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ABSTRACT

A number of group reports, speeches, and collections of notes have been compiled from a design workshop which dealt with the development of college facilities. The emphasis is particularly upon the recently formed local college system in the Canadian province of Ontario. Problems involved in the formulation of this system are related to considerations of the urban environment in which these institutions must exist. Some specific architectural questions are dealt with as aspects of university development and include--(1) the systems approach to design, (2) contracting methods, (3) planning and finances, (4) the importance of student housing, and (5) a view towards the future. (RS)

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Education and Architecture in the 20th Century

THE DESIGN WORKSHOP
COLLEGES OF APPLIED ARTS AND TECHNOLOGY

was held at the Talisman Inn
Ottawa,
November 18th and 19th, 1969

The attached group reports, speeches and notes are copies of material received from participants and group chairmen at the completion of the Workshop

SCHOOL PLANNING AND BUILDING
RESEARCH SECTION
ONTARIO DEPARTMENT OF EDUCATION

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OPENING ADDRESS
by S.T. Orlowski

I wish to extend a welcome to the participants who have come from this province, other parts of Canada and the United States to the third College of Applied Arts and Technology Design Workshop.

It is the thirteenth School Design Workshop organized by the School Planning and Building Research Section of the Ontario Department of Education. This Section was established in 1964 and soon after entered the field of planning post-secondary educational criteria for the future Colleges of Applied Arts and Technology facilities.

In 1967, twenty community colleges were established across this province. I consider it one of the greatest achievements of our time. It answers the needs of the community and even in these short two years of existence of community colleges, we can truthfully say that these words are not hollow.

There was a great problem of giving our young people education that would help them to cope with new demands created by technical development. It also gave an opportunity to adults to retrain and keep in step with the progress that in many cases deprived some people of their jobs.

From both educational and technical points of view, our colleges are trying to close the gap between the theory and action - because while our academic high schools and universities are concerned mostly with the theory and universal ideas, community colleges are building the bridge across the vast territories stretching from pure theory to the action line.

But this is not all. In the past several years, since the new ideas in the field of education emerged - we tried to employ several solutions to make these ideas work. The role of an architect is now more important than ever and also more demanding. I would like to quote here a passage from a lecture delivered by Mr. David Medd at a course at the Institute of Advanced Architectural Studies, University of York, England.

"The variety of provision, the variety of opportunity, the range of challenges that the school needs to offer, kill stone dead the notion of ranks of repeated rooms and circulation that still forms the popular image of a school.

Furthermore, in education, analysis is giving way to synthesis, so that the conventional distinctions between subjects, for example, are being merged. Academicism is giving way to relevance. As education no longer serves only the minority who accepted education as an academic process to be undertaken, a situation has developed in which education will not work unless it is seen to be relevant to the needs of those taking it. Therefore, the variety of activity for which schools have to be designed is only matched by the variety of life for which young people are being prepared."

Taking from here, as the educational programs are getting more and more realistic - dealing with actual happenings - the school buildings must blend with it. We do not want modern boxes that are only mechanically flexible, rigid within the pre-programed patterns, an imposed structure that is apart from the actual life. Neither do we want a "bubble kind of school" that would immerse us into the living world but would allow us only to view it through the glass panels.

Sounds like an impossible order. But as our programs are the product of our needs and interests and therefore, they are part of our lives, so our school buildings must be part of us, part of the environment.

How to achieve it? Picasso once said: "I do not seek, I find". Because to seek something we are unconsciously looking for a form that has already been shaped in our mind, while finding is a discovery.

But I do not want anybody to think that one can make a great discovery just by sitting and doing nothing. Discoveries are being made by people of great experience, by people working hard in a given field.

At the beginning our colleges were (and in some cases still are) located in temporary, primitive and old facilities, obsolete schools, rented houses, portables and even churches. Due to the enthusiasm, energy and knowledge of the Board of Governors, college presidents, and staff, we are now developing and occupying colleges which are aesthetic, functional and properly planned, in spite of the financial limitations and immediate necessities for space.

During this Workshop, we will discuss many problems of the college campus development. We must remember that the criteria in planning colleges should be based on the following:

a) Community colleges are in service for students.
b) Master plan must provide for the logical and coherent expansion.
c) Proper plan to eliminate the undesirable size of particular campuses.
d) Design of campuses which will accommodate progressive educational programs with freedom for flexible changes.

The educator and administrator, architect and planner must find the right solution so that the college will serve its purpose and at the same time will be enjoyed by its students and staff. And to debate on that seemingly impossible task, I give the floor to you gentlemen.

DESIGNING AN URBAN COLLEGE TO MEET URBAN AND NON-URBAN NEEDS
by J. Diamond

There are two aspects of catering to the needs of urban colleges and their communities. The first is the way in which a college or university goes about planning and implementing its development. The second is deciding the purposes for which the institution exists. More precisely, this second aspect is the ennunciation of goals, the long term ideals. The first aspect is concerned with objectives - the short range targets that help the achievement of long range goals - and policies - the way in which objectives are reached.

While the second aspect may be dismissed as so much motherhood-and-flag sentiment, and the first aspect acclaimed as the practical, useful methodology, I want to point out to you today that the first aspect I mentioned - that is, the way in which a college or university goes about planning and implementing its development, is profoundly dependent on the second aspect, the setting of goals, and that the relevance, usefulness and success of the whole program for institutions of education are dependant on the insight with which these goals are set.

Both aspects, in my opinion, require overhaul today. Let me begin by showing you how such a process can work out, for while I have divided the two aspects into separate categories, they are, of course, highly dependant upon one another. However, the following demonstration deals with the first aspect, planning and implementation.

Before demonstrating this, I first want to draw the significant distinction between a Master Plan and a long range development plan. Master Plans have traditionally given great attention to the formal aspects of physical planning. The delineate, with much detail, the shape and design of a campus. Master plans are an extension of the way in which individual buildings are designed - each element controlled to the smallest degree. While in a building this control is called for, the elements of a campus plan are not window sills or floor tile, but buildings themselves. Once there is such a change of degree, it becomes a change in kind. Therefore, this detail is not called for: each building, at the time of the formation of the master plan, cannot be planned with finality, because the needs of the users cannot be known sufficiently well, and even if known, usually change between the formation of the master plan and the construction of individual projects. If, as is usual, the success of the "plan" depends upon the design of the elements, then either the plan will fail, as it will no longer exist as the buildings change, or the buildings will fail if they are forced into the forms the master plan sets out.

A long range development plan, in contrast, first articulates the goals and objectives of the institution, in order that the many who are engaged in developing the institution, can devise, overtime, the most appropriate ways, or policies, to reach these objectives and goals. This goes for academic, administrative, economic and physical planning. If principles and performance criteria are set down, and these are satisfied, there is no necessity to set down, ahead of time, only one solution for their realization.

A building could, in a sense, be looked upon as a policy too - a physical means to reach educational or environmental objectives. Hence, at the time for taking action, the best alternative can be selected from the range available. Of course, the principles must indeed be carefully formed. This requires insight and the most judicious planning by those whose responsibility it is to form the institution: student, physical plant director, teacher and administrator. Thus an operating manual, outlining the institution's goals, the particular facilities' objectives, and the satisfaction required for a particular site can be given to each consultant, instead of presenting a set scheme to architects.
(At this time the projection screen was used.)

Here you see we compiled all of the available data. This information was taken from many sources, and, of course, was uncoordinated in its raw state. In order to make this material useful, we transformed all data and information to graphic form. Each set of factors was put on a separate transparency; this means that food services can be seen in relation to sewer lines, or library delivery superimposed over snow removal routes, or faculty offices and parking and so on. It is surprising how much information is available, and buried! As you see, the interface of two separate pieces of information provides a third piece of information, and even a new insight into the operation of the institution, and, of course, reveals existing and potential conflicts.

It is difficult for a large and complex institution to focus its views and articulate these concisely. As a result architects frequently become, by default, sociologists and educational philosophers, tasks they are, except in the most unusual cases, ill-equipped to take on. Consequently, we made strenuous efforts to get the university to articulate its goals objectives and favoured policies to reach the objectives. This was done after extensive consultation with groups of faculty, students and staff. We recorded, sifted and synthesized these views, and fed them back to the university for any required modifications. Once this task was performed, we used these views as the assumptions on which to base the planning.

Hence the transparent overlays you now see are physical consequences of enrollment projections, space needs by priority, affinity requirements

and, of course, the goals of the institution (The University of Alberta in this instance). As such they represent the long range development plan. You will see that we were careful to indicate the position of buildings without indicating particular designs for those buildings. The diagrams do, however, indicate what is expected of buildings to be built in those locations, expectations over and above the satisfaction which must be reached for the tenants. That is, each building has to both satisfy its inhabitants, and the general needs of the campus.

Lastly, I will show you diagrams which represent the results of negotiations with the city, in order to coordinate the efforts and expenditures to be made on movement systems; great benefit, as you see, can be derived from this cooperation. We shall, I believe, be able to eliminate many intersection problems, and sometimes the intersections themselves, at no extra costs to the institution or the city.

Naturally, planning in this way requires the contribution of first rate consultants.

It is much harder to find those who will use intelligence in the interpretation of principles, than to find those who will either dutifully fill in the missing gaps of a master model, or produce the stereotyped answer to problems facing us today. It is, therefore, of crucial importance to select consultants on the basis of their ability to tackle each problem afresh. The difference between mediocre performance and first rate service is the difference between rapid obsolescence and an unstimulating environment, and appropriate and effective institutions.

Now I would like to deal with some of the substantive issues raised in the second aspect I first alluded to, (if that is not too confusing), the goals of community colleges in urban environments.

As I am now straying beyond my particular field of expertise, I have simply listed some points of reference for the next part of this talk. I have listed these as points rather than describing them in detail, not because I believe we should confine ourselves, like poor technocrats, to a narrow field. On the contrary, it is precisely because those people who have a special training who will not concern themselves with broader issues that is seems machines are automating man, rather than vice-versa. But perhaps I have listed them, because -

1. I do not want to get held to what follows. (consistency being the hallmark of mediocre minds).

2. It is a pedogogical trick - I hope that the cryptic notes will encourage your speculative participation.

3. Because of laziness, it is easier to talk about than write about and

4. If I find I am boring you, I can easily leave some out.

CITY		COLLEGE
urban culture;	leaders' reaction to problems	technology & ideology
raison d'etre;		rural nostalgia
complexity & stimulus;		organization & statistics do not make a college
forms of order;	colleges not exclusive reservoirs of knowledge	enclave
alternatives & mobility;		campus - what does it mean for me?
	physical barriers to community interaction	
		residual institution; let the college take it on vs. new initiatives
	contribution to renewal of community;	
	facilities in relation to wider convenience;	

THE COMMUNITY ITSELF AS CAMPUS

In conclusion, I want to read an excerpt from a paper by William Birenbaum, Cities & Universities: Collision of Crises, which I believe to be of particular relevance.

"A first small step toward boldness is no longer a matter of choice: it is a necessity compelled by a citified North America. The impact of new knowledge upon the content of education forces a reconsideration and overhaul of the formalities and organizational structures of the learning enterprise. We are at a crossroad where the emphasis must be shifted from an educational system which merely serves the technology to a technology harnessed in the service of a new educational system.

How may we preserve the great academic traditions of the past and preshape the university mechanism so that the inheritance may be projected effectively into the future?

Within the concept of the modern city, the idea of "Campus" is archaic. The wide-open spaces, the monumental and inflexible architecture, and the insulation combine into an anti-urban phenomenon. The campus is more than a place; it is a system. It assumes turning the flow of human relationships inward. Its success depends upon imposing an isolated, contrived community upon the lives of its inhabitants. It is tenured, by the ranks, on a fulltime basis in a world where there is no tenure, ranking is officially abhorred, and no man can or should be "full-time" at anything.

Neither the lives of the teachers and the students, nor the problems confronting them, nor the configuration of urban talent conform to the "campus" version of life. "Campus" organizes the university's outrageous presumption that it can and does monopolize the best talents in order to do what it claims to do. In great cities, this presumption is absurd. It leads to the unnatural barracks-like life of the dormitory, to the deadening overlay of welfare-state services undertaken in behalf of "Learning for Freedom". The result is not the life and learning of free men, but a phony world leading students, teachers, their parents and friends to feel that "going to college" is an interlude rather than a part of life. For the city-based university, the circumstances of the urban environment and the rapidly changing nature of the content and methods of education raise the question: Why build forever? Instead of the conventional approach to building urban academic facilities for permanence and endurance, why not new standards to honor impermanence and to accommodate the reality of change? There is tremendous waste in the current processes used to plan and build academic facilities. Many of the new buildings, created to endure a half century or more, embody imperfect translations of what is needed to house the present educational operation. (Surprisingly few faculties and administrations can convey clearly to architects and engineers what they are doing now.) But there is an almost complete failure by those responsible for building the university to anticipate physical needs ten years ahead - let along fifty.

The style of city life - the problems of urban people and the patterns of their lives - and the changing content of knowledge combine to suggest the imperative of a continuum in the educational process. The insulation of "campus" - the place and the social system - will no longer do in the city setting. The exclusiveness and separateness of "university" are no longer acceptable, given the educational objectives we have established in this country. A new unity in educational activities at all levels is required.

To achieve this new unity, our universities and colleges must rely upon a much broader range of talents than they now employ. Many of the people upon whom the academic institution will have to rely should not and will not devote their full time to the university. Tomorrow's universities will have to be innovators in the mobilization of the best of the total community talents in order to teach, do research, and serve society. The part-time academic connection undoubtedly will become more prevalent than the full-time affiliation, especially in the city where the competition for brain power is bound to intensify. The future university - reliant upon a wide variety of industrial, governmental, and artistic resources and talents, but unable in view of the competition to monopolize the best of these talents available - will be compelled to redefine its concept of "campus". Necessity will lead to an extension of its day-to-day operations beyond the pieces of real estate upon which its special buildings stand. The function of the university will inevitably reach into the theaters, museums, industrial laboratories, libraries, and centers of financial, social, and political research housed in other urban institutions.

The future "campus", therefore, will be coincident with the pattern of location of central urban resources and will reach out to where those resources actually are. Great museums may become the future "departments of art". Symphonic and musical organizations may become the future "departments of music". Research centres in banking and finance may become the foundations of future "departments of finance and economics." Hospital research centres may become the future "departments of life sciences". Government commissions and research staffs may become the backbones of future "departments of political science".

Finally, the city itself may become the new campus, and learning - which is in fact coincident with living - intricately interwoven with the day-to-day activities of the city people".

THE PROS AND CONS OF EXISTING FORMULA FINANCING SYSTEMS AND A SUGGESTED NEW APPROACH

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A paper presented at the Colleges of Applied Arts and Technology Design Workshop, Ottawa, November 18, 1969.

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The opinions expressed here are not necessarily those of the University of Toronto, the Ford Foundation, or the Department of Education.

1. INTRODUCTION

During the current year the Colleges of Applied Arts and Technology (CAATS) of Ontario are expected to receive approximately $100 million in operating and capital grants from the provincial government to provide education to approximately 60,000 full-time and part-time students. Clearly, the CAATS are playing an increasingly larger role in the post-secondary education system of Ontario. At the same time, it is becoming increasingly more important that the CAATS are able to demonstrate to the Government and people of Ontario:

(1) that the level of expenditures on the CAATS is justified in view of competing needs in areas such as primary and secondary education, universities, health, welfare, economic development, etc.; and
(2) that the public funds allocated to the CAATS are managed efficiently and effectively.

The problem of financing higher education is a very sensitive one. It concerns the interface of education and government. Traditionally, education and government maintained a respectful distance. This was possible because education was privately financed. The CAATs, however, are largely dependent on the Ontario Government for financial support.

In view of this problem, it is important to understand the existing process of resource allocation and to explore ways and means to improve it.

2. THE EXISTING RESOURCE ALLOCATION PROCESS

Currently, the Ontario Legislature allocates funds for the CAATs through one appropriation (Vote 505) which also includes funds for adult training and Ryerson Polytechnical Institute. Subsequent to the formal appropriation, the Department of Education allocates the funds to the various colleges. The Colleges then prepare their own internal budgets.

There are, thus, three distinct levels on which resource allocation decisions are made:

(1) the Government of Ontario;
(2) the Department of Education, and
(3) the individual college.

How are decisions arrived at on each level? Five distinct steps may be identified:

(1) on April 1 of each year the Department of Education submits a long-term forecast of departmental revenues and expenditures to the Treasury Board. The forecast is based on its own projections of the level of activity in each of the programs which come within the jurisdiction of the Department.

(2) all Departmental forecasts are consolidated and reviewed by Cabinet and its committees during the summer in light of revenue projection, the economic condition of the province and political priorities. The review results in the establishment of basic policy directions and budgetary guidelines for all the departments.

(3) on September 1 the CAATs submit to the Department of Education a preliminary budget estimate. The estimate is based on the current budget adjusted for changes in wages, prices and enrolment.

(4) on October 1, the Department of Education submits its departmental budget estimates to the Treasury Board. The estimates are based on the submissions of the Colleges adjusted in light of the budgetary guidelines set by the Cabinet as a result of the review of the long-term forecast.

(5) the Treasury Board and the Cabinet review all departmental estimates and construct the final budget to be submitted to the Legislature in March or April of each year.

In the absence of a working formula financing scheme the Department of Education and the Treasury Board Secretariat are each using their own methods and standards to analyze line item submissions from the CAATs.

SOME OBSERVATIONS:

(1) the Department of Education is presently in a position where it has to prepare long-range forecasts without the benefit of a direct input from the CAATs.

(2) the preliminary budgets submitted by the CAATs to the Department of Education often arrive late and after the Department is required to submit its estimates to the Treasury Board (October 1).

(3) unless the CAATs are able to demonstrate their need for resources, both long-term and short-term, more effectively than has been done to date, they must be prepared to lose out in the vigorous competition for the limited tax dollar.

(4) both, the Treasury Board and the Department of Education would prefer it if the CAATs could agree on a formula for the equitable distribution of funds to the CAATs in general and each college in particular.

3. SOME FORMULA FINANCING SYSTEMS

In recent years, various jurisdictions have developed formula financing schemes. The system for Ontario universities, for example, is based on actual enrolment in various programs weighted on a scale from one to six. The total weighted enrolment determines the number of basic income units to be awarded to individual universities. The value of the basic income unit is determined by the Government in light of available resources.

A number of States in the U.S. have developed formula financing schemes. It is instructive to note the various approaches that have been taken in California, Florida, Kentucky, Oklahoma, Tennessee and Texas. (1)

Two types of formulas may be identified: base formulas and functional formulas. Both types differentiate the major functional areas within the college such as instruction, library, administration and operation and maintenance of physical plant. In a base formula, the direct expenditures of institutions are termed "base" expenditures and expenditures for other activities are dealt with as percentages of this base... In a functional formula anticipated expenditures for each activity are determined through a consideration of factors directly relevant to the activity itself.

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(1) The following is an adaptation from:

Miller, James A. Sr., State Budgeting for Higher Education, Institute of Public Administration, The University of Michigan, Ann Arbor, 1964, Chapter V, "Procedures Used in Selected States," pp. 94 - 150

Oklahoma uses a strict base formula, California and Texas have functional formulas and Florida and Kentucky and Tennessee, use a mixture of the two. Following are brief descriptions of the formulas used in the preparation of budget estimates for each of the major functional activities within the college:

3.1 FORMULAS FOR INSTRUCTIONAL COSTS

Each state begins the estimating process with a projection of full-time equivalent (FTE) student enrolment. The actual definition of FTE varies slightly from state to state but that is not too important.

On the basis of projected FTE enrolment, a calculation is made of the number of faculty members required:

- Kentucky uses a student - faculty ratio which is negotiated for each institution.

- Tennessee applies different ratios according to the size of each institution:

  15-1 for the first 1000 students
  30-1 for the next 2000 students
  20-1 for enrolment in excess of 3000

- Texas applies different ratios for each program ranging from 10-1 in Fine Arts to 19-1 in Liberal Arts.

- Florida calculates the required number of faculty members in terms of a ratio of student-credit-hours to FTE faculty which is renegotiated every two years for each individual institution.

- California has standard student-faculty ratios for each course. The ratio varies by subject matter, method of instruction (e.g. lecture, lab., or seminar) and enrolment by section.

- Oklahoma has determined the basic complement of academic faculty by reference to actual practice in smaller state-supported institutions. Additional faculty positions are allowed for enrolment above a certain minimum.

After each college has determined the total number of faculty members required, faculty salaries are calculated by multiplying the number of positions times the average salary in the various categories. No state has a set formula for the determination of staff salaries. Each state determines staff salaries through a negotiation process based on current salary levels in the state and the academic community concerned.

Estimates of other instructional costs such as supplies and equipment are handled differently in each state:

- California institutions each submit to the state a separate request for funds for institutional equipment and supplies.

- Oklahoma, Tennessee and Texas allow a percentage of academic salaries for instructional supplies and equipment. The actual percentages are based on past experience in each state and range from 15% to 33%.

- Kentucky negotiates an absolute amount with each institution.

- Florida calculates the amount separately for each institution on the basis of the cost per student credit hour for supplies and equipment (1964: $1.20)

3.2 FORMULAS FOR ADMINISTRATIVE COSTS

Administrative costs are calculated in several different ways:

- Florida, Oklahoma and Tennessee calculate administrative costs as a percentage of instructional costs ranging from 18% to 33%.

- Kentucky bases its calculations on a review of actual expenditures in past years adjusted for increases in workload and wages and prices.

- California has drawn up a master list of required administrative positions for various types of institutions. The cost is calculated on the basis of these fixed staffing patterns.

- Texas differentiates between institutions of varying size. The state allocates: (1961-63):

  - $2.20 per student credit hour for the first 120,000 credit hours (the approximate equivalent of 4000 enrolment);

  - $1.65 per student credit hour for the next 120,000 credit hours; and

  - $1.50 per student credit hour thereafter.

3.3 FORMULAS FOR LIBRARY COSTS

Five different methods are used by the states under study for the calculation of library costs:

- Two states determine library cost as a percentage of institutional costs: Oklahoma 8% and Tenessee 7.7%

- Kentucky awards $30.00 per student for libraries.

- Texas uses separate formulas to calculate (1) the number of library staff required, (2) the number of books required and (3) other operating costs.

  The number of staff is based on enrolment:
  one for every 300 FTE students for the first 1500;
  one for every 400 FTE students for the second 1500;
  one for every 500 FTE students thereafter.

- The size of the collection is specified separately for each institution and varies according to the programs offered and enrolment.

  A 6% of combined staff and book costs is added for other operating expenditures.

- Florida has made a commitment that each institution will be enabled to reach the standards set by the American Library Association.

- California applies a series of workload measures. The most important determinant is the amount of volumes allowed:

  4 volumes per student for the first 1000
  2 volumes per student for the next 4000
  1 volume per student thereafter.
  The total number of volumes is multiplied by an average cost per volume and then an additional 65% is added for processing and other library expense.

3.4 FORMULAS FOR PHYSICAL PLANT OPERATION AND MAINTENANCE

Three states calculate the cost of physical plant operation and maintenance as a percentage of institution costs:

- Oklahoma: 27%
- Tennessee: 18.5%
- Florida: negotiated each year for each institution.
- Kentucky and Texas apply a cost per square foot for various types of space.
- California uses a complex formula to calculate the number of positions and costs based on various workload factors such as: number of students, square feet of building space, acres of campus grounds, etc.

3.5 MISCELLANEOUS FORMULAS

In addition to the formulas described above, some of the states use formulas to calculate the cost of a variety of other activities, for example: Florida, Oklahoma and Texas add a small percentage of instructional costs for research. Oklahoma adds 10% of instructional costs for extension and public service activities. California uses formulas to calculate the cost of audio-visual services, student health services and student personnel services.

3.6 SOME NOTABLE FEATURES

It may be useful to highlight some of the more important features of the formulas used by the various states:

(1) In contrast with the Ontario university formula financing scheme, separate formulas have been developed for each of the main functional activities of the colleges.

(2) In each formula, student enrolment is the primary determining factor of the budget estimates of the institution.

