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ABSTRACT

The objectives of the Task Force on Computer Charging as approved by the Committee of Presidents of Universities of Ontario were: (1) to identify alternative methods of costing computing services; (2) to identify alternative methods of pricing computing services; (3) to develop guidelines for the pricing of computing services; (4) to identify alternative budgetary procedures for financing computing services; and (5) to examine the conditions under which a university could sell computing services to another university. The Task Force recommendations include: (1) that the universities adopt a full costing procedure to identify clearly the cost of providing computing services; (2) that the universities adopt pricing schemes that recover the full cost of all of the services; (3) that the universities establish budget line items for computing in departmental budgets; (4) that the universities permit the budgets for computing centers to be carried over from year to year to allow adjustment to the user needs; and (5) that universities with temporary excess capacity in computing services be encouraged to sell to universities who are temporarily short of these services. (HS)

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1. SUMMARY

The Task Force on Computer Charging was established in December 1969. The members were:

M.P. Brown, Director, Computer Co-ordination Group, CPUO

G.T. Lake, Director, Computing Centre, University of Western Ontario

P.J. Lewis, Assistant to the Comptroller, Trent University

D.S. Macey, Consultant, Computer Co-ordination Group, CPUO

G.R. Sparks, Associate Professor of Economics, Queen's University

J.C. Wilson, Associate Director, Computing Centre, University of Waterloo.

This document is the result of the work of this group, which met on seven occasions from December 1969 to April 1970.

It is intended primarily for the Presidents of the Ontario Universities, but it may be of interest to those concerned with or affected by policies on computing services.

## 2. INTRODUCTION

### 2.1 TERMS OF REFERENCE

The Committee of Presidents of the Universities of Ontario (CPUO) established the following policy directions for the activities of the Computer Co-ordination Group (CCG)

- that the CCG assist the universities in preparation for the era when computing services are purchased by real dollars spent in a free market
- that the CCG encourage bilateral and multilateral arrangements in order that the computing resources in the universities be utilized to maximum benefit to the system of universities
- that the universities be provided with the data necessary for planning university computing services.

The terms of reference of the Task Force on Computer Charging as approved by CPUO were

- to identify alternative methods of costing computing services
- to identify alternative methods of pricing computing services
- to develop guidelines for pricing of computing services
- to identify alternative budgetary procedures for financing computing services

- to examine the conditions under which a university could sell computing services to another university.

This document is the report of the Task Force on Computer Charging, and is directed to the university presidents in Ontario. It is the hope of the Task Force that the report will be of interest to the university community at large, particularly those concerned with or affected by policies on computing services.

## 2.2 BACKGROUND

Computing, in the late 1950's, was a new technology, which was introduced to the university community by a small number of dedicated people. Through the energy, foresight and leadership of these "missionaries", the horizons of researchers and teachers gradually broadened, and computer technology became established as a powerful tool with tremendous potential.

During the early years of computing in universities, it was not recognized that this was the beginning of a potentially exponential growth in computer usage. As with many new innovations, people were encouraged to make use of computers, through the provision of a free

resource. There may have been an implicit assumption that there was an upper limit to the amount of this resource any particular individual could use, in much the same way that there is an upper limit to the demands made on a library by an individual.

As the use of computers expanded, universities entered an interim stage, where attempts were made to achieve equitable distribution amongst users by various artificial controls such as rationing or individual constraints.

With the maturing of the computer technology, while we have experienced major downward shifts in the unit cost of computing, the demand for computing in universities in Ontario has grown to an estimated $12 million annually. This demand has evolved in an artificial environment where computing has been a free resource.

There must be some question as to whether or not the current expenditure on and distribution of computer use within a university reflects value judgements and economic decisions on the part of university programme supervisors as to the relative worth of computing to the programme as compared with other resources such as manpower, buildings and laboratory equipment.

There is general acceptance in the universities that the maturity of the technology and the economics of universities require that the responsibility for financing computing services be met by the users of those services.

The allocation of funds for computing for a particular programme must be as a consequence of value judgements, where the relative worth of many different expenditures is determined by a group of peers.

## 2.3 METHOD OF ANALYSIS

The Task Force took the view that the first stage in the analysis of computer charging was to identify the costs for computing.

Chapter 5 deals with the topic of costing, states the need for full costing and gives some special consideration to the question of capital costs.

This report provides a chart of accounts and an accounting procedure, which should form the basis for the determination of full costs.

Once the costs for the provision of the service are known, a university should choose a charging policy which will recover a majority of the costs from the users. Chapter 8 outlines some alternatives for cost recovery.

Pricing, as a means of implementing a charging policy, is reviewed in Chapter 7. No attempt is made to evaluate pricing schedules for specific services, but the report does provide a general analysis of pricing which may be usefully applied to a particular university.

The report closes with a statement of recommendations by the Task Force.

## 3. UNIVERSITY COMPUTING IN RELATION TO RESOURCES

### 3.1 THE USER COMMUNITY

The university community is a body of persons pursuing the objectives of creating, preserving and disseminating knowledge. The interaction between the parts of the community is characterized by the activities of teaching, learning and research.

Within this large university group there are smaller specialized communities centred around an academic discipline, a commonality of interests, or a facility important to the processes of teaching, learning and research.

The user community, in the context of computing services, is that body of persons concerned with the use of computing facilities including the administrative support of academic activities. The reason for there being a user community, which is more than a loose aggregate of individuals, is that the needs of one individual for computing could not be served independently from the needs of others, and the user community has grown in parallel with the development of the computing centre in the university.

The user community has developed structures for internal interaction in the form of user groups and structures for influencing the development of computing services through policy committees.

The computing centre, historically, has been a centralized facility consisting of computer hardware, software and computing specialists. Its purpose has been to foster the use of computers in the university, to serve the needs of the user community, and, prior to the formation of computer science departments, to advance the state-of-the-art.

In many ways, the computing centre has taken on the characteristics of a utility, where the concept of a utility is based upon the provision of services to a wide variety of users, the subsidy of some low demand services by high demand services, and the assumption that the user community, as a whole, must be served.

The computing centre, as a utility, must reflect, in the services provided and their prices, the demands of the user community.

If the university recognizes that there is community benefit in the existence of a viable user community, then the computing centre utility must be responsive to this policy in its charging procedures.

The types of service required by the user community have become many and varied. In some instances, it is not economically possible for the computing centre to offer all of the required services. It is in this area that purchases of computing services from other universities, or from computer service companies, become a possibility.

