment in Ontario, as elsewhere, was increasing. Sufficient revenue was being generated by the formula that universities had few financial problems. Government applied a ceiling to the funds they would pay in any year at 1% above that implied by the enrollment projection of the universities. This was simply a mechanism to protect government in a time of large enrollment increases and current-year financing.

However, in 1972-73, the increase in enrollment growth dropped off noticeably; some universities actually experienced a decrease in enrollment. The total increase in formula grants from one year to the next depends upon two factors: the increase in enrollment and the increment in the value of the Basic Income Unit. With very small increases in total enrollment, which were not compensated by correspondingly higher BIU values, inter-university competition for students became greater. Of course, with such a wide variety some Ontario universities have definite comparative advantages over others because of size, reputation, available surplus funds, or geographical location. It was never the intention that the operating grants formula should promote competition for enrollment among the universities. But by nature of its design, coupled with the general decline in rate of

enrollment increase, that is exactly what was developing. The universities felt that this was disadvantageous to the Ontario system as a whole, and drew up guidelines for the recruitment of students aimed at curbing unfair competion.

The Commission on Post-Secondary Education in Ontario, which reported in 1971, felt that the operating grants formula had a steering effect, in that it encouraged universities to maximize their income either by accepting students into programs where marginal revenue exceeds marginal cost or by setting up new programs on the basis of the net revenue to be gained. To some extent this conclusion was based on the feeling that the relative weighting structure was not correct. It was assumed, for example, that the Ph.D. weight of 6.0 was too high. As a result universities were tempted to expand their Ph.D. programs in order to maximize their income. However, such assumptions cannot be proven. In the absence of program cost information the relative weights cannot be tested. A portion of the Ph.D. weight of 6.0 is assumed to generate revenue for research expenditures. This is not true of the undergraduate 1.0 weight. It is true that graduate enrollments and Ph.D. programs did expand rapidly during the early period of formula operation, but it is not clear that this was the direct effect of the relative weights of the formula. Graduate enrollment in other jurisdictions increased just as rapidly during this period.

Equity and extra-formula grants

How well does the formula achieve its objective of allocating funds to the universities in an equitable manner? To answer this question we must define what is meant by equity. Roughly, we take it to mean that universities should receive the same levels of government funding for performing similar activities. With the great differences in the fifteen universities with respect to size, programs, professional schools, and graduate schools, it is hard to believe that any weighted enrollment formula could be truly equitable. Moreover, in the absence of any objective measurement criteria, it would be difficult to test a formula for equity.

Nevertheless it is most important that the formula be *seen to be* equitable, that the universities accept it as applying similar rules to everyone. It meets with as much acceptance as any formula could. There have been countless complaints about specific aspects of the formula, but in general, they have centred on individual weight changes or administrative details about the counting of students or the classification of programs. The major complaint has been with the value of the BIU, which is a financing level problem rather than an equitable treatment problem. There has also been some dissatisfaction with the extra-formula grants. It is here that equity has been constantly challenged and in far greater proportion than the amount of money represented by these funds. The concern undoubtedly arises from the discretionary nature of the grants. Since 1967-68, extra-formula funds have been provided (1) to the universities that have not achieved viable enrollment levels; (2) to support major new programs; (3) to support bilingualism; and (4) for trimester operation. The total is small in comparison with the total provincial grants (a peak of $23 million in 1968-69; for 1975-76 about $10 million). However to certain institutions, particularly the smaller ones, the grants represent a major portion of the total (close to 20% in one case). Consequently for these institutions the size of their extra-formula grant is more important than the degree of equity under the formula.

Extra-formula grants for size originally were based on a formula which assumed that all small universities would grow. After attaining a level of 4,000 BIUs, they would receive

no further extra support on the basis of size. But the small universities did not grow as planned and size has remained one criterion for extra-formula grants. However, the size formula has been discarded and such grants have become discretionary.

Other claims for extra-formula grants have been put forward: e.g., the argument that there is a particular minimum average weight that must exist in the university for formula revenues to be sufficient. This implies a certain mix of program offerings. If the university offers primarily undergraduate general arts and science programs, or has a small graduate school, it is held that extra support is necessary. Claims for extra-formula funds gave also been made on the basis of geographical location – inaccessibility which makes it difficult to attract students and faculty, and which leads to higher unit operating costs. Some requests for extra funds appear to have no other basis than that the university is in financial difficulty. Grants for bilingualism (French and English) in universities have expanded since 1967-68, although only one university has attempted to assess the additional cost of bilingual operations. Not only do these extra-formula grants beg the question of equity, they also leave a great deal of uncertainty as to the direction and magnitude of the shifts in their distribution from year to year.

Planning

From a planning viewpoint, the use of a formula offers little advantage over other methods of distributing funds. In fact, when the current year enrollment was used as the funding base, the Ontario formula prohibited planning in that the revenue from government grants was unknown until half-way through the fiscal year. The total grant for the fiscal year from July 1st – June 30th was only known after December 1st. The move to the slip-year system was meant to allow for more lead time. However, it did so only marginally. Enrollment was known before the start of the fiscal year, but the fiscal year was changed to commence on May 1, and in the first year of the slip-year system the value of the BIU was not announced by government until the end of February. At this point, only two months remained before the start of the fiscal year. But even if the funding level were known earlier, there would be little planning advantage in the move to the slip-year – budgetting has been completed, much of the faculty hiring has been done, and salary negotiations are either concluded or at an advanced stage.

Flexibility of funds

Since 1967-68 many of the changes have been made in the operating funds formula in order to clarify problems of interpretation and definition, but a number have also been made in response to changes in academic programs. The growth in the number of part-time programs, the moves toward a credit system and the extension of semester systems have all required formula modifications. They are minor in the sense that they have not changed the basic formula, but they have changed the administrative arrangements within the formula. For purposes of the formula, part-time student courses are converted into full-time equivalents. Previously this was done by dividing the courses by a factor of 6.0. With the growth in importance of part-time students, it was agreed that the factor should be reduced to 5.0 to put it more in line with the reality that part-time studies were leading to a degree and were not simply being taken as isolated courses. A number of universities have been accepting new entrants in January in addition to the traditional September registration date. With enumeration of students as of December, no provision existed in

the formula for including the January entrants for funding. To take care of this a trimester counting system has been proposed, which would include new entrants as well as eliminate dropouts.

Recently the University of Toronto reorganized its undergraduate curriculum in arts and science so tht there is no distinction between an arts or a science program. Students may freely choose combinations of arts and science subjects to make up a degree program. Because of the impossibility of dividing these students for counting and weighting, a new weight of 1.2 was adopted (later changed to 1.24). This was estimated to be an average weight for the students in that program.

The elementary teacher education programs which were formerly offered in Ontario teachers' colleges have been integrated into the university system. To incorporate them into the formula required a special study to develop appropriate weights and to agree upon phasing.

To discourage universities from permitting graduate students to prolong their studies, a maximum entitlement and a minimum entitlement for graduate students were established in terms of BIUs. No matter how long a student takes to obtain his graduate degree, he can only earn a maximum amount of income for his university. If he proceeds to his degree more quickly than average, his university still receives the minimum entitlement.

As a result of all of these changes there has been a loss of simplification in the formula. It is now necessary to have a manual of rules and regulations concerning its operation. The administrative load on universities and government to classify students, keep an updated information system, and have its data audited is immense. Further changes should be avoided. A simplified formula gives an allocation no less equitable than one which has such heavy administrative requirements. The Ontario operating grants formula has now lost one of its very attractive features – simplicity.

If from this discussion it would appear that the operating grants formula has remained flexible, adapting quickly to, and solving, financing problems (at least to the satisfaction of the majority) this is misleading. The changes were *ad hoc,* of an administrative nature, taken within the context of the formula. It has not changed to meet the two main trends which have caused funding problems during this period: (1) the reduction in enrollment increases to the point where moderate growth or steady state situations predominate; and (2) the constraints on government funds available for universities. Nor have there been changes which would align the formula weights with costs or expenditures.

And this is no accident. This is a *distribution* formula – any change which would increase the proportion of funds going to one university must necessarily decrease the grants to one or more other institution. Most of the alternatives which have been considered would help some institutions at the expense of others. Therefore, it is very difficult to obtain consensus on change. This may seem like a short-run view by those universities which will lose under a formula change, but the resistance is much greater than that. Even those universities which stand to gain by a formula change, in most cases would prefer to maintain the *status quo* because of the unknown problems associated with any new formula. Since the existing formula has been the basis for funding for 9 years and has been apparently equitable (or there have been sufficient *ad hoc* corrective mechanisms), the move to a new formula which might appear attractive would be rejected by the university system, because it is not clear what would be its implications after the first year of operation. The existing

formula, therefore, is in a peculiar position – it is subjected to criticism for various reasons and from all sides, but at the same time has become almost "sacred" and is protected against any substantive modification.

Ontario's experience offers proof of the strength of the *status quo.* Two major reviews of the formula have been undertaken within the past four years. The first was initiated in June 1971 at the request of the then Minister of Colleges and Universities, by a joint committee of the Council of Ontario Universities and the government's advisory committee, the Council on University.Affairs. The aim was to examine a number of factors contributing to unit costs, define the problems of the formula, and propose methods for incorporating solutions to these problems. Meetings with universities revealed the feeling that although there are a number of problems and probably there was room for improvement, the onus to propose changes is on those requesting change. They must prove that real improvement in distribution will result. There was consensus that inequities were an unavoidable feature of any formula, but that no gross inequity existed. No desire was expressed to continue with a full-scale review despite problems such as the relations of weights to costs, and the role of extra-formula funds. In particular, there was resistance to any examination of costs or expenditures.

Another review of the formula was undertaken in the last half of 1973, primarily to look at what were identified as three major problems:

- the substantial reduction in the rate of enrollment increase in total leading to little or no increases in some universities;
- the absence of objective criteria for determining adjustment for young universities of small size (which may also have problems of geographical location);
- the financial implications of an enrollment mix between undergraduate, graduate and professional.

After six months study a modified formula was proposed. It had three components: base income 1973-74, an inflation factor, and a growth factor. Base income would be modified, in some cases, by one-time formula adjustment grants determined by a mini-formula incorporating size and mix of program factors. Inflation would be accommodated by a simplification of the weighting system and the establishment of a minimum income level to provide protection against enrollment decline. Some aspects of the proposal were approved by some universities, but it did not receive the recommendation of the Council on University Affairs (on the grounds that enrollment data for the following year did not support the recommendation). But the real reason for its rejection was concern about recommending changes whose effects over the next few years could not be predicted. It was much easier to rely on the old formula.

Consequently, the problems persist and in some cases are more critical. The reliance on an enrollment base requires the universities to increase in size in order to survive. The problems of small universities and the need to provide objectively for size, program mix and geography still remain. The acquisition of operating funds for research still relies heavily on the Ph.D. weighting, which encourages large universities to further expand their graduate programs and prohibits those with small graduate programs from acquiring research funds. The ever-increasing portion of revenues directed to pay faculty salaries and the initial moves toward faculty collective bargaining may prompt a reassessment of the formula. From the government's viewpoint, the concern seems to be to relate the formula

more closely to costs i.e., so that the marginal revenue of an additional student is closer to the marginal cost of that student.

Alternatives

We do not intend to propose new alternatives here, but rather to outline some known alternatives that might usefully be considered. First, it is unanimously agreed that some set of formula is preferable to no formula. To avoid the problems associated with complete reliance on enrollment levels, it might be advisable to have a multi-factor formula. For example, the level of government grants to a university could be some function of the number of teaching faculty, the number and type of instructional programs and the enrollment levels in the programs. Such a formula could also incorporate a fixed component. This type of formula does not necessarily imply a change in the relative autonomy of the universities, although it does require the collection of more data. Its chief advantage would be to lessen the effects of fluctuating enrollment on revenue.

A more equitable method for the provision of research funds might be accomplished through the addition of a specific factor to the type of formula discussed above. Or an alternative would be to separate instruction and research, with a separate funding formula for each. Under such a system the smaller universities might obtain a larger share of the available research dollars. The main difficulty with this suggestion is the definitional one – how to split between instructional and research activities. And in the universities there is apprehension that such an approach would permit greater government control over each area.

Dr. J.B. Macdonald[1] has proposed one type of separate research formula. He suggests that the basic cost covered in a research formula would be faculty time. He defines a research income unit (RIU) as the unit to represent the faculty time cost, and proposes that one research income unit entitlement (and the corresponding dollars) be granted from provincial funds for a given number of dollars of sponsored research income received by the university. The RIU entitlement would vary depending on the discipline, thereby reflecting the relative costs of performing research in different disciplines.

Relating the formula more closely to costs or expenditures is difficult. Proponents of such a move suggest the replacement of the formula by a set of formulae each covering a budgetary component: e.g. academic salaries, physical plant expenditure, library expenditure. This is thetype of approach used in many American jurisdictions.[2] It is not at all clear that the additional work involved will in fact result in a more equitable grant distribution. The cost and problems of dealing with the quantities of data needed for such a system seem unnecessary. A broader approach toward the problem of relating grants more closely to costs would be to develop a formula which ties together the marginal revenue and marginal cost of additional enrollment. This would undoubtedly involve paying less for additional BIUs than is presently the case.

The special needs of the smaller universities could be incorporated into a formula in a number of ways. This would require study of the diseconomies of small-size operations and limited program offerings. But such a study must be undertaken in order to quell complaints about the inequity of extra-formula grants.

Conclusion

The Ontario operating grants formula may be said to have been reasonably successful in distributing provincial government grants among the fifteen universities in a manner seen to be equitable. In the last few years, it has lost its simplicity and has failed to deal satisfactorily with certain key problems, with the result that these are being resolved in discretionary fashion outside of the formula and there is growing complaint from the institutions which lose by this development. A number of alternatives might be tried which would improve this situation. For this to occur all parties will have to move away from the reverence in which they view the present system. There must be a real willingness to face problems rather than continue lamely to protect the *status quo.*

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Eliot C. Higbee*

UNIVERSITY MANPOWER PLANNING FROM AN INSTITUTIONAL PERSPECTIVE

The problems of manpower planning in post-secondary education have been, and continue to be, bombarded by a broad spectrum of analytical, policy, and procedural "solutions". This article describes the way in which they have been addressed at McMaster University. The very use of the term problem itself indicates a predisposition to conceptualize the issue in certain ways. One school of management theorists dislikes the term and would prefer to speak of staff planning opportunities.[1] Indeed, a case might be made that education leaders and administrators, both within institutions and in external agencies, should view the institutional roles of instruction, research, and service (and all the extensions of these roles) as opportunities to provide service to humanity. However, a goal-oriented atmosphere does not exist in most North American post-secondary education institutions.