(3) Most states recognize the fact that small colleges have higher per student costs because they are not able to take full advantage of economics of scale. Using different formulas for different size colleges compensates for small or growing institutions.

(4) Most states have established procedures for the periodic review of various formulas or unit costs.

4. ADVANTAGES AND DISADVANTAGES

Advantages claimed for formula financing schemes are:[2]

(1) Formula financing schemes assist in the analysis of resource needs and the presentation of budgetary information to funding agencies. It also assists in long term financial planning.

(2) Governments are provided with a means of foreseeing and controlling on a consistent basis, the general magnitude of college grants.

(3) There is a maximum incentive for the universities to be efficient and to arrange their affairs well; any notion that improvement in efficiency would lead to a corresponding reduction in support is offset.

(4) Formula financing usually has wide political acceptability. It protects governments from the charge of infringement on university autonomy. It facilitates the justification of increasing expenditures. The resulting grants are demonstrably equitable.

(5) Formula financing schemes allow individual institutions flexibility in course design and freedom in ordering their priorities.

(6) Private donors are assured that gifts for operating purposes are an added resource to the university and not a substitute for public support.

(7) Formula financing systems usually add a greater element of rationality to the budgetary process.

There are also criticisms:

(1) Formula financing is usually defended on the argument that it represents an equitable method of distributing financial aid. Exactly what equity is and why it is desirable is not clear. Furthermore, formula financing often tends to be arbitrary.

(2) Although formula financing systems are not intended to determine the pattern of spending within the university, pressures do develop within various parts of the university for funds to be distributed according to the "income generated by those parts."

(3) Formula financing often copes poorly with the development of new institutions and new programs.

(4) Formula financing provides no rationale for the allocation of public resources to universities as opposed to other areas of the public sector.

(5) Formula financing schemes have often built in false incentives. For example, the Ontario scheme encourages universities to maximize their income by increasing enrolment in specific categories.

(6) Formula financing schemes make it more difficult to effect basic changes in the system.

(7) Formula financing is useful only to determine the amount of government support. In many cases it is not useful in the internal budgetary process of each institution.

5. OBJECTIVES AND CRITERIA

The objectives of the formula financing scheme for Ontario Colleges

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[2] "Report of the Committee on University Affairs, 1967," Douglas T. Wright, Chairman, P. 12

of Applied Arts and Technology would be to meet the financial needs of the colleges to enable them to accomplish their basic objectives:(3)

(1) to provide courses of types and levels beyond, or not suited for, the secondary setting;

(2) to meet the education needs of graduates from any secondary school program, apart from those wishing to attend university;

(3) to meet the educational needs of adults and out-of-school youth whether or not they are graduates.

The formula financing scheme to be developed should have the following characteristics:

(1) it should be carefully defined and understood by all concerned.

(2) it should allow for differences among institutions not only in existing programs but also for differences in educational methods and administrative practices.

(3) the scheme should have built-in incentives for educational effectiveness and administrative efficiency.

(4) it should be sensitive to the most important cost variables of the colleges such as enrolment, subject areas, methods of instruction, size and location.

(5) it should be acceptable to the colleges and the Department of Education.

6. THE DEVELOPMENT OF A FORMULA

From the start, one fact must be clearly understood; the decision on the part of the government to fund educational programs at certain levels is basically a political decision. It is therefore dependent upon two factors:

1) the Government's assessment of the importance of the CAATs contribution to the well-being of the Province; and

2) their assessment of the financial requirements of the CAATs to make that contribution.

It is therefore, in the interest of the CAATs to demonstrate clearly to the Government of Ontario that

1) the educational services provided by the CAATs are essential for the well-being of a significant segment of the people of Ontario and for the economy as a whole; and

2) that the funding levels requested for various educational programs are necessary to maintain proper academic standards.

The first point is not of immediate concern here but will be discussed briefly, later in this paper.

The second point is of prime importance in the development of a formula financing scheme. So far, the colleges have not effectively demonstrated that particular funding levels are required for certain programs in order to maintain proper academic standards.

Current attempts at developing a formula financing scheme for the CAATs have been aimed at calculating per student program costs in each college with the hope of discerning consistent cost patterns to form a basis for a formula. The attempts have not been very successful because no consistent cost patterns could be discerned. This is due to the great divergence in the colleges of program offerings, teaching methods, administrative policies, etc.

One obvious way to overcome the current difficulty in developing a formula is to standardize programs, teaching methods and administrative policies for all of the colleges. In such a situation per student program costs would be very similar in each college varying only by enrolment and, perhaps, size and location of the college. However, this alternative is clearly undesirable from many points of view.

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(3) Ontario Department of Education, "Colleges of Applied Arts and Technology: Basic Documents", June 1967, P. 13.

A more positive alternative is to continue to allow colleges complete freedom in course design, teaching methods, etc., but specify some reasonable funding levels for each major program. The question to be answered for each major program (for a possible list of major programs see Table I) is: what is a reasonable level of per student program cost?

6.1 CONCEPTUAL APPROACH

Traditionally, per student program costs are arrived at through a detailed financial analysis of the budget or financial statement of the particular college. In the next few pages, an analytical process will be described which will focus primary attention on such variables as teaching methods, administrative policies and institutional characteristics. The basic purpose of the analysis is to develop objective information regarding the cost of a range of reasonable program alternatives in different institutions. The information will serve as a basis for the negotiation of specific funding levels for each major program between the CAATs and the Government.

There are four basic analytical tasks which need to be performed:

1. The first analytical task is to determine precisely the reasons for the significant variations in current per student program costs in each of the colleges. This analysis would result in the identification of the important cost variables in each major program. The variables would be divided into two groups: controllable variables (e.g. teaching method) and uncontrollable variables (e.g. size and location of the institution). (For a possible list of variables see Table II).

2. The second task would be to test the sensitivity of each of the controllable and uncontrollable variables. This may be accomplished most effectively through the use of a simulation model, With a a simulation model, it is possible to calculate the effect of a change in one variable while all others are held constant. The type of hypothesis to be tested would be, for example:

   (a) the size of total enrolment at the colleges significantly influences program costs;

   (b) the particular combination of programs offered at a college affects program costs;

TABLE I

POSSIBLE LIST OF MAJOR PROGRAMS

1. Technology
2. Technician
3. Mechanical
4. Apprenticeship
5. General Arts & Sciences
6. Communication Arts
7. Administrative Sciences
8. Secretarial Sciences
9. Marketing & Services
10. Library

TABLE II

ILLUSTRATIVE LIST OF VARIABLES

1. Variables Which May be Controlled by the College

    1.1 Teaching Method

        - Lecture
        - Laboratory
        - Seminar
        - Computer Assisted Instruction (C.A.I.)
        - Educational Television (E.T.V.)

    1.2 Administrative Policies

        - Staff Teaching Load
        - Space Utilization

    1.3 Program Characteristics

        - Years of Duration
        - Sessions Per Week
        - Hours Per Session

2. Variables Which May be Controlled Only with Considerable Difficulty

    2.1 Program Configuration

        - i.e. the combination of major programs to be offered at each institution

    2.2 Program Enrolment

3. Variables Which Cannot be Controlled by the College

    3.1 Geographic Location of College

    3.2 Certain Unit Costs

        - construction costs

(c) year round operations in a tri-mester system reduces program costs;

(d) special grants are required to initiate new programs.

The result of the simulation analysis would be to identify those factors which significantly effect program costs.

3. The third analytical task consists of the exploration and identification of the full range of reasonable alternative combinations of controllable variables which might be utilized to conduct each of the major programs.

4. The fourth task would be to calculate the cost of each set of alternatives and to test the sensitivity of the resulting per student program cost against the various uncontrollable variables of several institutions. Once again, this type of calculation may best be performed with the aid of a simulation model.

The analysis would produce two specific outputs:

(1) an extensive list of reasonable alternatives for the conduct of each major program; and

(2) the per student cost of each alternative to different colleges. (See Figure 1)

The extensive program cost information would serve as an excellent base for the negotiation of acceptable funding levels for each major program. For each dollar amount proposed the analysis would indicate which alternatives could be adopted by each college. Thus the negotiations could centre on the most important issue: which set of alternatives will enable the colleges to accomplish their basic objectives.

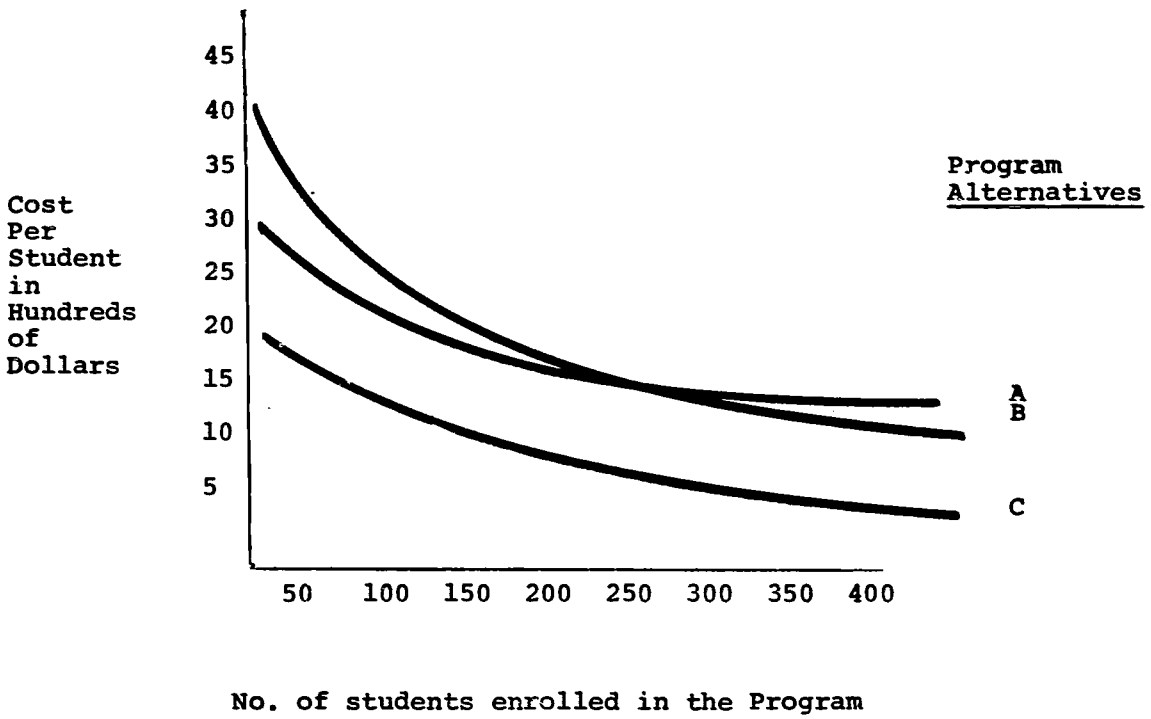
The process just described may serve to develop a formula for operating grants. However, the same basic process could also serve to develop a formula for capital grants. Indeed, the cost of physical facilities may be included as one of the many variables to be considered so that a combined operating and capital formula could be developed.

One point needs to be made quite explicit. No formula financing

FIGURE 1

PER STUDENT COST OF PROGRAM ALTERNATIVES

(ILLUSTRATIVE ONLY)



scheme is intended to determine the internal resource allocation process of individual colleges. It must be clearly understood that the formula to be developed would only be intended to determine the amount of financial support each college is to receive from the Government. In fact, the analysis as outlined above would provide each college with a complete range of alternatives it may want to adopt.

6.2 PROJECT OUTLINE

Using the conceptual approach described above, a formula could be developed in about four to six months. Thus if a project were initiated within the next month or two, it could be completed early in the summer of 1970, thereby allowing sufficient time for the colleges and the Government to adjust to the use of the formula for the 1971-72 fiscal year.

The project would have a number of identifiable stages:

(1) The first requirement is the establishment of a study team and the choice of several representative colleges for detailed study. Since simulation models have already been developed for three of the CAATs it would be logical if these were chosen for the first part of the study.

(2) The first part of the study would consist of a detailed analysis to determine precisely the definition of major programs, the list of variables which are significant and the sensitivity of each of the significant variables. This analysis could be accomplished in about two months if the campus model and the information collected at the three colleges would be used for the analysis.

(3) The third stage in the project would consist of the identification of the various alternative program designs employed not only by the three colleges chosen for the detailed study, but for all the Ontario colleges. As a result, the project team could produce a complete inventory of current program designs. In addition, the project team could explore alternatives such as C.A.I. or E.T.V. which are not yet widely used in all programs. The project team might decide at this point to limit further analysis to a limited number of alternatives for each major program.

(4) The list of program alternatives would then be simulated for small, medium and large colleges, given various administrative policies and different levels of enrolment. A list of alternatives and per student program costs for each alternative would then be produced.

(5) On the basis of the objective information concerning various program designs and their related costs the Presidents of the CAATs could then negotiate with the Department of Education and, perhaps, the Treasury Board the funding level to be adopted for each major program i.e. the formula.

(6) The entire process could be reiterated periodically, for example, every two or three years, to ensure that the funding levels for each major program remain adequate to maintain adequate educational standards. In between review periods, the funding levels for each program would have to be adjusted annually to compensate for increases in wages and prices.

Figure 2 illustrates one possible form which the final formula might take.

7. PLANNING, BUDGETING AND FORMULA FINANCING

The introduction of a formula financing scheme will of course require certain changes in the planning and budgeting process of the CAATs. Following is a brief outline of a planning and budgeting cycle.

FALL

(1) The most important step in the planning and budgeting process is the determination of the objectives of the institution. In the CAATs this requires the systematic analysis of the DEMAND for education in the field of applied arts and technology to meet the objectives and needs of STUDENTS and SOCIETY at large.
The first step therefore is to prepare accurate enrolment predictions and to evaluate current employment patterns in the community and the province. In light of the above analysis the college would then establish new objectives or adjust current objectives.

FIGURE 2

POSSIBLE FORM OF THE FORMULA

NOTE:. The amounts shown are hypothetical per student grants.

PROGRAM	PROGRAM ENROLMENT			
	0 - 50	50 - 75	75 - 150	150+
TECHNOLOGY	$4500	4400	4200	4000
GENERAL ARTS	$2800	2500	2500	2300
COMMUNICATION ARTS	$3500	3400	3300	3300
	COLLEGE ENROLMENT			
	0 - 500	500 - 1000	1000 - 2000	2000+
LIBRARY	$120	105	90	75

(2) The second step consists of the development of various alternative programs that would accomplish the objectives of the College. The impact on resource requirements of each alternative must then be calculated. This may be done most effectively with the aid of a simulation model.

WINTER

(3) The third step consists of the preparation and submission of a long-range forecast of the colleges' workload and resource requirements to the Department of Education.

The submission of the long range forecast would serve two basic purposes. First, it would include an accurate statement of the current college enrolment. This would serve as a basis for the final calculations of the formula income each college is entitled to for the current year. Secondly, the forecasts would allow
SPRING the Department of Education to prepare its forecast of total departmental operations which is required by the Treasury Board for April 1 of each year.

SUMMER

(4) As stated on page 2, the cabinet undertakes its basic policy review during each summer. Subsequent to the review, the Cabinet issues certain policy directions and budgetary guidelines. This allows the individual departments to prepare their budgetary estimates with some understanding of the size of increases that will be allowed. In the same manner, the Department of Education might be able to give the CAATs an indication of the general increase in funding levels (e.g. 3%, 6% or 8%) that could be expected for the next fiscal year.

FALL

(5) Early in the fall the CAATs would submit to the Department of Education a preliminary statement of enrolment of expected formula income. This would enable the Department to prepare its final budgetary estimates required by the Treasury Board in October.

(6) In light of the general budgetary guidelines, the colleges are then able, once again, to review their objectives, test alternatives with the aid of a simulation model, and revise the long-term forecase.

Admittedly, it will not be easy for the colleges to prepare accurate long-term forecasts at first. But after several iterations, the forecast should become both easier and more accurate.

8. CONCLUSION

In this paper, an attempt has been made to explore various formula financing systems, to consider their advantages and disadvantages and to suggest a new approach.

Underlying the entire discussion has been the realization that, ultimately the decision to allocate a certain amount of public funds to the CAATs is a political decision. The type of analysis outlined in Section 6.1 would provide not only a formula for the allocation of funds to each individual college but also a rationale for the determination of the total amount to be allocated by the government to the Colleges of Applied Arts and Technology.

THE SYSTEMS APPROACH TO BUILDING

by R. Halsall

The traditional methods of building construction have relied heavily on labour on the job site. Over the years more and more products have been standardized and factory-produced. Power tools and machines have been introduced to make labour more productive, but in the U.S. 10 years ago 2.7 million construction workers produced construction valued at $66 billion, $24,000 per worker. Last year, in constant dollars, 3.4 million workers produced $85 billion in construction, or $25,000 per worker. This represents a productivity increase of only 0.4% a year per worker, compared with an annual productivity of 2.5% for the economy as a whole. Negotiated wage increases in construction labour in this period have been far higher than increases for other labour, despite this glory lack of justification and clearly we have reached a state where some major breakthrough, either in design techniques, products or management methods, or all three, are desperately needed.

One other statistic here might be of interest.
In 1963 a careful study carried out by the division of Building Research of N.R.C., on a sampling of construction sites in Vancouver and Toronto showed that between 40% and 50% of field labour time was applied to non-productive activities. The report broke down this time into:

Receiving instructions
Searching for materials, tools and equipment
Waiting for materials, tools and equipment
Held up by other tradesmen
Personal delays
Idle for no apparent reason

It also pointed out that there was a significant variation in efficiency between one type of construction and another. Apartment and simple repetitive buildings showed relatively high efficiency, while schools, hospitals and more complex buildings became progressively worse.

Fortunately, there are some hopeful signs to be observed, and they are in fact flashing more clearly in Canada just now than anywhere else in the world.

Three areas of significant improvement are defined with the word "System" and they become rather confusing, but here are three definitions:

Definitions

The Systems approach to building is merely the application of the scientists' logic to a problem, rather than acceptance of ad hoc routines that have developed and become accepted over the centuries.

The traditional scientific approach to any problem is:

1. Definition of the problem clearly and comprehensibly.
2 Analysis of the problem into its components.
3. Hypothesize responses to the components of the problem.
4. Investigate and reuse until one is able to prove their validity.
5. Synthesize the proven values and relationships into a statement of solution to the problem.
6. Be persuaded to accept recognition and reward.

It has only recently been recognized that this is as equally applicable to constructing an educational building as it is to the study that goes on inside.

The ad hoc approach in many peoples eyes has been frequently rather different - I say this with tongue in cheek and emphasizing that this is only an unproven hypothesis.

1. Define the recognition and reward that must accrue to a solution.
2. Analyze the defined recognition into component concepts that will photograph effectively for the glassy journals.
3. Hypothesize drawings that might relate to these concepts.
4. Investigate and revise owner's requirements to prove that they conform to the hypothecated drawings.
5. Synthesize the unproven component concepts and relationships into the whole problem on a construction site.
6. Persuade the owner to accept the problem clearly and comprehensively.

Clearly the System approach is the better and it is rapidly being implemented by the better architects and engineers.

An example of the System approach to building is one of Ottawa's major builders, who retained a firm I am involved with to undertake a comprehensive study of his housing operations. After this was

completed, his house design was greatly rationalized but no change was made to the finished product that the house owner would recognize. All the product changes were in fact improvements in quality and performance and reduction in cost. The most newsworthy item that came out was that the builder acquired his own forests and lumber company. That is one result of the System approach to the problem of building houses on a large scale.

A Building System is generally meant to be coordinated and generally prefabricated set of components that can be assembled in different ways to perform one or more functions in a building - such as a structural system, a ceiling system, or a heating and coding system.

Systems Building is the whole process of construction using an integrated group of building systems, in which generally the planning, design, programing, manufacturing, site operation, scheduling. financing and management are coordinated into a disciplined method of mechanized production of buildings.

First of all we accept the logic of the systems approach and we apply this to whatever problem we have.

This has been done most remarkably to date in Toronto, in the S.E.F. schools project. It has resulted in the development and acceptance by Metro Toronto School Board of 10 Building Systems that are now being used in a Systems Building Program of 31 schools and one administration building, totally about 2 million square feet of construction.

The S.E.F. project is the most sophisticated product of a sequence of development taking place over the past 20 years. Just after the war a group of school authorities in England faced with an urgent need for new buildings developed a set of parts like a large meccanno set for constructing the skeleton framework of a school. This was the original CLASP system. Floor and wall panels have now been developed, but it is still a very rudimentary system and only provides a building shell. However, this part of the building is installed quite a bit faster than by traditional construction, and the modular discipline it impresses brings advantages also to the other trades.

A young American architect who had been working in Britain on the Clasp program then returned home and in 1961, with help from Educational Facilities Laboratories, financed by the Ford Foundation he persuaded a group of school boards in Florida to coordinate into one program the needs for 13 schools, about $30 million. This program was analyzed and it was decided that building systems could be developed to provide for main components of the school buildings:

Structure
Ceiling-lighting
Heating ventilating
Interior partitions,

covering about one half the total cost of each school.

Performance specifications were written defining clearly the properties, performance and target prices for these systems and proposals were received from industry. It was claimed that the cost of the products involved in the program was 20% less than the price that would have been obtained using existing standard items and the program was satisfactorily completed.

One very interesting item regarding the prices for the products developed for this program, S.C.S.D. is that the successful and the unsuccessful bidders have been busy marketing their system across the States ever since and the cost of the structural frames built to these specifications have been falling steadily, even in terms of contemporary dollars. The State of Florida has accepted the S.C.S.D. specifications for a $40 million school building program. In 1963, the initial S.C.S.D. structures were low-bid at _____ per square foot. In the most recent Florida tender call, structures using the same specification were priced at $_____ per square foot. This is the fact of progress we need.

In 1967 the Metro Toronto School Board launched its S.E.F. program aimed at 2 million square feet of school construction and in 1968 Montreal started work on the R.A.S. program with an objective of 3 million square feet of construction. The Montreal program involved 5 systems. The tenders received early this year were below budget and an ingeneous precast concrete structure was the result. I have no illustrations as there is nothing yet built but the political and administrative problem appear now to have been resolved and construction of a prototype building has recently been authorized.

The Toronto program is getting into full swing and I can give some illustrations. My firm was retained firstly by the Canadian Steel Industry Construction Council to advise them on industry participation in the venture, and then we were retained by a consortium to prepare a design and manage the whole project of testing, interfacing and bid preparation. This was the successful structural proposal and here are some slides of the end product.

Firstly, a small school addition was built as a test bid to demonstrate that all the low-bid systems did in fact perform as they were supposed to do. This was successfully completed and the first year's batch of schools, representing about one half of the program are now underway. The largest is Roden public school in the City of Toronto, a 3 storey building containing 83,000 sq. ft. The bare frame of this structure was erected in 8 days and the whole school is scheduled for completion within _____weeks of the contractor getting access to the site.

The schools in this program have much more elaborate capabilities than conventional buildings. They are fully air conditioned and carpeted. All electric electronic power and communication circuits are freely available by connection on a five foot grid throughout the ceiling. Partitions permanently demountable and operable may be located anywhere on the 5 foot grid and a complete range of surfaces are available. The only non system items are stairs, foundations, slabs on grade, field painting where necessary and exterior site work. Virtually all possible problems have been tackled and either eliminated or solved, in the design of the standard components and the design of the buildings, and their construction in the field becomes a quick and accurate process of assembly. The structure is designed to allow up to 4 stories, with clear spans of up to 35 x 65 ft. and a live load throughout of 100 pounds a square foot, with partitions locatable anywhere on the 5 foot module as I mentioned earlier. The cost with all these facilities is below the target set as the Metro ceiling cost formula at the beginning of the program and it is estimated that these schools, which cost about $11 a square foot, would cost $4.00 a square foot more if built by conventional construction.

These performance capabilities are in response to the S.E.F. specification, produced after a profound study of the present and foreseeable academic preferences in school buildings for the Metro Toronto area.