## 3.2 POLICY AND BUDGETS

Most universities in Ontario are attempting to move away from the provision of "free" computing services, while still recognizing that the needs of the user community must be served.

This raises a major policy question concerning the funding of computing services - "What are the alternatives to earmarked central funding of computing centres?" These range all the way from "discretionary funds" being provided in the budgets of the user departments to some degree of central funding combined with "earmarked funds" in the budgets of the user departments.

This paper attempts to provide a framework for policy decisions through an analysis of the various aspects of computer charging.

## 3.3 COMPUTER CHARGING

Computer charging is viewed as a means of

- allocating the funds for computing in a rational way
- arriving at economic stability through the free play of supply and demand
- regulating purchase of computing services, either from the on-campus utility centre, or from other universities or computer service organizations.

## 4. AN ECONOMIC MODEL OF COMPUTING IN A UNIVERSITY

In this chapter, an attempt is made to examine the nature of the problem. A simplified model of the facts and influences at work in the provision of computing services in a university is illustrated in figure 4-1.

The components of the model are:

The Budget: this is the source of energy of the system in the sense that all funds used to support the system enter it through the budgeting procedure.

The User: he is the consumer of services, and represents the output from the system. He makes demands for service, and his demands are, in turn, controlled by price.

The Service: this is the commodity which is being sold to the user. It is a complex package of specialized services and is characterized by being perishable, subject to time-dependent demands, with an upper limit on the resources available.

The Service attempts to meet the demands of the user, has a cost, and exercises control of the allocation of its resources through influencing the pricing system.

The Price: this is the major control mechanism for the system as a whole. Price is used to smooth loading

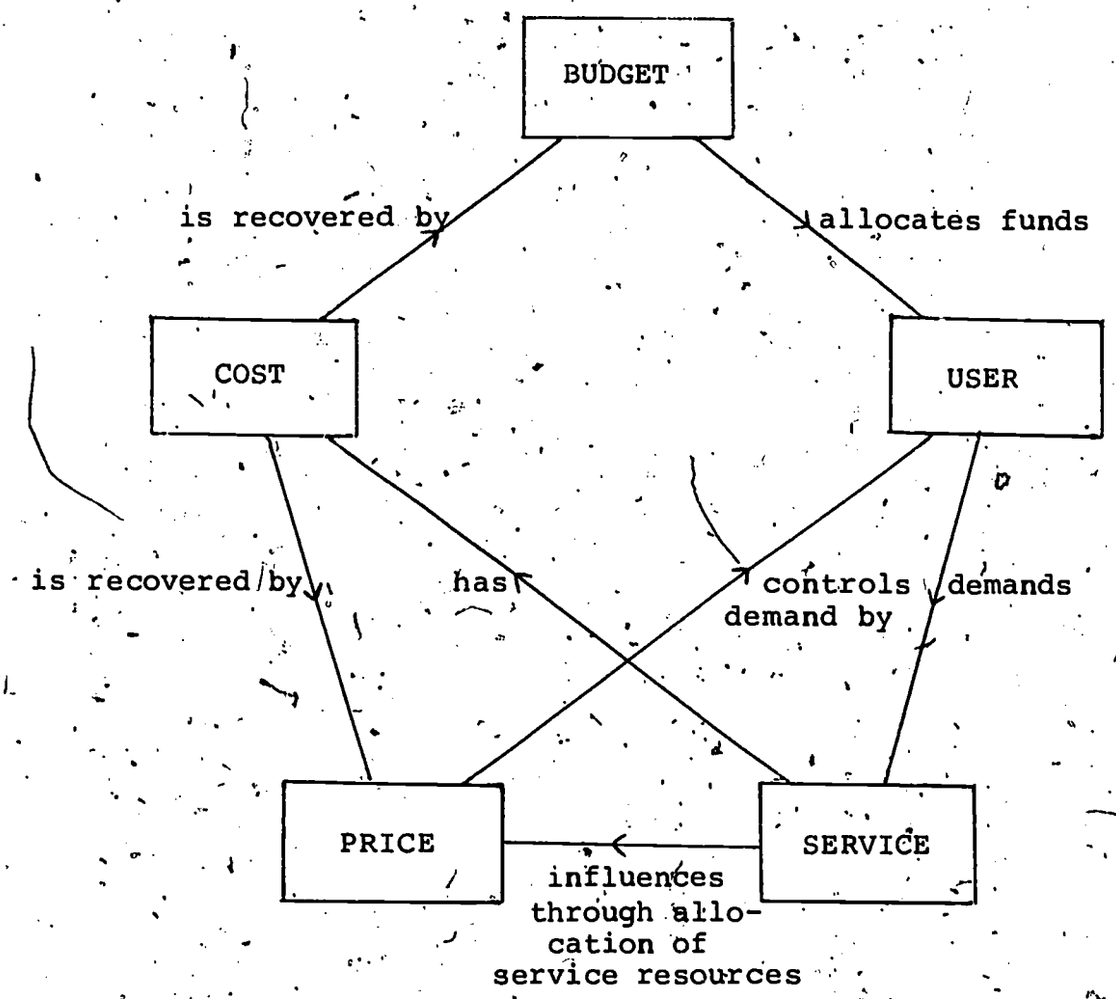


Figure 4-1: An Economic Model of Computing in a University

of the service in the domains of time-dependency and resource allocation. Price controls demand by the user, and recovers all or some of the cost of the service from the user.

The Cost: this is the basic fact of the economic system of computing services. Cost for services can be identified. Cost is recovered by means of the price to the user and, historically, by means of allocation of funds from the budget.

University policy determines the relative proportion of cost recovery from the use of a price/user charging mechanism as compared to a direct central funding mechanism.

Ideally, once university priorities are established through policy, and budgets are set, this economic system will find its own stability.

The five components interact in three cycles.

4:1 THE RESOURCE ALLOCATION CYCLE (figure 4-2)

If the other two cycles are not operative, this cycle corresponds to the formative years of university computing. A simple allocation of budget funds to the computing centre governs the amount of service available to the user community. The decision as to how much of the total university

resources will be allocated to the provision of computing services, is made at the policy level of the university.

4.2 THE LOAD SMOOTHING CYCLE (figure 4-3)

This cycle provides the management of the service organization with a control of how service resources are used through the use of differential pricing mechanisms. Thus high demands for a limited resource will cause an increase in price for that resource.

