WORKING PAPER
ALFRED P. SLOAN SCHOOL OF MANAGEMENT

A Case Study of Centralization vs. Decentralization and Stages of Growth In the Data Processing Function Within the Canadian Banking Industry

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WP No. 1000-78 May 1978

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ABSTRACT

This paper presents the results of a case study of the data processing function within four Canadian banking organizations. The study is motivated by the issues of centralization vs. decentralization of data processing, and the stages of growth phenomenon, within the DP function. Specific models - Rockart's Decision Assistance Framework, and Nolan's Stage Hypothesis - are employed to interpret the results of the study with respect to these two issues. The Rockart Framework is found to be valuable in providing an overall conceptual scheme for the analysis of the centralization vs. decentralization issues. Seven broad areas are identified and discussed, that might provide grounds for extension or modification of this framework. The Stage Hypothesis is found to be an effective predictor of interrelationships between growth factors in three of the four firms; the fourth firm provides insight into situations where the Stage Theory does not seem to apply in its fundamental form.

I Introduction

Computers first entered the organizational fold about twenty-five years ago. While the early commerical computer applications were highly constrained by the available technology, the limits of both the equipment technology and users' technical skills expanded outward very rapidly. This growth in technical knowledge was not accompanied by a corresponding growth in knowledge of how the computer resource ought to be managed, however. The form and substance of technical debates surrounding computer usage have evolved and shifted substantially over the past two decades. However, many of the burning managerial issues are still unanswered.

This paper addresses one such managerial issue - perhaps the granddaddy of them all: centralization versus decentralization of computer systems within an organization. Restated in broad terms, the centralization/decentralization (or "C/DC", for short) question asks, "given that an organization intends to use a computer-based information system, how ought the various pieces of that system, and processes required to operate it, be organized and managed?" Since this question can be made almost arbitrarily broad, it is not surprising that most investigators attempt to deal only with a small portion of it at one time. However, some initial attempts have been made to address the C/DC issue in fairly broad terms, as discussed below. This study is primarily directed at verifying and expanding the these efforts.

This paper is organized as follows. Following this introduction, Section II contains background information on various aspects of the C/DC question. In particular, Rockart's "Decision Assistance" model, and Nolan's "Stage Hypothesis" will be examined in detail, as they form the focus of much of what follows. Section III provides contextual information about the particular firms that participated in this study. These four companies are all large Canadian banking institutions - three national chartered banks and one large provincial credit union organization. These banks were selected as a study site for a number of reasons, including

- the author's initial familiarity with Canadian banking practice;
- the fact that all four firms have large, reasonably sophisticated, and growing data processing operations;
- all four firms have many commonalities (eg, the economic environment), and all four are much alike in terms of their orgainzational "view of the world";
- in spite of the previous point, each firm has taken a unique approach to the C/DC question and related DP organization issues.

This four-firm case study then provides, at a first approximation, a controlled experiment: situational factors are "held constant" while similarities and differences among the variables of interest are examined.

Section VI comtains an assessment of some general issues that have implications for centralization/decentralization in the banking context. Many of these issues arise with respect to Rockart's and Nolan'

frameworks, and some suggestions are made, particularly with reference to Rockart's framework, for extensions, both of a general nature and extensions particular to the banking industry. Each framework is assessed in terms of its descriptive and prescriptive power.

Concluding comments and certain considerations for further study of the C/DC question are presented in the final section.

All notes and references appear at the end of this paper. Notes are designated as ^{n}, while references are designated $^{(n)}$.

II The Centralization/Decentralization Question.

A. General Background

Why has the question of EDP organization been so widely debated over the last 15 years? There is an abundance of reasonable arguments in favor of both alternatives - centralization, and decentralization - but above all resides an issue of philosophy. Over the last two decades or so, most large organizations have come to accept extensive decentralization of their operating units. Creation of profit or investment centers, development of transfer price schemes, and the general spreading-out of corporate control has become widespread. A recent survey by Dean[13] indicated over 90% of U.S. manufacturing firms were organized decentrally. However, until recently, nearly all data processing functions in major organizations were organized in a highly centralized fashion. Thus a divisionalized firm whose management was deeply imbued with the decentralized, shared-authority-and-responsibility managerial practice might run a corporate DP system, servicing all divisions from one central site. As the corporate DP operation grew in importance in the eyes of division management, the ambiguity of a centralized DP function in a decentralized firm assumed greater and greater significance.