They are not necessarily appropriate to the particular needs of other education systems, but many authorities want to take advantage of this new hardware. Vancouver School Board have commissioned an architect to use 5 of the major S.E.F. components. Boston is accepting virtually the whole S.E.F. spec. on two large schools immediately and enquiries are being received from across the continent by the participating manufacturers.

A sales organization has been established to offer a group of systems that were developed for S.E.F. in an integrated fashion and with some modification to the products to lower the cost somewhat by remaining the most expensive of the sophisticated refinements requested by Metro Toronto. I expect that the systems developed for the Montreal program will also soon be actively marketed. The two cities had significantly different requirements, but the basic modular dimensions are the same and some interchangeability between components is likely to develop.

So much for the hardware of systems developed for educational buildings. Many of these are probably directly applicable to large areas of community college buildings, providing high performance, flexibility of function at controllable and modest cost (S.E.F. price lists).

There are not really very many areas of a community college where one can honestly guarantee that components will be the right things in the right size in the right place for the 50 years or whatever that the building shell might be acceptable for. Probably only auditoria, stairwells, dormitories, swimming pools, main mechanical and electrical rooms and washrooms are genuinely fixed. Other elements that may have a permanent type of occupation may vary widely in desired size and service - such as libraries, cafeteria, lecture rooms, laboratories, shops. Who can say what future courses or teaching methods will require.

For a building to be suitable for organic growth or rearrangement it is really necessary for the various elements to have a dimensional precision that can only reasonably be achieved by factory manufacture.

However, the systems now available on a large scale do not by any means meet all the requirements of a community college building project and we return to the Systems approach.

Define the problem.

Analyze it into its components - see how far existing Systems can most efficiently meet some of the needs.
Investigate remaining needs and see if other systems should be developed or other rationalization carried out.
Synthesize the systems into the most efficient whole.

Here are some slides indicating in a diagramatic way the Systems approach applied to fundamental planning developed by one firm of architects with whom we collaborate, and directed specifically at community college buildings.

To close, I should mention other areas where systems building is coming into prominence. These include hospitals, apartment buildings and residences, service stations and motels, houses and parking structures - to name only the fields in which I personally have become involved, and to show that systems building in the hands of good architects can produce most pleasing as well as efficient buildings, here are some final slides.

DECENTRALIZED MODULAR SYSTEMS VERSUS CENTRALIZED SYSTEMS

by R.E. Crossey

The assigned title of "Decentralized Modular Systems versus Centralized Systems" suggests a paper which would involve a detailed collection and synthesis of innumerable cost items. These items would then be displayed in complicated graph and tabular form. I do not intend to develop this type of study. "Modular Decentralized Systems" is a term that designates the development of mechanical systems that solve relatively small portions of a building complex by the installation of standardized equipment and distribution routes. This solution is then repeated throughout the building design.

Mechanical engineers have continued to implement design methods which have been developed through a continuous evolution of centralized systems. This practice was reinforced by successful experience with this equipment as opposed to relatively sad exposures to the early unitary equipment installations. We have all been plagued with numerous incidents of poor quality construction, as well as a relatively continous barrage of misleading published information. However, this past history should not automatically condemn the present trend towards unitized or modular design which is occurring throughout this Continent. At the present time there are many reputable manufacturers who publish data on their equipment which is as reliable or more so, than anything received in the past on centralized equipment. The manufacturing techniques and reliability of the equipment itself has improved tremendously to the point where the manufacturers themselves are willing to accept the maintenance contracts for the complete system involving their equipment. We no longer can afford the luxury of dismissing this type of system to the so called lower quality category of residences, apartment buildings and supermarkets. It might also be worthwhile to investigate our attitudes towards these areas of design as they constitute a larger and more important portion of the economy than the specialized fields of educational buildings.

Recent cost studies of educational buildings indicate large differences in heating, ventilation and air conditioning costs that may vary between $2.00 and $8.00 per square foot. This spread in cost figures can be somewhat justified by the variation in the loads imposed on the spaces and their specific performance criteria. However, there have been many incidents where equal performance has been achieved at prices that vary from $3.00 to $5.50 per square foot. The lower cost figures are being obtained by systems which have been designed to handle relatively small portions of the building as a mechanical module or system area.

The concept of modular design often uses the existing pieces of unitary equipment, but in many cases it is still necessary to blend the items of built-up equipment with unitary items. In the future I expect these two generally recognized classes of machinery to thoroughly blend so that they are no longer recognizable.

The building industry is now belatedly entering the era of technological manufacturing methods which relate all component items to cost control, performance and flexibility. The engineer can no longer work in a vacuum and exercise his arts to achieve known results with known methods and materials. He must recognize the greater world in which he performs which includes all the functions of political science, sociology, psychology and economics.

The client must be identified and accepted before proceeding into design decisions and commitments. In the education field he can best be though of as the representative of the general public with all the hopes and fears for the future of their children and their willingness to bear taxation and assign priorities for expenditure of public funds. The present growth of educational capital and operating budgets has in effect stated the constraints which must be followed in the selection of all components of the building including the heating, air conditioning and ventilation systems. These are as follows:

1. Interest Rates

   Interest rates have risen to such a degree that it is obvious that all capital expenditure must be arranged so that the maximum use and benefit can be achieved in the shortest possible period of time. We cannot afford the luxury of building large, oversized facilities which will not be fully used to capacity until some vague date in the future which may be ten or fifteen years away.

2. Cash Flow

   Due to the large number of institutions which are simultaneously being built, the expenditure of funds must be related to the budgetary methods of obtaining funds and therefore would be ideal if it could be restricted so that it follows the curve of annual enrolment.

3. Flexibility

   This very much misused word has become major requirement in the design of these colleges. Flexibility relates to change and time. In the case of the colleges, time can be day to day during the design and construction period, and month to month following construction. The change portion of flexibility can only be handled by permitting the change of an individual component in the selected system or providing space for the addition of a special solution for the individual case.

4. Programed Coherence

   A continually expanding building program required a general solution which can be applied during the initial and following stages of construction. This general solution should be selected so that it can easily follow changes in size, use, shape and orientation. It must permit the inclusion of future technological development without the penalty of changing or having to accept a rigid system of distribution of energy and operating methods.

5. Cost

   Cost control of the design is perhaps the prime restraint. The cost of mechanical systems in the recent past has demonstrated that there is a tremendous variation in the contract cost involved in education buildings. One of the prime elements that is contributing to the cost of building is the extremely high cost of field labour rates in the construction industry which is still increasing at an accelerating pace. When this high labour cost is combined with low efficiency in the field, it is obvious that all our efforts must be directed at increasing the work performed at the manufacturer's factory while reducing the work load at the job site.

Our office is presently developing one approach to this problem and trying it out in a series of designs. This solution is not being offered as the panacea of all problems but may be usefully described as an illustration of what can be presently achieved. This system utilizes gas or all electric multi-zone roof top units. The equipment being used is a direct development from the California system which led to the S.E.F. program in Metropolitan Toronto and the systems developed for the Catholic School Board in Montreal. The Ontario Fire Marshal's office restricts the use of fuel burning equipment to

one installation per 4,000 square feet of roof area. Self contained packaged heating, cooling, ventilation and humidification units are available in sizes up to 14,000 cubic feet of air per minute. The combination of these two items restricts the design of a roof mounted fuel burning system to buildings of three storeys or less, as 14,000 cubic feet of air will handle a maximum of 12,000 square feet of gross space. When this is related to the Fire Marshal's regulation of 4,000 square feet of roof area, a building configuration of three storeys or less is determined. However, this limitation is not absolute as electric energy is not restricted by the Fire Marshal. Therefore it is still possible to design modular mechanical systems for higher buildings that operate on the all electric principle or are combined with a central fuel burning boiler plant that is either in existence or may be selected for the specific project. It is to be hoped that future development will give us more numerous tools to work with and somewhat ease up on these present limitations. If a system can be designed so that the air handling units are repetitive and either mounted externally on the roof or internally on a continuous series of penthouses, then all heating and cooling can be accomplished by air. Where specific requirements arise such as entrance ways, stairwells, receiving areas, etc. these can be solved economically by the use of local electric heat. The air handling, heating and cooling of all units may be energized with gas, oil or electricity. Ceiling systems are available that incorporate lighting, supply air diffusers and return air plenums. The ductwork can be selected to use a restricted number of sizes, and all pumps, pipe insulation and piping can be removed from the installation with the resulting benefits of simplicity, construction time and field labour cost reductions. Control sequences for the air handling equipment are standardized and installed in the manufacturer's plant, thereby reducing the heartaches involved in the field installation of highly sophisticated individual control systems which are difficult to install and operate.

The evolution of this concept can be illustrated by looking at the design of a series of buildings. The first slides show the new Life Sciences Complex at Dalhousie University. The large concrete shafts on the perimeter of the building enclose a series of air handling units which feed the adjacent areas of the building. These units are stacked vertically up to three units high and are fed from a central heating and cooling plant.

The second series of slides show the Manpower Building of Sir Sandford Fleming Campus in Peterborough which is very simple and is achieved by roof top units.

The final series of slides show the campus of Cambrian College in North Bay and the new campus of Sir Sandford Fleming in Peterborough. In this design the roof top units have become part of the total building concept and are repeated on definite intervals.

The concept of repetitive units at regular spacing is now being applied to penthouse and duct distribution systems for the new addition to Scarborough College and is being proposed for the Prototype Terminal Unit for airport design being developed for the Department of Transport.

When the modular system is used a large portion of the design effort is concentrated on the early development of the mechanical, electrical, structural and architectural elements. This demands a complete acceptance of this approach by all members of the design team and a continuing discipline of all members during the later development stages. The repetition of these elements has a pronounced effect on the configuration of all building elements and imparts a cohesive theme to the complex. If the selection has been well made it will result in a building which is continuously expandable and is capable of handling all of the forecastable requirements. Future alterations and conversions will be simplifed and maintenance operations will be repetitive and capable of organized scheduling.

PLANNING THE TECHNOLOGY AREA - Its Inflexibility by Weight of Mechanical Servicing by C.E. Stockman

A. INTRODUCTION

Colleges of Applied Arts and Technology comprise three fundamental functions; namely, academic, technology, and administration. Each area must be designed to perform a specific function and should do so in the most efficient manner. This is a basic responsibility of the planner and the designer.

All of us here are aware of the tremendous advancement achieved in education. The changes in teaching philosophies and in techniques in fact have been so great that the designer has difficulty in keeping pace with these developments. Although this may be a problem for the designer, he is faced with a much more challenging task, if not an impossible one. That is - how to design a plant which will enable the teaching profession to implement the latest teaching techniques and philosophies of tomorrow in a building built today. The teaching profession's answer to this challenge is "design for flexibility". This answer may be feasible in the academic areas and in the administrative areas, where changes are not so severe, usually involving partitioning, lighting and other minor changes to the building services. In the case of the technology areas, flexibility is a major problem. In this area the user service, the planner, and the designer must decide (a) how much flexibility is required, and (b) how much flexibility is economically justified.

B. TECHNOLOGY AREAS

In order to fully appreciate the difficulties in providing fiexibility in the technology area, it is necessary to consider some of the activities which take place, and to analyze their requirements on the building and its mechanical services.

1. Laboratories

(a) These can be broken down into individual rooms, such as Chemistry Laboratory, Physics Laboratory, Electronics Laboratory, Testing and Control Laboratory, and others. The space required for these activities is quite comparable to the conventional classroom space. Finishes may not be as critical as that for classrooms. The mechanical services required include electrical power, gas, compressed air, water, acid resisting sinks, and acid resisting drains, fume hoods, distilled water, etc. These services usually are piped to the laboratory desk from the ceiling below if this is possible, or are piped down from the ceiling space. These services usually enter the laboratory from conveniently located and accessible pipe spaces. In addition to these specific services, the room itself must be planned for proper lighting and environmental control. In the latter case, provision must be made for the use of fume hoods, which exhaust in the order of 750 to 1,000 CFM per hood. This may vary, depending on the hood capacity. Unless the more costly induction type exhaust hood is used, this exhaust air must be provided through the main environmental control system. In this case provisions may be necessary to interlock the fume hood operation with the return air system to retain some degree of balance between supply and return and exhaust air.

Another item affecting the design of the environmental control system is the student occupancy, which in the case of a laboratory is based on 50 sq. ft. of floor area per student, whereas that of a classroom is in the order of 20 sq. ft. of floor area per student.

Electronics Labs obviously will not have the same requirements for all the plumbing services previously mentioned. On the other hand, their requirements from an electrical service standpoint are much greater. Also their impact on the environmental control system becomes a factor which must be provided for in the design of this system, in that the degree of heat dissipated from the equipment can be a major factor in determining the capacity of the environmental control system for this laboratory. In a similar manner, the Control and Instrumentation Laboratory may present another design problem for the engineer. Some test equipment may demand controlled temperature and relative humidity, the control tolerances of which are more critical than that provided for in conventional laboratory or classroom space.

(b) Drafting Laboratories

The space required for drafting laboratories is quite similar to that of a conventional classroom. In this area the intensity of illumination is much greater than is normally provided for in a classroom. This area should have an illumination in the order of 100 to 150 f.c., whereas conventional classroom illumination is approximately 60 to 80 f.c. Again the environmental control system must be

designed to accommodate the higher heat load developed by this added lighting load.

2. Shops

The Shop Section of a Technology Area may include Civil Engineering, Mechanical Engineering, Welding and Heat Treatment, Machine Shops, Motor Mechanics, Metal Working, and Hydraulics. This space is of an industrial design incorporating a high ceiling (usually 16 to 18 foot clearance) and requires only industrial type finishes. Provisions in this area must be made for some, if not all, of the following:

(i) Vibration - foundation isolation for heavy test equipment.

(ii) Heat treatment ovens with exhaust hoods.

(iii) Material testing equipment.

(iv) Welding machines with suitable power outlets and associated fume exhaust systems.

(v) Heavy metal working equipment with associated cooling systems as are required on metal cutting machines.

(vi) Material handling systems such as a monorail with chain blocks.

(vii) Power outlets, designed to accommodate heavy electrical motor loads. (This is usually provided for in the form of a higher voltage bus duct.)

(viii) Engine testing and exhaust systems.

(ix) Heat transfer systems.

Most of this equipment, of necessity, should be located on the ground floor slab.

Of necessity, the environmental control system of this space is unlike that of a classroom or a laboratory. A much higher rate of ventilation must be provided since the exhaust air requirement in this area is much greater than in any other area. Environmental control is less critical than in academic areas. For these reasons, shop environmental control systems are usually separate from any central environmental control system. Furthermore, this system must be designed to accommodate intermittent operation of the fume hoods.

C. REQUIREMENTS OF A FLEXIBLE DESIGN

Flexibility implies the miltiple use of a given space and/or the economical conversion of a space from one function to another. Here one must not overlook the importance of the meaning of "economical conversion". Also implied is complete accessibility and expandibility of all mechanical services mentioned previously to meet the new demands of the teaching profession. The review of the individual rooms in the technology area clearly indicates that complete flexibility of space is not economically possible. What degree of flexibility then is economically possible? In order to intelligently answer this question it is necessary to examine various systems which will produce some degree of flexibility.

1. The Central Double Walled Corridor Concept

This concept involves a central corridor with laboratories on either side. In order to provide access and flexibility of mechanical services, a double corridor wall is provided on one or both sides of the corridor. Distribution of services is by means of ring mains at the lower level with vertical risers located in the double corridor wall extending the full height of the building. The double wall must provide free access to all mechanical services at each floor and for this reason the space may vary from a minimum of two feet to a maximum of four feet clearance. Depending on the length of the building, banks of risers are strategically spaced so as to reduce the horizontal runs within the double wall space to a minimum. From this space, mechanical services can be extended through access panels into any laboratory ceiling space, or behind laboratory desks depending on the type of distribution system utilized in the laboratory design. This type of flexibility is utilized primarily in multi-storey buildings where the demand on mechanical services is extremely high.

2. The Perimeter Double Wall Corridor Concept

This concept is somewhat similar to the Central Double Walled Corridor concept, but differs primarily in the location of the corridor. In cases where environmental control tolerances are much more demanding, this scheme in essence eliminates the effect of the exposure on the environmental control system. For this reason, corridors and the double wall shafts are located

around the perimeter, forming an envelope around the laboratory areas. Pipe shafts again are provided in the manner described for the Double Corridor system. Needless to say, the shape of the building, or the shape of the area involved, also influences the choice of system selected.

3. A Central or Multiple Service Shaft Concept

This concept is intended to reduce the added cost factor of the Double Wall Corridor Concept, which is quite substantial. Through careful planning, laboratories may be located so that mechanical services can be provided through a common vertical service shaft rising the full height of the building. Again these service shafts should be designed in such a manner that the services contained therein are completely accessible at each floor. This concept usually involves a greater degree of horizontal distribution piping. The horizontal distribution piping can be reduced if the laboratories can be so arranged that each group is serviced by its own service shaft. This system does not provide the flexibility of the two systems previously mentioned, but does increase the ratio of net floor area to gross floor area, thereby reducing the cost of the building.

All the above concepts are primarily intended for laboratory services such as compressed air, gas piping, distilled water piping, drain services, power, instrumentation, etc. They will make possible the conversion of a chemistry laboratory to a physics laboratory. They are not intended, however, to enable the conversion of a chemistry laboratory to a civil engineering lab. They will permit the extension of existing services into laboratories without any serious cutting and patching of the building walls and floors. Also they will permit the addition of new central services.

D. ENVIRONMENTAL CONTROL SYSTEMS

Up to now we have considered ways and means of providing some degree of flexibility to building services, as applied to the technology areas. However, not to be overlooked, and of equal importance, is the environmental control system or systems which form an integral part of the building. The major factors which affect the design of this system can be summarized as follows:

(a) Design of building fabric.
(b) Exposure.
(c) Lighting intensity.
(d) Occupancy.
(e) Laboratory equipment.

Of these, only the first two factors are constant. The latter three factors probably will change with a change in activity. In order to accommodate this change, the central plant and the air distribution system must have a built-in flexibility. This flexibility can be provided only in one form and that is excess capacity. This excess capacity must be designed into the system initially, which means oversized ductwork, oversized heating, and cooling, coils, and excess fan capacity. Needless to say, this represents dollars which most programs can ill afford. Furthermore, is this added cost justified as it may never be used? It therefore, is quite apparent that such excess capacity cannot be justified and in fact is not justified. The end result is an environmental control system which is rather inflexible.

E. ECONOMY OF DESIGN AND FLEXIBILITY OF MECHANICAL SERVICES

What is the effect of a flexible mechanical system on the budget of the project? The degree of flexibility has been reviewed and was found to be somewhat limited. This degree of flexibility which can be provided undoubtedly will increase its cost accordingly. If cost is no major consideration, there is no problem. Unfortunately all of us, including the academic staff of a College of Applied Arts and Technology, must accept the fact that this is a major consideration. In this day of rising construction costs, the emphasis is on economical design. What is an economical design?

F. ECONOMICAL DESIGN

An economical design involves all design descriptions. The building must be well conceived and carefully planned. Activities requiring common services must be grouped so that the cost of providing mechanical services can be reduced to a minimum. Flexibility of space must be carefully studied, particularly by the user service, who also must appreciate and accept the limitation of mechanical services previously outlined. In light of this fact, all who form a part of the design team must appreciate this limitation when attempting to create a flexible building.

G. CONCLUSION

Two questions previously have been asked - "how much flexibility is required?" and "how much flexibility is economically justified?" The battle of the budget which the entire construction industry and the design profession in particular is fighting, makes the answer to the latter question quite obvious - very little, if any. To the former question, it is my contention that with thoughtful planning, and careful design, very little flexibility is in fact required.

SUMMARY by J. Levine

In this report we have described our progress to date and some of our initial findings. More detailed information on the project is available in other reports that are either in draft form or still in preparation as shown in Table I.

Simulation models for each of the three pilot colleges are now operational on data gathered from the colleges. We are presently carrying out the first simulation experiments for them and thus beginning the evaluation phase of the project. An information system has been designed and set up in the colleges. It includes procedures and forms for gathering and preparing the data needed as well as for reporting on the results of a simulation. A computer terminal has been installed in each college to allow it to communicate with its simulation model and data that have been stored on an IBM 360-65 computer in Ottawa. The economic reason for using the large computer is shown in Table II. In the appendices of this report we have described the kinds of problems that can be addressed with CAMPUS (CAATS)^2 and some sample analyses.

Preliminary estimates indicate that the cost and time required to implement CAMPUS (CAATS)^2 in the other CAATs will vary with the size of the institution and the number of colleges that proceed together. The elapsed time needed to develop an operational model of one of the other colleges will be no less than 4 months and no more than 6 months at a cost of between $15,000 and $36,000. The annual operating cost, including time of internal personnel, external technical assistance and computer time, will be between $10,000 and $20,000 per year.

The pilot phase of this project will be completed before the end of Januray. The initial results thus far have been most encouraging and we are confident that the final assessment will demonstrate clearly the benefits of the system that has been developed.

PROJECT REPORTS

Volume I	-	The CAMPUS (CAATS)^2 Project: A progress report on the development of cost simulation models for three Ontario colleges of applied arts and technology, November 1969.
Volume II	-	CAMPUS (CAATS)^2 Input Documents
Volume III	-	CAMPUS (CAATS)^2 System: 1. Information requirements and reporting Structure 2. Output reporting structure 3. User command language 4. Remote CAMPUS
Volume IV	-	CAMPUS (CAATS)^2 Sample Input and Output Reports
Volume V	-	CAMPUS (CAATS)^2 The Pros and Cons of existing formula financing systems and a suggested new approach

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The following documents are in preparation:

CAMPUS (CAATS)^2	-	Its use in planning physical facilities
CAMPUS (CAATS)^2	-	Its use in evaluating changes in academic plans and policies
CAMPUS (CAATS)^2	-	Its use in evaluating changes in administrative plans and policies
CAMPUS (CAATS)^2	-	Its information requirements and a design of general information systems for operating control and reporting
CAMPUS (CAATS)^2	-	Users Manual
CAMPUS (CAATS)^2	-	What it is; how to use it; what it costs
CAMPUS (CAATS)^2	-	A cost benefit evaluation and recommendations on its future

The Cost and Time of Simulating the Operations of a College of Applied Arts and Technology for 10 Years using CAMPUS (CAATS)[2]

Calculations Done By [*1]	IBM 360-85 Computer	IBM 360-65 Computer	IBM 360-40 [*2]	Man and a [*3] Calculator
Time Needed	30 seconds	3 minutes	12 hours	6 months
Cost	$30.00	$40.00	$1,200.00	$4,000.

*1 Estimate number of calculations and steps to be followed 150,000,000.

*2 An estimate only it may not be technically feasible run on this size machine.

*3 Assuming no errors in calculations or procedure.

A. Introduction

Beginning Januray 1st, 1969, Systems Research Group undertook a project to develop operational cost simulation models of three of the Colleges of Applied Arts and Technology in Ontario. These models, and the data needed to feed them, have been developed and are now operating. This report describes our progress to date and identifies the remaining activities in the study and from the initial results thus far suggests alternative ways of proceeding beyond the present undertaking.