4.3 THE COST RECOVERY CYCLE (figure 4-4)

The cost recovery cycle corresponds to the 'real dollar' world, where the user, through the purchase of service, makes demands for service. There is an associated cost for the service provided which is recovered by the use of a pricing system. Price, in turn, will affect demand, in that a price increase may reduce demand because the user has limited funds. Alternatively, a price decrease may increase demand for service, since more work can be done for the same amount of money.

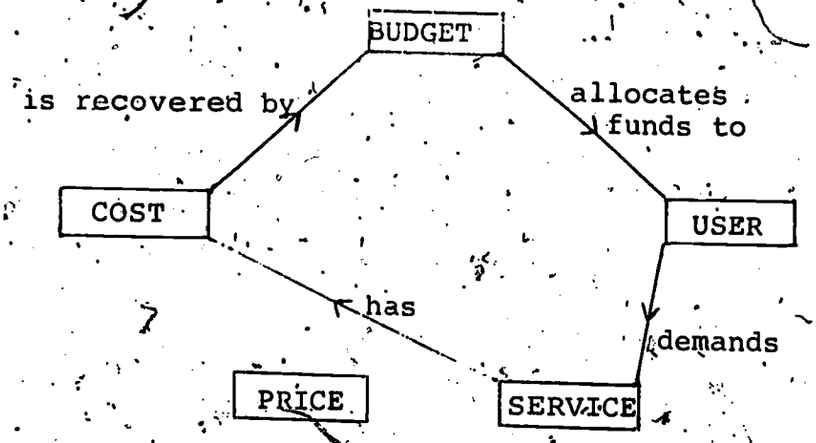


Figure 4-2: Resource Allocation Cycle

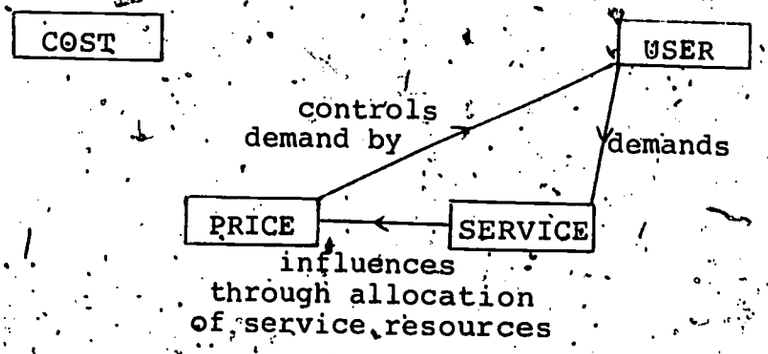


Figure 4-3: Load Smoothing Cycle

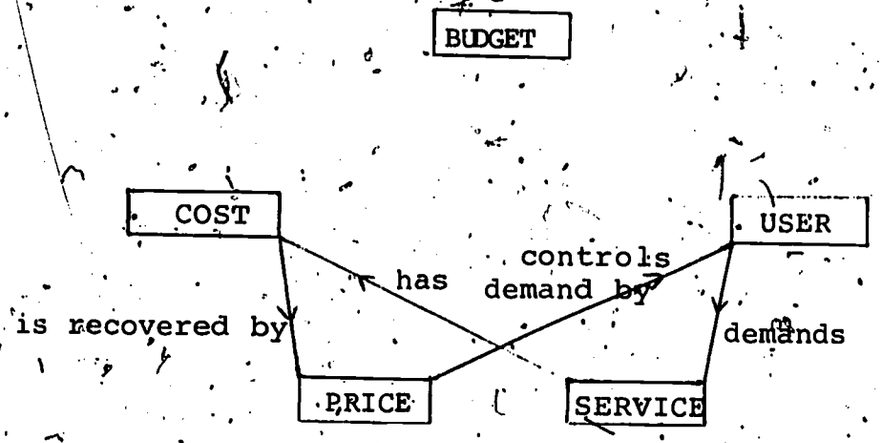


Figure 4-4: Cost Recovery Cycle

## 5. COSTING OF COMPUTING SERVICES

### 5.1 PURPOSES OF COSTING

The purposes of costing are

- to relate the actual costs in a given period to the computing services provided during that period
- to provide the university with information on the relative "success" of its computing services
- to provide a basis for pricing of computing services
- to allow the university to allocate its resources between the computing cost centre and other cost centres in the university according to priorities established by the university.

### 5.2 DIRECT AND INDIRECT COSTS

A cost centre is a segment of the university, clearly defined by the management of the university. The aggregate of all of the cost centres is the university. The computing cost centre is that part of the university organization whose function is to provide computing services to the university. There may be more than one computing cost centre in a university. As an example, there may be a computing cost centre based on the computing services required by the library.

Direct costs are defined as money which must be spent to acquire, produce or effect the computing services provided and whose expenditure does not acquire, produce or effect any other product or service.

Indirect costs are defined as money which must be spent to support the provision of computing services whose expenditure, in total, supports other programmes and services in the university, as well as computing services.

The Task Force considers that it is important to identify all costs as a basis for a charging policy.

Direct costs to the computing cost centre are those costs which are clearly identifiable as pertaining to the provision of computing services.

Indirect costs such as space, light and purchasing services emanate as charges from other cost centres in the university, and are allocated as costs to the computing cost centre on the basis of a cost allocation policy exercised by management.

Which indirect costs are applied to the computing cost centre and the relative proportion of such costs is a

judgement made by university management.

Evidence indicates that indirect costs make up about five percent of the total cost of computing services.

## 5.3 COST ELEMENTS WITHIN A COMPUTING COST CENTRE

The Task Force has reviewed the costs which are applicable to a computing cost centre. These have been grouped into nine main categories

- salaries
- benefits
- equipment
- software
- supplies
- utilities
- services
- financial
- other

Appendix 2 provides a complete chart of accounts for costing a computing cost centre.

The Task Force recommends that universities adopt this chart of accounts as a basis for costing computing services.

5.4 CAPITAL COSTS

Included amongst the cost elements set out in Appendix 2 were several relating to computer hardware. The identification of the costs associated with such hardware and other capital items over a given period requires that proper consideration be given to depreciation accounting.

A charge for depreciation of capital assets is not normally included in current operating expenditures today, unless the assets are those of a self-sustaining "ancillary enterprise". Depreciation is generally regarded as inappropriate, particularly when capital assets are provided by gifts or grants - and therefore have not been, and, it is argued, will not become, a charge against operating revenues.