However, until recently the weight of argument, as well as DP practice, favored the centralization alternative. A number of these arguments are discussed below. A strong common thread of the centralization arguments is that of improving efficiency of the data processing operation. This is a natural outgrowth

of the high cost of the associated technology and specialized staff, and the complexity of the DP function. All of the energy and resources of data processing personnel were consumed in managing the computer system, making it work, and filling up its capacity, with very little left over to ask whether it was being used in the most appropriate (ie, effective) way.

A number of changes have taken place during the past few years that have greatly altered the DP landscape from that of the 1960's. Leading the way in terms of change has been the phenomenal drop in price, and increase in performance of computer hardware. The computer industry's rule of thumb states that hardware prices fall about 20% per year. Furthermore, this rate of change is forecast to continue through 1980.[12] EDP options that were economically inconceivable as little as 10 years ago are becoming relatively common.

A second feature of the current DP scene that is greatly affecting the C/DC decision concerns the coupling of computers and communication facilities. The ability to easily interconnect different computers into networks, and to access computers remotely in various ways has largely eliminated the location of the computer facility, per se, as an important issue. This "uncoupling" of the location of hardware from other C/DC considerations has provided DP managers much more freedom in their design decisions.

A third feature of data processing activities today - one that is often overlooked - is that the DP function, while in detail still tremendously complex, is much better understood and appreciated, and less feared, by nontechnical personnel today.

The unrestrained awe and wonder felt by so many people on being first exposed to computer systems was not infrequently followed by great disenchantment when they discovered how "dumb" computers really are, and has finally been moderated to a level somewhere between the two extremes. Most important, a large proportion of the nontechnical personnel in organizations today have a rough idea, at a "macro" level, of what computers are capable of, and where the important tradeoffs lie between "having a computer do it" and "having a person do it".

Primarily for these reasons, options for structuring and managing the data processing function - where to locate hardware, what hardware to have, where and how to do system development, and how to manage the overall process - are presenting themselves as viable alternatives today that were either impossible or clearly undesirable as little as 10 years ago.

Before highlighting the key arguments on both sides of the C/DC issue, two points should be noted. First, whereas the arguments in favor of centralization tend to emphasize the efficiency of the DP operation, most of the decentralization arguments focus on the effectiveness with which DP services are provided to the organization's clientele. Roughly, one is the "dual" of the other: the centralization proponent strives to maximize efficiency (or minimize cost) within a set of service constraints, while the decentralization proponent trys to maximize service level, however measured, while keeping costs within some set of budget constraints. The above argument is obviously an oversimplification, but a useful contrast to keep in mind when thinking about the motivations in favor of centralization or decentralization.

The other point to be noted is the feedback effect that has occurred between the manufacturing and user sides of the DP industry. A regenerative cycle, as illustrated below, has been underway for some time now.