B. A Review of Completed Project Activities

The following is a list of the major project activities that were identified in the original proposal of September 4th 1968:

" a) Meet with the full committee of presidents, their administrative representatives, planners and architects to define the range of planning problems facing the CAATS. The scope of the model in terms of the analyses that it would be able to perform and the kind of information that it could supply would be identified at this time. While the pilot model would not be designed necessarily to handle all the specific problems of each of the colleges it would be built in such a way that it could be expanded to do so in the event that the pilot project proved its worth.

b) Prepare the technical systems design specifications of the model including its data requirements and the form and substance of reports that it would generate.

c) Assess in detail the proposed model and its ability to cope with specific planning problems of the three sample colleges. Make whatever modifications are necessary in order to accomplish this.

d) Develop with the three colleges the information requirements of the model and help them to formulate the kinds of planning analysis that they will carry out using the model when it is completed.

e) Carry out all computer programming to have the model working on a computer that is made available to the colleges, thoroughly test the programs and prepare them for use by the pilot colleges.

f) Work with the colleges in helping them to use the new tools on a variety of planning problems and iron out any remaining computer programing or model design problems.

g) Consider the following with respect to the pilot model and its wider use by the other colleges:

- The cost of implementing the model in the other colleges broken down as to initial cost and its ongoing operational costs.
- The potential benefits from its use to various types and sizes of colleges.
- The organizational questions of how the model would be made available to the colleges and the role of their own personnel in using it.
- The means by which the colleges would physically communicate with the model and perform analyses on it. This would include the question of confidential data.
- The question of training administrators in understanding the full potential and usefulness of the new tools and exactly how they can be used by them on their problems.
- The information needs of the model and their implications in a wider sense for information systems design within the colleges, including an assessment of the costs and benefits of computerized and manual information systems on staff, students, space, finance and so on to be integrated with the model and its communications network.

h) Present the results as steps (g) and (f) to those who were involved in step (a) for their comments and criticisms and discuss in particular the relevance of results of step (f) to the problems of the wider group of colleges.

i) Consider the technical requirements, the cost and benefits, the information requirements, and the compatability problems involved in developing a 'systems level' model of all of the colleges.

j) Prepare a report summarizing the results of the project and make recommendations on any next steps deemed to be desirable. "

Steps a, b, c, d and e have all been completed. Step f is in progress; step g is in progress and our initial findings in this area are reported on in this document; step h has yet to be undertaken and will probably take place in the first part of Januray; step i is in progress and our initial findings are reported on in this document; and step j has been begun as demonstrated by the reports that accompany this summary.

C. Information Systems Design

A complete system for gathering information needed by the model has been devised. Forms and coding sheets that describe information on staff, students, space, finance, programs and curricula, and general policy have been prepared, tested and used in the colleges. The document entitled "CAMPUS $(CAATS)^2$ Input Documents" contains a set of each one of the coding sheets that has been used. This information is not only useful to the model directly, but also indirectly to the colleges themselves. A computer program has been written as an adjunct to the main model that analyses this information and puts it into readable report formats that can be used by the administration. Samples of these reports are contained in section A of the document "CAMPUS $(CAATS)^2$ Sample Input and Output Reports".

The document entitled "CAMPUS $(CAATS)^2$ Systems" describes the way in which data are gathered, how they are processed and analysed and the relationship of the reporting system to the basic data contained in the files.

In addition to the design of this system to meet the needs of the computer model we have begun a study to analyse the broader information needs of the colleges for purposes of internal control and day-to-day information requirements. An initial design of this information is currently being prepared and should be ready for discussion by the first week in December. We hope to produce, as a result of this study, general recommendations on the kind of information that should be maintained, the form in which it should be maintained, and the integration of this data with the operating needs of the colleges and the Department of Education. Included in our final report on this area will be estimates of the costs and benefits to be derived from developing this system in a number of ways including computerized extensions of the existing model information system as well as manual extensions of it.

D. Management and Planning Reports

An extensive set of reports has been developed for the model. These can provide concise summaries or very detailed elaborations depending on the needs of the user. Information can be provided on one particular

simulation period, or summarized over a number of periods into the future. The selection of reports is at the complete control of the user and he may ask for or delete any or all of the reports available. Information can be produced in both tabular and graphical form. The graphs are generated by a Calcomp plotter that produces continuous line graphs from the output of the model. The document entitled "CAMPUS (CAATS)^2 Systems" has a detailed section describing all of the reports that are available and the document entitled "CAMPUS (CAATS)^2 Sample Input and Output Reports" contains examples of each of the reports that are available.

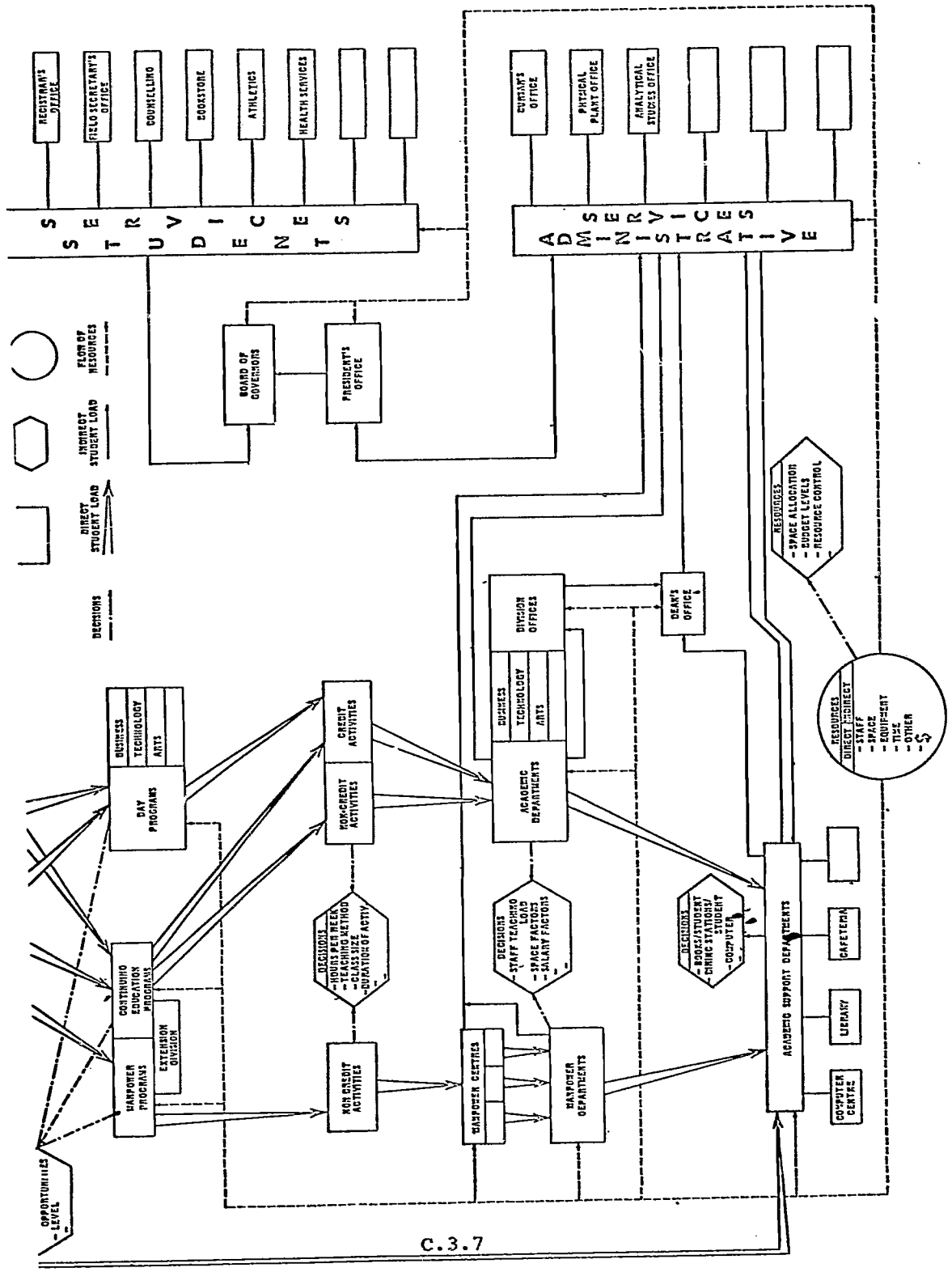
An additional feature of the reporting system is that it has been developed so that it can function not only on simulated data from the model, but also on historical data that is gathered to describe what has actually taken place in a particular semester or year.

Thus these reports, or rather the reporting system from the model, can be combined to produce an information system that supplies continuous information over time in the same format. In other words, should a person in one of the colleges want to get information on the costs of a particular educational program he would select a report number that gave him the amount of detail he wanted. If he were interested in information on what had happened in 1967, then he would go to the information system and receive an historical summary. If he wanted information on what would likely take place in 1972 he would ask for a report from the simulation model. The only difference in the two reports would be that one report would be entitled "simulated", the other "historical", but the formal and presentation of data would be the same. This concept helps to develop confidence in the use of the system and make it easy for people to recognize the data as presented and get the maximum amount of meaningful information from it. It should be emphasized, however, that these reports are for management and planning purposes and are not intended to include the detailed control functions, in particular of the accounting departments of the colleges.

The reports that are available from the model are structured not only on an organizational basis, that is, by division, department etc., but also on a program basis. Thus the colleges can be looked at from one of two different viewpoints and the cost of its operation analysed from both with respect to determining the impact of making changes in curriculum, administrative policy, teaching methods, etc. The program oriented reports also provide a useful adjunct to a formula financing or program budgeting system as will be pointed out later on in this report.

E. The Campus (CAATS)^2 Simulation Model

At present we have developed a fully operational and tested computer model which can represent each of the three colleges we are dealing with in the pilot study. This model can be adapted with relatively minor modifications to the other colleges in the system. The computer program presently consists of 15,000 Fortran language statements, and is being operated on an IBM 360-65 computer. Some twelve programers and systems designers were involved in the model development effort, and while the system is now operational, they are continuing to modify and add improvements to it. The figure entitled "Colleges of Applied Arts and Technology Schematic and Resource Loading" describes the basic logical structure of the model. In essence the model accepts descriptions of the academic programs being offered in the college, the way in which they are being carried out, combines this with quantitative descriptions of administrative policies, and simulates the operations of the institution under these conditions.



C.3.7

It seems appaient now that the model is too large to be operated on any of the computers that the colleges are likely to have on their own premises. This means that they will have to communicate with some kind of outside service, either by taking advantage of a university's computer or one of the commercial computer utilities that has grown up in the province.

F. The Use of the Model

The staff support required to operate the model once it has been established can be broken into two types of personnel. The first involving a person or persons who can help the decision-makers in the colleges to formulate their problems for analysis and then interpret the results of these analyses back to them. The problem formulator will probably only have to be a part time person in the college who will have working with him a couple of part time assistants to aid in particular with the data preparation. These people should, in our opinion, reside within the colleges, and probably be drawn from existing staff. On the other hand, there is a need for a technical capability to maintain the models and information systems to insure that they function properly and to adapt them to the changing needs of the colleges. This capability we feel should be provided from some central technical body so as to lower the cost to the participating colleges. We do not feel, however, that the problem formulator type of staff can be drawn from a central group. These people must be part of the ongoing organization of the institution if the use of the model is ever to have a real impact on decision making.

While Systems Research Group personnel are at present functioning as the internal staff and problem formulators, we see no problem in transferring this role to the college staff once the study has been completed, and if the colleges and the department decide to proceed in an ongoing way. In fact, in some of the pilot colleges, this transfer has already taken place.

In order to test the concept of the central technical facility, we have incorporated the simulation models of the colleges into a new system that has been developed by SRG called Remote CAMPUS. Under Remote CAMPUS a college using the CAMPUS model is not required to have any technical staff nor any major computer facilities. The simulation model that represents the participating college and the basic information base of that college are stored on a large central computer. A number of alternative means of communicating with the central facility are established and SRG functions as a technical support to the colleges. See Figure 1.

In the case of the community colleges, the three models and associated data bases for the pilot institution are stored on an IBM 360-65 computer operated by Systems Dimensions Limited in Ottawa, Ontario.

INFORMATION, DECISION, AND CONTROL*with a look at the CAATs
by G.S. Tracz

Before any valid (relevant) analysis of the "system" of the Colleges of Applied Arts and Technology (CAATs) can be made, it is necessary to refer to the initial objectives under which this new level of education was established in Ontario. These are listed on page 13 of Basic Documents on CAATs as published in 1967 by the Ontario Department of Education:[13]

...one may recognize three major responsibilities of every such college:
(1) to provide courses of types and levels beyond, or not suited to, the secondary school setting;
(2) to meet the needs of graduates from any secondary school program, apart from those wishing to attend university; and
(3) to meet the educational needs of adults and out-of-school youth, whether or not they are secondary school graduates...**

Since today's topic deals with information systems as they relate to long-term educational programing, the platform that I will use to overview the path of attainment of these objectives, to identify the important decisions to be made, and to develop an information framework to assist decision-makers, is the Educational Flow Chart given in Figure 1. Most of you are familiar with this chart: it is taken from the Guidelines for Planning the CAATs,[14] and has been included in many of the colleges' descriptive literature on entrance requirements.

This flow chart, then, depicts the movement of students through various levels of the Ontario educational system, from the elementary grades through to the CAATs and universities. Because education is for students, the pivotal element about which everything revolves should be the student himself; he should be the center of the education universe. If this point of view is adopted as one possible approach, the identification of the educational information required might be greatly simplified.

Specifically, information node no. 1 (Figure 1) calls for the meaningful development of the population and demographic data required for planning.

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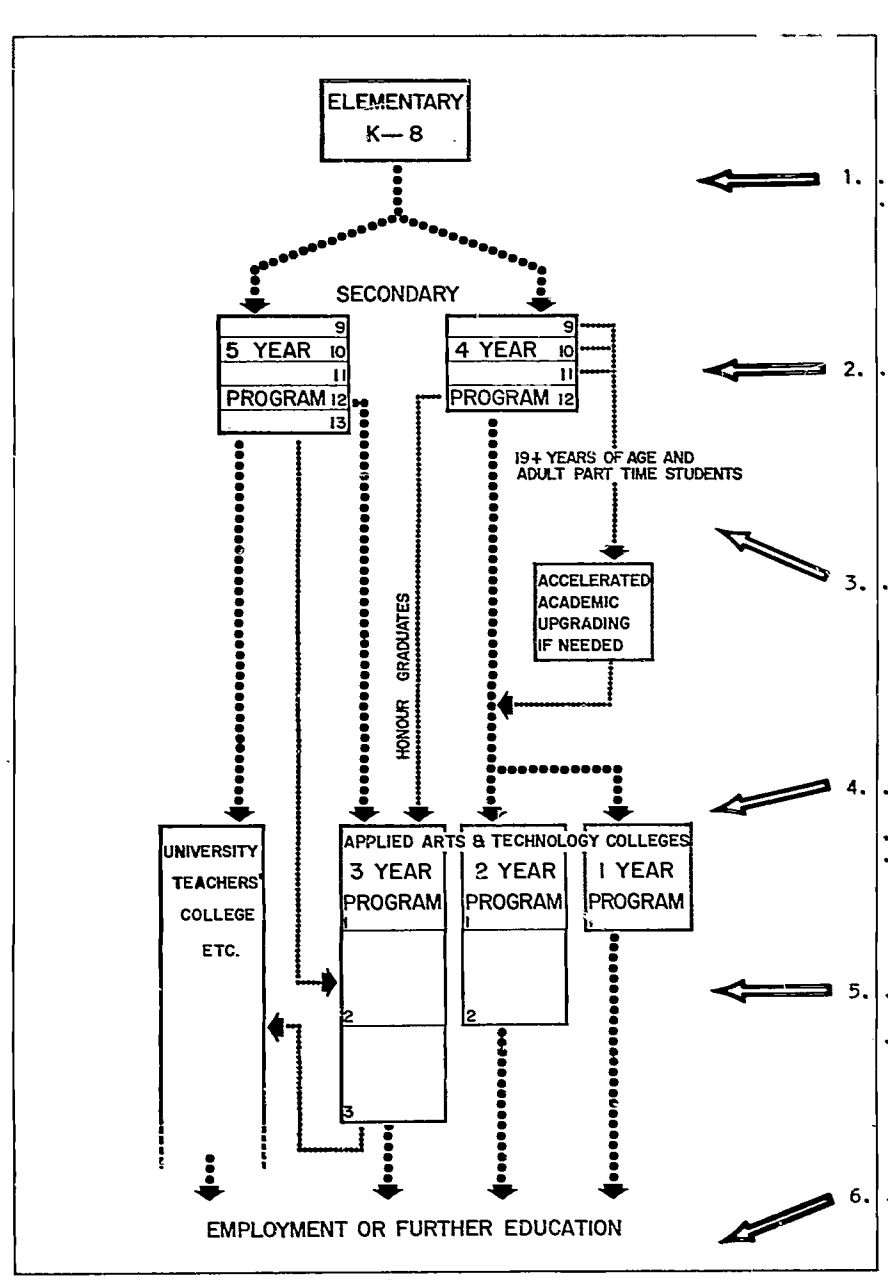
* Research reported in this paper has been made possible in part through funds made available under the Federal-Provincial Research Agreements of the Federal Department of Manpower and Immigration, and by the Ontario Department of Education (Schedule 10) for the project entitled, "Technology, Education, and Employment, II." The views presented here are solely the author's.

** Statement by the Minister, The Honourable William Davis, in the Legislature, May 21, 1965.

Educational Flow Chart *

Chart 3



*Reprinted from reference 14, p.8.

FIGURE 1

Table 1*
Select Population Data Needs for State Education Decisions

I. Population
- A. total numbers
  - 1. age
    - a) 0-4
    - b) 5-12
    - c) 13-17
    - d) 18-24
    - e) 25-65
    - f) over 65
  - 2. sex
  - 3. language spoken
  - 4. religion
  - 5. income
    - a) 0 - $4,999
    - b) $5,000 - $8,999
    - c) $9,000 - $11,999
    - d) $12,000 - $14,999
    - e) over $15,000
- B. density rates
  - 1. central city areas
    - a) age
    - b) language spoken
    - c) religion
    - d) income
  - 2. surburban areas
    - a) age
    - b) language spoken
    - c) religion
    - d) income
  - 3. rural areas
    - a) age
    - b) language spoken
    - c) religion
    - d) income
- C. migration rates
  - 1. age
    - a) 0-4
    - b) 5-12
    - c) 13-17
    - d) 18-24
    - e) 25-65
    - f) over 65
  - 2. sex
  - 3. language spoken
  - 4. religion
  - 5. income
    - a) 0 - $4,999
    - b) $5,000 - $8,999
    - c) $9,000 - $11,999
    - d) $12,000 - $14,999
    - e) over $15,000

II. Households
- A. total number
  - 1. families with children ages 1-18
  - 2. income class
    - a) 0 - $4,999
    - b) $5,000 - $8,999
    - c) $9,000 - $11,999
    - d) $12,000 - $14,999
    - e) over $15,000
- B. migration rates
  - 1. families with children ages 1-18
  - 2. income class
    - a) 0 - $4,999
    - b) $5,000 - $8,999
    - c) $9,000 - $11,999
    - d) $12,000 - $14,999
    - e) over $15,000

III. Income
- A. per capita income
  - 1. total
  - 2. language spoken
  - 3. religion
- B. household income
  - 1. total
  - 2. language spoken
  - 3. religion

IV. Expenditures
- A. food
- B. clothing
- C. total recreation
- D. total transportation
- E. total housing
- F. medical
- G. utilities
- H. education
  - 1. primary
  - 2. secondary
  - 3. higher
  - 4. other
- I. other expenditures

V. Leisure
- A. average hours worked per week
- B. time spent on non-credit educational coursework
- C. length of school day
  - 1. primary
  - 2. secondary
  - 3. higher
  - 4. other
- D. time spent in recreation participation per week
  - 1. primary school facilities
  - 2. secondary school facilities
  - 3. higher education facilities
  - 4. other

VI. Specialized Services
- A. individuals requiring specialized education

*Reprinted (with minor modifications) from reference 15, p. 9.

One important group of information data, identified by W.Z. Hirsch in (15) as being needed for education decisions, is presented in Table 1. These data are grouped under the following headings: population, households, income, consumer expenditures, leisure, and special services. Hirsch suggests that most of the population data for education decisions should be made available on city block, census tract, municipal, county, and economic region levels. It is obvious that the nature of these data calls for coordination among many agencies, so that forceful and well-conceived efforts to integrate provincial and regional data collection, projection, and dissemination can be undertaken with a minimum of duplication.

An ongoing project in the Department of Educational Planning is concerned with the questions of population (birth, mortality) and migration.[8] Such demographic studies are critical in projecting the future population levels in various regions of Ontario, and these levels serve as input for the projections of school enrolment -- from kindergarten to post-secondary. Indeed present and predicted enrolments in Grade 12, or of Grade 12 graduates, are important date in assessing the supply of candidates for a college in a particular community.

Another important activity of the Department of Educational Planning is to provide a continuing series of Enrolment Projections. I am sure that registrars, administrators, and other officials of the CAATs involved in the planning process have found the information contained in Report No. 2, Ontario Secondary School Enrolment Projections to 1981-82, very useful. In early 1970, the contents of this report will be updated with the release of Report No. 5.

For the past year, Saeed Quazi and his research staff in this Department have been working on additional reports in the Enrolment Projections Series. Report No. 6 Enrolment of Post-Secondary, Non-University Students, which will be available about June 1970, is even more specifically oriented toward the needs of the colleges.

I would like to make a few personal remarks on this project. While most of the colleges have been very cooperative and helpful, especially the ones I personally had the opportunity to visit, there are five colleges whose response has been very negative. While no college refused outright to provide its data or to allow our staff to collect it, each of these five colleges successfully postponed the actual collection of the data required. As a result, the original publication date of the report, summer 1969, was not met. Furthermore, because of the incompleteness of the data, the report may contain projections for all the colleges collectively, rather than individually. While it is true that the increasing

number of demands by external agencies and institutions is straining the colleges' already understaffed personnel, registrars and administrators might be able to overcome this "information-transmission" barrier by keeping a record of requests. Such an analysis would provide the "who-what where-when-why" nature of the demand for data, and would facilitate the construction of an "information-demand" framework. Some of these requests could then be coordinated, and others rerouted to the proper agencies.

The necessity of providing enrolment information cannot be over-emphasized. I shall provide a couple of brief illustrations. The setting up of the CAATs can be regarded as the emergence of a new level of education in Ontario's system. The unexpectedly high enrolment in 1967 and 1968 seems to have been followed by a leveling off in 1969 (according to some preliminary informal reports). Offhand, it is possible to suggest two factors:

1. Analysis of the age of the first-year students reveals that a very high proportion is over nineteen. In other words, in its first two years of existence, the CAATs have picked up those students, from about 1966 back to the early sixties, who had no access to a post-secondary non-university education. By 1969, this backlog of "clients" has been used up and there was a decreased contribution to enrolment from that non-post-secondary sector of the population.

2. It was planned that the other main contribution to the CAATs would come from the Grade 12 student population. However, the past two years have seen an easing-off in emphasis on marks, examinations, and overall lowering of barriers to Grade 13 entrance. The net effect is that more Grade 12 students are in a position to enrol in Grade 13. There is a snowball effect and, when in Grade 13, they set their sights on university attendance. Note that once again the supply of potential CAATs candidates has been decreased. On the other hand, if Grade 13 had been made more difficult, would more Grade 12s be contemplating enrolment in the CAATs? Another interesting question to ponder is the effect that will arise when Grade 13 is scrapped altogether. Will there be a shortage of the number of available places in universities, and complete indifference to the CAATs? The colleges can assist in the analysis of such possibilities by providing information to various agencies and institutions that want to provide a numerical basis for short-term and long-term planning.

Let us return to the educational flow chart and come to another critical decision point that requires information. It is identified as node no. 2. Here the student--in Grade 12, Grade 13, or an adult student-- contemplates enroling into a CAAT. Since it is the student that it's all about, it is vitally important that he, too, be placed on the information flow network. More attention should be devoted to the role of "messages" or information inputs as shapers of the student's perceptions. The perceptions that an individual develops about his future educational possibilities, perceptions that may be strengthened or changed by the various kinds of information and communication channels, relate to the actual enrolment decision he makes. Questions that our information system should be able to answer are of the following type: (a) What kinds of information do candidates receive about post-secondary education? (b) What are the channels by which they receive such information? The Department of Educational Planning was fortunate in having Dr. Mary Corcoran, of the University of Minnesota (College of Education), spend her sabbatical year here (1968-69) and undertake a study on this topic. It is expected that her research results will be available before the summer of 1970.

It is true that the colleges' staff have devoted much of their own time to visiting high schools and delivering addresses to the students (one hopes to the grade-niners too), and it is desirable that they continue this task. However, while students are aware of the CAATs as a new level of education in Ontario, they may have built up a "mental block" because of preconceived notions related to financial, geographical, educational, and motivational factors. These notions must be patiently explained, and any barriers that have been erected must be brought down by means of relevant communication.