The charging of depreciation calculated on the basis of a computing cost centre's capital assets is, however, both necessary and desirable in the view of the Task Force. It is desirable because of the obvious cost disparaties that would arise in the 'rented' vs. the 'purchased' situations - which would become important when considering inter-university sales, and also, for

example, when examining the relative positions of sub-centres within a university.

Of more importance, however, is the necessity to take proper account of depreciation in light of the current government's policy on the funding of computing at universities in Ontario. Capital grants are no longer available, and computing must be provided from current operating funds. Unless depreciation is written (and, ultimately, funded) a university will not be able to provide for the replacement or up-grading of computer facilities without seriously distorting a single year's operations - both in terms of cash requirements, and the provision of meaningful financial reports.

It is noted that the value of the B.I.U. operating grants for 1969-70 and 1970-71 specifically included amounts for computing - if operating costs against which these grants are, in a sense, measured, do not include very material costs relating to computers, the grants may appear disproportionately high!

Accordingly, whether or not charging for computer services is adopted as a policy at a university in Ontario

owning a computing facility, depreciation would seem to be necessary. If the university does charge for these services, it would appear to be both necessary and desirable.

## 5.5 USEFUL LIFE OF THE EQUIPMENT

A computer manufacturer will offer a component or system for purchase at a price equal to the present value of expected future net rental charges, calculated by using a discount rate appropriate for the risk involved. Risk, for the manufacturer, is dependent on market considerations such as obsolescence through technological advances, and competition with and from other manufacturers. Thus a company whose intention is to capture a larger segment of the market through rapid technological advances may expect to obsolete its own equipment earlier than a manufacturer which is not so motivated.

The ratio of Purchase/Rent can be considered an approximation of the manufacturer's estimate of the economic life of the system.

In general, this may be expected to be less than the useful life of the system to the user.

Sharpe (1) indicates that for 483 types of computing devices in production in 1967 the Purchase/Rent ratio was 44.2.

For three of the manufacturers the ratios were

| | |
|---|---|
| CDC | 40.1 |
| IBM | 46.0 |
| Burroughs | 49.7 |

To illustrate the significance of the Purchase/Rent ratio for the useful life of the equipment, let us assume that a manufacturer has established a Purchase/Rent ratio of 48 and a required rate of return of ten percent per annum.

The monthly rent figure is related to the purchase price as follows

$$R = \frac{1}{m} C + \frac{r}{12} \frac{C}{2}$$

where R is monthly rent, C is the purchase price, m is the anticipated life, r is the rate of return per annum, and C/2 is the average amount of capital tied up.

For C/R = 48, and r = 10%, solving for m gives an anticipated life of 60 months.

## 6. A COMPREHENSIVE ACCOUNTING PROCEDURE

In the analysis of costing for large capital items, the task force encountered two problems.

First, the cost of capital used in the purchase of a computer system is dependent on the way in which the capital is provided. For example, the capital may come ffom government grants, savings in operating expenditures or bank loans.

Second, the estimate of the useful life of equipment appears to be a subjective judgement, and to use an arbitrary figure somewhere between four and ten years will not give a sound basis for calculating costs over a period of a year.

The accounting procedure presented in this section avoids these problems and provides a framework for reporting accurately on costs and the surplus/deficit picture of a computing centre over the lifetime of the equipment.

It should be noted that the procedure is general, in the sense that it also holds for universities whose computer equipment is leased.

It is proposed that the computing centre accounts be divided into two accounts (Figure 6-1).

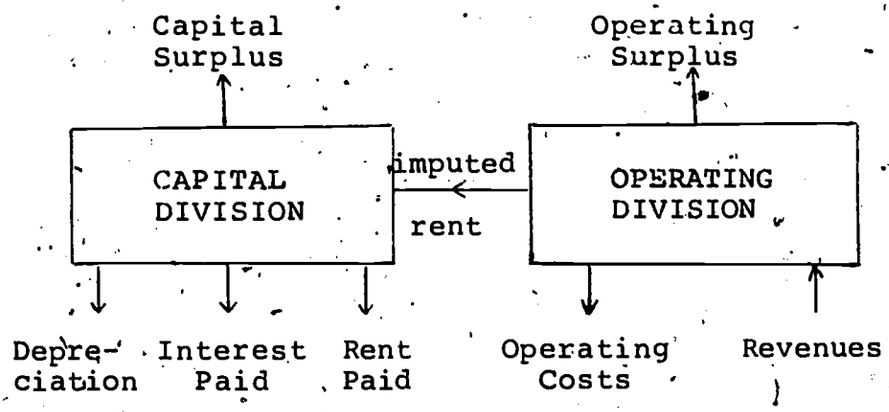


Figure 6-1: Capital and Operating Accounts of Computing Centre

## 6.1 OPERATING ACCOUNT

First, an operating account which will reflect the surplus or deficit of a hypothetical operating division of the computing centre. This operating division can be thought of as gaining revenues from the sale of computing services, and having expenditures in the form of operating costs and the payment of an "imputed rent" for the computing equipment. Such payment is made to the other hypothetical division of the computing centre.

## 6.2 CAPITAL ACCOUNT

Second, a capital account which will reflect the surplus or deficit of a second hypothetical division of the

computing centre. This capital division can be thought of as purchasing and renting equipment, gaining revenues from the rental of the equipment to the operating division and incurring costs related to depreciation and interest.

6.3 IMPUTED RENT

It is proposed that as a measure of imputed rent we take the manufacturer's pure rent figure, net of discount, but including taxes, if any. Further imputed rent includes actual rental paid for leased equipment.

In the case of purchased equipment, imputed rent is the amount the manufacturer would have charged, if known, or an amount calculated by management when the manufacturer's figure is unknown.

6.4 DEPRECIATION

The capital division may be thought to have a depreciation schedule which is more or less than that implied in the imputed rent. Thus, if in the judgement of management the equipment has an economic life in excess of that implied in the imputed rent, and if this judgement is substantiated by performance, there will be a saving in depreciation.

## 6.5 THE ACCOUNTING PROCEDURE

Based on the above hypotheses the following relations hold:

### 6.5.1 Operating Statement

Revenues - Operating Costs - Imputed Rent = Operating Surplus

In terms of figure 6-1, this states that the flow into the Operating Division equals the flow out.