Several years ago, Clark Kerr defined the multiversity as a group of independent entrepreneurs held together by a common concern over parking.[2] Since then, the institutional essence has not tended toward a cohesive, purposeful whole; multiversities have drifted even further into a condition of anarchy. They have become multiadversities. Each constituency – administrators, faculty, non-academic staff, blue-collar trades, students, and external pressure groups – has become organized, more cohesive with respect to certain issues, and hardened its position. Faculty and students want smaller classes. Faculty want higher salaries and fewer assigned responsibilities. Students want faculty to teach more effectively, to be more readily available. They also want lower fees and higher student aid. Government funding agencies want more productive output (more students graduated, more research completed) for less resource input. Community pressure groups want less bureaucratic encroachment. Harried administrators simply want peace.

In the midst of this potpourri of adversity, the work of instruction, research, and service continues. At times observers wonder how. After analyzing the political arena in the university, McGeorge Bundy reaffirmed the axiom that, in spite of all the apparent chaos, the faculty still are in charge, providing the measure of stability required to keep the enterprise afloat.[3] But many critics challenge that axiom. Students counter with the truism that if there were no students, there would be no university. It is not quite a complete truism because there are certain research endeavours – e.g. research on heart disease involving animals and patients – which would continue just as well without students. In addition to the challenge of students, secretaries and janitors assert their indispensability. But a student on one end of a log and a secretary or janitor on the other does not constitute a university. Faculty are at least the *sine qua non* of the university.

In many universities, even those drawing a large portion of their annual budget from sponsored research, the salaries and benefits of faculty comprise 40% - 50% of expenditure, the largest single component of the budget. As a group and as individuals, the faculty are

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the highest paid, most articulate proponents for (and critics of) the university. They are the constituency with the greatest stake in the institution. Thus, manpower planning in the institution must begin with them. And in spite of the management theorists, this poses a significant planning problem. How does a large, complex research-oriented university plan for, acquire, maintain, control and support a vital productive faculty during an era of limited growth, in the face of economic pressures and a minefield of adversary relationships? In this article we present tools and techniques for addressing some aspects of this question. We shall employ Ackoff's definitions of, and distinctions among, the terms, tools, techniques and methods.[4] As a case example we shall describe the experience of McMaster University, which is a medium-sized, complex, research-oriented university not atypical of many universities in North America. It has 11,000 full-time-equivalent (FTE) students, approximately 900 FTE faculty, a medical school, and a $50 million operating budget, 20% of it in sponsored research.

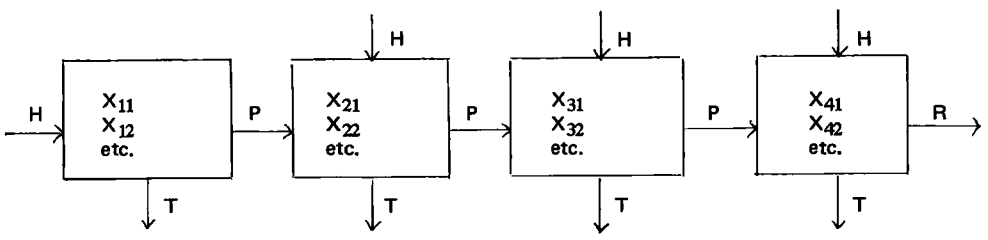
Models for academic staff planning

As mentioned earlier, faculty payroll is the largest single component of university expenditure. Beyond that, faculty activity is the driving variable at the academic unit level – department, research centre, faculty, and school. The activities of all other staff – support personnel, technicians, graduate teaching assistants (T.A.s), etc. – are directly dependent upon faculty activity. Therefore, manpower planning for an institution must begin with them. Staff planning in an institution which has a number of relevant exogenous, state, and endogenous variables, all of them inter-correlated, requires a conceptual model and a means of "massaging" that model. The wide recognition of this may be seen by the almost simultaneous development of academic staff flow models across North America. These models are an integral part of such systems-wide and individual institutional planning models as the Campus VIII, Campus Colorado, RRPM 1.6, and the University of California cost simulation model.[5]

Flow Models

The basic structures of these models are similar; each involves a description of the faculty flow process. Their structures proceed from the traditional appointment-promotion (including tenure) -resignation-retirement process which has remained quite stable in our universities since the early 1900s.

This process can be conceptualized as follows:

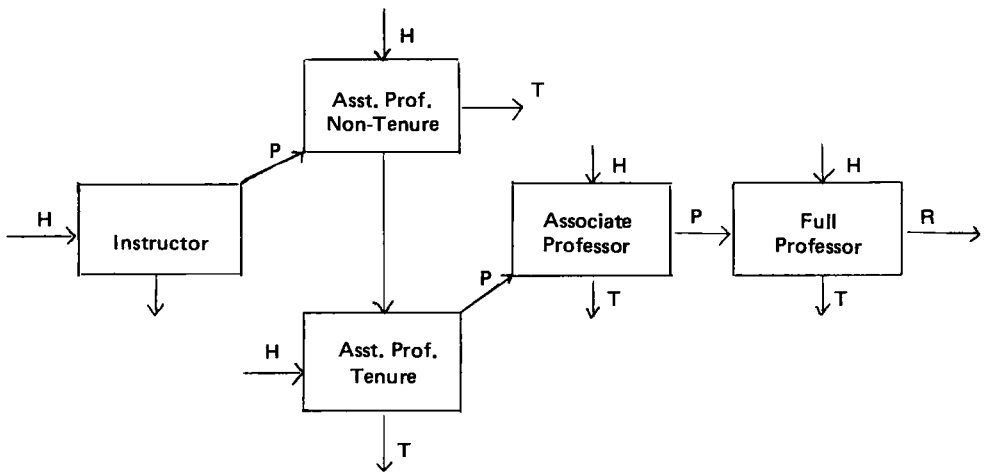


where:
(1) X_1, X_2, X_3, and X_4 represent the four major academic ranks in North American

academe: instructor, assistant professor, associate professor, and full professor.
(2) The column subscripts – i.e., the second subscript on each variable – represent the appointment status (e.g. contractually-limited, non-tenure, tenure) within each major rank. Additional gradations within a rank – e.g. the steps used in the California universities – can be accommodated by adding a third subscript. Age distributions can be constructed for each specific group in a rank.
(3) H represents new hirings to a rank.
(4) T represents terminations due to resignation or death.
(5) P represents promotion between ranks.
(6) R represents retirement.

Theoretically, retirement could occur at any rank, but common practice involves promoting prior to retirement in order to optimize the faculty member's pension benefits, even if scholarship considerations did not warrant earlier promotion.

At McMaster, this conceptual model was made analytically tractable by including only those ranks and rank statuses in common use in the institution. The resulting model was as follows:



A review, by department, of the tenure status of academic staff revealed the following:
(1) The granting of tenure is quite mechanical, based entirely on academic criteria. Therefore, in terms of a staff planning model, it is simply a state variable.
(2) At the time of the analysis, the proportion of faculty holding tenure appointments was so high that even if it were treated as a control variable, it could produce no significant control effect on the faculty flow process. Therefore, considerations of tenure were deleted from the analysis and the model was structured as follows:

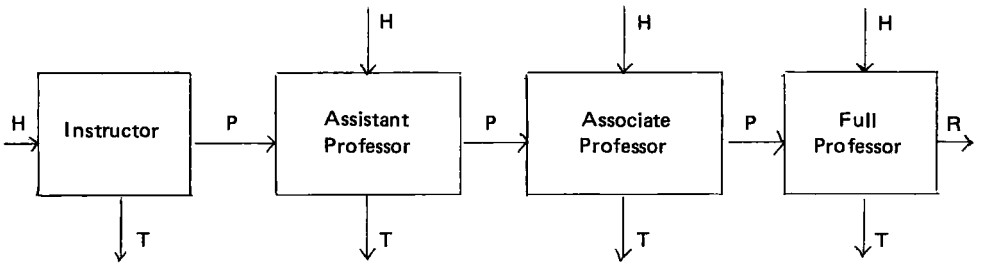
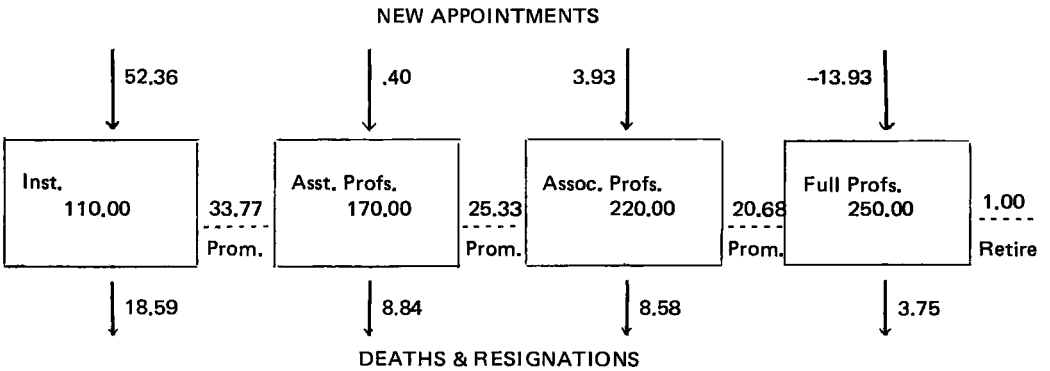


Table I depicts data for the model for a given year. This model formed the basis for a number of analyses and more comprehensive planning and budgeting models within the university. Several of these applications are presented here.

TABLE I FACULTY FLOW IN STEADY STATE



RESIGNATION & DEATH RATES		PROMOTION RATES		AVERAGE SERVICE LIVES	
Inst.	.169	Inst.	.307	Inst.	2.100 years
Asst. Profs.	.052	Asst. Profs.	.149	Asst. Profs.	4.975 years
Assoc. Profs.	.039	Assoc. Profs.	.094	Assoc. Profs.	7.518 years
Full Profs.	.015	Full Profs.	.012	Full Profs.	37.037 years
			(retirement rate)		

NEW FACULTY ENTERING THE SYSTEM EVERY YEAR
(OR FACULTY LEAVING THE SYSTEM EVERY YEAR) 42.76

TOTAL FACULTY IN THE SYSTEM 750.00

FACULTY DISTRIBUTION

Inst.	14.66%
Asst. Profs.	22.66%
Assoc. Profs.	29.33%
Full Profs.	33.33%

Demand models

Many institutions have some form of formula for determining the number of academic staff required by an academic unit – department, college, school, etc. These can be divided into two types: student/faculty ratios and work load formulae. The first consists either of simple ratios (e.g. the ratio of the total number of FTE students to the number of FTE faculty) or more sophisticated ones containing weighting coefficients for various types of students. The second type usually incorporates variables related to class size, teaching load, class contact hours per week, numbers of students enrolled in courses, etc. Institutions and external funding agencies apply such formulae with varying degrees of rigour and precision. The level of academic unit to which they are applied also varies.

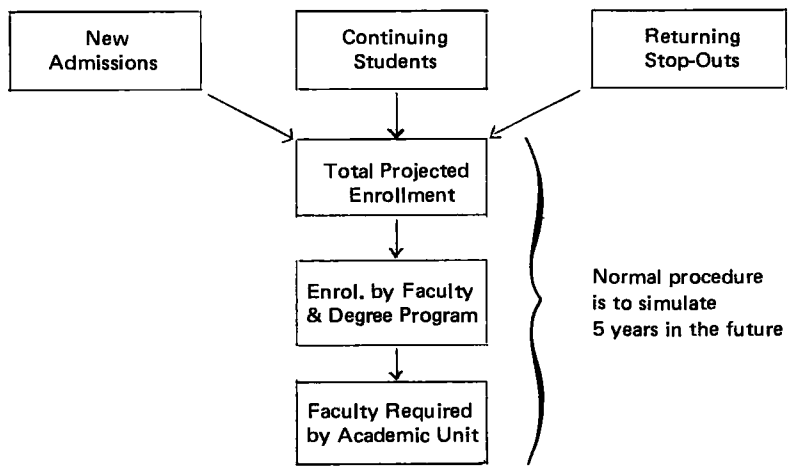
At McMaster during the past four years, a weighted student/faculty formula has been used as a flexible guideline for staffing at the faculty level. Faculties usually include between five and ten departments. The formula has the following form:

$$\text{Staff} = \frac{\text{Undergrad. Studs.}}{X_1} + \frac{\text{Masters Studs.}^*}{X_2} + \frac{\text{Ph.D. Studs.}}{X_3} + \frac{\text{MBA Studs.}^{**}}{X_4}$$

The present value of X_1, X_2, X_3, X_4 are 21, 10, 6, and 14 respectively. All students are defined as FTE based on a department's contribution to the teaching and advising of students. That is, an FTE student at the undergraduate level is defined on the basis of an induced course load matrix (ICLM).[6] At the graduate level an FTE student is defined either on the basis of an ICLM (on the portion of his program which is course based) or on the basis of supervision given for project and thesis work.