The same strategy must be adopted at the other (analogous) decision point for students, when they contemplate the large number of employment opportunities.

Another type of information that involves students is socioeconomic information about themselves (node no. 3, Figure 1). Table 2 lists some basic requirements (note that some entries will be extracted from Table 1):

TABLE 2*

BASIC STUDENT DATA REQUIREMENTS

FAMILIAL STATUS	PERSONAL STATUS	BEHAVIOR IN THE SCHOOL SYSTEM
Father's occupation	Age	Grade in school (or highest grade or exam. completed)
Size and type of residentia[illegible] munity	Sex	Type of specialization in secondary school and college
Father's education Mother's education	Intelligence	School marks in current or last completed grade
Family income	Birth order in family	Characteristics of schools attended (socioeconomic composition of the pupils, size of school, etc.)
Size of family		
Religious, ethnic, or racial status		

*Reprinted from reference 16, p. 39.

One more remark about data on the movement of students from high school to the CAATs. In one case, I was pleasantly surprised to see some of the "forms" of data kept up to date by some registrars. I emphasize form because the data base has not been expanded but instead has been "messaged" to provide useful insights into the enrolment mechanism. For example, explicit records are kept of the "no-show" candidates that had been accepted, and of the "non-acceptable" candidates.** It is extremely helpful to keep information about the background of these types of students for planning purposes.

Resources are getting even scarcer, and come September the daily newspapers will be playing the "no-space" song. Therefore, a critical necessity, as far as information and decision-making are concerned, will be to examine the application and selection mechanism for the CAATs. It is gratifying that a committee is looking at methods of preventing duplication of application forms, of reducing the number of "no-shows", and of facilitating decisions on the acceptance of candidates (node no. 4, Figure 1).

**This is the practice of John Holt, Director of Admissions and Student Records, Sir Sandford Fleming College, Peterborough.

This committee is composed of the registrars of the Metropolitan Toronto colleges, and is the direct result of a resolution passed at the ACAATO Conference held in Kingston, June 1969. Besides its work in the design and implementation of a common application form, this committee is preparing a student questionnaire that will include background information to assist in the analysis of the inflow of students into the CAATs. In my view, the use of a common application form need not be equated with the establishment of a central registry.*

Research very much related to this problem has just been completed by my colleague, W.P. McReynolds in a report titled, "A Model for the Ontario Educational System."[12] In this work, McReynolds presents a general flow model of an educational system and its application to secondary schools in Ontario, and a set of sub-models concerned with the transition by students from the final grade of secondary level to the first year of tertiary education. Specifically, he deals with the problems of place allocation in post-secondary education, with the preferences of individual students for the various post-secondary destinations, and with the analysis of the process of student competition on an examination or set of examinations.

By this point, we have entered the CAATs and are moving on through to the graduating year. In my opinion, we are confronted by two problems that require information related to long-term programing. The first is being attacked and solved by the use of simulation models; Dick Judy and Jack Levine have ably demonstrated the relevance of applying quantiative tools to the analysis of institutional problems (node no. 5). The second problem is to provide feedback mechanisms and adaptive means to evaluate the curriculum and the means of modifying it (node no. 6).

Consider, for the sake of argument, the following as possible primary objectives of a curriculum:

1. The primary objective of the massive investment into the CAATs is, of course, to provide industry and commerce with young men and women with occupational competence.

2. The second is adaptability to technological change.

3. The third major objective is social competence at a responsible level; that is, personal and technical effectiveness as an important

* Additional information can be obtained from G. Fawcett, Ontario Manpower Retraining Program, at the Applied Arts and Technology Branch, 55 Eglinton Avenue East, Toronto

and responsible member of a working group.

4. The function of educationalists is not to tell the industrialists what jobs their technicians ought to perform (which would be to invite disaster), but rather to assist in identifying clusters of occupations that have common elements in their educational requirements and can be accommodated within a single curricular framework.

Job analyses should be the basic data upon which the consideration of curriculum content and syllabus detail are founded; otherwise, one runs the grave risk of producing a first-class course for technicians who are not required.

Helpful information can be fed back in the following manner:

1. The experiences of people in the technical manpower pool, who have been in the labor force for less than ten years, could be investigated. It should be possible to ascertain a good deal about the subjects, about the kinds of curriculum elements that have been found useful for their degree of occupational mobility.

2. Changes in technology, as they have affected different occupations and industries, could be studied, along with the rate of diffusion of technological change and the demands made on technical manpower.

3. International organizations (such as the Organization for Economic Co-operation and Development (OECD) contribute a great deal by making information on practices in different countries available (16, 17, 18).

Since we have been discussing systems--colleges, curricula--and exploring the potential benefits of the feedback mechanism, it might be helpful to introduce the notion of initial conditions. A general theorem from systems theory states that the description of a system and of its future behavior is incomplete without the specifications of that system's initial conditions. For example, a college may have a good set of "statistics" and yet, by its failure to itemize initial conditions, be unable to adapt its operations when external distrubances act upon it. Let me illustrate by means of a slightly exaggerated example in which a large local firm has requested a substantial number of graduates in mechanical technology, say forty, to be made available as soon as possible. Liaison committies of the college and the firm concerned agree on an appropriate curriculum, and soon enough the request is fulfilled. A very small statistical addition would be the initial condition for setting up the couple of courses related to the firm's request. If this item were not added, the college would produce forty or so graduates during the next few years, to meet what really was a short-term shortage of the particular manpower. Therefore, reasons for the introduction of new courses and new curricula should be listed and kept on record, and these initial decisions ought to be reviewed each and every year (or term) so that the teaching content can be adapted to advances in technology and changes in manpower requirements.

It follows, too, that information feedback from industry's use of graduates of the colleges is necessary in order to evaluate present educational programing policies (node no. 6). Surveys and studies should be planned and carried out in various firms and industries.

There is already some background information on the historical development of the courses and programs in the CAATs. From 1967, the Applied Arts and Technology Branch has been providing a "College Course" matrix, in the form of the brochure, Programs 1967-68, CAAT Chart no. 1, and has annually updated this extremely useful information.[19]

If we regard the student as the main product of our system, it is now necessary to obtain some information about his entrance into the real world--his first full-time employment (node no. 6, Figure 1). A method must be devised to quantify the CAAT-employment link. One could use an approach analogous to that of Dr. Keddy's destination tables of high school leavers (graduates and non-graduates).[20]

The main difficulty in obtaining information about the employment of graduates is that most are not committed to any job just before graduation. After the student has left college and checked out half a dozen of companies, he may decide to accept an offer. Tracking him down entails a tremendous amount of follow-up work, beyond the resources provided to the student services officer. A feasible alternative would be to put the onus on the student (enough has already been done for him) and on industry (so far, it has done little for us or the student). The policy would be that industrial firms should notify those colleges whose students had been accepted as full-time employees, and inform theDepartment of Labour, or other such agency, whose responsibility it would be to monitor this information about first-time employees and then follow their progress in industry.

In return for passing this information to the colleges, the industrial firms (and other employers) would receive diplomas from the colleges to be distributed to the graduates just hired. No first-time employee

could remain employed if he did not receive his diploma within a certain period (similar to the period required for the issuance of a driver s license). Note that there is a troika of responsibilities: employee--> firm--> college. A "drop-out" first-time employee would receive an appropriate academic transcript; thus the college would be provided with information about the type of position he managed to obtain without completing his course of study. In this manner, the diploma, or transcript, as the case may be, which has been underutilized as an information device, would serve as the key link in providing information about the most relevant flow -- the movement of students from their educational institution to their first employment.

How does the Department of Educational Planning of OISE attempt to contribute toward this need for education-employment feedback analysis? Let me briefly outline a large project called the Ontario Study of Vocational-Technical Training, begun in 1967 in our Department[10] and presently nearing completion. The purpose of this important three-year study is to generate empirically based insights that might be useful in planning and guiding the development of vocation-technical training in Ontario. It is expected that a critical examination, of the approximately three-year period between the completion of technical training and the adjustment to employment condition, will yield useful information about the strengths and weaknesses of the present pre- and post-employment training programs and provide valuable clues to ways in which the system might be made more effective.

The specific objectives are as follows:

1. To assess the appropriateness of each pre-employment training program as a preparation for employment.
2. To assess the effectiveness of the vocational guidance and placement procedures.
3. To measure the mobility of employees in various locations.
4. To assess the need for technical training in areas where there is no training.
5. To estimate the type, need, and extent of on-the-job training among persons with technical training.
6. To determine the economic value of vocational-technical training to both the individual and society.
7. To seek predictors of successful employment.

So, please keep in mind the forthcoming final report.[10]

It is appropriate at this stage of the discussion to summarize the various kinds of information that confront decision-makers and planners involved in educational research:[11]

1. Haphazard feedback based on unplanned face-to-face contacts.
2. Systematic but non-formal feedback based on planned face-to-face contacts.
3. Information arising from the activities of pressure groups.
4. Regular statistics gathered as by products of the administrative process.
5. Regular statistics specifically collected for the planning activity, which would not normally be by products of the administrative process.
6. Ad hoc surveys.
7. Research into educational, economic, and social situations, and into the reactions of such situations to changed inputs.
8. Seminar activities that disseminate the results of research and other forms of information among different groups, and the different interactions among these groups.
9. Information about other countries, transmitted among the various groups (OECD, UNESCO).

Table 3 depicts an attempt to identify the main elements of the complex of decision-making, administrative action, and planning activity.[11] It is essential to distinguish and indicate the main information flows that are relevant to these problems. Table 4 enumerates a partial list of the various agencies as they exist in Ontario, and illustrates the manner in which they relate to the "players" defined in Table 3.

Such an "information/decision-making" network can be extremely helpful in identifying the audience we attempt to reach, and in partially answering J.M. Porter's* well-made remark, "We have all heard it before; let's tell it to all the others!" (author's paraphrasing)

*J.M. Porter, President, Sheridan College, Brampton, Ontario.

	Ultimate decisionmakers (UDM)	UDM – Ministerial	Economic Evaluators	Sources of Finance	Administrators	Implementors	Experts – Economic	Experts – Educational	Producers – Institutions	Producers – Teachers	Political Evaluators	Organized Interests	Presentation Specialists	General Public	Researchers	Planners
To	**A**	**B**	**C**	**D**	**E(1)**	**E(2)**	**F(1)**	**F(2)**	**G(1)**	**G(2)**	**H**	**I(1,2)**	**J**	**K**	**L**	**P**
From																
P		⊗	X		⊗	⊗	X	X	⊗	⊗			⊗	⊗	X	
A																
B	☒		X	X												
C	☒	X		X											X	X
D	☒	X	X												X	
E(1)		☒													X	X
E(2)		X			☒				☒	☒					X	⊗
F(1)		X	☒		X			X	X	X	X	X	X	☒		X
F(2)		X			X		X		X	X	X	X	X	☒		X
G(1)		☒			☒	☒				☒	☒	☒	X	X		⊗
G(2)		☒			☒	☒			☒		☒	☒		X		⊗
H	☒	☒														
I	☒	☒			☒											⊗
J																⊗
K	☒	☒		☒	☒						☒	☒	☒			⊗
L		☒	X				X	X	X	X	X					X

TABLE 3*: MATRIX OF INFORMATION FLOWS

LEGEND:

Main flows are marked with an X. They may relate to any of the types of information specified in the presentation and be relevant to the credibility, effectiveness, or viability of the educational plan.
Flows marked with a circle are those to which the planner must pay particular attention; if he generates information, he will be in a position to disseminate it effectively.
Flows marked with a box are the ones to which the planner needs to pay great attention in terms of dissemination.

*Reprinted from reference 11, p. 30.

TABLE 4

PLAYERS	AGENCIES*
Planners	Division of School Planning and Building Research; college president and staff of CAATs
Ministerial decision-makers	Minister of Education, Council of Regents, Board of Governors
Economic evaluators	Industry, Department of Labour
Sources of finance	Minister of Education, Treasury Board
Administrators	Applied Arts and Technology Branch
Implementors	Staff of CAATs
Experts-economic	Department of Treasury and Economics
Experts-educational	Applied Arts and Technology Branch, The Ontario Institute for Studies in Education, Educational consultants
Producers – institutions	CAATs
Producers – teachers	Industry, universities
Political evaluations	Legislature, legislative committees on education, Municipal Council
Organized interests	Advisory committees, industry
Presentation specialists	Planning consultants, architects, engineers
General Public	Parent power, student power
Researchers	Department of Education, The Ontario Institute for Studies in Education

* A partial list. Other bodies could be added to each entry.

My personal feeling regarding the coordination of information systems for CAATs on a provincial level is that such proposals must be considered and examined very carefully. Information is power, and divulging too much information, or information of a certain kind, can dissolve some of that power. There seems to be a failure to understand that an information system is only a sub-system of the entire organizational structure. An information system must be imbedded in a control system.[21] In turn, a control system requires an organizational unit charged with control-responsibility, and must be so placed in the organization's structure that it has access to the decision-makers and to the information required to carry out its function.

How does this "information, decision, and control" network affect the CAATs? There is a very definite possibility that if information systems of some type are set up, systems theory structure would dictate that some sort of control mechanism ought to be established. For example, the Council of Regents may find itself in a position in which it is forced to introduce control measures. Another possibility could be the establishment of a planning secretariat for the CAATs at the provincial level.

My concluding remarks will be directed to information systems. It is agreed, I think, that the preoccupation in the last few years with so-called management information systems (MIS) has approached the proportion of a technological fad. The best way to warn you to proceed with caution is to extract some very relevant remarks from R.L. Ackoff's article on "Management Misinformation Systems".[21] He identifies five assumptions commonly made by designers of management information systems. Furthermore, he emphasizes that these assumptions are not justified in many (if not most) cases and hence lead to major deficiencies in the resulting systems. The assumptions are:

1. The critical deficiency under which most managers operate is the lack of relevant information.
2. The manager needs the information he wants.
3. If a manager has the information he needs, his decision-making will improve.
4. Better communication between managers improves organizational performance.
5. A manager does not have to understand how his information works, only how to use it!

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CURRENT DEVELOPMENTS IN CONTRACTING METHODS

by John Gordon Spence

Two different approaches to Construction Project Management have been discussed. The first approach is that of a Project Management Development and Construction Organization since its nucleus has been formed from individuals with a development and construction orientation.

Whether the architect is commissioned separately by the owner or directly by the Project Management Construction Organization, the implications of this contractual situation may be that cost and time scheduling tend to over-ride program-planning and design.

Providing that the functional building program and the design are already satisfactorily solved and approved, it is quite appropriate that the cost and time scheduling of construction should assume the prime importance they are given by this approach of the Project Management Construction Organization.

If, however, building program and design have not been previously set, or are not independently set, there is danger of this approach obtaining for the owner, at his approved budget and at the time he requires it, a project which has subordinated program and design to cost and time, and is obsolete both functionally and aesthetically on the day its doors are opened.

The second of the two approaches to Project Management might be called that of the Project Management Consultant Organization, distinguished from the Construction Organization in that the Consultant Organization has had its nucleus formed from individuals with professional consultant experience. The Consultant Organization approach implies a contract with the owner for services from, and including, the initiation of programing and design to the management of the cost and time scheduling of the total project.

Whether the actual construction management of the project in the field is done by qualified staff of the Project Management Consultant Organization, or whether construction management is performed by a separate Construction Management Organization by selection or tender, the implication of this priority of procedures is that cost and time scheduling tend to be subordinated to the constultants' prime interest of programing and design.

Providing that the functional building program and design can be obtained within the client time and cost allocation it is quite appropriate that the building program and design should assume the prime importance they obtain by this approach of the Project Management Consultant Organization.

If however, cost and time allocations are not satisfactorily met, this approach of the Project Management Consultant Organization is in just as serious trouble as a Project Management Construction Organization which may provide an ill-considered solution on-budget and on-time.

Which type of Project Management Organization is placed by the owner in prime control of the project should very reasonably be determined by the particular problems of the particular project situation, and not just by who happens to get to him first, or most forcibly!

An unresolved complex program and design problem requires first the prime emphasis on this aspect; an approved program and design solution requires prime emphasis on cost and time scheduling.

To have chosen a good type of Project Management Organization which is wrong for the particular needs of the owner's particular project can be an unfortunate situation, indeed. To be stuck with a prima-donna pitcher at the plate when he needs a home-run specialist, can lose the owner and his team the entire Building Game.

To get to the finals and the pay-off the owner needs to have working for him a flexible organization which will permit substitutes that will win him the particular situation of his particular ball game.

We have a great pool of talent and resource in our construction industry but too often the individuals and organizations are not being used imaginatively or to best advantage. Too often both individuals and organizations are caught up in a revolving squirrel drum of useless perpetual motion so that their expertise is lost to us.

The two main approaches discussed are only two variations of the many possibilities of Contract Method which now confront an owner. The owners' initial difficulty is in distinguishing between all the individuals and corporations which offer their services in Project Management. And after he has chosen his team, the owner can often very well be excused for not being sure "who is on first" or

indeed whether the person he has put "on first" is really a member of his own team!

Even the terms Project Management and Construction Management are at times in confusion.

Generally, however,

- a Project Manager is one who commences with the initiation of policy, programing, design, costs, and carries through a single complete responsibility to the owner from initial study to completed construction.

- a Construction Manager is one who performs services for the owner, principally directed to the maintenance of construction schedules, coordination of site work, control of costs, and liaison with other members of a consultant group.

Despite the popularity, today, of claims to provide these Management Services, the plain facts are that, if the system of Project Management really took hold as a major contract method, there would be an extreme scarcity of the responsible senior talent which is available and directed toward giving the detailed kind of total cooperative management required by this method. Too many people in the construction industry are still just selling "their own thing" and too often this does not make sensible use of the other members and facilities of the construction team. Indeed it appears at times as though the traditional method of contracting had been arrived at, not as the most efficient means of construction, but as a complicated series of checks and counterchecks which didn't succeed without ending, for at least one member of the team, in Russian Roulette.

For this reason, a year ago, in collaboration with the Department of Public Works, Ontario, the Design and Contract Study Committee of the Ontario Association of Architects, was formed.

Its purpose was to investigate current trends of contract procedure and to report to the public on new procedures which could obtain the general acceptance of the Design Professions, Construction Management, and owners, and which could result in increased construction industry efficiency.

As chairman of this committee I have had the cooperation from the outset, of Mr. D.G. Creba and his committee from the Department of Public Works, Ontario. Representatives of The Association of Professional Engineers of Ontario and The Ontario General Contractors' Association, on the invitation of the O.A.A., have also collaborated in committee and these two organizations have now forwarded the Committee Recommendations to their Councils for ratification. It is expected that these recommendations will be released early in December.

While the completed recommendations will not be presented as a conclusive statement of method, it is hoped that they will provide guidance and a firm platform from which future innovation can be made in up-dating contract procedure to match technological progress.

The recommendations of the Committee cover the entire project management term of operation from inception of program to completion of project, but they are designated as Construction Management Procedures because they separate the Construction Management function from the total project management time-term in order to fully utilize the value of existing construction organizations.

The procedures are general enough, of course, to provide for the circumstance where the construction manager is capable and suited to lead the entire design and construction team. In certain highly unique types of special construction, the owners representative may be the most qualified to assume the responsibilities for total project leadership. So, also, of course, the architect or engineer consultant organization may be most suited as leader depending on the particular type of project and the particular intermix of talent, personalities, and capabilities making themselves available to the project.

The recommendations, therefore, propose the establishment of an executive group for a project, composed of representatives of the owner, architect and engineering consultants, and the Construction Management Organization. From this executive group will be selected a chairman who will then be responsible to the group for the successful expedition of the total project.

The intent of these recommendations in summary is to provide greater opportunity - by the use of a cooperative management structure as distinct from an 'opposed faction' structure - for creative innovation in the solution of complex project problems by all the major contributors to the construction of a project.

Mr. Ronald Stirling, of the Ontario Department of Education has posed several basic queries pertinent to this panel discussion and I will relate these to the proposed recommendations of the Design and Contract Study Committee:

1. The organizational structure of duties and responsibilities of client, architect, consultants, managers, is proposed as being formulated into that of an Executive Group. This group would have an appointed chairman from its number who would be responsible to the group for the executive direction of the total project. The authority and responsibility of each member of the group, nevertheless, would be determined by their own separate contractual agreement with the owner.

2. The proposed organizational structure compared with that of the stipulated sum contract structure would be that of a team with team responsibilities rather than an'opposed faction' structure which pits owner against everybody and everybody against the owner. In effect, the construction manager joins the professional team. To do this, he must give up the normal contractual practice of charging % profit on trade work. He must have all work done by subcontractors on whose work competitive bids have been obtained and presented to the executive group.

3. In comparing the proposed fee structure with that of a stipulated sum contract, generally, if the owner gets more in service - such as an early start in construction and more choice in control during the planning and construction operation - he must expect to pay more fees for the increased management of the team in order to effect speed and economies in actual construction. There is as yet no generally accepted fee set for Construction Management Services but the Ontario General Contractors' Association is preparing recommendations. The O.G.C.A. does not favour tendering for Management Services: Some past projects have been taken on at low fees which preclude proper service. Prequalification of bidders as to organizational capability, reputation and experience, is favoured as a means of selection.

4. With regard to the pros and cons of various contracting methods: With the stipulated-sum contract the owner only has to assume responsibility for paying for the sum determined by complete documentation before construction commences, (providing that he does not make subsequent changes).
A management type contract involves the owner in a more detailed policy decision responsibility if he really wishes to obtain his project at a set budget future. Starting before complete documentation in order to obtain early completion and save financing costs, the owner may have to make many value judgments in conjunction with his team as to which items are to be deleted or re-specified if prices beyond the contract control have increased.

The Management Technique introduces controls to ensure that the work can be built for a budget figure but it does not guarantee this. The stipulated sum contract does guarantee this.

The owner, like all other human beings, would like to think that it is still possible to get something for nothing. This may have been a possibility in our more free-wheeling past, but it is not likely in our future. If we cannot pay a fair, competitively obtained price for what we want we are going to perhaps have to want a little less: something which we can afford.

The Management Technique places the owner in the position of knowing what he can afford as the scheme is developed, and permits the revision of his requirements to suit what he can afford, before construction is completed.

Management Techniques are directly opposed to the Development Proposal method of contracting, which implies an economy which can afford free choice of as many as a dozen developed designs and estimates for the price of one, with the industry, and supposedly not the owner, absorbing the cost of producing the eleven unsuccessful designs and their detailed estimates. Our economy cannot afford the waste inherent in the Proposal Call system.

Package-Deal or Turn-Key Contracts will continue to be applicable for private-funded contracts where a contractual relationship of personal trust exists or can be established. A Package-Deal may be fair and advantageous from aspects of dollar economy and speed of construction, but such warranted situations of trust are exceptional and not a particularly normal situation today.

The great volume of public-funded contracts must be able to engage the great normal common denominator of the construction industry if it is to contribute to a volume of new construction which, by the end of the century, will equal that of our existing construction.

Public-funded contracts just must be designed for accountability of their funds, and designed to protect the owners, consultants, contractors, suppliers, and workers who all represent the industry, as well as protecting the interests of the public who are paying for the facilities obtained by public contracts.

The recommended procedures of the Design and Contract Study Committee of the O.A.A. have been formulated to reinforce responsible practice by all members of the construction team and to assist in achieving more creative relationships and innovative techniques for the complex construction programs in our future.

CURRENT DEVELOPMENTS IN CONTRACTING METHODS

by V. Bennett

For those who are not familiar with the Concordia Group, before presenting the paper covering the topic under discussion, a few comments on our Group may not be out of place.

The Concordia Group is organized to carry out integrated real estate developments. Its objective is to create economical, functional and well-designed developments.

The Concordia approach to this objective is based upon a disciplined and integrated organization designed to solve the entire range of development problems, taking into consideration, in broad outline, the following:

Project Evaluation

- to determine the future of the site based upon economic analysis and market projections; in the centre of the region, the city and the immediate area.