### 6.5.2 Capital Statement

Imputed Rent - Depreciation - Interest Paid - Rent Paid = Capital Surplus

i.e. flow in equals flow out for Capital Division.

### 6.5.3 Total Surplus

Total Surplus = Operating Surplus + Capital Surplus

Total Surplus = Revenues - Operating Costs - Depreciation - Interest paid - Rent paid

### 6.5.4 Capital Surplus

Capital Surplus = Interest saving + Depreciation saving + Tax saving

This equation has not been illustrated. Its purpose is to explain that a capital surplus may occur because the interest rate which the Capital Division must pay for capital and the depreciation rate which it chooses for the equipment are not necessarily the same as the manufacturer's. Furthermore the manufacturer may be liable for taxes which are not applied to a University. It is unlikely that the exact breakdown of the capital surplus among these sources could be obtained in fact.

## 6.6 IMPLICATIONS FOR PRICING

Looking ahead to the chapter on Pricing, as a consequence of this method of accounting, there are two distinct alternatives for pricing.

### 6.6.1. Zero Operating Surplus

In this case, the total surplus is equal to the capital surplus. This means that the capital costs of the existing equipment are recovered, and, depending on how accurate the depreciation schedule is, the accumulated capital surplus may be used for expansion or to retire obsolete equipment.

### 6.6.2. Zero Total Surplus

Here, there is an operating deficit, which is offset by an equal capital surplus.

The Task Force recommends that a charging policy should have as one of its objectives the accumulation of capital surpluses, specifically, that the operating surplus should be zero.

## 6.7 A SAMPLE APPLICATION OF THE PROCEDURE

To illustrate the accounting procedure described above, we shall assume that a university has a computer installation which consists of equipment purchased at a price of one million dollars and equipment rented at one hundred thousand dollars per annum.

Further, operating costs are assumed to be four hundred thousand dollars per annum, and that the initial capital ($1,000,000) for the purchase was raised as follows: five hundred thousand dollars by means of a grant from government sources, and a bank loan of five hundred thousand dollars at an interest rate of ten percent per annum.

The university is assumed to have adopted a depreciation schedule of one hundred and fifty thousand dollars per annum, which corresponds to a write-off period of approximately seven years.

Assuming that the purchase/monthly rent ratio is forty eight, the annual imputed rent for the purchased equipment is two hundred and fifty thousand dollars.

Applying the relationships in section 6.5, figure 6-2 illustrates the procedure for this example.

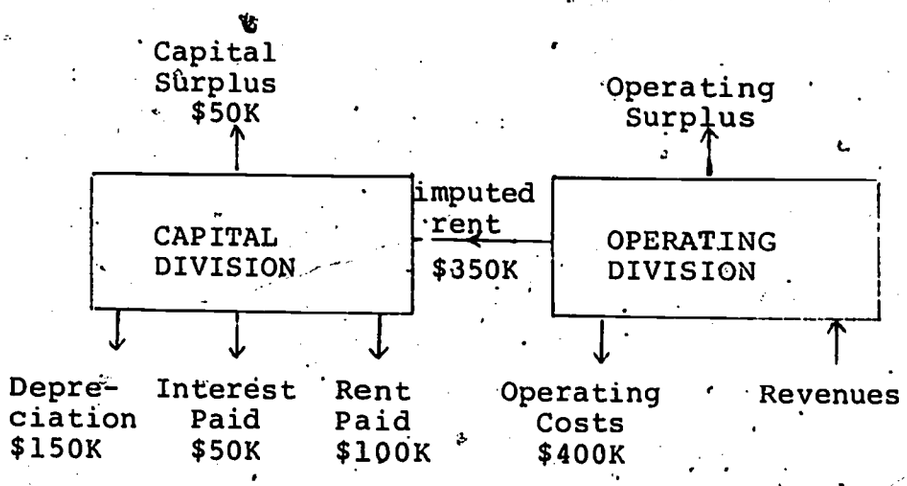


Figure 6-2: Sample Application of Accounting Procedure

For zero operating surplus, annual revenues will be the sum of the operating costs and the imputed rent, i.e. $750,000.

If the depreciation schedule of $150,000 per annum is correct, and the equipment is used for seven years, the total surplus over this period is $350,000. This is the saving arising from the decision to purchase rather than lease.

For zero total surplus, annual revenues will be the sum of the operating costs, depreciation, interest paid and rent paid, i.e. $700,000, corresponding to an annual operating deficit of $50,000.

## 7. PRICING OF COMPUTING SERVICES

### 7.1 PURPOSES

The purposes of a pricing policy are defined as follows

- Recovery of Costs
- Control of Demand
- Smoothing of Peak Loads
- Provide Reflection of the Relative Costs of Different Services

### 7.2 PRICING MECHANISMS AND THEIR RELATIONSHIP TO PURPOSES

It is important to recognize that there are two domains in which a pricing mechanism must operate with respect to Control of Demand.

7.2.1 When capacity exceeds demand, it may be legitimate to have a pricing mechanism, which will encourage the purchase of the output, so that demand increases and capacity is not wasted. Purchasers of services provided, in this domain, must know that the price for the services reflects the fact of temporary excess capacity, and should not expect the price for those services to remain the same, when capacity is exceeded by demand.

7.2.2 When demand exceeds capacity, a pricing mechanism may be used to allocate computing resources.

7.2.3 With regard to reflection of the relative costs of different services, a pricing mechanism may

- serve to educate the user
- respond to a user's needs for priority
- respond to a user's needs for special equipment or software
- reflect the cost to the user of services which could be provided by outside suppliers
- permit recovery of funds from granting agencies.

7.3 DEMAND AND CAPACITY

It is probable that during the long term operation of a computing centre, capacity can be increased in a manner which is not strictly discontinuous, because of additions such as core and peripherals.

For the purpose of this analysis, it is assumed that discontinuities do exist when a computing centre upgrades to new equipment. This "step function" is illustrated in figure 7-1.

The demand curve is assumed to be a continuously increasing function of time, which crosses the capacity curve after a time $T_1$.