The power of this relatively simple formula (a tool in Ackoff's terminology) does not lie merely in using it to calculate the number of faculty an academic unit should have, based on its current instructional activity. Its power lies in its incorporation into a dynamic faculty-demand simulation. This may be depicted as follows:

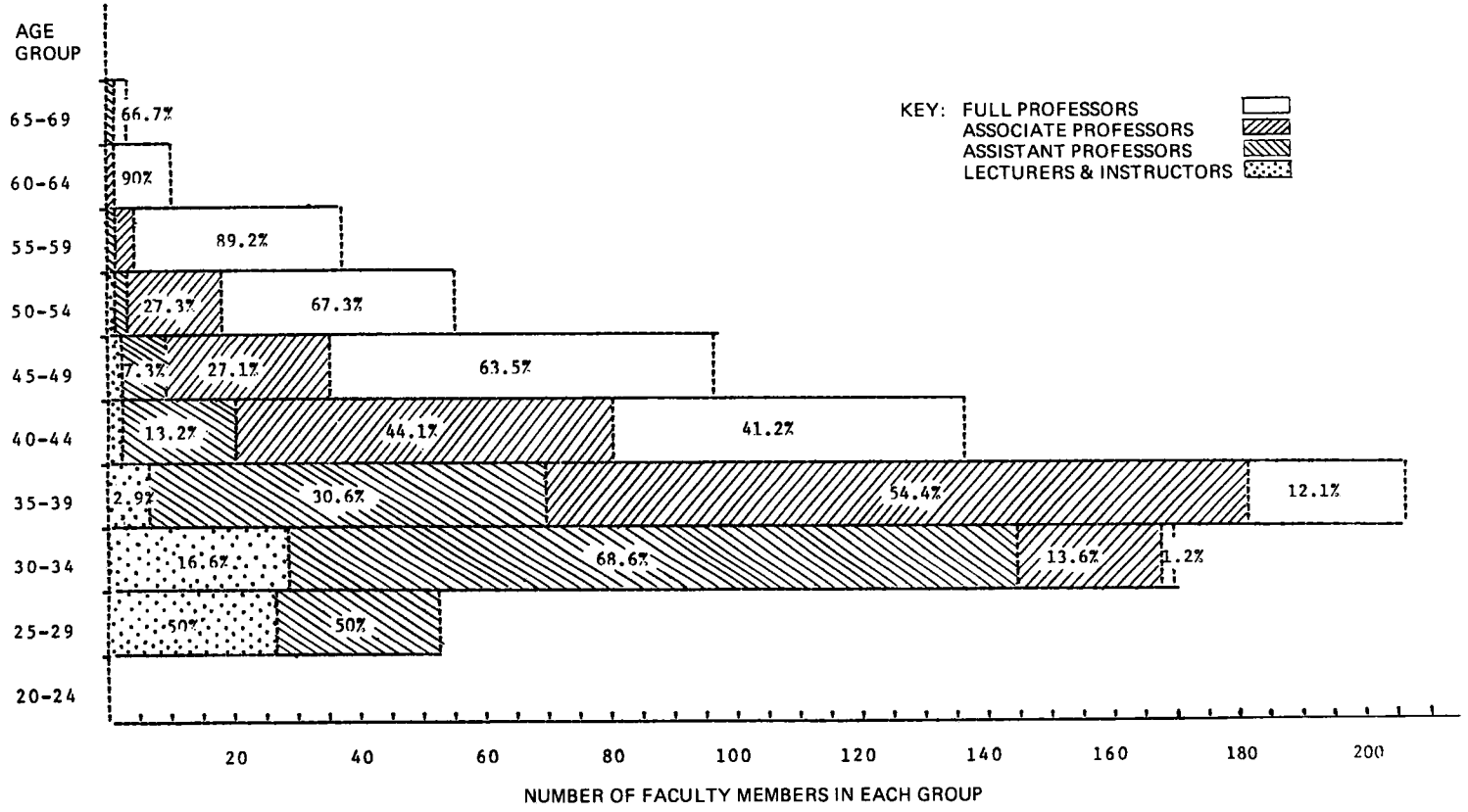
FACULTY DEMAND MODEL



*Masters students in all non-professional programs.
**Masters students in professional programs, currently defined to include Masters of Business Administration only.

TABLE 2

FACULTY AGE DISTRIBUTION
McMASTER UNIVERSITY
1973-74



Enrolment projections are based on a broad range of analyses which include demographic forecasts, consideration of socio-economic factors, enrollment constraints at other Ontario universities, etc. Given year-by-year projections of FTE students, the number of faculty required by an academic unit is estimated using the faculty entitlement formula described above. Once the faculty demand has been estimated, it can be compared to supply based on a simulation utilizing the faculty flow model described above.

That simulation is conducted in the following manner:
(1) An age rank distribution (see Table 2 for a typical example) is constructed by extracting current data from the university staff records.
(2) Values are specified for the state and control variables in the faculty flow model. Simulations are normally run based on current data for the state variables (e.g. counts of faculty by age and rank) and on both current data and alternative assumptions for control variables.
(3) The estimates of faculty supply over a five-year period are compared to the estimates of demand provided through the enrolment projection – faculty entitlement technique.

This technique not only provides the deans and vice-presidents with an estimate of the future demand for new faculty (faculty hiring requirements), it also demonstrates the sensitivity of these estimates to varying assumptions about control variables – e.g. turnover rates, promotion rates, etc. This latter feature is extremely important because the opportunities for control in the area of academic staff are tightly constrained by several significant factors, among them:
(1) University finances and market conditions which sharply affect a university's ability to compete for new faculty.
(2) Promotion rates which are fairly inelastic in the short run.
(3) Turnover rates which are strongly influenced by conditions outside the institution.

In an earlier work dealing with the issue of faculty flow at the University of California at Berkeley, Oliver summarized the constraints on control variables in the faculty flow process as follows: "Conservation requirements that must hold for appointment, promotion and attrition of faculty and quota restrictions on the total number of faculty severely restrict the choice of independent variables".[7]

Early retirement model

In their desire to explore ways of extending control over faculty flow, several universities have studied the issue of early retirement.

Following Hopkins' analysis of the potential of an early retirement plan at Stanford[8], a similar analysis was undertaken for McMaster.[9] It took the form of simulations based on the faculty flow model described earlier. The range of simulations incorporated various assumptions about persons opting for early retirement (the plan was assumed to be voluntary), future salary escalations and turnover rates, and the number of faculty who would be replaced during a given time period.

The results supported the findings of the Stanford Study and the Beloit College Study,[10] specifically:

(1) In certain situations early retirement can extend significantly an institution's control over faculty flow, by opening a substantial number of new positions.

(2) A lowering of retirement age expands control over faculty flow only during the time

required for the system to adjust from one closed dynamic state to another, often about five years.

(3) Changing student demand patterns often tend to lessen the benefits derived from early retirement.

(4) Obviously, the greater the number of faculty made eligible for retirement by lowering the retirement age, the greater the resulting control over faculty flow through increased new appointments.

(5) Inflation at current levels sharply reduces faculty members' inclinations to opt for early retirement.

(6) The greatest benefit, in the form of additional control over faculty flow, can be obtained from a flexible early retirement plan, one in which the university can *selectively* encourage faculty to retire early.

At McMaster, the issue of early retirement is under discussion, no plan has been adopted. The report OIR-28 describes in more detail the studies undertaken to date.

Models for non-academic staff planning

At McMaster the term, non-academic staff, is used to denote all employees who do not hold faculty rank as conferred by the university Senate. By definition, the non-academic staff category is large and includes a wide range of job classifications, from accountants and audio-visual specialists to welders and yardmen.

At the beginning of this paper we described faculty activity as the driving variable at the level of the academic unit. At this level, the activity of non-academic staff is directly dependent upon that of faculty. Such staff, at that unit level, includes secretaries, technicians, teaching assistants and such professional-management staff as administrative coordinators. Their collective payroll represents the second-largest chunk of the budget of the academic unit, therefore financial considerations suggest that manpower planning for non-academic staff be treated almost as rigorously as that for academic staff. However, since their activity is tied so closely to that of academic staff, logic suggests tying planning for them closely to planning for faculty. Several universities have incorporated planning for non-academic staff into the overall model used for academic staff.[11] This procedure can be represented as follows:

$$\text{Total Staff} = \sum_{i=1}^{N} X_i + \sum_{i=1}^{N} \sum_{j=1}^{M} Y_{ij}$$

Where X_i = the number of academic staff required in the i-th academic department, determined by the academic staff demand model

N = the number of academic departments

Y_{ij} = the number of support staff of type j required in the i-th academic department

M = the number of types of support staff

Academic staff requirements are determined as we have already described. Non-academic

staff can be treated by assigning coefficients for each separate category (e.g. secretaries, technicians, etc. for every so many faculty), or by an analysis of the fixed and variable demand for each type of non-academic staff. The model could also be further disaggregated to accommodate academic staff at each rank.

At times, analysts are prone to violate Paretto's principle. That is, they try to get the last drop of benefit out of a situation by applying a torrent of analysis. At McMaster, we tried to avoid that error; simple ratios were adopted. The specific groupings of non-academic staff to be tied to academic staff and the co-efficients to be used are presently under review in conjunction with the university's budgeting process. The development of an overall model to support this process is discussed in the following section.

Staff planning models and the university budget

The format of program classification structure (PCS) which has been developed by the National Centre for Higher Education Management Systems (NCHEMS) at the Western Interstate Commission for Higher Education (WICHE) is clearly a serious effort.[12] The PCS captures the functional and programatic essence of university operation. The earlier work at the University of California had paved the way for the PCS and subsequent studies have attested to its general applicability.[13]

The PCS has two main divisions: primary programs and support programs. The former are instruction, research, and service. The latter include academic support, student service, instructional support, and independent operations. This structure provides a logical base for developing an integrated staff-planning, long-range budgeting model. Obviously in the short run, universities employ a number of budgeting tools and techniques (e.g., periodic cash flow analysis, freezes or expenditure streaming, zero-based reviews, micro simulations). However, in the long run – since lead time for developing, altering, or curtailing primary university programs is quite long (up to 10 years) – a relatively stable, long-range, staff-planning-budgeting model is essential.

Such a tool does not have to be *completely* programatic in structure. That is, it does not have to be a program budget built upon the PCS. But it must incorporate program considerations if it is to provide stability at the program level. The faculty flow, faculty demand, and non-academic staff planning models discussed earlier are tied to programatic bases – e.g. research activity, student demand for programs, etc. Integrating these models into an overall university budgeting model that includes all non-academic staff and other operating resources can provide the basis for planning that will facilitate the operational stability required for the university to function effectively.

The model

The following model is intended to be utilized in a long-range, staff planning-budgeting mode. It incorporates features of the academic and non-academic staff planning models described earlier.

$$\text{Total Univ. Budget} = S_f \sum_{i=1}^{N} X_i + \sum_{i=1}^{N} \sum_{j=1}^{M} S_j Y_{ij} + \sum_{i=1}^{N} Z_i$$

$$+ \sum_{k=1}^{P} \sum_{\ell-1}^{Q} S_\ell A_{k\ell} + \sum_{k=1}^{P} B_k$$

where:

- X_i = the number of academic staff required in the i-th academic department
- N = the number of academic departments
- S_f = average faculty compensation, including fringe benefits
- Y_{ij} = the number of support staff of type j required in the i-th academic department
- M = the number of types of support staff in academic departments
- S_j = average support staff compensation for the j-th type of support staff
- Z_i = the cost of supplies and other expenses in the i-th academic department
- P = the number of university support departments
- $A_{k\ell}$ = the number of support staff of type ℓ in the k-th department (non-academic university support department)
- S_ℓ = average salary of support staff of type ℓ
- Q = the number of types of support staff in non-academic university support staff departments
- B_k = the cost of supplies and other items in the k-th department (non-academic support department)

The model can be utilized in the form of a dynamic simulation over a reasonable planning period, say five years.

It should be noted that this deals only with university operating budgets. The model could be further disaggregated to treat areas of interest that are significant enough to warrant closer study – e.g. energy costs (oil, electricity, etc.), during a period of rapid inflation. Inputs and outputs to the model can be summarized and arranged in a variety of formats. For example, one particularly useful summary from the point of view of the vice-president or president is as follows:

						FTE Support Staff			
Acad. Unit	FTE UG.	FTE Grads.	FTE Fac.,	Avg. Fac. Salary	Secs	Avg. Salary	T.A.s	Avg. Salary	...Other Unit Expenses
1									
2									
3									
.									
.									

Implementation of the model

Successful implementation of a long range planning model such as this requires at least four conditions internal to the institution:

(1) adequate computer hardware
(2) competent analysts
(3) relatively complete data bases
(4) top management support and conceptual understanding

These factors are listed in order of their frequency of occurrence in North American universities. Adequate computer hardware is everywhere. But rare is the institution that has a president both committed to, and having an understanding of, long-range planning models. When such commitment is present it usually has been the result of external prodding.

A second set of conditions, external to the institution, is also required for effective implementation:

(1) Demands for education, research, and service must be fairly predictable.
(2) External funding arrangements must have a measure of stability.
(3) The trends of economic factors must be discernable.

Given these conditions, the model can provide the user with valuable insights into the institution's future. Strategic and tactical plans can be developed that will improve the use of resources and eliminate some of the day-to-day operational problems which beset university administrators. Unfortunately, many university administrators are so beleaguered by the problems outlined at the beginning of this paper, they cannot remove themselves to an objective distance from the fire-fighting issues of the day sufficiently to derive benefit from a model of this type.

In our introduction we alluded to some of the pressures against planning in our universities. In order to complete the perspective of manpower planning in an institutional context, several other pressures and issues should be mentioned. They can be divided into current and future issues.

The current pressures

Beginning in the late 1960s in the United States, and about three years later in Canada, the decade of higher education glory began to fade quickly. Nearly every major study of higher education published in the past several years has described this with agonizing repetition. The events proceeding from this transition period that directly affect university manpower planning and the related issue of long-range budgeting are less spectacular than the riots at Berkeley, but more pervasive in their inference. Six are briefly mentioned here:

The first seems hardly relevant but it actually is most important. It is the changing concept of the academic dogma. In an insightful and somewhat caustic analysis, Robert Nisbet described its demise.[14] For him, the historical academic dogma was the concept of scholarship for its own sake and teaching to promulgate the results of scholarship. It was a pure, unencumbered intellectual art form. In a recent seminar on university financing, a member of the McMaster faculty summarized this historical dogma as follows:

"As I see it, our great universities are the only institutions in our society that combine, in any significant measure, research and teaching at the highest possible levels. Indeed, the function of the university is to combine learning with teaching – to embrace from the multifold areas of human knowledge what is known and what has been thought, to

examine it, assess it, question it, add to it and transmit it. The function is historical and critical, exploratory and inventive".[15]

Nisbet traces the deterioration of that basis of the university, asserting that for all practical purposes it is dead. What has replaced it? The multiadversity referred to in our introduction. The faculty has become a collection of independent entrepreneurs more concerned with their research grants, contracts, consulting, publications for the sake of recognition and income than with the basic mission of the university. In that environment the university (recall that the faculty are the university) stands as a house divided against itself facing internal and external pressures.