Programing and Design

- to reflect present and future client and market needs, evaluation in terms of economic, functional and technological requirements and aesthetic considerations.

Construction Management & Construction

- to provide a comprehensive organization to apply disciplines of construction, economics and technology in terms of accurate budget estimating, phasing, scheduling, cost control and execution of the work during the entire process from initial project evaluation through to the construction stage.

Property Management & Leasing

- to evaluate through a complete management organization the specialized requirement of maintenance programs, operating economics, building functions and leasing parameters which are incorporated from the Stage of Project evaluation, through design and construction, to the leasing and operation of the completed project.

Concordia's experience has shown that the interaction of these skills properly managed produces creative and successful results.

At Welland, Concordia was invited to submit a proposal for construction management which would bring the skills of the private developer into the field of public building, we hope that our performance over the past year has justified the confidence originally placed with us.

Advantages of Including a Construction Manager with a General Contracting Background in the Basic Development Group

The main advantages of engaging an experienced and able General Contractor to act as Construction Manager are as follows:

1. It results in a more economical development.
2. It allows completion of a project in advance of other methods.
3. It gives an early return on investment and stimulates interest.

This is achieved within the constraints of cost and time controls which is becoming more and more important when maximum use of available funds is to be achieved. We elaborate further on these items:

1. Economy:

a) In producing projects the measure of the success is the Cost, Aesthetics, the Schedule and the Workmanship, and all four are inter-related. By carrying out a project on this basis, the contractor is on hand at the beginning of the design development to work with and advise the architects and owner as to alternative methods of achieving the same effects at less cost. To estimate precisely what the saving would be on a particular project is rather difficult.

An overall cost reduction could be realized by the carrying out of effective screening of drawings as they are being developed.

b) This type of arrangement permits an effective overall project cost control system to be initiated at the beginning of the design. As soon as the detailed budget estimate is prepared it becomes the hub of the cost control system and regular cost reports are made to continuously inform all concerned if the budget estimate is being met. Changes or refinements which may affect cost are immediately spotted by the Construction Manager and analyzed with a stated cost for the Owner's decision to accept or reject the proposed change or whether redesign is necessary to achieve a similar desired result at a smaller cost increase.

Frequently, the situation has arisen with owners, who decide to wait for a completed set of drawings upon which to call for lump sum bids only to find that the bids are far in excess of the anticipated cost. At this point, the owner has expended all the money allotted to architectural and engineering fees and is then faced with the dilemma of abandoning the project, waiting another year or so for a complete redesign or paying a high price for a building which, if it had been evolved in a more efficient manner, would have been within the budget. An early and effective cost control system will result in lower costs.

c) This contractual arrangement results in lower architectural and engineering design costs because of the expediting influence of the construction operation and the Construction Manager. Architects and Engineers, because of their training and background, quite frequently have as a prime goal a building which is an outstanding architectural achievement. In striving for this goal, without a strong counterbalancing influence, design costs and schedule may suffer.

d) A general misconception of this type of arrangement is that it means that all the work is carried out on a cost plus fee basis. In fact, all the sub-contracts which represent 80% to 90% and perhaps more of the total construction costs of the project are carried out on a lump sum basis. More competetive prices are obtained from Sub-contractors because more specific information can be made available to bidders regarding the schedule and method of building construction which is not possible when bidding to several General Contractors, each of whom may have a different approach to the way in which they intend to carry out the work.

The balance of the 10% to 20% of the cost of the work is done by either the Construction Manager's own forces or it can also be packaged and called as a lump sum.

e) On contract and sub-contract work, the Construction Manager's expert estimators scrutinize carefully any sub-contractor's claims for additional payment to ensure that they are valid. If a General Contractor is engaged on a lump-sum basis, the close examination of sub-contractor's claims is an expense for which they are not adequately reimbursed and in the industry today it is invariably not done properly.

f) By awarding the contract early on a fixed fee basis to a competent Construction Manager, the Owner is not required to employ staff on a temporary basis for the duration of the project, but obtains experienced personnel who are engaged full time in the construction business. On a large, long duration project, this would result in a considerable reduction to the Owner's payroll.

g) The Construction Manager's personnel, in effect, are on the Owner's staff, therefore, the need for other Consultants in many specialized areas where he is knowledgeable is often greatly reduced.

h) This type of general construction allows the compression of both the design and construction times and thereby reduces general overheads and interest charges. Further cost savings are obtained by the call of specially prepared bids for packages of work which is strictly carried out by one trade. There has been a tendency to incorporate in sections of specifications work which is carried out by several different trades; where this happens, the Section Sub-contractor is, in effect, a General Contractor and there is an accumulation of profits which is reduced by the calling of more separate bids for smaller parcels of work. This method also enables a comprehensive list of unit prices to be obtained which can be used to cover items of work to be added, deleted and changed. The existence of such a list of unit prices results in more reasonable prices for extra work being obtained should none of the unit prices be applicable.

2. Earlier Completion:

The final completion of a project is advanced substantially. When a project is handled at the outset with a Construction Manager, portions of the work can be commenced in a sensible and logical sequence in the very early stages of the project. Such items as demolition, shoring, excavation, foundations, which in some buildings are substantial, can be commenced and completed to dovetail into the overall schedule.

All the other trades of which a building is comprised (dependent upon deliveries and installation times) are likewise scheduled in a logical sequence for various completion times. Thus the Architect or Engineer is allowed his required design study time while at all times each item is co-ordinated and sequences in accordance with the Master Critical Path Schedule.

The scheduling of the work in this manner permits a more detailed breakdown of the building specifications so that individual tender calls can be made for long delivery items, these being placed on order prior to the selection of the Sub-contractor responsible for their installation. The saving in cost is a benefit which the owner receives directly and is not subject to co-ordination and supervision fees by the Trade Sub-contractor.

3. Controlled End Design:

Under this system the Architect or Engineer does not have to commit himself as early with respect to every detail and refinement in the project as he does when he has to prepare completed drawings and specifications for a lump sum bid. By consultation with the Construction Manager and reference to the Master Critical Path Schedule, it can be determined for each trade the time available for study and development.

Also, when innovations or new products come on the market it can be determined if and how these can be incorporated into the project. This is particularly significant with respect to the Colleges of Applied Arts and Technology. In today's technocratic society, new aids to teaching are frequently being announced as well as new discoveries in the field of industry and commerce. Long-range planning and flexibility of building space being built today has to contend with developments which we know nothing of at the present time. Programs of technology may be replaced with those of humanities and vice versa, depending on the geographic location of the College and the idiosyncracies of the local student population. The Colleges, therefore, are alive and will result in a superior form when, throughout their development they have been subjected to constructive criticism from all who will benefit by their existence.

4. Early Return on Investment:

Although we tend to think of investment in terms of a dollar return, early commencement of construction in addition to giving early credibility to a project with respect to the public and civic authorities, also excites the interest of the prospective users and therefore gives an important boost to the community in which our most rewarding investment lies.

CURRENT DEVELOPMENTS IN CONTRACTING METHODS

by A.J. LeBlanc

The terms of reference governing our talk today are contained in the title on your programs "Current Developments in Contracting Methods".

In presenting these comments for your consideration we ask that you accept the various statements and recommendations not as arbitrary answers to your current problems but as some matters that should be reviewed in an attempt to improve client-architect-consultant-contractor relations with a common target of maximum return for construction dollar. A detailed and proper analysis of the various types of contractual arrangements would require much more than the allotted time. Each phase of a construction project could well be the subject of a separate seminar or study group with plenty of scope for discussion.

In my brief remarks I will refer to some aspects of the standard and traditional procedures, and to the trend towards the type of contractural arrangement being presented here today.

I am sure that those among you who have projects under way or in the planning stage will have very definite opinions of the methods to which you have been exposed and may very well resist the trend to new methods which somebody has told you will guarantee what we have all been striving towards for many years.

- good architectural design to meet the owner's requirements.
- construction to a predetermined budget and on time.

I don't guarantee anything.

There are various possible contractual arrangements for the successful handling of a construction project.

It has been traditional to employ standard contract forms covering 'stipulated sum' and 'cost plus' percentage or fixed fee. These standard forms of contract and the general conditions which form part of the documents have been evolved to their present state over some years.

In addition to those contract documents recommended by the RAIC and CCA, there are various government departments and agencies that have standard contract documents which they require to be executed and these specimens sometimes form part of the tender documents to indicate the form of contract that the successful bidder will be required to complete.

It is customary and desirable to secure construction services through some method of competitive bidding or proposal. Such competition forces the contractor to be aware of the most recent and efficient construction methods.

The current procedures for calling competitive tenders (which ever method is used) should result in a mutual spirit of respect and cooperation between the contracting parties as between themselves and the architect-engineer or project manager who is administering the contract as the owner's agent.

Each has a measure of responsibility to ensure that the rights and responsibilities of the contracting parties are adequately protected and that the duties and powers of the supervising agency are clearly defined.

The following general standard forms of contracts have been developed over many years by the Royal Architectural Institute of Canada and the Canadian Construction Association. They meet the general requirements stipulated above, governing the duties, responsibilities and authorities of the interested parties.

These contract forms have been amended and revised from time to time to eliminate disparities and plug some loopholes that became apparent in actual practice.

It is most important that all concerned realize that to be successful a contract must be equitable to each of the parties thereto.

It is also likely that there will be further refinements and revisions to the standard documents listed herein but it is unlikely that there will be any change in the responsibility of all concerned to use diligence, skill and sound business judgment in the preparation of the contract documents, if unnecessary friction, misunderstanding, misinterpretation or unexpected cost are to be avoided.

1. Standard form of agreement
   Client and architect
   (To be used between owner and architect concerning the architect's professional services, fees, etc.)

2. Canadian standard form of construction contract and general conditions - stipulated sum - document 12 revised (when contract is for a fixed amount with specifications and working drawings completed).

3. Canadian standard form of construction contract and general conditions - cost plus percentage or fixed fee - document 13 revised (when contract is for "cost of the work" plus a fee).

4. Canadian standard form of contract between contractor and sub-contractor (For use by general contractor and trade contractor with regards to subcontracts).

An increasing indication in many areas, internationally and in this country, that construction is following the procedures described today whereby a construction management group is retained to manage the project for a "management fee".

Once the principle of construction management is accepted for a particular project, certain basic policies should be established and procedures initiated.

It is most desirable that the owner select the construction management team or contract manager as early as possible in the planning stage.

Each member of the team has a critical and important function and the success of the venture will depend on the willingness of members to recognize that each has much to offer in particular skills and experience.

The owner-architect-consulting engineer component of the team should be willing to accept the fact that a competent and well-organized contractor is ready to share in the responsibility of completing the project on time and to a budget which he has helped to develop.

The team participates in all phases of the planning and design period, so that the ultimate design concept and budget estimate are developed jointly with those responsible for completion of the project on time and to a predetermined budget.

The terms of reference, areas of responsibility and extent of authority of each member of the team must be clearly defined.

As the input to the development of the final design will vary with the type of project, it is difficult to set out a standard but it is basic to ultimate success that the overall responsibility for co-ordination of the planning and design activity must be vested in the "project manager" with authority to call on the resources of the team members to meet the requirements of the schedule and the **budget.**

Obviously if he is to perform efficiently he must be appointed early and should be thoroughly experienced.

So much for the theory of the subject matter - but how does it really work in actual practise?

First let us realize that "construction management" is not new. It has been carried out under various names in certain industries for many years.

It does not replace all other forms of contractual arrangements.

It does however have certain advantages over traditional methods.

CONSTRUCTION MANAGEMENT

In presenting the case for "construction management" we should be cognizant of the various methods and alternative commonly grouped under this classification, e.g.

1. Owner-built

   - the owner assumes total responsibility for all phases of the construction program.
   - usually retains own architect or has architect on staff.
   - usually has his own construction forces or engages for specific project.
   - requires considerable volume of work to justify skilled construction personnel and equipment on a full time basis.

2. Turn-key

   - a difficult type of contractual arrangement for general construction operations.
   - usually used in process industries and petro-chemical developments.
   - purchase of a process necessitates freedom of design.
   - owner must state requirements and specifications clearly to avoid unsatisfactory performance and inflated costs.

- turn-key contractor requires skilled management and technical capability and is primarily responsible for handing over an operational plant or facility and is generally required to start up and operate for a training and break-in test period.

3. Design & Build

- divided responsibility between owner and contractor.
- owner involved in design and documentation.
- selection of contractor is an important factor and generally difficult to get a firm price or reasonable estimate unless design and specifications are complete.
- no competitive bidding and generally no guaranteed cost although an upset fee might be arranged.
- construction can start on preliminary work before design is complete.
- more rapid construction but at a higher cost.
- often used when completion date is critical and additional cost acceptable.

4. Consultant supervised

- responsibility for construction planning and control is divided between the consultant and the contractor.
- this method could result in duplication and problems in communication.
- small projects such as industrial plants are reasonably and successfully handled by this method.
- the contractor assumes the responsibility for planning and control.
- the consultant is usually selected by the owner on the basis of design experience.
- the owner and consultant are generally not skilled in construction management and the necessary coordination and control of construction operations is lacking.

5. Construction Management

The success of this type of contractual arrangement depends on the skills and experience of the contract manager, who

- acts as the owner's agent - is responsible for planning, documentation and control.
- sets construction program sequence and schedules.
- sets budget estimates.
- calls competitive contracts.
- negotiates contracts as the owner's agent.
- administers contracts and controls the work.

Competitive bidding of specialist subcontractors takes advantage of the current market in materials and labour.

Competitive sub-contract bidding and budget analysis permits design control and contract negotiation to a budget.

Skilled construction management achieves the best cost results if controls are adequate.

GENERAL COMMENTS

"Construction Management" as the name implies means just that!

The construction manager is charged with the responsibility of coordinating all phases of the construction operation, and with the completion of the project on time to a specific predetermined budget.

The complexity of most large projects requires that the construction manager possess considerable skill in construction management techniques and engineering experience.

"Construction Management" by reason of efficient performance, and well qualified construction managers is generally considered a good method of handling construction operations. If competent sub-contractors bid competitively this method should result in the best cost results and controls.

The following are general considerations and phases in a typical construction program. They are in approximate chronological order, but may be considered in other than the listed priority:

Owner requirement and program - basic scheme
Feasibility study - financing
Preliminary engineering - design concept
Design specification report - preliminary estimate
Detailed plans and specifications
Construction planning and scheduling
Budget estimates
Control (time, cost, methods)
Procurement and expediting
Contract administration and construction operations
Progress reports and budget analysis
Evaluation and follow-up

Clients generally expect that total project management will be provided by consulting engineering firms.

Some consulting firms have the capability of providing this service. They have the organization to plan, design, budget and coordinate, as well as procure and supervise construction.

Although this is a requirement for package building projects where architectural and engineering content is minimal, the package builder usually cannot offer the capability of total project management.

Every project must be evaluated as an investment.

Competent project management using competitive contract/sub-contract bidding offers the best chance of maximum value for the construction dollar.

There are some basic requirements to project evaluation and performance:

Comprehensive initial planning
Outline specifications
Budget estimates
Cost control procedures
Reasonable project scheduling
Adequate contract methods
Construction cost control

The construction management team having been selected, the following activity must be launched on a planned and coordinated program:

- the owner requirements are determined if not already available.
- preliminary design, concept, drawings and outline specifications are prepared for review by the team,
- the mechanical/electrical consultants should take part in the early planning.
- similarly the practical experience and professional skills of the contract manager or construction management group will make a significant contribution at this stage.
- a preliminary budget estimate is prepared on the basis of the preliminary design and outline specifications. This budget estimate is reviewed by the team.
- the concept and budget estimate are presented for approval.
- final design, working drawings and detailed specifications are prepared.
- the construction manager sets the construction time table and determines the time available for design and working drawings, based on the necessary construction time to meet the target completion date.
- the construction manager coordinates the overall activity of the team to insure that targets of time and budget are achieved.

Some advantages and disadvantages of the various methods and contractual arrangements might now be considered.

Competitive tenders from a list of general contractors is the most popular of the various methods.

- guaranteed cost to owner.
- competitive bids should result in lowest price from competent contractors.
- least trouble for architect and contractor, if no design changes.
- "stipulated sum" and therefore an incentive to keep costs down and complete project as soon as possible.
- traditional and therefore widely accepted.

Some Inherent Disadvantages

- time required to prepare final drawings and complete specifications.
- tender period adds additional time.
- assessment of bids and consultation before selection of contractor - more time.
- site work cannot commence before all these matters are resolved.
- contractor is not consulted until selection - not available during design period.
- tendency to select the low bid is prevalent and sometimes very dangerous.
- open tendering attracts marginal and incompetent contractors.
- some tender periods too short resulting in lack of adequate tender procedures and planning.
- contractor must consider contingencies and risk, as he is ultimately responsible his tender might be excessively weighted.

Variations of this type of Tender

- contractors required to prequalify before receiving tender documents.
- a selected list of qualified contractors invited to submit competitive tenders.

Cost Plus Percentage (or fixed fee)

About the only justification for this type of contract is:

- when time does not permit the preparation of complete drawings and specifications.
- where it would be impossible to estimate the cost of the work. (Some projects actually fall into this category.) Owners are generally not in favour of this type of arrangement but in some cases their use is justified.

The contractor may be appointed on the basis of past performance or selected by competitive tender covering the extent of his fee.

Disadvantages

- no guaranteed cost of final work although an estimate may be submitted.
- subcontracts on specialist work can be called competitively on a firm price basis.
- the contractor's fee increases with the cost of the work.
- this type of contract requires additional administrative burden on the architect to cover the additional accounting procedures required.

Variations

A variation is the cost plus fee with a guaranteed maximum price. There is usually a bonus and penalty clause incorporated in this method.

In this type of work the selected contractor sometimes assists in the preparation of the budget estimate.

The difficulty of selecting a satisfactory contractor on other than stipulated sum work may well have triggered some of the procedures now being used on projects using the construction management method.

Construction management, in some form, presents the best opportunity to evolve contract management techniques which should result in good functional design with construction on time and to a budget. As stated earlier it should result in maximum return on the construction dollar.

Results on projects using the contract manager, management contractor or construction management group methods have indicated a significant saving in total construction time.

The preparation of a significant budget estimate based on preliminary design drawings and outline specifications.

A skilled construction management group forming part of the project team from the outset can easily apply budget considerations to all phases of the design.

Cost control begins to be effective during this period and is continued throughout to project completion.

The techniques of cost control are well known to those engaged in project management services. It is not my intention to detail this aspect of the method.

There is a misconception that construction management as we have discussed it today becomes another form of cost plus.

This is not so but there is a possibility that some owners might, in effect, have purchased cost plus results thinking they were buying skilled, ethical and effective construction management.

There is much to be done towards gaining the acceptance that construction management methods warrant.

The competition for the construction dollar makes it mandatory that we work towards this objective in a spirit of cooperation among all those involved.

Finally

There are many comments and much publicity about the sad state of the construction industry and the necessity for change in the architectural profession.

In many cases the traditional role of each has led to abuses and certainly some improvement is warranted and necessary.

The construction industry spokesmen and the architect/engineer associations have engaged in much self-criticism and have in fact set up study groups to consider these matters.

There is no easy solution. Modern technology has made methods accepted such a short time ago, completely obsolete.

Is it too much to expect that the various professions and industries along with the clients work towards a cooperative effort to eliminate many of our current problems.

This should result in achievement of our common target -

Maximum value for the construction dollar.

AN URBAN STRATEGY FOR AN URBAN ONTARIO

by J.C. Parkin

Introduction

Architecture (like politics) is a social art in the service of man and committed to human betterment. There may be architects who believe that they are artists in the sense that painters and sculptors are artists; that their concerns are exclusively form, texture and colour. They are wrong. They are avoiding their responsibility and attempting to escape from urban reality. If cures are to be found for the urban migraine which has beset out nation, architects cannot remain unconcerned.

The architect has, after all, some things in common with the politician. Lobbying is an occupational hazard for both. Apathy is the normal climate in which both appear to work. There are no second prizes for either -- one builds or one governs. The alternatives are to simply observe or to criticize. (And when one stops building or stops governing it is, as the late Honourable C.G. Power once said, "but a short step from the private car to the upper berth".)

The Urban Time Bomb

We are, in fact, sitting on an urban time bomb. The urban reality which faces us is an inventory of mediocrity, blight, congestions, pollution, alienation and increasing urban disturbance. Today, about one-third of the world's three billion people live in urban areas. By the year 2000 (only thirty years away) more than 60 per cent of an estimated six billion population will be urbanized.

In these terms, Canada (indeed all of North America) is urbanized now. The population of our eleven largest cities is over eight million and has increased at twice the rate of growth of the remainder of Canada (10.4 per cent as opposed to 5.2 per cent). Two-thirds of the population of Canada live in communities of more than 100,000 and 80 per cent in communities of over 30,000. While we have not yet reached the position of the United States, where 70 per cent of the urban population is concentrated on one per cent of the total land area, we are well on our way. For example, in fifteen years the area from Niagara Falls to Oshawa will be one giant urban complex.

While the city itself is 5,000 years old, the metropolis is a new phenomenon, no more than 100 years old. A few population concentrations however, already exceed present metropolitan concepts and are now more properly termed megalopitan. In fifty years, the majority of the world's population may well be accommodated in vast megalopolises, each with populations of 20 million or more.

The city merges into the metropolis, and the metropolis into the megalopolis. This pattern is already becoming identifiable. The spread from Boston to Washington, a continuous urban form planners term a "conurbation", is the wealthiest, most idustrialized area in the world. Other examples include Milwaukee to Chicago to Cleveland, or San Diego to well north of Los Angeles. This new phenomenon in the history of society has implications so vast that one scholar described it as giving "one the feeling of looking at the dawn of a new stage in human civilization".

The population explosion and rapid urban growth have been accompanied by a technological explosion. The range and variety of materials and systems available to architects and engineers today offer limitless possibilities to suit any building purpose. And the environment--thermal, visual and acoustical--can be controlled to meet practically any design criteria.

The incredible expansion of construction can be described most graphically by the fact that every object in North America must be doubled between now and the year 2000. For every expressway that now exists another must be built in the next thirty years. For every building, house or machine, there must be another building, house or machine built within that time. It has taken nearly 400 years to create the physical "plant" that is North America today. In the next thirty years it must be doubled.

The measure of the success we achieve in the remaining years of this century is of critical importance in the survival of our species. The issue of "how will man live?" is second only in importance to "will man live?" We have often been described as the only species which will foul its own nest. We have been obsessed with quantity and only incidentally concerned with quality. So far, man has gone on the assumption that men, women and children are almost infinitely plastic, provided they get certain minimal amounts of water, food, light, space and air. Little thought, and less experimentation, has been directed to the quality of the space in which man lives.

The Governmental Crisis

Clearly, sweeping and fundamental changes are required in the decision-making techniques forming our cities--if indeed there ever were any conscious decision-making processes at work at all. The nature and form of our environment is capable of being controlled. The question is: Are we willing to bring collective pressure to bear on the problems inhibiting the achievement of man's optimal environment? This must be done by governments, but ironically

one of the principal impediments to the renewal of cities appears to be partly overgovernment and partly absence of government. Indeed, we are overgoverned, at least in the sense of being overcrowded with governments. Besides the one federal, ten provincial and two territorial governments, there are 4,866 municipal jurisdictions--a total of almost 5,000 governments. Only the 4,866 multipurpose municipalities are specifically charged with the task of dealing with urban detail. Many of the municipalities verge on bankruptcy, with the principal decisions affecting them being made by the senior and absentee levels of government. Several of the more populous provinces, in fact, appear to fear the potential political power of their major metropolitan areas far more than they fear the power of the federal government. It is politically expedient for the provinces to ignore many of the major urban problems of their municipalities for fear of losing real power to the cities.

Unfortunately the senior levels of government often make decisions affecting cities and towns without fully understanding the physical consequences. Provincial governments build highways or establish commuter train services, install major utility services, build houses, provide electricity, erect their own plants and buildings, and determine or greatly influence many other factors, including centres of higher education. Together, the province's actions go a long way towards determining the broad outline of development in any region. At the same time, the federal government builds harbours, airports, buildings, and regulates railways and pipelines. All of these have a great impact on our cities.