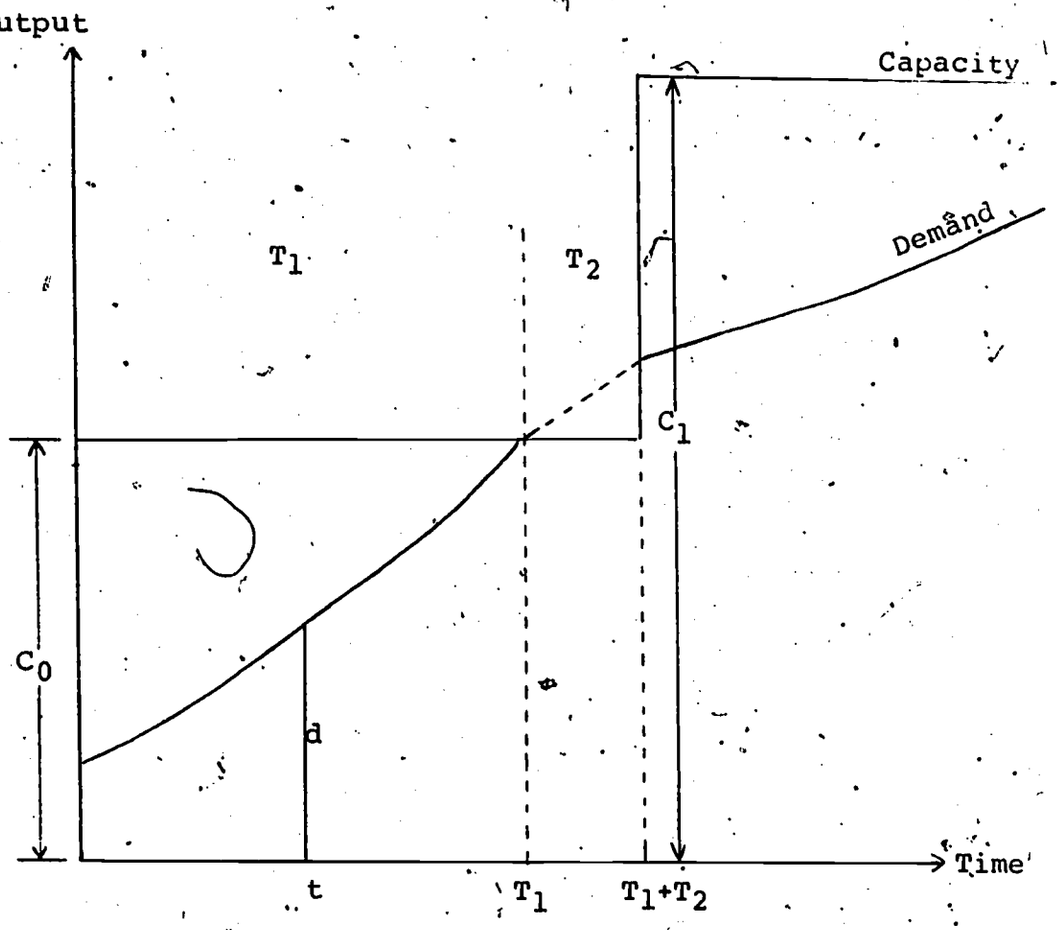


Figure 7-1: Capacity and Demand

The period $T_2$ is the time during which the capacity of the on-campus facility does not meet the demand. Excess demand can be met through the use of outside facilities.

7.3.1 Useful Life

The useful life of the system is $T_1 + T_2$.

After this period, it is assumed, for simplicity, that the system with capacity $C_0$ is replaced by a system with capacity $C_1$.

While the actual useful life of a system is difficult to establish in advance, it appears that it is of the order of 50 or 60 months.

7.3.2 When on-campus Capacity is Inadequate

When demand exceeds capacity, i.e. for $T_1 < t \leq T_1 + T_2$ the price for output provided by the system with capacity $C_0$ should be approximately equal to, but not substantially below market price.

Market price is the price at which the same amount and kind of output can be purchased off-campus.

It should be noted that a university which accepts the idea of maintaining a cohesive user community may adopt a policy of purchasing off-campus computing at market price through its computing service organization and selling this output at a discount to members of the user community. This would have the effect of keeping the users together in a community. Such a policy would mean a subsidy to users of the off-campus facility which could come about by charging somewhat more than cost for existing on-campus services.

7.3.3 Recovery of Cost

During the lifetime of the machine, i.e. for $0 < t < T_1 + T_2$ the output required, i.e. demand d, is sold at a price, $P_t$, which recovers at least the cost of the capacity provided during the interval $T_1 + T_2$.

7.3.4 Revenue

The revenue from output required and paid for by the user is the product of the output required and the unit price of output. The output required is based on the user's value judgement.

7.3.5 The unit price, $P_t$, of output at time t may be determined as follows:

$$\sum_{t=0}^{T_1 + T_2} P_t \cdot D_t = \text{Total Cost} + \text{Required Surplus}$$

provided that $P_t$ is approximately equal to market price for $T_1 < t < T_1 + T_2$. (see 7.3.2)

where

$T_1$ is the time at which demand is equal to supply

$D_t$ is the output required at time $t$

$C_0$ is the total useful capacity of the system during the period $T_1 + T_2$. Note that $C_0$ may be set at less than the maximum capacity, in order to facilitate the purpose of smoothing peak loads, or offering the required turnaround.

## 7.4 ALTERNATIVE PRICING SCHEMES

Five of the main types of pricing scheme as described in (2) are reviewed in this section in relation to how they meet the purposes of pricing.

Single Price Scheme

Every completed job is priced at the same rate.

Variable Price Scheme.

Prices change based on time of day, week, month or year.

Multiple Input Queue.

Prices are dependent on which queue the job is placed in. In advanced schemes, the user may buy a position in the queue he selects.

Perfect Market Schemes (Tâtonnement Market)

Prices are determined by auction among the users at the beginning of a time period.

Right of Access Scheme

Users purchase rights of access to a service which perishes on a cyclic basis (e.g. every week). Priorities at any time in the cycle are based on the relative proportions of actual usage to purchased rights of access.

Table 7-1 summarizes the relationship of these schemes to the purposes of pricing.