The second issue is collective bargaining. Since 1966, collective bargaining activity has skyrocketed among academic staff. A number of universities now have formal agreements between the university and a recognized faculty bargaining agent.[16] Those familiar with collective bargaining in other sectors of society will recognize the fundamental changes brought on by the introduction of formal collective bargaining.

The third pressure is created by rapid changes in student demand. The quick and sustained growth of the 1960s has been followed by a plateau pock-marked with gullies. Large swings in student demand – from the humanities to business, from physical sciences to bio-sciences – coupled with socio-economic and demographic shifts render enrollment forecasting (one of the basic components in university manpower planning) a hazardous business. Institutions must use all the tools and techniques available to them to forecast enrolment, continually updating their forecasts and incorporating the Bayesian element (often in the form of the "feel" of high school liaison people, admissions officers, deans, etc.).

The fourth issue, one that is closely related both to student demand and to government fiscal policy (discussed next) is external attempts at manpower planning. Not infrequently professional regulatory agencies and government dabble in global manpower planning, attempting to influence university enrolments (particularly at the graduate level) by establishing quotas, limiting grants to graduate students, and introducing regulations to dissuade students from attending, for example, by tightening student visa provisions.

Frequently these attempts at manpower planning are disjointed and at best *ad hoc*. They fail to take into account the transferability of students from one discipline or profession to another, even several years after entering the profession. They do not allow for the play of socio-economic forces and the long lead time required to implement their "plans". An example of this phenomenon may be seen in undergraduate engineering enrolments during the past ten years. In the mid 1960s engineering enrolments and the demand for engineering graduates were high. In the late 1960s the job market turned downwards, but it took several years for this message to filter down to high school students, so that they transferred their plans to other professions. By the time enrolments fell, the job market had improved and there was again a shortage of engineers. Because of the naturally long lead time in reorientating student and faculty thinking, the effects of efforts by governments to reduce engineering enrollments did not become operational until the time the job market was improving – thereby compounding the shortage of engineers. These efforts simply accentuated the hog cycle. Internal university manpower planning is difficult enough, without the confounding effects of poorly-conceived and poorly-articulated external *ad hoc* manpower planning.

In these days of inflation and tight budgets, government fiscal policy and intervention in university operation comes to the fore as the fifth pressure affecting university manpower planning. A rather rapid turnaround in financial resources available to the university would have been a serious problem in itself. But it has been heightened by gross unpredictability. One need only to review the events related to university financing in California, Illinois, Michigan, Florida, New Jersey, Massachusetts, Ontario and Alberta (which is the single example in this list that runs contra to the prevailing trend – i.e. in Alberta the purse strings have been loosened) to realize how difficult long-range manpower planning and budgeting are for the individual institution.

The sixth issue in this list is that of rapid inflation. When the cost of major purchased items (e.g. library materials, oil) triple in one year, any "five-year plan" is in for some drastic reworking.

Future pressures – a concluding note

This paper has briefly outlined the context of the issues currently facing a complex university, and some of the tools and techniques for manpower planning available at the institutional level. The task is difficult but not impossible, and we have reported experience at McMaster University. As the planning problems have become more complex and the state of flux in society more rapid, the tools and techniques available to university planners have increased in power. Computer hardware, analysts, and data bases are available to implement modern tools of operations-research and systems analysis. Flow, demand, and budget models of the type described here can be brought to bear on the problems of the contemporary university. Obviously their effectiveness depends upon the support and understanding provided by top management. By judicious, repetitive analyses and planning, with the tools described, it is possible to improve manpower planning in a complex university – improve it over the laissez-faire approach to staffing and improve it beyond the current state of the art in most universities.

However, that scenario may be changed rapidly. Futurists concerned with the relationships of energy, ecology, and the distribution of world power foresee radical shifts for both developed and under-developed countries.[17] What will happen to the university in a society which is much concerned with basic issues of survival? The marginal institutions undoubtedly will collapse. Readers of *The Chronicle of Higher Education* will recognize that this development is already under way (hardly an issue passes without a note about the closing of some institution or phasing out of a major program). And the question remains, will the strong complex multiversities survive?

To answer this question history may be seen as optimistic. Universities had their beginning in a period of adversity: the middle ages. In that instance, the great academic dogma – consensus about the central mission of the university – dominated the institutions. Manpower planning was self-generating and tightly constrained. Faculty only came to universities if they could generate their own support. Today's world is different. The self generating support of competing faculty is a divisive price of great power. If the institution is to remain strong and paramount it must make a conscientious effort at communal manpower planning.

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ACCESS TO HIGHER EDUCATION: A SUPPLY MODEL INVOLVING QUALITY AND FINANCIAL DIMENSIONS

University administrators have long sought to know the sequence of decisions and the interrelated effects of recruitment, tuition, financial aid, and structural institutional policies upon the student's choice of an undergraduate college or university. This article reports the beginning of inquiry into these problems. A national supply model has been developed which categorizes all high school graduates in the United States by the need for financial aid, SAT verbal scores, and sex. The model provides administrators with a means of assessing how the supply of potential students will vary over time, along the three dimensions listed, when certain university controlled variables are changed.

Assumptions concerning segmentation dimensions of students in the model

Verbal scores

From the outset some qualifications should be made about the use of a verbal score as an approximation of a student's scholastic ability. Its usefulness has been questioned and there is evidence that it is not an infallible indicator of academic success.[1] However, it was chosen as a supply dimension since there is also some evidence to show that verbal score is a basically reliable predictor of college success,[2] since information about the verbal scores of recruitable freshmen is available, since many administrators express concern about this attribute, and since other studies use verbal scores the results will be comparable.

Need for Financial Aid

The financial need of a student is defined as the difference between his total expenses and the amount he and his family can pay. The family's ability to pay is approximated by procedures used by the College Scholarship Service. Total educational expenses include tuition, room and board, and personal expenses. The cost of tuition is considered the primary university-controlled variable since it is assumed that the price of room and board, although controlled, is set at the break-even level.

The uncontrollable environmental variables included in this study are:

Number of male and female high school graduates
Verbal ability of high school graduates
Drop-out rates for high school seniors
The ability of parents and students to pay educational expenses of high school graduates
The relative and current income levels of parents of high school graduates
The relationship between verbal aptitude and relative or current family income of high school graduates

The controllable university variables are:

Tuition
Room and board

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The national supply model

The national supply model will estimate the number of recruitable freshmen by sex, verbal aptitude, and financial need, over time. To develop it, a series of mathematical functions was derived describing the relationship among the variables listed above.

For example, estimates were derived using the two following functions:

$N_t^1(a, s \mid T)$ = the number of male high school graduates in academic year (t - 1, t) who have verbal aptitude scores greater than or equal to "s" *and* also have a financial aid need less than or equal to "a" when tuition expense level is T

$N_t^2(a, s \mid T)$ = same for female high school graduates, where

$200 \leq s \leq 800,\ T \geq 0$, and $0 \leq a \leq T + RB_t + PE_t - SE_t^i$

(RB_t and PE_t) are room and board and personal expenses; SE_t^i is the student's summer earnings (i=1 for male students, i=2 for female students) all fixed for each year t.

Thus, $N_t^k(a, s \mid T)$, k = 1, 2, is a segmentation model which estimates the national supply of high school graduates by sex, verbal aptitude, and financial need. The model includes the effects of the listed uncontrollable environmental variables and shows the direct consequences of the controllable tuition variable. Time t refers to the year the graduates normally might enter the fall term of their freshman year. Verbal scores range between two hundred and eight hundred, and financial aid need takes on values between zero and total educational expense less summer earnings.

Unfortunately, these model functions cannot be directly estimated. No direct information exists about their form or attributes. Therefore, other available data are used to approximate these attributes. For example, since information on financial aid need over time is not available, it is estimated, in part, by using projections of income of adults provided by the U.S. Census Bureau. Each of the major model parameters was estimated in the following manner:

1. High School Graduates. Due to the limited information about the differences between high school seniors and high school graduates, the study assumes that the attributes of high school seniors are representative of the graduates. Even though not all high school seniors graduate, those who drop out of school during their senior year constitute a relatively small percentage of the total and the numbers of dropouts have decreased over the last decade. Thus, the model derives most of its information about high school graduates from the behaviour of high school seniors, and high school graduates are considered synonymous with the supply of recruitable freshmen – the target population of the study.

Estimates for the number of high school graduates and the proportion of each sex were provided by Census Bureau projections. This group is expected to decline, see Table 1.

2. Verbal Achievement Ability of Recruitable Freshmen. The SAT score was used. The important question here concerns the distribution of SAT scores from one high school senior class to the next. This study assumes that the percentage of seniors falling in each score range will remain relatively constant. The assumption is based on the fact that high school dropouts tend to pull down the verbal score distribution, and the dropout rate of

TABLE 1 ACTUAL AND PROJECTED HIGH SCHOOL GRADUATES IN THE UNITED STATES, 1955 TO 1979 (in thousands)

	Year	Male	Female	Total
ACTUAL	1955	648	703	1,351
	1956	682	739	1,421
	1957	696	750	1,446
	1958	729	784	1,513
	1959	790	849	1,639
	1960	898	966	1,864
	1961	958	1,013	1,971
	1962	941	984	1,925
	1963	959	991	1,950
	1964	1,129	1,173	2,302
	1965	1,337	1,378	2,715
	1966	1,326	1,346	2,672
	1967	1,332	1,348	2,680
	1968	1,341	1,360	2,702
	1969	1,408	1,431	2,839
	1970	1,433	1,463	2,896
	1971	1,456	1,487	2,943
	1972	1,490	1,516	3,006
	1973	1,501	1,536	3,037
	1974	1,537	1,558	3,095
PROJECTED	1975[1]	1,549	1,570	3,119
	1976	1,556	1,576	3,130
	1977	1,563	1,585	3,148
	1978	1,557	1,576	3,133
	1979	1,536	1,550	3,086

Sources: U.S. Office of Education, *Projections of Educational Statistics to 1978-79.* Washington: U.S. Government Printing Office, 1969, Table 20; and U.S. Office of Education, *Projections of Educational Statistics to 1982-83.* Washington: U.S. Printing Office, 1974, Table 20. Numbers are graduates of regular day schools representing more than 99 percent of public graduates and 97 percent of nonpublic school graduates.

[1] 1975-1979 projections assume: (1) that the 1966-1973 trends of the percentage of male and female high school graduates to total males and females 18 years of age will continue and (2) that nonpublic total graduates' and male/female mix will remain constant through projection period.

seniors has been decreasing. Improved teaching methods and special federal, state, and local programs have tended to increase verbal ability of all seniors. Thus the two forces tend to offset each other, and it has been assumed that the verbal distribution is constant over time. This is the claim made by Doermann, when reporting some results of unpublished CEEB studies: "William H. Angoss, Executive Associate of Educational Testing Service, has added that other less complete, unpublished information suggests that relationships between test scores and the proportion of the high school population able to achieve various levels of performance on the test has remained relatively stable from about 1950 until the present". The assumption is also borne out by a 1966 College Entrance Examination Board (CEEB) national norming study of the PSAT. PSAT scores range between 20-80 and are analogous to the SAT 200-800 scores. These CEEB PSAT results are an estimate of the portion of all seniors scoring at each verbal level, since adjustments were made to account for the fact that not all seniors took the test. Our study uses the PSAT results as an estimate of the SAT verbal aptitude of the national supply population of high school graduates.

3. Financial Aid Need As Derived From Ability To Pay. The model defines financial aid need as a linear function of both the school's tuition and the ability of the student and his/her family to pay, i.e., Financial Aid Need = Total Educational Expenses – Family Ability to Pay – Student Summer Earnings. The estimation problem was to decide what estimates best describe the family's ability to pay.

In 1955, the College Scholarship Service published the first nationally applicable tables relating the current value of family resources to their ability to pay.[3] Since 1955 financial aid administrators have had access to tables revised on an annual or biennial basis. Revisions since 1962 have provided adjustments for inflation and new information derived from data collected by the U.S. Bureau of Labor Statistics (BLS).[4] CSS contends that its role is to serve as a national standard of objective measurement of families' ability to pay for higher education.

Table A of the CSS reports shows that the standard ability to pay of parents is a function of net family income and the number of dependent children. After allowances for federal income tax and business expense deductions, net family income is defined to include total wages, dividends, interest, property income, capital gains, social security benefits, pensions, child support, alimony, aid for dependent children, subsistence and quarters allowances, allotments, and aid from friends or relatives.[5] That is Table A is used when no unusual expenses are incurred by the family. These include housekeeping expenses for a working mother, medical and dental expenses, extraordinary expenses, debt repayment, schooling expenses, and expenses for other dependents.[6]

If the number of dependents and income were known for the families of high school graduates, then this table would be directly applicable, but the Bureau of the Census does not publish information about the size of high school seniors' or graduates' families. For this study, a family with three dependents was taken as representative over time of the high school graduate's family, based upon the fact that 2.8 is the average number of dependents in families filing Parents' Confidential Statements with CSS.[7] Therefore, given the net income distribution for high school graduates, the CSS table for families with three dependent children is assumed to interpret the ability to pay total educational expenses. The progressive increase in ability to pay represents the education expenditure elasticity coefficient based on the BLS information. To extrapolate this table into the future, piece-

wise linear functions were derived for each year from 1955 to 1980, based on tables published for 1963 and 1970. The estimate of this function assumes that for each income level there is a constant rate of decline in contribution from year to year. This indicates that the same parental current net income will be able to pay for less and less of the student's educational expenses over time.