The municipalities are at the receiving end playing a dual role. First, they have to provide basic services to the community: the roads, water and drainage that service property directly. Second, they are expected to coordinate the activities of all three levels of government, to say nothing of those of the private sector. The municipality is asked to take the responsibility of planning its area when it has no jurisdiction over the vital actions of many departments and agencies of the provincial and federal governments and has only limited means of guiding private development. Even the school boards within its territory are beyond its reach. Municipalities are thus reduced to making partial plans to cope with an unpredictable future.

In view of the significant function of municipal government in our country, is it not ironic that our constitutional discussions are centered almost totally on the relationship between the federal and provincial governments to the exclusion of the nearly 5,000 governments to whose care is entrusted the urban dweller? The rationale used to justify this neglect is that urban renewal and city change are properly provincial and primarily local functions, according to current interpretations of the British North America Act, and therefore not federal functions at all. If the BNA Act is responsible for this anomaly, perhaps it should be amended.

If the constitutional conferences in the immediate future fail to address themselves to local and urban problems and disparities, as well as to federal-provincial constitutional abstractions, the consequences might well be serious for the 70 per cent of this nation's population who live in cities.

An Urban Strategy

The nation's festering problems are urban concerns -- inadequate housing, mass transportation, crowded educational facilities, lack of recreational outlets, pollution, poverty, and so on. The level of government that first tackles and solves these urban problems will inherit the authority that counts in deciding the future of this land. Human ingenuity and human will can solve the problems we face. We must mount an attack on the urban problem. We must defuse this time bomb.

The Federal Government's Role

In theory, Ottawa is scarcely allowed to acknowledge the existence of our 4,866 incorporated municipalities for the British North America Act gave the provinces exclusive power over municipal institutions. In practice, however, through an increasing system of grants to the provinces for various municipal programs, the reality of "junior" governments is, in fact, recognized. What is lacking at the federal level is an integrated coordinated program of attack on urban problems. No one would dispute the obvious need for a Department of Agriculture, but where is the equivalent department to coordinate specifically urban problems -- our federal Department of Urban Affairs?

Such a department should be created and charged with interrelating federal aid in the fields of housing, poverty, pollution and transportation.

The Provincial Government's Role

Much of the foment and action in Canada has passed from Ottawa to the provincial capitals. Not only are the provinces now spending as much collectively as the federal government, but they are spending in areas of more immediate human concern: education, health and social welfare. Their spending, however, lacks coordination.

In Ontario, for example, there is a Department of Municipal Affairs whose administrative business is the affairs of some 500 municipalities, many of them small. But the Minister of Municipal Affairs does not hold a brief when the departments of welfare, education and health bring down new regulations which the cities must implement and finance. Obviously, there is an inherent conflict in the purposes of local government.

The proliferation of provincial boards and agencies, from some of which there is little practical appeal, must be checked. Surely there is no excuse for the existence of boards whose decisions cannot be appealed through the Courts.

The need is not for tighter, more authoritative control, but for a clarification of the purposes and duties of local government in an urban age. We need a provincial Department of Urban Environment to deal with all aspects of city life.

The Role of Government Agencies

Crown corporations, agencies and government boards make countless design decisions daily on all levels, often without realizing it. When the Saskatchewan Power Corporation decides underground wiring is a luxury the consumer must pay for, when the Canadian Broadcasting Corporation contemplates a production facility not in accord with the best principles of planning, when public buildings are located without appropriate thought given to their beneficial influence on renewal, when cultural centres are wrongly thought of as slum clearance projects, then government fails in its understanding of planning issues.

The Canadian National Railways, on the other hand, has in recent years, and in all forms of design, fulfilled a unique leadership role. From a provocative symbol, and imaginatively designed rolling stock, through to notable contributions to the urban cores of Edmonton and Montreal, CN presents a distinguished example of enlightened corporate design patronage.

The Role of Taxation

Taxation should be used to encourage better planning performance. Both local property tax and federal income tax can be adapted to reward the man who maintains his property. Assessment should encourage, rather than discourage, good architecture. Tax incentives should be created to encourage those who provide open land, plazas, arcades or development rights for public use. The tax lever should be used on those who pollute air, land and water, with remissions when the offending source is removed.

New concepts of assessment are urgently required. Assessment should be heavily weighted against land and lightened on buildings. Most present assessment discourages quality development, and results in underdevelopment. Parking lots and shoddy "taxpayers" abound.

A National Building Code

We have an excellent National Building Code of Canada backed by the resources of the National Research Council. We must adopt this code nationally for none of our municipalities have comparable means at their disposal to adapt, test and modify code requirements. Yet some of our cities prefer an independent course and permit their officials arbirtary discretionary interpretation of their codes. The resulting chaos confuses not only would-be homeowners, but builders as well.

The Role of the Social Sciences

There is no budget for urban research worthy of the name though millions are spent yearly on farm, forestry and fisheries research. Worthy as all these programs are, they are product-oriented not people-oriented.

According to a report in Time magazine the social sciences get less than 3 per cent of U.S. federal research money, while "there is always plenty of money available from almost any foundation for cardiac disease and cancer research."[1]

Canada's record is no better

The scale of urban development is so immense, and our ignorance of cause and solution so vast, that we shall need the simultaneous and perhaps competitive research of many minds in many institutions -- public and private, profit and non-profit -- to even begin to understand the human problem and to project answers.

Protection of Natural Resources

Men may find God in nature, but when they look at cities they are viewing themselves -- and what we see mirrored in our cities these days is not very flattering. Resource control, conservation and pollution control could be a practical demonstration of cooperative

[1] Time, March 17, 1967, p. 68.

federalism. We Canadians should demand of our legislatures effective control of land use, air, water, noise and even visual abuse.

Water control, the politics and strategy of water management, has been the basis of civilization since history began. In Canada we only dimly apprehend water politics, despite the fact that we possess one-quarter of the world's supply of fresh water. We North Americans are on our way to putrefying every major river system by unchecked dumping of raw human sewage, pesticides, detergents, and industrial chemicals and wastes. We are indeed the effluent society!

The dynamics of a national-regional water transportation distribution system could enable us to support a vastly greater population over a greater geographic area. Our water resources are our most valuable Canadian asset. Unlike certain of our other natural resources we own 100 per cent of our water potential -- or do we?

> Just go out for a breath of air,
> And you'll be ready for Medicare.[2]

Air pollution is so vast a problem that it has inspired mostly apathy. Some of our cities have no pollution control laws at all, and laws elsewhere are for the most part weak, archaic or unenforced. Expert advice suggests that 50 cents per head per year would keep most cities in Canada reasonably clean -- more, apparently, than most Canadians are prepared to pay.

Provision of Urban Transportation Systems

Federal and provincial governments must be made to recognize that integrated urban transportation systems are a shared responsibility. Our cities face a traffic jam expected to at least double in twenty years. There is undoubtedly a point of saturation, probably at the ration of one car for every person who can drive. Growth of the automobile population, therefore, will be tied to and limited by the growth of human population, as great as that may be. Building roads for this controlled total is at least a definable, if enormous job.

Our transport habits have changed in the past fifteen years with the move of industry and homes from city centres. No one transportation mode -- cars, buses, subways or commuter trains -- can handle all the traffic growth that is forecast. Achieving the correct mix is the essence of an integrated transportation policy. The cost of providing the necessary variety of transportation modes and the size of the areas to be covered are obviously beyond the scope of any one government level.

[2] "Pollution" by Tom Lehrer

The Non-Material Aspects of Urban Living

Most of the preceding discussion has concerned statistical, strategic and political matters. But a nation of urban excellence cannot be built without consideration of matters of subjective judgment. We ought, as Canadians, to pursue a higher quality of public art.

We must complete a national inventory of historic buildings and landmarks. When we have identified those buildings of true value, let us create a "National Trust" to maintain them. Let us permit their owners lifetime occupancy on condition that the buildings be deeded to the state. We all accept the validity of our need to establish and maintain national parks and herds of bison in the wilderness. Why not extend this concept to the heart of our cities? Why not provincial parks for cities?

Where buildings are concerned, let us be very sure that sentiment does not cloud our concern for real quality. History is constantly in the making. Time may prove that what is being built today is superior to our inherited architecture. Cities are organic living things: they have never been immutable in their form. Our older buildings were valid in their time, but does the space occupied by some of them fulfill today's highest purpose? Toronto's old City Hall is a case in point. Urban space -- and buildings are but urban space -- is to be lived in, as well as looked at. While cities must not be allowed to sacrifice their architectural heritage, they cannot become mere museums. Cities, after all, are where the action is.

The same thoughts apply to public sculpture. Not only should it be radically expressive of our age, but capable of probing the future. The rights of the minority elite who studiously and sincerely are devoted to contemporary art should be as respected as any other minority right. In fact, they should be as respected as the more obvious rights of the majority. It should be possible for a civic body to purchase a piece of contemporary sculpture for a public building without the irresponsible jeering that accompanied the purchase of the Henry Moore for Toronto's Nathan Phillips Square.

A percentage of the cost of all buildings should be devoted to the arts. To ensure that that percentage is wisely spent the choice must be left to the judgment of the thoughtful and informed few.

In short, we must preserve all that is worthy from our past public art, while encouraging the best in our present and future public art.

Conclusion

One of my favourite urban guidelines appears on a street sign in Edinburgh:

> The Amenity of our Streets is recommended to your care.

Not only our streets, but all the worthy elements and details of our cities are recommended to your care.

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PLANNING AND ADMINISTRATIONAL PROBLEMS AND THEIR RELATIONSHIP TO BUDGET FINANCING by T. Murray

Budget is a term in such common usage these days, and is a source of such controversial interpretation at times, that I thought it would be useful to go back in history a bit and trace the origins of the word, or the origins of the term. In this connection, I consulted the Oxford Dictionary and you might be interested to hear some of the definitions supplied in there.

In 1432, budget was referred to as a pouch or wallet. In 1794 "budget" was referred to as a boot in a carriage for carrying luggage. In 1816, a budget was partly described as a "leathern socket for the butt of a cavalry carbine. Now the direct resemblance between the charge of the light brigade and some budgetary experiences is after all not totally obscure, hence presumably the influence of the cavalry in defining budget. In fact, I might say that being Irish, my first experiences in architectural budgeting had to do with the Church and I can assure you that it was "Cannons to the right of me - Cannons to the left of me". However, on pursuing the Oxford Dictionary, definitions of budget, I found the last entry in the dictionary, of greater relevance to the problem at hand here. It states that a budget is a statement of the probably revenue and expenditure for the ensuring year, with financial proposals founded thereon, annually submitted by the Chancellor of the Exchequer for the approval of the House of Commons, now that definition is dated 1773, and to great extent has remained fairly consistent down to the present day. The intent of today's budget has not changed that radically in the meantime, but the external forces that come to bear on it seem to change by the day. This gives us a clue as to the nature and characteristic of this element as a tool in management control. In attempting to identify some of the influences that bear upon budgetary controls, amongst others, one might consider the following:

INFLUENCES ON BUDGET

a) The pressure as a whole from outside and within the community carries a great weight of public opinion, brought to bear upon any educational program, and depending regional implications of such a program, the influence of such opinions may emanate from a large area. There are of course the local considerations of public opinion and then there is a certain opinion within the academic community itself, that has a profound bearing on budgetary attitudes.

b) Secondly, there is the demand for large building programs, which come as a result of sustained growth in a student enrolment.

c) Thirdly, there is the recruitment and utilization of teaching staff as a direct result of increased enrolment.

d) Fourth, there is the influence of the academic philosophy of the financial resources available. (This is a difficult area to gain access to - academic freedom vs. responsible spending.)

e) Fifth, there is the use of cash resources and temporary investments which might provide additional income. (Debentures, Insurances, Pension funds)

f) Last there is a complexity of operations, which now become large and costly involving maintenance departments, electronic date processing, costly instructional aids, elaborate foods and catering programs and involved parking systems.

TECHNIQUES OF CONTROL

The financial expertise in school administration is beginning to cope with these diverse situations in a variety of ways. First of all there is long term planning. This involves -
a) What resources will be available in the future?
b) What future educational requirements will consist of.
c) Planning how best to use all available resources.
d) Choosing programs that the future community can sustain.

CASH FLOW

is another budgetary technique that is being applied, where cash flow forecasting projecting monthly, weekly and in some cases daily, information to determine cash balances both now and in the future.

Another technique employed is OPERATING BUDGETARY CONTROL - The overall budget being broken down into areas of specific personal responsibility with the particular officer being held responsible for control of his department.

CAPITAL BUDGET

The area that affects the architect most, is of course the capital budget as opposed to the operating budget and by comparison in graphic terms, one is seeing the operating budget as a horizontal line, whereas the capital budget is essentially a rising and descending curve, rather like a perabola.

Where then, one may ask, do these various disciplines integrate and coordinate?

For the architect, the beginning is of course, the receipt of the commission.
With the commission, comes the establishment of the program.

A clear-cut academic philosophy, usually defines the building program perameters. However, this program in its early phases must, of necessity consider the following:

a) The Regional situation as a whole

The area growth, amongst other factors are,
The student enrolment
The community requirements and
The demand for courses.

The program must reflect the particular budgetary techniques necessary to ensure the smooth flow of funds.

a) Is the finance predicated on total needs
b) What is the timing of program approval and budget approval.
c) Is escalation considered as a real factor - that is, recorded, published and remembered.
d) The funds for building may be required on a variable basis. Not on allocated and fixed - as is often the case. As I understand it, the criteria for establishing needs are the same for all colleges, but its up to each college to establish its priority -- could this technique be more equitably applied.

It has to be borne in mind, that at a provincial level, one is first of all competing with -
elementary schools
high schools
trade schools
and any other form of educational establishment. All participating for a share in the education dollar, which of course in turn is competing with universities, hospitals, highways and welfare programs.

At what level of government management, can one best contribute towards the case for ones requirements.

Budgets are established on a department level within colleges - it is human nature to request the maximum, not the minimum - this influences the planning approach, producing rigid and inflexible systems, not permitting later variations as budgets may demand.

In the detailed area of involvement with the architects and engineers, the following criteria influence the budget:

a) Escalation.
b) Construction contingencies, strikes, controversial suppliers - Have you tried specifying American Brick lately? Geographic areas peculiarities - the availability of certain trades.
c) The variety of contractural arrangements also have an effect on the budget -

    1) There is a lump sum contract
    2) Management contract
    3) Negotiated contracts or
    4) Even a Development Proposal - that currently fashionable form of contract that conveys the illusions of a better system for delivering the building.

At this stage of the program, in the evolution of the budgetary system, I am forced to make reference to the CAAT system, that is in current use by community colleges. The now well established system of CAAT approvals for drawings and finance and contract awards, seems to work well. It has proven a valuable means of control and information flow to all associated with it. Despite the clarity of the form, human nature still manages to confuse the issue. But I am also heartened by William Blake's poem on the Greatest Cat of All - the Tiger - wherein Ogden Nash pulled back the bamboo bush and changed the first lines to read, "Tiger, Tiger, my mistake, I thought that you were William Blake".

In brief conclusion, then I would point out the following.

Financing and budget control should not be geared to fixed requirements, but should recognize the dynamic character of a building program and be capable of continuous modification within broad perameters.

In this connection, I would make the following recommendations therefore:

1) For Management:
That an institution should have a qualified planning team who establish the prioities and under its guidance formulate policies that consider the full spectrum of finance and generate policies for implementation.

2) That a Physical Plant Department - perhaps called Planning and Administration be formed to receive the policies - develop and implement them realistically, and to assume responsibilities to adjust and be flexible as needs arise.

3) That the architect and consultants should be in direct contact with the Planning and Administration and preferably not articled to the individual department users. Any contact with the users, should be in the presence of planning and administration representatives.

4) That the architect and consultants have to meet varying needs to adjust to financial fluctuations - such flexibility must be recognized in engaging his services - cost control should be carried by an in-house system, in planning and administration, or by an outside consultant, or be identified as an over and above cost within the terms of reference of the architects's role.

Finally, general contractors can play a greater role in the future, whether they are ready to become sophisticated agents of the owner, or still think in terms of trade contractors as yet remains to be seen.

PLANNING AND ADMINISTRATIONAL PROBLEMS AND THEIR RELATIONSHIP TO BUDGET FINANCING by D.F. Pinker

The 1966 decision, by the Province of Ontario, to simultaneously sponsor the development of 18 Colleges of Applied Arts and Technology (now 20) - was a bold and imaginative move in the field of higher education.

Some critics may now argue - with the benefit of three years hindsight - that given the present tight financial situation the Province would have been wiser to initiate a less ambitious program of "Community College" development. And yet the many achievements of Colleges to date, enrolment pressures and the evolving needs of society - all attest to the wisdom of that 1966 decision.

The fact that College funding - both in terms of capital and operating budgets - is in a restrained position, should come as no great surprise. The instantaneous, expensive and inflexible educational monolithic college campus was all an illusion and existed only in the mind of its creator - be he planner, architect or College President.

Colleges of Applied Arts and Technology are "no licence to print money" as some critics may suggest, for though their funding is not determined by the same yardsticks as applies in the private entre-preneurial sector of the economy they have nevertheless to compete with many other financial demands on the Provincial Treasury.

Current Federal and Provincial measures to curb inflation have created, as far as Colleges are concerned, a degree of uncertainty approaching organized chaos respecting both short and long range development plans.

Even when inflation is brought under control we should all be cautious as to the degree we may expect capital and operating budgets to be augmented. For the future brings its own problems and the Provincial coffers will be hard pressed to balance the increasingly varied demands on its financial resources. Though University and Community College financial requirements will continue to grow, particularly up to the mid-1970's, they will have to compete with increasing public and Provincial concern, and therefore need for public financing, respecting internal regional disparities particularly in Northern Ontario, hospital and health and welfare programs, air water and soil pollution and relief to municipalities to enable them to deal with increasing urban problems.

Not just today, but through the 1970's I therefore see Colleges always being subject to vigorous financial restraints. As a consequence we will have to switch from planning by the "seat of our pants" and move in the direction of an equitable distribution or allocation of financial resources in relation to College needs but within the limited cash flow that can be made available. In the process we will all need to get a lot smarter than we have been to date - and by we, I mean the Province, the Colleges and their Consultants.

The planning process becomes futile if Colleges are not able to make reasonably accurate assumptions as to the funds they may receive and the criteria that will be applied by the Province. Erroneous guesses by Colleges, as to funding, leads to false starts or major modifications of programs. As a result cynicism sets in and support for sensible long range comprehensive planning becomes lukewarm. If Colleges are therefore to meet their obligations they have a right to know the funds they may individually receive - not just for the next academic year, but for five years ahead. This implies that the Province will have to increase its capabilities in 5 year socio/economic and budgetary planning to a much greater degree than it has done in the past.

As far as some Colleges are concerned their administrative structures pose real problems respecting planning and budget finance for they are still geared to the linear approach; first academic planning; then physical planning, then financial planning. By comparison the private sector, and some government agencies have long since adopted contemporary analytical methods involving system analysis, simulation, monitoring and feed-back communications and other requirements of comprehensive planning. These latter techniques, applied to a College's operations make possible an appreciation of the interdependency of all its parts and the ability to determine optional methods for meeting its goals within the financial restraints imposed upon it. Without the rigour imposed by the adoption of such techniques, planning and budgetary control are vulnerable to frequent mind-changing or indecision due to lack of comprehensive analysis.

Where the internal College administration is overly committee-orientated and may of its planning operations compartmentalized the College's Consultants are often placed in the position of internal coordinator - a role they have not right to perform and a sure guarantee of frustration and uneconomic and inefficient planning.

College Master Planning is not a static once-in-a-life time operation. It is a highly complex on-going, indefinite operation. It is a continually

refining process. If the administration of a College is not sensitive to the need for on-going planning then it will not be organized to plan efficiently no matter how generous its budgetary finance situation may be. As a result its original Master Plan, no matter how competently prepared, will peter out through obsolescence.

Consultants, in their turn, need to re-evaluate their role in College Development programs, Some have undertaken planning work for which they are not qualified to follow through on in an optimum way. Their approach has sometimes been simplistic. The development of a College is an extremely complex operation. It require many types of specialized knowledge and it is time consultants organized themselves into multi-disciplinary teams that recognize the role of specialized skills and when they are phased in and out. Consultants should also welcome, indeed they should encourage, the establishment by Colleges of their own internal institutional research and planning departments. Colleges should equip themselves to handle their own comprehensive planning operations in which the consultant team is used more in an advisory capacity than in the role they have sometimes performed to date where they have made, or were forced to make, a fair number of educational decisions for their clients.

You will note that so far I have exercised the licence of a speaker to change the title of his address. Rather than discussion planning and administrative problems as separate entities and how they relate to budget financing, I have attempted to show the interrelationship between planning, administration and financing. One cannot be considered without the other two nor can the role and responsibilities of the Province, College Administration or Consultants be viewed as separate entitles.

Let me now turn briefly to a situation with which I am particularly familiar.

How do you plan a College for 15,000 students within the densely built up central area of Canada's largest metropolis where land can cost $500,000. and upwards an acre. That was the problem facing President Lloyd, and his planning team, at the George Brown College in Toronto. The response to the challenge was fairly unique in that the traditional centralized campus approach was rejected and replaced by a concept which states the "City is the Campus". The College is viewed as a network of educational opportunities, and facilities, distributed throughout the City. The College becomes a series of Schools subtly infused and meshed into the fabric of the existing City. Six locations have been selected with individual projected enrolments varying from 1,800 to 3,500 students each. The educational content of a particular School, and its specific location, will be directly related to that part of the City where a corresponding real life urban activity exists. A Marine School will therefore be located in the Toronto Harbour, a Business School in downtown and yet another School will be in an urban area offering an educational experience directly related to the needs of the inhabitants of the area. An overall small administrative unit will be located on its own in the midtown district of Toronto.

Approximately 50% of projected facilities will be built by the College on its own land. The remainder will be provided by longterm leaseholds with options to purchase at certain time periods (a least purchase) - at depreciated building value, the College continuing to pay a site rental rather than eventually trying to purchase high value land.

The George Brown strategy is a consequence of examining the inter relationship between planning in the larger sense of that word, administration and budget financing.

The College believes that if it is to serve its community it must add a lot to the City and take little from it. It must not destroy part of the City's living fabric. A centralised campus would destroy an area of the existing City by the very process of land assembly. It would also be inordinately expensive. Opting for a series of dispersed locations within the inner City permits the College to combine with other compatible urban activities. As a consequence the College can become part of a larger urban renewal program using where appropriate the lease purchase method of financing. Where this financing approach is used it allows the College to reduce some of its requirements for heavy capital financing. It does, however, require an increase in the operating budget to pay annual rentals but it is felt that the Province may absorb such costs out of the normal increase in provincial annual revenues in preference to further increases in its debenture debt.

The administrative features of a dispersed operation are not deemed any cause for concern by the college administrators. Most of the private sector of the economy manages to operate this way quite efficiently within the communications systems that exist today and those of the future.

Granted the George Brown College urban situation is somewhat dissimilar from other Colleges and yet its strategy of operation and its desire to involve itself in urban affairs has implications for other Colleges as they give consideration to the development of their satellites.

"THE POTENTIAL OF STUDENT HOUSING"
by H. Sears

The chances are that you have given very little thought to student housing to date. Most educators find other issues more pressing and therefore more important. You are probably wondering why you should give any though to it now. If you do happen to be one of the few who have given it some consideration, it is likely that you have considered it as a peripheral matter and one which is best treated as a necessary evil. I suppose my function here is essentially to raise the issue of whether indeed you should be concerned and if so to provide some stimulation to the thinking that might emanate from that concern.