## 7.5 PRICING BY SERVICE

In the report by Leppik (3), a case is made for the pricing of each computer service individually. The Task Force is in general agreement with this approach, but cautions that the price for a particular service may not relate to the cost of providing that service. (see paragraph 3.1 re utility and subsidy of low demand services)

There are services provided (e.g. Watfor), for which accurate cost figures can be obtained, but there are

| SCHEME | PURPOSE: Recovery of Cost | Control of Demand | Smoothing of Peak Loads | Reflection of Relative Costs of Different Services | COMMENT |
|---|---|---|---|---|---|
| Single Price | Yes | No | No | No | This is the traditional pricing scheme |
| Variable Price | Yes, but more difficult than with the single price scheme | Yes | Yes, this is the main purpose of this scheme | Yes | This scheme is being adopted more widely |
| Multiple Input Queue | Yes, but increasingly difficult | Yes | Yes | Yes | This is a complex scheme which may be difficult to implement |
| Perfect Market | Doubtful | Yes | Yes | Doubtful | This is of theoretical value only |
| Right of Access | Yes, this scheme should recover cost very effectively | Yes | Doubtful | Yes | A simple approach which resolves the problem of perishable computer time |

Table 7-1: Pricing Schemes Related to Purposes of Pricing

other services where accurate costing is beyond the precision of available means of measurement.

Thus, what is costed, should be measurable and should be worth measuring.

Going further into the question of "Pricing by Service", it is felt that the price for a particular service need not necessarily recover the cost for that service. Cost recovery should be based on revenues accruing from all of the charging mechanisms. The price for a given service may serve to control demand, possibly by creating a demand through low prices or inhibiting demand through high prices. Further, the price for a given service may be established with a view to smoothing of peak loads.

7.6 SUBSIDIES

The university community establishes priorities which are reflected in policies and budgets. Computing in universities, for many years, has been funded by means of central grants to the computing centres.

It is the view of the Task Force that such funding constitutes a priority judgement by university management.

Management may, in the interests of the community as a whole, wish to make or influence such judgements. An element of subsidy gives them this power.

All such subsidies or grants should be identified explicitly, irrespective of the way in which they are distributed, either to a central facility or to an individual user.

## 8. BUDGETING

Budgeting is the means by which the university's resources are allocated to all of the departments of the university. Some of these resources are used to provide computing services and result in the expenditure of funds in support of the computing facility. It is felt that an item for computing should appear on departmental budgets. These funds should be "tied" in the sense that they cannot be spent on anything except computing.

"Tied" funds may be of two kinds: "tied-local" and "tied-global". "Tied-local" funds are funds which can only be used to purchase services from the on-campus computer facility. "Tied-global" funds may be spent at the service agency of the users choice. This could be the computing centre or an off-campus service bureau.

"Tied" funds should be distinguished from "discretionary" funds in that discretionary funds can be spent on things other than computing.

The Task Force considers that the use of discretionary funds will almost certainly result in a deficit budget for the computing centre, and should be discouraged, at this time.

Table 8-1 and Figure 8-1 illustrate some budgeting alternatives. It is noted that because of probable uneven expenditure of "tied-local" funds over a period of one year, a budget deficit may occur in the computing centre, unless an expiry control mechanism is adopted which accounts for the perishable nature of computer time.

The Task Force favours the gradual introduction of "tied-local" funds, subject to the expiry control referred to above.

Further, it appears reasonable that eventually the buying power of the users should be the dominant factor in the economic system of computing services. Thus the "tied-local" funds should exceed substantially the centrally provided computing centre budget as in cases 7 and 8 of Table 8-1.

To facilitate long run adjustment of the computing centre to the demand of the users, budgets for computing centres should be carried over from year to year. This will allow deficits to be balanced against surpluses and permit adjustment of equipment and support staff in response to user needs.

With regard to "tied-global" funds, the Task Force agrees that these will be necessary to meet the needs of some users. The policy question of how the expenditure of these funds is controlled must be addressed by each university.

| Case | Total Funds for Computing | Total Funds Spent Locally | Central Computing Centre Grant | User Discretionary Funds | User Tied-Local | User Tied-Global |
|---|---|---|---|---|---|---|
| 1 | 100 | 100 | 100 | 0 | 0 | 0 |
| 2 | 100 | 100 | 75 | 0 | 25 | 0 |
| 3 | 100 | 90-100 | 75 | 0 | 15 | 10 |
| 4 | 115 | 90-115 | 90 | 0 | 0 | 25 |
| 5 | 100- | 75-100 | 75 | 25 | 0 | 0 |
| 6 | 100 | 75-100 | 50 | 0 | 25 | 25 |
| 7 | 100 | 75-100 | 25 | 0 | 50 | 25 |
| 8 | 100 | 75-100 | 0 | 0 | 75 | 25 |
| 9 | 100 | 10-100 | 10 | 15 | 0 | 75 |