4. Joint Distribution of Family Net Income and Verbal Aptitude. Although there have been no national or regional studies which estimate the joint distribution between income and verbal aptitude, there have been a number of studies which indicate simple correlations between various other measures of aptitude and socio-economic categories in the range of .35 to .40.[8] This study assumes a joint distribution between income and verbal aptitude* with a correlation of .40. The correlation is also assumed to be uniform throughout all levels of verbal scores and relative income levels, as well as unchanging with time.

5. Current Net Family Incomes of High School Graduates. Net family income for all high school seniors is retrievable from census tapes available from the U.S. Bureau of Census. Their net income definitions are not exactly comparable to the CSS income definition. Census income includes wage and salary income; self employment income; net income (or loss) from rents; royalties; interest; dividends; income from estates or trust funds, Social Security benefits; pensions; veterans payments; allotments for dependents, alimony; and receipts from insurance policies or annuities. 1960 census income was estimated to report about 94% of the total money income for persons 14 years of age and older, 99% of the total wage and salary income alone.[9] In estimating the net family income of future years direct extrapolations were not used. Instead, estimates were adjusted for: (1) the general growth in income of families with children of high school senior age, and (2) an increasing growth in lower income families whose children previously had dropped out before high school graduation[10] in the population.

Discussion of model

At this point the relevant external information available to help derive the functions of the model was virtually exhausted. Given the above correlation between net family income and verbal scores and the verbal score distributions given in the CEEB reports an attempt was made to approximate a comprehensive segmentation description of high school graduates. Since data from diverse sources have been combined, several *caveats* must be made.

First, instead of just college bound high school seniors, the *entire* set of high school graduates in the United States was used to make the model as generally applicable as possible while maintaining relevance to private and public colleges. Since many private colleges recruit nationally, and there is inadequate regional or state income information for further disaggregation of the model by state location or distance from a particular college, travelling expenses were not included.

Second, the assumed relationship between net family income and ability to pay college expenses is inexact. The relationship used in the model is the best estimate from the available information. The years 1963 and 1971 were chosen to show the progression of ability-to-pay curves. However, both the magnitudes and shapes of these published curves are changing from year to year. This suggests that although CSS has the intent to be an

*Bivariate Normal Probability Distribution.

objective measure of ability to pay college expenses, CSS cannot derive a fixed form for the relationship. Also the estimated income growth for the next decade is based on the anticipated replication of the economic conditions of the past decade, which probably is unrealistic.

Third, CSS curves are based on empirical information about what parents were willing to pay for college-like expenses at one point in time. However, this empirical basis gives little information about the current and future willingness of a family with the same income when faced with new prices, recruitment techniques, an ever increasing number of low cost public four-year and junior colleges, state and federal scholarships, student aid programs, and other major changes.

The recruitable freshmen segmentation model would be more useful if there were (1) measures of the uncertainty of the parameters, and (2) a sensitivity analysis of parameters. Measurements of uncertainty are quite complicated due to the manner in which the information sources were aggregated. Sensitivity analysis should be performed as part of further research to understand better the relationships described by the model. The author feels the CSS curves are the most uncertain and sensitive parameters. Moreover, even if the CSS ability-to-pay curves did describe willingness to pay, there is a reporting discrepancy between actual net family income of census information and the amounts reported to CSS on the Parents' Confidential Statement. Consequently, in order to utilize the ability to pay of the parents of high school seniors, the relationship between the *actual* net family income and the *reported* net family income on the Parents' Confidential Statement to CSS must be known.

Results

Before integrating the supply model results the aptitude results will be presented. Table 2 characterizes the supply of potential freshmen by the single dimension of verbal aptitude. Since the verbal distribution is assumed stable, Table 2 merely applies the verbal distribution to the supply totals of Table 1.

Table 3 displays the two dimensional results. The supply of students is shown by verbal aptitude and financial need. Since financial need changes for a student, depending upon the confronting expenses from each particular institution, specific levels of tuition are not assumed. Instead, cumulative student numbers are presented for different levels of ability to pay total educational expense. These estimates show the importance of studying the supply of high school graduates in the three dimensional segmentation manner. The estimates of national numbers of students classified by various characteristics are shown to be changing at very different rates. Thus, the model, although unproven in its validity, appears useful in understanding how the supply characteristics of students are changing.

Table 3 can also be used to approximate the national supply of students which potentially are recruitable for any specific institution. For example: suppose for 1975 an institutional tuition is $2,500, room and board $1,300, and personal expenses $700 so that educational expenses total $4,500. If it is assumed that a student will be able to contribute $500 from summer earnings toward his college expenses, then students to attend this specific institution without additional financial aid must be able to pay at least $4,000. From Table 3, we see that in 1975 there are approximately 79.6 (in thousands) male students in the U.S. with the ability to pay at least $4,000 *and* a verbal aptitude of at least

TABLE 2 U.S. RECRUITABLE FRESHMEN IN VERBAL SCORE SEGMENTS: 1955-1979, BY SEX[1]
(in thousands)

	Male			Female		
Year	$200 \leq s \leq 400$	$400 \leq s \leq 600$	$s \leq 600$	$200 \leq s \leq 400$	$400 \leq s \leq 600$	$s \leq 600$
1955	369.4	244.2	32.4	393.7	274.2	35.2
1956	388.7	259.2	34.1	413.8	288.2	37.0
1957	396.7	264.5	34.8	420.0	292.5	37.5
1958	415.5	277.0	36.5	439.0	305.8	39.2
1959	453.7	302.5	39.8	475.4	331.1	42.5
1960	511.9	341.2	44.9	541.0	376.7	48.3
1961	546.1	364.0	47.9	567.3	395.1	50.7
1962	536.4	357.6	47.1	551.0	383.8	49.2
1963	546.6	364.4	48.0	555.0	386.5	50.0
1964	643.5	429.0	56.5	656.9	457.5	58.7
1965	762.1	508.1	66.9	771.7	537.4	69.0
1966	755.8	503.9	66.3	753.8	524.9	67.3
1967	759.8	506.2	66.6	754.9	525.7	67.4
1968	764.4	509.6	67.1	761.6	530.4	68.0
1969	802.6	535.0	70.4	801.4	558.1	71.6
1970	816.8	544.5	71.7	819.3	570.6	73.1
1971	829.9	553.3	72.8	832.7	579.9	74.4
1972	849.3	566.2	74.5	849.0	591.2	75.8
1973	855.6	570.4	75.0	860.2	599.0	76.8
1974	876.1	584.1	76.8	872.5	607.6	77.9
1975	882.9	588.6	77.5	879.2	612.3	78.5
1976	886.9	591.3	77.8	882.6	614.6	78.8
1977	890.9	593.9	78.2	887.6	618.2	79.2
1978	887.5	591.7	77.8	882.6	614.6	78.8
1979	875.5	583.7	76.8	868.0	604.5	77.5

[1]The ten score intervals have been aggregated into three intervals for ease in exposition.

TABLE 3 NATIONAL SUPPLY ESTIMATES: CUMULATIVE[1] NUMBERS OF HIGH SCHOOL GRADUATES BY VERBAL APTITUDE, ABILITY TO PAY EDUCATIONAL EXPENSES (FINANCIAL NEED), AND SEX
(in thousands)

	MALE								FEMALE							
	≥$0[2]		≥$2000		≥$4000		≥$6000		≥$0		≥$2000		≥$4000		≥$6000	
	≥400	≥600[3]	≥400	≥600	≥400	≥600	≥400	≥600	≥400	≥600	≥400	≥600	≥400	≥600	≥400	≥600
1955	272.8	30.5	54.4	10.9	22.2	5.5	8.0	2.0	309.3	35.2	63.5	12.9	24.4	6.0	8.8	2.2
1956	287.1	32.1	58.4	11.5	22.8	5.7	9.5	2.4	325.2	37.0	68.4	13.9	25.0	6.2	10.4	2.6
1957	293.0	32.8	61.0	11.9	23.5	5.8	8.9	2.2	330.0	37.5	71.6	14.4	25.6	6.3	9.7	2.4
1958	306.9	34.4	65.5	12.6	24.8	6.2	9.1	2.3	345.0	39.2	77.3	15.4	27.0	6.7	10.0	2.4
1959	335.1	37.5	71.1	13.7	26.7	6.6	8.9	2.2	373.6	42.5	83.2	16.6	28.8	7.1	9.6	2.4
1960	378.1	42.3	76.9	15.2	29.4	7.3	8.4	2.1	425.0	48.3	89.6	18.1	31.9	7.9	9.1	2.3
1961	403.3	45.2	83.1	16.3	31.7	7.9	9.0	2.2	445.7	50.7	95.5	19.3	33.9	8.3	9.6	2.4
1962	396.2	44.3	86.6	16.5	32.6	8.1	10.6	2.6	433.0	49.2	100.2	19.9	34.5	8.5	11.2	2.7
1963	403.7	45.2	87.7	16.7	32.9	8.2	9.5	2.4	436.0	49.6	100.0	19.8	34.4	8.5	9.9	2.4
1964	475.3	53.2	99.1	19.3	36.6	9.1	8.7	2.2	516.1	58.7	112.3	22.6	38.4	9.5	9.2	2.3
1965	562.9	63.0	115.0	22.7	41.4	10.3	7.9	2.0	606.3	68.9	128.4	26.0	43.2	10.6	8.1	2.0
1966	558.6	62.7	116.0	22.9	42.0	10.6	8.2	2.1	598.9	68.1	131.5	26.8	43.8	10.8	10.0	2.5
1967	560.8	62.8	124.1	23.5	43.8	10.9	11.4	2.8	593.1	67.4	139.4	27.6	44.8	11.0	11.6	2.9
1968	564.6	63.2	134.9	25.0	45.7	11.4	13.0	3.2	598.4	68.0	151.1	29.3	46.8	11.5	13.4	3.3
1969	592.8	66.4	149.1	27.3	49.1	12.2	14.4	3.6	629.6	71.6	166.7	31.9	50.5	12.4	14.8	3.6
1970	606.3	67.5	150.5	27.6	49.7	12.4	12.3	3.1	643.7	73.2	169.2	32.4	51.3	12.6	12.7	3.1
1971	613.0	68.6	163.7	29.6	52.4	13.1	13.6	3.4	654.3	74.4	183.2	34.5	54.2	13.3	14.0	3.5
1972	627.4	70.2	178.7	31.9	56.0	13.9	15.3	3.8	667.0	75.8	198.3	36.8	57.6	14.2	15.8	3.9
1973	631.9	70.7	179.4	32.0	57.9	14.4	13.6	3.4	675.8	76.8	200.3	37.2	59.9	14.7	14.1	3.5
1974	647.1	72.4	198.4	34.6	68.9	16.5	16.0	4.0	685.5	77.9	218.3	39.6	70.6	16.7	16.4	4.0
1975	652.2	73.0	212.8	36.4	79.6	18.5	18.3	4.6	690.8	78.5	233.3	41.4	81.6	18.7	18.8	4.6
1976	655.1	73.3	217.9	37.0	84.9	19.5	17.4	4.3	693.4	78.8	237.9	42.0	87.1	19.7	17.9	4.4
1977	658.1	73.7	232.8	38.8	96.2	21.5	20.5	5.1	697.4	79.2	254.3	43.9	98.7	21.8	21.0	5.2
1978	655.5	73.4	248.1	40.6	104.5	23.1	23.4	5.8	693.4	78.8	269.6	45.6	107.1	23.3	24.0	5.9
1979	646.7	72.4	253.3	41.0	107.4	23.5	23.4	5.8	682.0	77.5	274.0	45.8	109.7	23.7	23.8	5.9

[1]Each cell represents the total number of high school graduates of a particular sex, who can afford *at least* a certain educational expense level, *and* with at least a certain verbal aptitude.

[2]Ability to pay total educational expenses (ability to pay in addition to summer earnings).

[3]Verbal aptitude.

400, 18.5 with the ability to pay $4000 and a verbal aptitude of at least 600, and 81.6 and 18.7 female students respectively. From 1975 to 1979 male students with the ability to pay at least $4,000 and a verbal aptitude of at least 400 increase 35% (from 79.6 to 107.4). However, due to the rise in tuition, room and board and personal expenses, by 1979 a student may have to be able to expend $6,000 to attend the same institution without financial aid. (This, of course, depends in part upon the tuition increases.) By 1979, the number of male students with the ability to pay $6,000 and a verbal aptitude of at least 400 has decreased to 23.4 (in thousands), a decline of 71% in students who do not need financial aid. This dramatic decline in supply could be devastating.

If the estimated CSS curves are correct, then there is a widening gap between the student's ability to pay college expenses and costs of private institutions. It is estimated that from 1971 to 1974 the average ability to pay increased at an annual rate of 4.5-6%, while college costs increased (and are expected to continue to increase) by at least a rate of 6-9%. Thus, a gap is forming between the increasing ability of families to pay college expenses and the increasing expenses themselves.

Summary

It is evident that there is a great need for further research into the choices of high school seniors when they are confronted with alternative access routes to higher education. Not only must the parameters of these decisions be more explicitly defined, but the effect which recruitment techniques have on different students must be better understood. The national supply model, outlined here, provides a description of potentially recruitable students which explicitly interrelates growth of population, high school retention rates, parental ability to pay college expenses, growth of parental income, and students' verbal aptitude.

Many questions remain unanswered; a more careful analysis of the CSS curves is needed. Further study must relate willingness to pay with ability to pay. Also although verbal ability is measured by estimated SAT scores, the model should include other attributes which are important objectives of various colleges. But even in this form the supply estimates quantify the depressing news already conveyed in other ways. Student supply will level off and decline in the years ahead. Growth in ability to pay college expenses is lagging behind the rise in institutional expenses. The net effect for each institution will depend, of course, on specific tuition rates, recruitment effectiveness, and other factors. But, in general, the estimates predict a substantial decline in the number of students who will not need financial aid or will need little aid. When every institution is faced with this situation, some very serious problems will emerge and it is difficult to avoid the conclusion that, for many colleges, the only way to combat enrollment decline will be to lower "quality" substantially.