I would like to start by some examination of the extent to which the option exists for you to be interested or to be disinterested. How aware are you of the housing situation in your community? How aware are you of the actual needs and desires of the students who go to your College? How many students indeed do come from the community in which your College is located? How many commuters come and from how far? How many rent accommodation in the community? Is the student who rents in the community satisfactorily housed? If not, what alternatives are there available for him? If these are not available is his dissatisfaction of sufficient intensity to convince him to select another College, or to drop out of College all together? Does the community itself have the capacity to house, in a satisfactory manner, the increment in students which will be created by the proposed growth of your College? Do the pressures on and demands for housing in the community allow for this growth or even provide assurance of the continued provision of accommodation for numbers of students currently housed in the community? Most educational institutions cannot answer these questions with any degree of confidence or with any degree of exactness.

One College with which I am familiar, Cambrian College in Sault Ste. Marie did undertake a useful preliminary examination of the housing situation of its student body. We collaborated with Project Planning Associates Limited, Planning Consultants to the College, in this examination. Here are some of the facts which were apparent:

- over two-thirds of the students came from other cities and towns in Ontario.
- students housed in the community apparently have occupied most of the available satisfactory accommodation now.

Although most of the students consider their accommodation satisfactory, 20% termed their accommodation only adequate, and 8% found it unsatisfactory.

It appears likely from the examination of the rate of growth of housing in the community and the amount of accommodation currently available that very little of any growth in the student body will be able to be housed in a moderately satisfactory fashion within the community. And thus it appears that future growth of that particular institution is already directly related to its ability to provide housing to accommodate at least some portion of the planned increment in its student body.

This is a reality that has already been accepted as policy by some Universities in Ontario. For example, Queen's University in Kingston and the University of Guelph are proceeding on the carefully studied premise that their ability to grow in accordance at the rate agreed to by the institutions themselves and the Province, is directly related to their ability to provide housing. In other words the failure to provide housing at the required rate will likely restrict growth below planned level.

At the University of Guelph we have worked in consultation with the University to develop an immediate sensitivity to changes in the available housing stock within the community, and to develop a methodology for forecasting with some accuracy the quantities of housing to be provided as part of a long range program. We shall be able with some confidence, predict demand and indicate the implication of inadequate provision.

Housing is then for many educational institutions a direct and very practical consideration which you can indeed override many of the planning considerations. Generally accepted as more critical if one adds to this fact some understanding of the considerable time necessary between the first expression of concern about housing through the necessary processes until the actual availability of accommodation on campus (about 3 years) then it seems evident that there is a need for an understanding of and a rapid responsiveness to the constantly changing and developing housing situation of the student body. I feel it should become not an issue of peripheral concern but one of major emphasis. For while it might not be necessary for every College to provide student housing it will likely be useful if not essential for every College to at least be sufficiently knowledgeable about the housing situation of its students to be able to make the decision and to provide housing based upon the conviction and assurance of factual evidence rather than the rather arrogant and possibly ill-founded assumption based on intuition and "Hope".

If one wants to go beyond these immediate "practical" (and possibly disastrous) considerations and raise the question of the quality of education, and the potential impact of a living environment which might reinforce and enhance the learning experience of the student, then we have added another dimension to the problem. For if after much deliberation you come to the conclusion that you must, or wish to, become involved in the provision of housing for your students, then you must determine how to most usefully, efficiently and meaningfully employ the housing which you are then going to provide. What function should this housing serve? What purpose should it fulfil? How does this relate to the education of the student in the broadest sense.

However, before we can fruitfully explore these qualitative considerations and usefully examine the range of accomplishments that can be provided through the creative employment of student housing at an educational institution, we should look, for just a moment, at what an educational institution can do to develop a useful and appropriate housing policy. For in order to explore the housing situation of your students to formulate an appropriate policy, and to ensure that all of your activities in the field of housing fulfill the aims of that policy, your institution must develop a method by which this will happen in an orderly and effective manner.

Once we have accepted that fact that student housing is at least worth examining, even if this is arrived at somewhat reluctantly then there is a value in developing what I refer to as a "comprehensive housing policy". By this I mean simply that the College should:

1. develop a thorough understanding of the housing situation of all its students,
2. formulate an overall approach to the problem of housing, and then evolve a program of activities to accomplish the ends set out in this approach. This does not infer that the College must assume responsibility for the provision of housing for all or even for some of its students. It does assume that the College is interested in the housing situation of its students and will provide appropriate actions as they flow from the housing situations of the student body.

The College by having established its location has generated a set of housing situations and problems. It probably has attracted students from a fairly wide region and possibly from a large part of the Province. It might therefore be interested at least in identifying the kind of situation it has created. And perhaps even in initiating the actions necessary to ensure the satisfactory solution of the housing problem of its students, it is useful to understand the variety of individuals and agencies who do now or might in the future assist in the provision of housing for its students. For the solution to the housing problems of even a small student body is a multi-faceted one. Some students live at home with their parents, other students live in a variety of rented accommodation privately provided ranging from a room in a basement to a group of students banding together in an apartment. Still others might live in accommodation provided directly by, or through the encouragement of the College itself.

Once the nature of the actual and projected housing situation is clearly understood, the College should establish an approach to or philosophy of housing, and then develop a program of activities to accomplish the ends as set out in that philosophy. The vehicle for accomplishing this within the structure of any particular College is of course peculiar to that College. For the purpose of our discussion it should be adequate to indicate that the responsibility for the development, and implementation of the approach should lie within an agency or committee with the authority and position within the College to make and to implement decisions of consequence.

The area of interest of the committee extends to the housing of all its students. In the investigative aspect of its work it will be interested in the degree of satisfaction of all the students in their accommodation in the impact their housing situation has in their learning experience while at the College, in the plan of action of the College - including the establishment if necessary of an off-campus housing service, the provision of appropriate counselling services to deal with housing problems and in determining whether or not the college should become involved in the actual provision of accommodation and if so what quantity and what type.

Lets assume for a moment that the College has established a committee, that the committee has explored in some detail the housing situation of the students now in attendance and those projected for the future, and has come to the conclusion that at least part of the solution of the housing situation requires the provision of housing by the College itself for some of the students within the community itself. If this investigation has not by this stage created too great a state of panic, the College should ask itself some basic questions about the housing which it intends to provide.

The most basic question that we can begin with is "what kind or kinds of environment does the College seek to create to foster learning"?

An institution of learning certainly is more than simply buildings. It is generally agreed that learning derives from the totality of the environments of both its academic and its non-academic life, and by the ways in which they reinforce each other.

Some educators today consider the out-of-classroom learning experiences of the student to be of equal importance to the structured classroom experiences. The living environment which the College will provide for its students should provide opportunities for informal learning experiences to develop. How indeed should this take place?

This housing can form an integral part of the total environment provided by the College. What function should this learning environment provide?

What are the needs and desires of the students who will occupy this accommodation?

To what extent will the College be involved in the lives of the students in this living environment?

To what extent will it be directive acting as surrogate parents? To what extent will it be a support resource, provider and advisor? To what extent will the students control and manipulate their own environment?

From the point of view of the student the housing enviroment constitutes both the tangible or physical of the building itself, and the intangible presence created by the interaction of student-to-student and student-to-administrator. Where should the housing be? Should it be an integral part of the complex or should it be separate from the formal educational areas?

What kinds of activities would we like to see take place within the living-environment? What kinds of social interaction do we wish to encourage?

What should be the basic approach to eating and food services? Should meals be provided in dining halls? Should kitchens be provided for students to cook their own? Should there perhaps be a combination of the two?

What kind of social and recreational facilities should be provided and what functions are they intended to perform?

These are some of the basic questions to be examined and the rather complex answers to them will establish the framework, the basic approach to the housing to be provided. Unfortunately there are no simple or magic answers to these questions. The body of available experience is limited. The examination and the development of fresh concepts is essential, not merely desirable. These concepts should include both physical and administrative aspects, and well conceived should provide living environments which will reinforce and complement the educational philosophy which guides the College. It is not possible to explore in detail the vast range of possible concepts which can be evolved from these deliberations. Because we are on the threshold of knowledge and experience, student housing at the moment is at a rather interesting and creative stage. The traditional approach to housing has become generally accepted as being obsolescent both as an administrative concept and as a physical concept. "In loco parentis" is a rapidly disappearing phenomenum in even the most conservative educational institutions. It is not longer acceptable to students or administrators. We are just beginning to create forms, concepts, and administrative approaches which can meet the needs of the contemporary students, and the students as we imagine he will be in the near future. As far as Colleges of Applied Arts and Technology we are just approaching the threshold.

There is little direct experience and little understanding of the particular nature of the prblem, if indeed it is unique. My one experience dealing with the students at Cambrian College in Sault Ste. Marie was a refreshing one. In a few short hours we were able to explore in a preliminary but thoughtful way the limitations of some approaches and the opportunities of others. The students with some proding and encouragement were able to point out what they really wanted was different from what they thought they would get. The acceptance of this potentially unsatisfactory accommodation was based on the feeling that was what "they" would give them. "They", the administration however imposed no such limitations and were able to explore a concept which was to their liking without inhibition. I feel that at the Colleges perhaps even more than Universities the function and purpose of housing should be carefully examined. The specific nature of the student body at the College particularly the ones located in small communities remote from the large urban centres deserves examination. The impact of their education on the students from rural or semi-rural areas whose very training will alienate them from their homes affects obviously the approach to education. Is the College for these students a kind of "half way house"? If so, perhaps a carefully integrated housing program can reinforce the educational process and provide some assistance to students going through a rather traumatic period of

their life. This is an area we must explore together over the next few years. I thought it might be useful with some slides to illustrate some existing examples of housing in a variety of forms and indicate to you some of the possibilities which do exist. These are not intended as examples to emulate without question, but to perhaps give some sense of perspective to the opportunities available.

Conclusion:

These examples I have shown indicate some but only some of the potentials that can exist in student housing.
Opportunities in student housing today are limited only by our own creativity and the normal restrictions of time and money. However, within a fairly rigid financial framework we should be able to provide housing that can provide the opportunity for a meaningful environment for your students. Housing can be more than just "shelter", if you want it to be so.

It is not my purpose today to convince you to provide student housing. I do feel it is essential to understand the fact that as an institution you are possibly the generator of a housing problem. I wish to emphasize again I feel it is important to develop a responsiveness to the housing situation of your students and to develop an ability to act in accordance with the situation as it develops and adjust through time. When the nature of the situation indicates that part of the solution to the problem is the need to provide accommodation for your students, I then feel it is your obligation to provide, within the imposed limitations and restrictions, the best and most appropriate solutions that you can. To do so you must provide the capacity withint your institution to identify the situation, to analyze the problem and forecast the future needs and actions, and then to creatively develop solutions to the problems.

Extracts Edited from a Speech and Interview given by Dr. H.B. Gores, Director of the Educational Facilities Laboratories, New York

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EFL has $2 million U.S. dollars given to it by The Ford Foundation, to finance studies by non-profit educational bodies. Four year ago, EFL changed its charter so that we could make grants to Canadian non-profit schools and colleges. We run the whole gambit from pre-natal to probate and are interested, as Stan Orlowski says in the solids of education, anything you can with impunity kick with your foot, rather than the gases of education like the curriculum or the other philosophical matters. The Toronto SEF Program is backed 50% by us and 50% by the Metropolitan Toronto Board of Education. Montreal Separate School Board has a systems program we assist financially and there are a number of other grants to Canadian groups.

I am going to discuss the shape of things to come - what are colleges and schools going to look like. I'll make several predictions probably half of them will turn out wrong, and I don't know which half. Say it is 1984, (or let us not pick that year - 1983) and let us arrive by helicopter and take a look. From the air they are increasingly going to look like connected shells of space. They are going to be less Cartesian than our buildings are now, less symmetrical. More and more young architects will stop putting Descartes before the horse (as somebody says), they will learn how to turn a corner in other than 90 degrees - which seems to be a pleasant experience in most cultures except our and the Germans. You are going to see curves flung against the sky, increasingly.

From the air the big university is going to look less like a sun flower. Typically gargantuan, monolithic universities, (at least in the United States, I can't generalize to Canada, are great sun flowers with a great central space and then there are petals. On this petal you sleep, on this petal you exercise, on this one you eat, on this one you go to class, and so forth. Then frequently, in the middle there is maybe the library and at a couple of institutions that turns out to be the stadium. But in general it is a single blossom. My guess is that in 1983 when you look down on this place - (for those you can see, and there will be some you can't see) it is going to look not like a single blossom, but like a bouquet of small blossoms. There will be a cluster of colleges coming with little villages of their own.

I have said, there will be some colleges you can't see. For example, if you go to the country of Kuwait, you will find that they are so far ahead of us that they are saying "why do we respond to climate and weather"? Technicologically, we can cancel out climate and weather and latitude, so Kuwait is now seriously considering whether just to go out to a place in the desert and create an acre of June. They will throw up a bubble 750 feet in diameter, 250 feet to the apex and it will house June. Under this air-conditioned, climate controlled dome, which is larger than the astrodome in Houston, they will put structures for 6,500 college students. So a total environment is created, cancelling out the snow and the heat and all of these things. I think we will have more and more of these space and they are going to come in North America, not because the educator decided that was the sensible thing to do, but they are going to come from professional football. Buffalo is going to be building a great super Bucky Fuller, geodestic type dome. Then from professional football, will come a new design, and that isn't a strange place for it to come from either, because as I look at the schools, I see that many of the inventions brought into our schools came up out of the basement from the athletic coach. The athletic coach's teaching is evaluated every Saturday afternoon by 10,000 howling people who paid admission. He gets instant evaluation, whereas, the mathematic teacher up there in the attic, who can tell if he taught anything, if anybody learned anything? Therefore, the coach who is on trial and public display with instant evaluation, tends to have been the teacher who brought in the audio visual mechanisms first, because he is playing for keeps. When the first overhead projectors came into education, did they come into the English department? Of course not, the English departments are still trying to get them in the budget but the coach has passed beyond them to closed circuit television with instant replays.

The Detroit Institute of Technology is trying to become one of these colleges that you can't see. When they build, they will build a fragment of the city and the line will blur between town and gown and will drift off into the people, and the people will drift in and from the air you won't be able to tell where the university is; it won't be discrete and separate from its neighbours. This will happen, not out in the bucolic setting of the birds and the bees and suburbia, this will be in the nitty gritty of the inner city where the university puts out feelers and tentacle fingers into the community and the university will just drift away into the people and the people will like it. Those days when we used to talk about site requirements and always we were trying to square up the site socialogically - just the opposite thing that we should have been doing - those days are over. Square up the site you have the least perimeter. On the assumption that the university is a good neighbour, you should extend your perimeters. You ought to look like an amoeba and get all the perimeter you can to maximize the number of neighbours who can say "I live next to the university". Now, if you aren't worth living next to, you might as well then go back to the square.

As you look at this new college from the air, you will see two or three very large shells. The first one, I have already referred to as the poor man's asterdome, this acre of June, this great cover. I am not sure if it is going to be a hemisphere or if it is going to be a block of space - I just know it is going to be air-conditioned space; general space in the clear mutible, Maliable - with never a post to dictate how people will arrange themselves. The place will be open day and night and its usefulness will be determined by what you bring in the door. If they are playing something in there that requires a hard floor, then you will have a hard floor, if on the other hand, you do it better by playing on a field, you will roll down the field - just roll it down and roll it up when you don't want a field anymore. If people want to skate, (this is not too popular here in Canada, but they have come up with a substitute for ice), they will put down and take up plastic ice - so in Texas the kids will be skating. This will make nature's ice obsolete because it is so expensive to maintain, (cheaper for you, but still expensive), and furthermore, with regard to the climate or the seasons, we can obliterate the calendar.

Furthermore, another thing we can do is obliterate the clock. I see some evidence of this now as I roam around colleges and high schools. They are getting more sensitive to the students. For example, I know of a couple of colleges that have noticed some of their most creative students are nocturnal animals - that their metabolism does not come up until about 10 o'clock at night and that is when the plant closes down, just when the kids are beginning to roll. It was out at Notre Dame last Thursday and Father McCluskey opened the meeting at 9:30 a.m. and welcoming us to Notre Dame campus said, "Don't be fooled by the fact that this campus seems to be very quiet and sleepy. The problem with meeting at 9:30 a.m., is that the student body hasn't got up yet". Well we have got these nocturnal people and that kind of space will be opened irrespective of the hour or the day or the season or the latitude. If two kids want to play tennis at midnight - they go play tennis because that is when they play it best. Of course, at 7 o'clock next morning they are vegetables, but there are such people. We made a grant to the Great Circle campus in Chicago to study special requirements of art and architecture students and ran into this very thing. When you asked the kids what they wanted, many of those art and architecture majors wanted a place to work at night. You could close it up in the morning as far as they were concerned.

Another big space is going to be the library and ultimately the library

will consume just about everything. As we move from the group to the individual - we will stop throwing out a net and scooping in the school of children. Now as they come into kindergarden or first grade every year, they jump a ladder like salmon, but always in a group, which is insensitive to the individual. As we get better at tracking the individual the group breaks up, therefore, the boxes break up. When you move from teaching, (as was said earlier today) to learning, the emphasis rests on learning rather than teaching, then the boxes break up and we get big zones of space. Thanks to air-conditioning, we can have great zones of space that will not overheat. Another thing that will affect this library is the general move towards miniaturization. As you construct new colleges, watch how much money you spend on very intricate and expensive apparatus that institutionalizes the information, then somehow, in some electronic way connects with somebody who wants to use the information. There is a copying revolution coming. It won't be long before it will be more economical, and I think better education, if we have "Hands-On" material. Sometime ago, EFL got twelve college librarians together and I asked the question "What has changed the college library most in the last ten years?" and I thought, that it would of course, be - we college librarians adopt the theory that..." That wasn't the answer at all. The answer was the Xerox company has done more than anything to change the university library. Xerox, or rather xerography has made the information in books a "Hands-On" material.

The other night I saw a little machine about the size of a Coke machine in which you take a 90 minute cassette (90 minutes of sound), and you put it in the machine, it copies 24 times speed, so in about 3 minutes out popped 5 copies of this cassette. The beauty is you don't have to buy the machine anymore than you have to buy your telephone or buy your Xerox machine, you only pay when it clicks, so you pay for the service.

That also gets into the operating budget and it is easier to get operating money than it is to get capital money (at least where I come from, New England once, now New York, it is easier to get operating money). Somehow or other the taxpayers who are going to let you operate are the ones who don't want you to build anything. So, you rent this cassette copier, then you can copy any sound, fast inexpensively. It is "Hands-On", easy to carry. Now you can have the things out where the need is rather than to institutionalize them. We are only about 3 years away I am told from copying film. That is, you can take the single concept, continuous loop, Super 8, sound, color, motion picture, you know the little 5 minute cartlidge, and stuff it into a little machine. The target price of one machine trying to be developed right now is $32.00. So, instead of the three, four, five hundred dollar machines which are for groups, we are very close to having a $32.00 machine, which the individual can have, which you can let him have, the institution owns them and he borrows the thing. Watch out, too, because by 1983 I am sure that all these wires that we are running around with now, will have been replaced by miniature batteries such as we are trying to develop for electric automobiles. I am sure the spin-off from that will somehow give us an economical way to use these nickel-cabium batteries or whatever, quickly re-chargeable and when that comes, it is a whole new ball game.

The biggest change really will be coming, and it will be forced by economics, is that we will trust the kids to regulate their own intake - then we've got a whole new institution. Now we don't trust them to regulate their intake, we ration what their intake is and somebody called the "teacher" determines how much access a child will get to what he wants to know. And all kids want to know. They just don't want to know some of the things we want them to know and we make bad judgments as institutions as to what is appropriate, especially for the younger kids.

If we could only get from teaching over to learning and get on trust - trust the student to regulate his own intake. Just as we try to get the building out of the way, get the teacher out of the way. In many instances the teacher is an intrusion between the kid and the access he wants to what he wants to know. This means that this library-like space is growing because more and more kids are there regulating their own intake, with instinct, with their natural thirst that Einstein said all young children have until it is beaten out of them by education.

As the library keeps growing and growing and it will absorb those small cells, so watch out, don't build any more boxes than you absolutely need to, and make sure you can get rid of those walls some day, because they are coming down and you are going to have big zones of space. Also if you are air-conditioning some of your old buildings, make sure that in spending this new money on air-conditioning, you don't accidently freeze the old design of the egg-crate space, or that will just delay the day that you take the hammer to the old building and reshape its interior to get it out of the way of the people.

That is why, you will see more and more open planning coming. It is coming out of Germany where, as you know, they have done a number of "landscaped" corporate office space. Those of you who are contemplating a college building should go down to the University of Houston and take a look at their school of Education Building. It is just some great layers of June in which the teachers, the students, the curriculum cut their own pathway through this pleasant space. There is visual division where you

need it - which doesn't include running partitions all the way to the ceiling. There is acoustic privacy when you want it, so you don't have to be listened to if you don't want to be, or listen to somebody else. The Dean, who is a very bright guy, insisted that he not have an enclosed office with the partitions going all the way to the ceiling, you know - the maximum security vaults we put Deans in. Down in my way, you know Deans are getting captured literally - at MIT, Berkely, Harvard etc., so somebody said to the Dean - "look, you are going into this open plan, you are going to be back of some plantings there, people can't see you unless you want them to see you, they can't hear you unless you want them to hear you, but you are going to have a sense of territory, so you will know where your turf is - as people need to. If you go into this room, Mr. Dean, with no maximum security, it is going to make it easier for the student body to catch you and the Dean said - "That is where you are wrong I am betting that the very ease of my being captured guarantees that I will never have to be captured. Now sure - I will be picking little darts out of my skin all the time but that is alright because no one will ever toss a hand grenade over the transom, because there is no transom".

We need to make some very fundamental changes in education, as in many other institutions, and we are likely to make them if we are in an environment that supports change. Most of the buildings for education in the past have tended to dictate how people will relate to each other and what size groups will be formed. Now that we want to free the individual to proceed at his own pace, we need new schoolhouses that get out of the way. Not only do we need to get the schoohouse out of the way, in many cases we need to get the school teacher out of the way as well - that is true in both lower and higher grades.

The disturbances on campuses are not caused by inhumane environments, thats not the basic problem, but it contributes to it by making all other problems worse. When you create college residences that are not nocturnal filing cabinets, defensively designed to have low maintenance costs rather than as a good place for young humans to be, and to learn, and to grow in grace we are just asking for trouble and we are getting it.

If we can't trust the young, we are dead anyway. I know of no institution that has deliberately set out to trust its student body who found that that trust was broken. Typically the young rise to our aspirations of them and what we have done in the past is to underestimate their decency, their goodness. Instead, what we have done is to design around the presumed evil nature of the child - lets design around their goodness and they'll take care of it.

We must begin to trust the student to manage his own intake and place the emphasis on learning rather than teaching. In the new institution, the student will be expected to get his facts mostly from things, and his values mostly from people - so that is why the library is going to grow too - that is the place you get the facts to argue with and it is the argument of education that is the difference between education and training.

I know one institution that was so proud when it told me some years ago that it had 6,000 students and only four classrooms - well it seems to me such an institution mistakes information for education. Sure - information is basic, you had better know something, but what determines the education is what takes place in the pit, in the forum. I would call it a classroom except the architects will make it look like a kitchen and it ought to be like a livingroom. But anyway, those gathering places where in the presence of a wise adult, call him a professor, the kid and his peers argue out the meaning of it all, what is moral, what is immoral, what is amoral, what is true, what is false, what probably will turn out later to be false is true, where does it lead us, what good is it, what will we do next - that is why the teachers need have no fear of the technicalogical revolution because to teach, people are cheaper than machines, for argument. For fact dispention, or dispensing, if that is all the teacher is going to do is to dispense facts the machine is cheaper

In the United States it is very clear that the battleground for democracy is in the central cities - suburbia has the money and the strength to survive about anything. The city univerisities, colleges and schools hold the key to how we shall reorganize these cities so that there is a higher quality of life for everybody. Name any instrument we have that can do it as well as the university can do it. They have the ability and they should care, all we have to do is improve their connecting with their milieu, so that in a sense, the inner-city university becomes responsible for the quality of life in a whole fragment of the city and that the institution, in a sense, will blur out into the community, reach out to the people and then we will need fewer guards at night.