Note: 100 units represent the cost of operating the on-campus facility

Table 8-1: Some Budgeting Alternatives

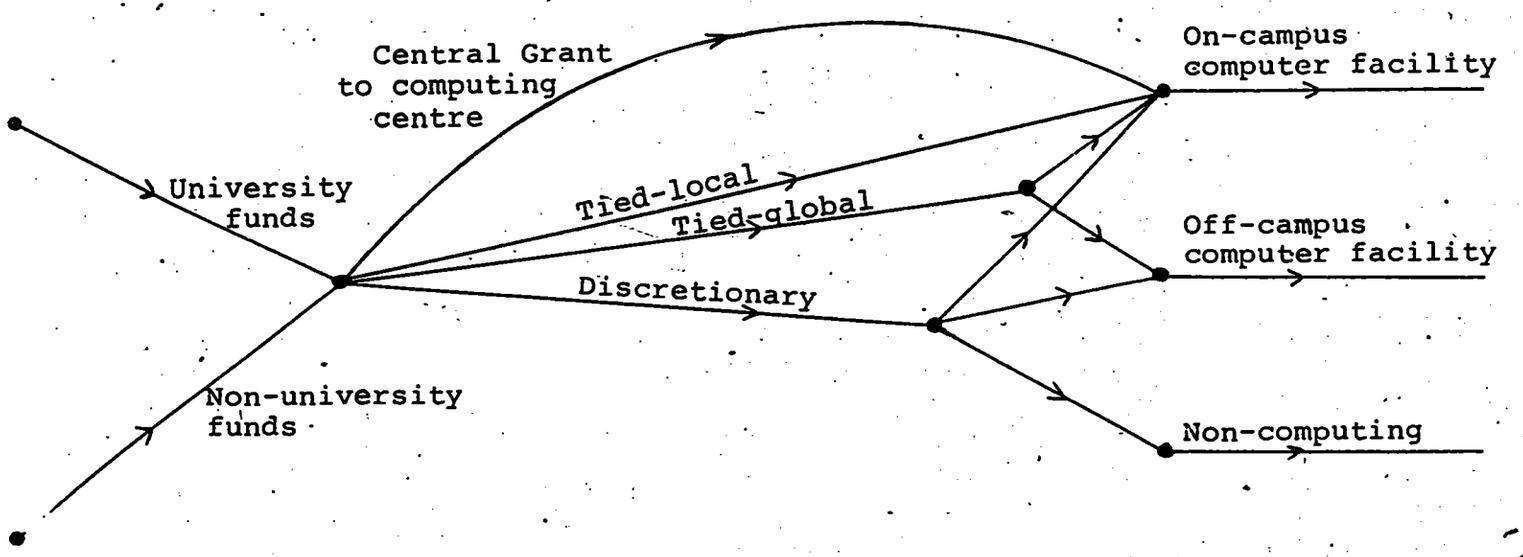


Figure 8-1: Flow of Budget Funds for Computing

## 9. INTER-UNIVERSITY SALES

In response to the directive from CPUO, the Task Force recommends that universities with temporary excess capacity in computing services should be encouraged to sell to universities who are temporarily short of these services.

### 9.1 PURCHASE OF SERVICES FROM ANOTHER UNIVERSITY

A university should recognize that there is a policy decision which must be made: "Who controls external purchases?" The Task Force suggests that in addressing this question, the university should concern itself with its view of a "user community" and what communal laws should be established to maintain this community as an entity, while giving the individual user some freedom of choice.

The Task Force agreed that, as a bare minimum, purchases of services from other universities should be reported, as a matter of courtesy, to the computing centre.

It appeared to the Task Force that if the university supports the idea of a viable user community, then the control or co-ordination of external purchases should be in the hands of the computing centre.

9.2 COMPUTER CO-ORDINATION GROUP INVOLVEMENT

The Task Force recommends that, in order to assist the CCG in its work in identifying the long term needs of the universities, details of inter-university trade should be furnished to the CCG.

9.3 PRICES

Prices for computing services should be at least as great as the costs for the services computed on the basis of the chart of accounts outlined in Appendix 2.

It is recommended that the indirect costs be estimated on the basis of being approximately 5% of the direct costs.

9.4 CENTRAL GRANTS AND SUBSIDIES

All central grants should be identified.

The Task Force recommends that all central grants to computing centres (e.g. from the operating grant of the university, or the NRC computing centre grant) be excluded in inter-university pricing.

## 10. RECOMMENDATIONS

The Task Force on Computer Charging recommends

1. That the universities adopt a full costing procedure to identify clearly the cost of providing computing services.
2. That the universities implement the Chart of Accounts given in Appendix 2 as a basis for their accounting of costs.
3. That the universities include depreciation of capital assets in the cost of computing.
4. That the universities adopt charging policies which provide for the accumulation of capital surpluses, and make the operating surplus zero. (See 6.6.1)
5. That the universities adopt pricing schemes which recover the full cost of all of the services.
6. That the universities identify all subsidies and grants for computing services.
7. That the universities establish budget line items for computing in departmental budgets.
8. That the universities do not use "discretionary" funding as a basis for financing computing facilities. (See Chapter 8)

9. That the universities adopt a staged introduction of "tied-local" funds in departmental budgets. The eventual goal should be that these funds exceed substantially the centrally provided computing centre budget.

10. That the universities permit the budgets for computing centres to be carried over from year to year, to allow adjustment to the user needs.

11. That universities with temporary excess capacity in computing services be encouraged to sell to universities who are temporarily short of these services.

12. That the co-ordination of all external purchases be in the hands of the computing centres.

13. That the Computer Co-ordination Group be furnished with details of inter-university trade in computing services.

14. That the prices for inter-university trade in computing services be at least as great as the costs for the services computed on the Chart of Accounts in Appendix 2.

15. That the indirect cost component of inter-university prices be taken as 5% of the direct costs.

16. That all central grants to computing centres be excluded in inter-university pricing.

17. That the Computer Co-ordination Group be directed to undertake a follow-up study on the application of the principles in this report in the Ontario universities.

APPENDIX 1

## REFERENCES


1 Wm. F. Sharpe, "The Economics of Computers" Columbia University Press, New York London, 1969.

2 Uri M. Possen, W. Richard W. Sutherland, William Wolfson, "Resource Allocation and Pricing Principles for a University Computer Centre", University of Toronto Working Paper 6819.

3 John J. Leppik, "Proposal of Terms of Reference for The Institute of Computer Science", University of Toronto, November 1969.

APPENDIX 2

## CHART OF ACCOUNTS FOR A COMPUTING COST CENTRE

The chart of accounts given below provides a basis for the definition of costs within the computing cost centre. The cost elements are direct costs except where indicated.

COST ELEMENTS WITHIN A COMPUTING COST CENTRE

Salaries

- Management
- Operations
- Input/Output and Quality Control
- Data Preparation
- Systems Software Development
- Systems Software Maintenance
- Applications Development (possibly indirect)
- Applications Maintenance (possibly indirect)
- Applications Production (indirect)
- Hardware Development
- Hardware Maintenance
- User Services (liaison, training, consulting, seminars)
- Secretarial

Benefits

Pension

Life Insurance

Long Term Disability

Health Insurance

Equipment

Computing Equipment

Main frame

Peripherals - on line

(tape drives, disc drives, drums, data cells, printers, readers, punches)

Peripherals - off line

(plotters, A/D converters, graphics)

Communications (possibly indirect)

Data Preparation (possibly indirect)

Site Equipment

(temperature recorders, tape racks, card cabinets, etc.)

Office Equipment

Other

Software

Operating Systems

Compilers and Assemblers (possibly indirect)

Utility programs

Applications (possibly indirect)

Supplies

Books and periodicals

Technical Literature

Office Supplies

Data Processing Supplies

Maintenance parts

Utilities

Maintenance (indirect)

Heat (indirect)

Air Conditioning (possibly indirect)

Electricity (indirect)

Water (indirect)

Gas (indirect)

Telephone (voice) (possibly indirect)

Services

Printing (possibly indirect)

Renovations (possibly indirect)

Communications (Data) (possibly indirect)

Professional Fees

Administrative Overhead (indirect)

Financial

Insurance (indirect)

Space (indirect)

Interest charges

Other

Travel

Relocation Costs

Business Expenses

Advertising (possibly indirect)

Contingency