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A COMPARATIVE STUDY OF SCIENCE, SYSTEMS ANALYSIS AND FUTURISM

One of the characteristics of the roles of decision-makers in general, and of government officials in particular, is the extremely large number of problems they have to face. One of their most difficult problems is the large variety of solutions offered by specialists and experts. Therefore, it is of interest to present a systematic perspective on different methods of approaching the solution of a problem, and this is what this paper attempts to do.

The question of the existence of different ways of solving a problem is of importance because it is possible to logically prove that, given certain assumptions about the nature of a problem and its solution, there is only one way to solve it. This is not the point of view we adopt here, because the conclusion reached with respect to uniqueness of solution depends upon the definitions of the problem, method of solution, and solution; and in many cases, these definitions are open to question. Our point of view here will be that the proper framework for studying different methods of problem-solving is to recognize that there are different approaches to the analysis of reality. And three approaches will be considered – Science, Systems Analysis and Futurism. Their similarities and differences will be studied in the framework of the "Theory of Knowledge".

One difficulty inherent in the method to be used in this paper is that Philosophy, Science, Systems Analysis and Futurism are all what anthropologists would call cultural systems, i.e., they are not only logical constructions that can be learned, but they are systems of values, preferences, and expectations that have to be internalized. As a consequence, it is possible that not only the learning of an endless variety of different logical constructions might well be a task beyond human capacity, but also it is unlikely that humans can internalize many different cultures. It is extremely difficult to understand the meanings which persons in different specializations attach to different expressions (and to the same expression). It is impossible to express equivalence precisely. Even if the expression of equivalence could be successful, not all persons with the different specializations will agree with the final result. In this type of translation the emotional content attached to the different expressions is lost. The emotional content is felt only by persons who have been indoctrinated into (have internalized) the culture of a specialization. For them, part of the meaning of an expression *is* its emotional content.

Other problems arise because there is no complete agreement as to what Philosophy, Science, Systems Analysis and Futurism are. What their methods are, how their results are expressed, etc.

Nevertheless, it is worthwhile to try to build interdisciplinary bridges, otherwise the usefulness of different approaches for the study of reality might be considerably reduced or completely lost.

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We shall begin the presentation of the systematic perspective of the different approaches to the study of reality, by discussing the basic common element of all, i.e., the concept of a theory or model. Then the use of this instrument in Science, Systems Analysis and Futurism will be described, emphasizing what they have in common, and what is particular to each.

What is a model?

To construct a model is to build an idea of a phenomenon that occurs in reality. First, samples are selected of the phenomenon to be studied. Next, the characteristic elements of the phenomenon are determined. For the sake of simplicity, I will call these *variables.*

Those aspects of reality which are not considered essential are left out of the model. This cannot be avoided, due to limitations of human capacity. The first consequence of this is that a margin of error is introduced in all models. Other consequences will be referred to later.

The selection of the variables is a first step in abstraction. From the point of view of the person studying the phenomenon, the variables selected and the phenomenon are – except for the error just mentioned – identical. However, if the same phenomenon is studied by more than one person, or by the same person taking a different point of view, different variables will probably be selected. For example, one person studying a group of students in a class might be interested in intellectual ability, while another might be concerned with their consumption of calories. For the first person, I.Q.s could be used to define the phenomenon, for the second some scale of the number of calories.

Different variables will take different forms. For example calories consumed will be expressed in numerical values. But the variables to indicate "quality of teachers" would take the place of a scale of adjectives indicating *good* and *bad.*

The set of all the forms that a variable takes is called its *range.* The next step consists of the model builder subdividing the range of the variable into subsets, which will be called *subranges* of a variable. For instance, each number between 0 and 3,500 could be one of the subranges into which the range of calories consumed is subdivided. Each subrange of a variable can include one or more forms of the variable. The term *refinement* of a subrange will be used to refer to the proportion of the number of forms of a variable in each of the components of the subrange, with respect to the total number of forms in the range: the more refinement, the lower the proportion for the subrange with more forms. (It is assumed that the number of forms that a variable can take will be finite if discrete, or bounded above and below if a subset of real numbers. In this second case, it will also be assumed that each subrange is a closed interval.) The subranges of a variable will be identified by a representative number or term. In the example above, *good* would represent a subrange of the forms of *quality* of the teachers.

The person studying the phenomenon will also observe that not all the subranges of one variable appear together with every subrange of the other variables. For example, not every class size appears together with every quality of education; it might be usual for a medium-size class to occur together with good quality education. Not every "price" of a good appears with every quantity demanded. For "high" prices the quantity demanded is usually "low", for "low" prices "high". From his observations, the person studying the phenomenon can determine which subranges of the variables appear together.

Thus far, we might say the person studying the phenomenon has purified the phenomenon he wishes to study of all the complexities that surround it in reality, but are irrelevant from his point of view. Next, he links the variables in causal relationships, stating that whenever a variable cause takes specific subranges of forms, a variable effect will also take a specific subrange of forms. For instance, he might note that whenever high quality teachers are available, the proportion of "repeaters" in school is low, and conclude that the high quality of the teachers is the "cause" of the low proportion of repeaters. Another relationship of this type might be that high prices "cause" low demand, and low prices "cause" high demand.

Several characteristics of the cause-effect relationship should be observed: (1) one variable effect might have more than one cause; (2) one variable might be both a cause and effect simultaneously (i.e. a cause in one relationship and an effect in another); (3) since the cause-effect relationship depends upon the point of view of the person studying the phenomenon, the relationship might change if his point of view shifts. A change in viewpoint might also result in the disappearance or reversal of a cause-effect relationship, e.g., in the relationship between education and production. In a particular time sequence, education is a cause (i.e. factor) of production; while in another, production (i.e. income) is a cause of education.

In the analysis of the phenomenon some variables may be found to be causes only. These are called *exogenous* variables which means that, while they are not influenced by the phenomenón studied, they do influence it. Variables that are both causes and effects, or are effects only, are called *endogenous* variables. For example, in the models dealing with student flows it is assumed that the number of school-age persons in the population influences the educational system, but is not influenced by it. That is, the number is an exogenous variable. On the other hand, in the same models, the number of students passing from one grade to the next (or from elementary to secondary school) is an endogenous variable. In short-term economic models, population is usually an exogenous variable, in some long-term models it is treated as endogenous.

The idea of a cause-effect relationship is the basis for the concept of explanation of a variable. When given the subranges of forms of all of its cause variables, it is possible to determine the subranges of forms of an effect variable. This effect variable is explained, and the more refined the subranges of the effect variables. the better the explanations. For example, in a model the proportion of repeaters with subranges *high* and *low* might be a consequence of the quality of the teachers with subranges *high* and *low* and the characteristics of the physical facilities with subranges *good* and *bad.* The proportion of repeaters will be explained when it is stated that the proportion is *low* (*high*) when the quality of the teachers is *high* (*low*) and the physical facilities are *good* (*bad*).

It might be possible to include the same variable in several causal chains. For example, let us consider the relationship between per capita income and quality of student. One causal chain might be the direct relationship between the income of the family and the quality of the student, another might be the level of per capita income which influences the salary of the teachers, the salary which influences the quality of the teachers, and the quality of the teachers which affects that of the students.

This possibility of several causal explanations for one variable imposes one obvious condition on a model. The possibility that different causal chains might lead to contradictory explanations for a single variable should not exist. If, in the example given, it were

stated that high per capita income is the cause of poor students, while high per capita income provides good teachers and therefore good students, something clearly would be wrong with the model. Some intervening variable has been left out, or some causal chain has not been properly characterized.

To complete our presentation of the concept of models, the idea of consistency must be introduced. The relationships in a model are consistent if, given the subrange for all the exogenous variables, the subrange of all the endogenous variables can be determined; and if, regardless of what causal chain connecting the exogenous variables to the endogenous ones is used, the possibility of contradictory explanations does not exist. A model is a set of (a) variables, (b) their classification in endogenous and exogenous, (c) cause-effect relationships among them, and (d) the consistency condition. A more detailed analysis will be presented below.

Variables in a model

In the previous section we gave the name "variable" to the characteristic elements of a phenomenon. It was observed too that these variables take different forms and that these forms are classified in subranges. A large number of examples of educational variables could be mentioned, among them the number of students in an educational system, their quality, the number of teachers, their quality, etc. Well-known economic variables are prices, qualities supplied and demanded, national income, etc.

This brief statement does not indicate the importance of variables in the study of a phenomenon, or the risks involved in defining a variable. An example will clarify these points: **Race**, in whatever way it is defined, has been considered to be an important variable in social studies. However, it is often difficult to give any empirical content to the abstract idea of race. Hence, many investigations based on this variable have little or no scientific value. To a large extent the progress of a science is geared to the definition of appropriate variables. This is not surprising if one considers that from the point of view of the person studying a phenomenon, the variables selected and the phenomenon studied, except for the error involved, are identical.

It was also mentioned above that subranges are defined in the range of variables. In some cases, the subranges merely are different slots used for classification. University students might be classified according to their field of study, in which case each field is a subrange of the variable under consideration; production might be classified by industrial origin; persons by social class, etc. In other cases, the different subranges of a variable may be ordered according to different intensities, such as the distinction between subranges identified with *very bad, bad, good, very good,* etc. Two cases of different intensities can be considered: In the first, it is not known how to determine the magnitude of the change from one intensity to another, e.g., if it is decided that teachers can be classified as *bad, good* and *very good,* it is not known whether the difference between *bad* and *good* is the same as the difference between *good* and *very good.* In this case the variables are in a ranking scale. In the second example, the magnitude of the difference between one intensity and another can be determined. Usually it is possible to enumerate or measure the different forms of the variable because the variables are in an interval scale. Examples are the number of students in an educational system, the size of an individual class, prices and qualities of goods, etc.

When the subranges of a variable are only slots for classification, or when it is not known how to determine the magnitude of the change from one level of intensity to another, the variables are said to be qualitative. In the other case, they are said to be quantitative.

Models deal with both types of variable. However, the definition and analysis of qualitative variables is more difficult. It is difficult to say whether two qualitative aspects of a phenomenon are two different forms of the same qualitative variable or two different variables. Also, problems exist in the determination of relationships which include qualitative variables. Finally, the definitions of the terms characterizing the subranges of the qualitative variables tend to be vague (i.e., there are objects which cannot be definitely included or definitely excluded from their extensions). A very large number of examples of models which include qualitative variables can be given. The theory of consumer behaviour in economics includes utility or preference of the consumers. Quality of education is one of the most important such variables in educational models.

Relationships among the variables

As we have seen, another element of a model is the causal relationships among the variables. The person studying the phenomenon first asserts that a cause-effect relationship exists between two variables. Then the form of the relationship must be determined. This means that a rule has to be specified, given the way to determine the subranges of the effect variables once the subranges of the cause variables are determined. It will be said here that the specification of this rule is the determination or evaluation of the *parameters* of the relationship. For example, if the cause variable is the number of students, and the effect variable is total cost, the person studying the phenomenon must determine how total cost increases with the number of students. To give a simple case: it can be stated that if the cost is $300 per student, then the total cost will be

$$(1) \qquad \$300n$$

where n is the number of students. In this case, $300n is the form of the relationship between number of students and total costs, and 300 will be the parameter of the relationship.

A well-known relationship used in economics is

$$(2) \qquad C = cY$$

where C is consumption per capita
Y is Income per capita
c is the parameter of the relationship.

Usually it is possible to obtain some approximation of the form of the relationships among quantitative variables, that is, it is possible to determine a mathematical expression defining the operations that must be performed on cause variables and parameters in order to obtain the value of the effect variables, and it is also possible to determine the numerical values of the parameters. In example (1) above, the variables are related linearly, and in (2) it is possible to assign a value to c. It is more difficult to establish parameters for relationships between quantitative and qualitative variables. This could be the case, for instance, if the quality of teachers were related to salaries.

Earlier it was observed that in the construction of a model some aspects of reality are left out. As a consequence of this, an error exists in the model. The aspects of reality left

out of the model characterize the parameters of the relationships among the variables in the model. As an example, let us consider the relationship between population and enrollment, usually included in models dealing with students flows. It is frequently stated that enrollment is a fixed (or increasing) proportion of the school-age population. However, the precise value of the proportion depends upon the characteristics of the country involved – e.g., on its per capita income, an aspect which is not included in the model. The cost per student in relation (1) will depend, say, upon the salaries paid to teachers, an aspect which is not considered in the model formed by that relation.

Because of the influence of the aspects left out of the model on the parameters of the relationships among the variables of the model, whatever the refinement adopted for the subranges of the cause variables, it will not be possible to reduce the refinement of the subranges of the effect variables beyond certain limits. These limits are determined by the unknown variability of the aspects of reality left out of the model. There will always be some uncertainty in the form the effect variables will take, regardless of the refinement adopted for the cause variables.

Verification of a model

The problem of verification of a model is that of deciding whether to accept or to reject it as an instrument for the analysis of the phenomenon for which it was constructed. As mentioned above, a model is a description of a real phenomenon in terms of variables and the relationships among them. To specify these relationships, their parameters have to be determined or evaluated. If we want to verify a model relating enrollment to school-age population, we need to know the proportion of school-age persons who enroll. When we know the proportion is, say, 60 percent, we can proceed to verify the model. It should be remembered that values such as the 60 percent mentioned above are determined by the aspects of reality not taken into consideration in the model, and that when such values are known it is possible to determine the subranges of the endogenous variables when those of the exogenous variables are known.

To verify a model we begin by observing the actual subranges taken by the exogenous and endogenous variables. Next, the observed subranges of the exogenous variables are used in the model. The links among the variables in the model make possible the determination of the subranges of the endogenous variables. Thus, two sets of subranges of the endogenous variables are available: those observed in reality and those obtained from the links among the variables in the model. These two sets of subranges are compared. If, for the purpose that the scientist has in mind, the subranges of the endogenous variables observed in reality and those obtained in the model do not differ too widely, the model is accepted.

Let us consider a simple example, a model having two variables and a single relationship: the endogenous variable is new students entering high school, and the exogenous variable graduates from elementary school. The link is that 70 percent of the elementary school graduates go to high school. To verify this model, the graduates and new entrants of past years are observed. Next, the number of new entrants is estimated with the model, using as a starting point the observed values of elementary school graduates. When the observed number of new entrants and the estimated number are compared, it can be determined whether the agreement is good.

It is the scientist who determines how close the agreement between the observed and obtained subranges of the endogenous variables should be. In some cases, he will feel that a very close agreement is required; in others, that this is not necessary. In the example above, if the obtained number of new entrants is used to estimate the number of teachers required, a difference between observed and obtained numbers of, let us say, 10% would be acceptable because a teacher might well be expected to teach 40 or 44 students equally well. However, if it is used to determine the payroll list for teachers, a 10% difference would not be acceptable because it means that some teachers would not be paid.

It can be seen from this example that the problem of verification of a model is not very difficult when the variables take quantitative forms. The problem becomes more complicated when qualitative variables are considered.

Models and mathematics

Although they are frequently thought of together, models and mathematics are not conceptually related. A model is an abstraction of reality, as described above. Mathematics is but one of the possible instruments, first to test the consistency of a model, and then to express and analyze it.

Actual process of constructing models

Another point which must be stated is that any attempt to apply in sequence the steps for constructing and verifying a model described above would meet with failure. It is quite unlikely that all the data needed to evaluate the parameters of a model would be available immediately after the person studying the phenomenon defines the variables and their cause-effect relationships. As a consequence, one usually proceeds from one model to another. At first, unsystematic and casual observations of the ranges, subranges and forms of the variables are used to conclude that regularities do exist, to evaluate parameters and to verify the model. When such preliminary observations have been successful, additional effort is put into obtaining data. Quite frequently, the additional data collected suggest the new variables, and cause-effect relationships have to be redefined and the process is begun once more.

Thus far we have reviewed the process of making an analysis of reality – a process which leads to the concept of models because most thinking is done in terms of models. In other words any thought, when logically consistent, is a model. As a consequence models are invariably used in any systematic thinking. This does not mean that any thought is a model. Not all thoughts about reality are necessarily consistent. However, all the other elements of a model: the selection of important aspects of the process to be studied, their classification as endogenous and exogenous, and the establishment of cause-effect relationships among them, are included in any thinking process. If this is the case, then there is no point in discussing whether Science, Systems Analysis and Futurism use models. The only points of interest are their peculiar approaches to model construction, and the reasons for these differences. This analysis will include:

- the objective of constructing models in each of the approaches
- the scope of the models constructed
- the variables defined in the phenomena studied
- cause-effect relationships among the variables

- data requirements and evaluation of the parameters, and
- consistency of the relationship defined.

Objectives of the construction of models

These can be classified as, (a) knowledge, explanation and prediction, and (b) forecasting and control.

We have already observed that a phenomenon is explained when, given the subranges of the exogenous variables, it is possible to determine those of the endogenous variables. To achieve such knowledge is the main objective of pure science, and therefore "explanation" can be considered equivalent in meaning to "prediction". Apart from the satisfaction of knowledge itself, models make it possible to control processes, i.e., to orient the endogenous variables towards desired values. This aspect is emphasized in Systems Analysis and Futurism.

In explanation (prediction) the only point of interest is that when the exogenous variables take a set of forms, there is agreement between the actual subranges of the endogenous variables and those determined by use of the model. The forms taken by the exogenous variables are of no interest for the Scientist. The meaning of prediction will be extended here to signify any estimation of the future value of endogenous or exogenous variables which does not attempt to influence that value.

In Systems Analysis and Futurism the exogenous variables are classified as instruments: those under the control of the decision-maker (management, government, etc.) and those which might be called free exogenous. The future subranges of the endogenous variables depend upon the forms both of the instrument and of the free exogenous. The problem of Systems Analysis and Futurism is that of determining the forms of the instruments so that the endogenous variables will achieve certain goals in the future. Since the subranges of the endogenous depend also upon the free exogenous, Systems Analysts and Futurists need to know the future forms of the free exogenous. This creates a problem, since they lack a theory to predict these forms. To overcome this lack usually it is assumed that the past trends for the values of the free exogenous will be maintained in the future and these past trends are modified to obtain minimum, intermediate and maximum predictions. As a consequence, alternative sets of forms for instruments and endogenous variables are obtained. The sets of forms of the instruments needed to achieve the desired subranges of the endogenous variables will be called *policies.*

There is a difference in point of view between the future adopted by Systems Analysts and by Futurists. For Systems Analysts the larger the period of time between present and future, the less important the future. For sufficiently long time periods, the future is unimportant. With the result that Systems Analysts work mainly with the "present values" of the future. Their position might be interpreted as follows: the future is important because we cannot avoid reaching it from the present.

For the futurists the future itself is important. Their position might be interpreted as follows: the present should be controlled, not because present or immediate future have more value in themselves, but because through them we will give the desired characteristics to the distant future.

It should be noted that both in prediction and forecast, the assumption always is made that aspects of the phenomenon left out of the model will remain constant. If this assumption does not hold true, the actual values of the endogenous variables and those predicted or forecast might be substantially different.

Scope of the models in science, systems analysis and futurism

By scope here we mean the type of phenomenon studied with the models. There are important differences in the scopes of scientific, systems and futuristic models, differences which are the consequence of the objective of the model.

First, we shall compare scientific models with those of systems analysis and futurism. Scientists search for knowledge and understanding. As a consequence, they can adapt the phenomena under study to their abilities and instruments. If they choose a phenomenon they cannot cope with, they can simply specialize in some aspect of it. They are not obliged to consider the more complex phenomena that are not treatable. This is not true of Systems Analysts and Futurists. Their object is to control a given phenomenon *as it is;* they cannot simplify it. This helps to explain the emphasis placed on the whole system and on interdisciplinary analytic approaches by Systems Analysis and Futurism.

The emphasis placed on the immediate future by Systems Analysts and on the distant future by Futurists also characterizes the scope of the models they build. The forms of many variables that remain in a specific subrange or constant, for all practical purposes, in the short term, do not do so in the long term. The type of variables will also be affected by differences in the scope of the models. Scientific models are more likely to include only quantitative variables. This is because there are better instruments (mainly in mathematics) for study of such variables. Therefore scientists may restrict their attention to the study of phenomena where only this type of variable can be defined. And also because a variable is quantitative when it is unidimensional in the sense of vector spaces – aggregated variables that represent several aspects of reality are less likely to be unidimensional.

Systems Analysts and Futurists, on the other hand, have to cope with classificatory and qualitative variables.

Cause-effect relationships among the variables in scientific systems and futuristic models

We have already mentioned that in passing from scientific, through systems to futuristic models the number of variables tends to increase, the refinement of the subranges of the variables tends to decrease, and the vagueness of the definition of the terms representing these subranges tends to increase. If these possible trends actually occur, the following consequences will appear:

- The difficulty in observing regularities will increase because in Futurism more regularities have to be observed; actual regularities might be lost (since sets with larger numbers of variables are involved), the subranges of these variables are less refined, and the definition of their characteristic terms is more vague.
- Because of the problems involved, Futurists do not always state explicitly the cause-effect relationships among all the variables they have defined, but only among subsets of them. This means that in most cases the subranges of variables of the subsets are not completely determined, since they depend upon the subranges of the variables in other subsets. Therefore tests of consistency seem to be impossible. Nor does it seem to be possible to forecast and control. However, this is not so. To predict the subranges of the variables not completely determined in the model, methods similar to those used to predict the values of the free exogenous variables can be used. The effect of this on data requirements will be discussed later as well as the problems which this approach yields with respect to consistency.

- Once the regularities among the subranges of the variables are observed and the person studying the phenomenon determines the "cause" variables, the cause-effect chains are likely to present the following characteristics: (1) The number of cause variables in each cause-effect relationship will tend to increase from scientific to futuristic models, since more variables are considered and regularities involve sets with larger numbers of variables. (2) The magnitude of the subranges of the effect variables with respect to their total range will tend to increase from scientific to futuristic models, since this is a characteristic of the variables defined by Scientists, Systems Analysts and Futurists, and also because Scientists can discard models with the characteristics described and reorient their study to simpler phenomena.
- Finally, models in the several cause-effect chains are more likely in Futurism than in Systems Analysis, and in Systems than in Science.

Data requirements and evaluation of the parameters

The first problem we face in this section is the vagueness of the definition of "data". The second is the difficulty of distinguishing between good and bad data and other types of information. Here we shall define "data" as those "facts" which are collected systematically and the best data as those facts specific to the study in question. By systematically we mean that the correspondence between the variables studied and the data is purposely sought. One method of obtaining this correspondence is through the techniques of statistical sampling. The second type of data are those collected systematically, but without a specific model as a term of reference. In this case, despite the efforts made by the person studying the phenomenon, the correspondence between variables and data might well be deficient. Finally, there is "information", other data obtained through casual observation.

The following is a summary of the data requirements and uses mentioned earlier:

Requirements and uses common to Scientists, Systems Analysts and Futurists are: (a) data needed to determine the correlation between variables and define endogenous and exogenous variables; (b) those needed to evaluate the parameters in the cause-effect relationships; and (c) those needed to verify the model and predict the forms of the variables explained.

In addition, Systems Analysts and Futurists also need data to predict the form of the free exogenous variables.

And Futurists also need data to predict the forms of the endogenous variables that are not explained by explicit systems of cause-effect relationship.

In addition to the variety of data required there are differences with respect to the quality of the data used, due to the different scope of the models in the three approaches. If a Scientist finds that he needs data that are not available and cannot be collected by himself by methods 1 and 2 above, he reduces the scope of the model he is constructing until its data requirements fit the criteria of availability (or possibility of being collected). Systems Analysts and Futurists cannot do this. The phenomena they study are fixed, regardless of the data available to study them or the possibility of collecting data by methods 1 and 2. Therefore, in many cases what we called casual observations have to be used. Such observations take several forms. We shall mention only two. The first might be termed "polls of future behaviour". Information is collected on the intentions of samples of persons (consumers, entrepreneurs, voters, students etc.) which is used to

predict the future behaviour of these groups. Clearly, such a method can only provide short-term information. The second has been called the Delphi technique. It is a rapid and relatively efficient way to 'cream the top of the heads' of a group of knowledgeable people. In these two methods the cause-effect relationships which bring about the opinions of the informers are not stated.

The second problem we face in this section is in relation to the evaluation of the parameters. Statistical and econometric techniques are available for this purpose when quantitative variables are being used and the cause-effect relationships have been explicitly stated. These techniques are also frequently used with qualitative variables, but interpretation of the result obtained is not satisfactory.

Consistency of the relationships among the variables

Two different approaches can be used to test consistency. For the first, the cause-effect relationships among the variables and the characteristics of the random effects have to be explicitly determined. Therefore, it is used mainly in Science and less frequently in Systems Analysis. To apply this method, the deterministic components of each cause-effect relationship are identified with a mathematical function. Thus the deterministic part of the model becomes a system of equations, and mathematical methods used to test consistency in a system of equations can be applied to test consistency in the model.

But this method cannot be used to test the consistency of a model when the cause-effect relationships have not been explicitly stated, as is the case in Futurism. In this case the intuitive knowledge (judgement) of the person is used to help him/her to make his/her understanding of relationships as explicit as possible. For this purpose Futurists use direct comparisons of predicted forms of the exogenous and endogenous variables they consider. In some cases these comparisons show clear inconsistencies that must be eliminated. In this way "reasonable" predictions can be obtained. Such sets of consistent predictions are called *scenarios*. As in the case of the scientific predictions and systems forecasts, Futurists usually find that several scenarios appear to be reasonable.

To pass from scenarios, to predictions, to forecasts, Futurists need to determine how to achieve "predicted scenarios". But the lack of explicit cause-effect relationships causes most serious problems. Futurists cannot explain how to control the endogenous variables that are not determined in the model. At most they can state that their values should not be permitted to go beyond certain limits.

Conclusion

These observations suggest that Scientists, Systems Analysts and Futurists alike attempt to make the best possible use of their human mental abilities and of the knowledge and data available at a specific time, to solve closely related but somewhat different problems. However, in spite of the differences in the problems, the tools commonly used by one such approach can be extremely useful in the others. The hope is that explorations such as this will improve the applications of one by the other so that all such techniques might be extended.

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Frank Jackson and William Heeney*

RESOURCE MANAGEMENT – DALLAS STYLE

The accelerating reduction in the value of the dollar coupled with an increasing scrutiny of public expenditure is compelling school districts to reexamine their resource management operations. In the Dallas Independent School District this has led to development of a new component in its resource management system, the Campus Level Planning Model.[1]

Dallas had early experience in developing management systems which would provide opportunity for community participation. Examples are "Project Ice" and "Operation Involvement",[2] both of which were programs for the identification of needs and the allocation of resources on the district level. But, even as these programs were being evaluated, the Research, Evaluation, and Information Services Department of the Dallas Independent School District had started work on the Campus Level Planning Model in order to extend the success of the earlier projects to the level of the individual school campus. Their intention was to bring the planning process closer to those who implement plans in order to ensure more effective utilization of the district's resources. The model is viewed as the vehicle which will move the *process* of planning down to the campus level.

The D.I.S.D. approach may be described by two definitions of planning process. The first, developed by the Resource Corporation of The Association of School Business Officials, considers planning as "the process of guiding internal change so that the school adapts effectively to the dynamic society of which it is a part".[3] The Dallas Independent School District serves one of the largest cities in the United States. Its programs must meet the needs of students representing every level of the social/economic structure and every level of ability. They must be constantly *adapted* to function effectively and efficiently in a *dynamic* and increasingly complex society whose demands for public education are increasing. At the same time this society increasingly is demanding accountability and efficiency in the management of school service, weighing carefully the value received from dollars spent.

The second definition is the widely quoted one of Dror, "Planning is a process of preparing a set of decisions for action in the future, directed at achieving goals by optimal means".[4] Implementation of the model results in a zero-base budget which identifies campus goals, procedures for accomplishing the goals, and the optimal allocation of resources. In effect it produces a set of "decisions for action". The zero-base budgeting process utilized in this management system explicitly defines the relationship that exists between goals attained and resources allocated. A campus team does the actual planning, programming, budgeting and evaluation as the initial step in implementation of the model. This team's composition must be diverse enough to assure a broad decision-making data base, but cohesive enough to work together in the solution of local educational problems. In the Dallas schools involved in the pilot project of 1974-75, the planning/management teams typically were composed of classroom teachers, community and student representatives (in some teams)

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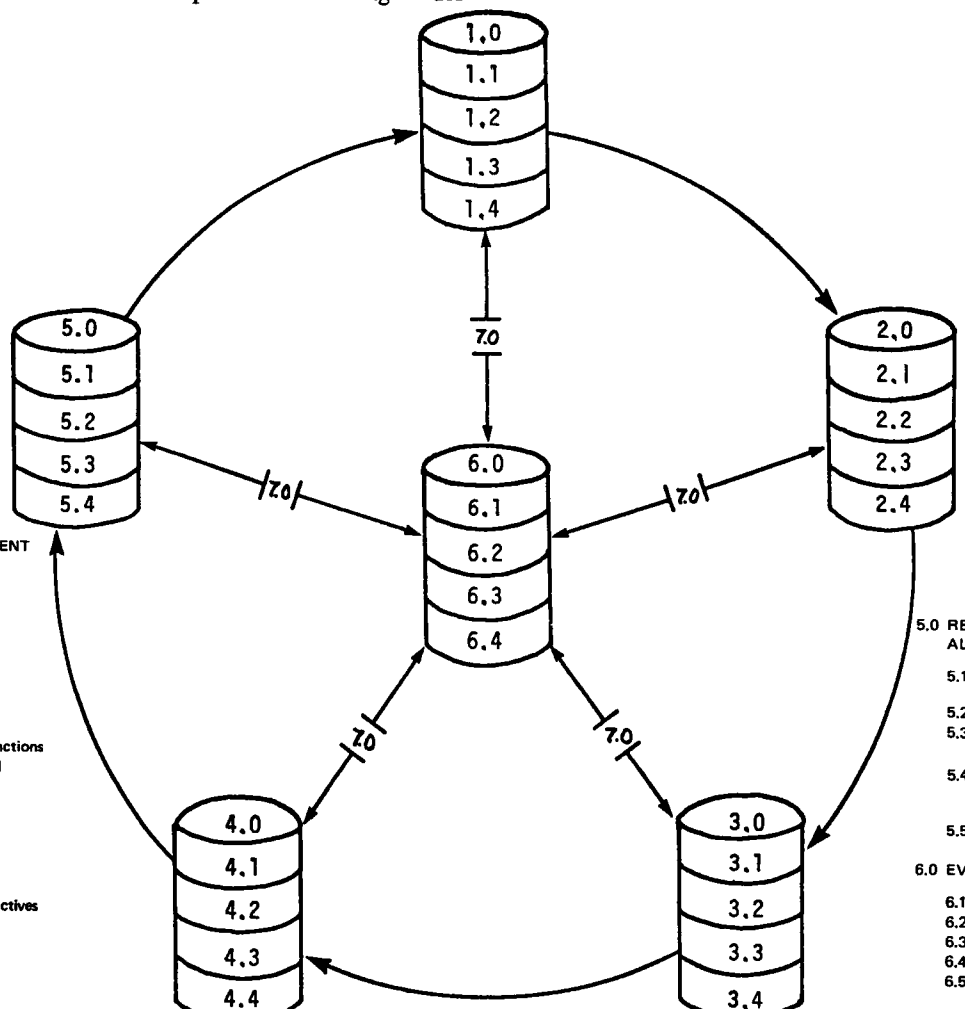
Figure 1

Campus Level Planning Model



1.0 ORGANIZATION OF CAMPUS LEVEL PLANNING/MANAGEMENT TEAM
- 1.1 Community
- 1.2 Staff
- 1.3 Students
- 1.4 Planning Staff

2.0 REVIEW OF EXISTING GOAL STRUCTURE
- 2.1 Review of district goals
- 2.2 Review of campus goals & functions
- 2.3 Establishment of campus level priorities

3.0 NEEDS ASSESSMENT
- 3.1 Instrument development
- 3.2 Data collection
- 3.3 Data analysis & review
- 3.4 Development of program objectives

4.0 PROGRAM STRUCTURE
- 4.1 Sub-unit planning
- 4.2 Alternative strategies design
- 4.3 Cost-effectiveness analysis
- 4.4 Selection of programs

5.0 RESOURCE INVENTORY & ALLOCATION
- 5.1 Review of current resource allocation
- 5.2 Projection of available resources
- 5.3 Review of program resource requirements
- 5.4 Reconciliation of program resource requirements & available resources
- 5.5 Development of program budget

6.0 EVALUATION DESIGN
- 6.1 Context evaluation system
- 6.2 Input evaluation system
- 6.3 Process evaluation system
- 6.4 Product evaluation system
- 6.5 Data collection & review

7.0 RECYCLING FOR PROGRAM CONTINUITY

Figure 2 Campus Level Planning Role Matrix

Major Activities	Principal	Planning/ Management Team	Operations Planning Department	Teachers & Other Staff	Students	Community
Establish P/M plan	R	–	–	P	–	–
Develop preliminary management plan	P	R	P	–	–	–
Review district goals	I	R	I	–	–	–
Develop needs assessment instrument	I	P	R	I	–	–
Needs assessment	P	R	P	P	P	P
Perform analysis of needs assessment data	P	P	R	–	–	–
Establish program priorities	P	R	I	I	I	I
Develop performance objectives	I	R	I	P	–	–
Develop program structure	I	R	I	P	I	I
Analyze cost effectiveness of alternative strategies	I	R	P	I	–	–
Review current resource allocation	I	R	P	–	–	–
Projection of available resources	I	R	P	–	–	–
Review program resource requirements	P	R	P	–	–	–
Reconcile program resource requirements & available resources	P	R	P	–	–	–
Develop program budget	P	R	P	–	–	–
Develop evaluation design	P	P	R	P	–	–
Collect evaluation data	P	R	P	P	P	–
Review evaluation data	P	R	P	P	P	–
Recycle information	P	R	P	–	–	–

Legend: R - Responsible Agent P - Participant I - Information Source

and administrative representatives (in most groups). Figure 1 depicts the organization of the model's seven major tasks and their sub-systems; Figure 2 possible role assignments of the team members.

The initial responsibility of the planning management team was to review the goal structure at both the district and campus level, to resolve conflicts between the two, and to identify areas of particular concern. Identification of the priority areas provides the content for the next basic task – needs assessment.

Each campus develops its own needs assessment to determine (1) the extent of agreement upon goals and priorities, and (2) the difference between desired and existing levels of performance in achieving identified goals. The teams in the schools now implementing this planning model have established the following criteria for developing instruments to assess local educational needs:

- The directions must be easily understood by each of the publics to be assessed.
- All program areas should be included in the content.
- The instrument's response structure should provide data compatible with automated processing equipment.
- It must make provision for rating both the existing condition for each program, activity, or function and the condition desired for each.

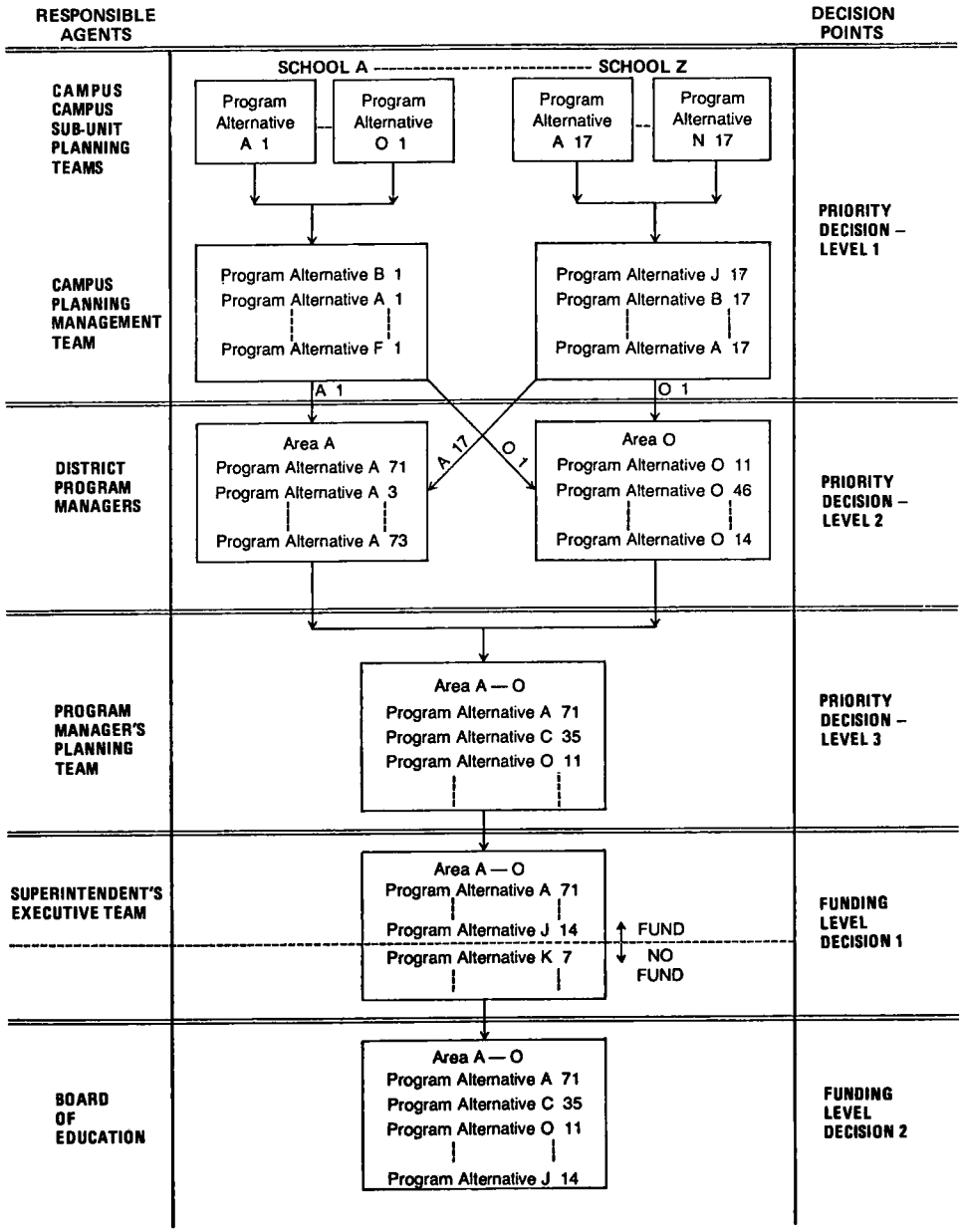
Schools in the pilot group have used various methods to implement the needs assessment phase of the model but they have been unanimous in their decision on the publics to be assessed – *community, students,* and *staff.* To date the results have borne out the wisdom of this decision.

Following the collection and analysis of needs assessment data and the review of institutional data, the team identified programs to be supported, assigning each a priority. The next step, and it is critical, is to develop performance objectives for each program. Realistic planning of performance objectives requires consideration of all viable alternatives and carefully studied selection of those which show most need and greatest probability of realization. This selection obviously is subject to the restraints of limited resources.

Given the performance objectives the planning/management teams' next task is to develop program plans consisting of interrelated learning and support activities designed to attain those objectives. This phase of the model has resulted in broader faculty involvement as sub-unit planning groups are developed in specific program areas. This involvement of staff with particular competencies in sub-unit planning areas is essential to successful program planning. Not only does it focus the efforts of trained and experienced staff on alternative strategies for goal achievement, it also affords them the opportunity to participate in resource allocation. In itself this ensures improved cost-effectiveness; those involved in implementation are in a much better position to make intelligent resource allocation decisions than district level administrators to whom this responsibility has traditionally been assigned. Involved in the team's process of resource review and allocation are such things as cost-effectiveness analysis, reconciliation of program resource requirements and available resources, and the development of a program budget.

The program budget involves conversion of allocated resources to dollar figures and assignment of the dollars to designated programs. This step includes not only final reconciliation of program needs and available resources, according to established priorities, but also preparation of the necessary budget documents for review and approval by the

Figure 3 Resource Management Work Flow Chart



appropriate administrative staff and the Board of Education. A key element in this process is the understanding of both the team and the funding authority of the direct relationship between goal attainment and the level of resources committed. If the recommended funding level is not met then goal attainment will be equivalently reduced. These decisions for action are key elements generated in the zero-base budgeting process as described by Pyhrr and adapted by the D.I.S.D.[5] Thus the model affords the degree of visibility so necessary for effective accountability, which obviously implies the next step in the process, evaluation.

The evaluation system chosen for inclusion in the campus level planning activities was the C.I.P.P. (context/input/process/product) Model developed by Stufflebeam.[6] Although this is designated as step 6.0 in the Campus Level Planning Model, it should be pointed out that development and application of the evaluation design activities proceed throughout the planning process. Review procedures are continuous and systematic so that pertinent findings can be fed back into the planning cycle, making it more responsive to changing contexts.

This is a circular model which can be entered at any point. If at any point data become available to campus management that indicate necessity for redirection of effort, then the team has the ability to enter those data into the appropriate system. This allows the entire model and, more importantly, the entire school to be more immediately responsive to altered conditions, reordered priorities, system break-downs, etc. It is this characteristic of the Campus Level Planning Model which is enabling the schools of the Dallas Independent School District to meet, indeed to anticipate, the needs of a changing society.

As each campus defines its goals, priorities and budgets, they are added to the total information system to determine the district's goals, priorities, and budget. Thus the traditional pattern of budgeting and goal setting is reversed. Rather than a determination of district resources and appropriate allocations emanating from the top administration and disseminated down through the several hierarchical levels, now these will be determined for each campus and the sum will comprise the District's goals, priorities, and budget. A graphic representation of this process is shown in Figure 3.

Summary

The Campus Level Planning Model provides seven basic steps for a planning, programming, budgeting, and evaluation system. The planned extension of campus level planning to all schools in the district should result in better decisions, broader staff involvement and support, a better informed and hence more supportive public, and improved educational programs for children.

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