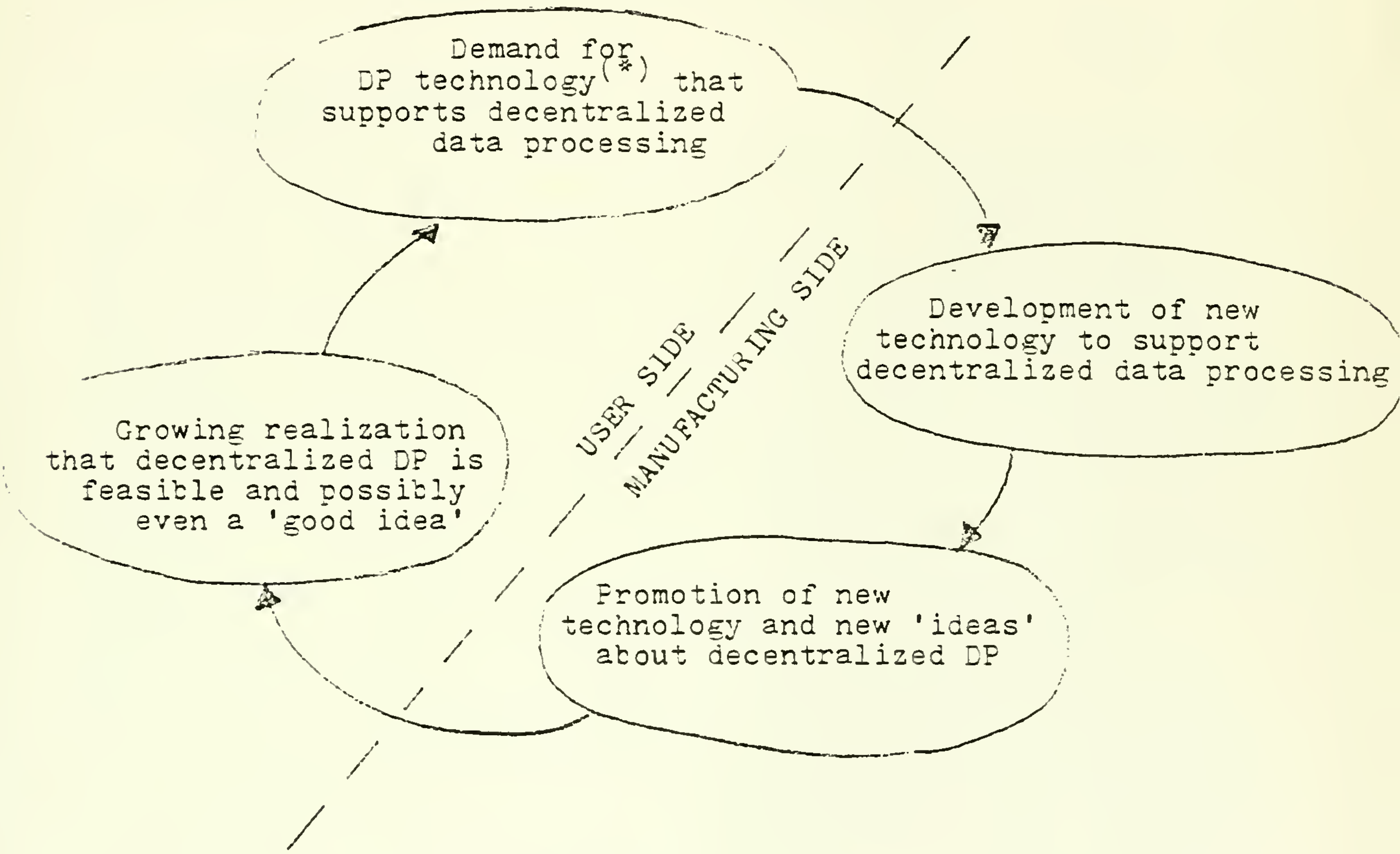

Figure II-1

* including business-oriented minicomputers, mini software packages, computer network technology, "intelligent" terminals, etc.

The overall point being made here is that the swing to decentralization currently taking place in data processing is neither a supply-driven nor demand-driven phenomenon. Simplistic characterizations of these changes are inadequate. Part of the purpose of the study reported here is to better understand the interactions and forces that are bringing about these changes.

B. <u>Distributed Processing</u>.

Distributed processing is a topic that has generated a great deal of debate and discussion of late. Arguments run a full gamat from pro to con, with a third alternative as well: that "distributed processing" is a content-free expression.[38] The problem, of course, is that the phrase means different things to different people; no common definition exists. Since the arguments and concepts surrounding the C/DC question impact distributed processing and vice versa, it is important that we locate this notion within the overall context of the C/DC milieu.

At its simplest, distributed processing is exactly that: a DP system wherein data is processed (manipulated by a computer, or "processor") at more than one geographic location. A common example might be a simple order entry system using programmable terminals (containing micro-processors and a small amount of programmable memory). The terminals may be pre-programmed to perform edit and error check operations, such as insuring that numeric fields contain numeric characters. After performing these operations, the entered data would be transmitted to a central computer for further processing (file update, or whatever).

This view of distributed processing focuses attention upon the physical location of the hardware processors. We could contrast the above scenario with two others: (1) all the data processing associated with the order entry function occurs within the central computer (order data is entered via non-intelligent terminals or perhaps via punched cards); (2) order entry processing all takes place within a separate, stand-alone minicomputer dedicated to that task alone. Other minis are used for other functions, and data is shared among the various processors by exchanging card decks or tapes.

From the admittedly limited point of view of processor location, distributed processing may be thought of as occupying a middle ground between centralized processing and decentralized processing, as illustrated in Figure II-2.

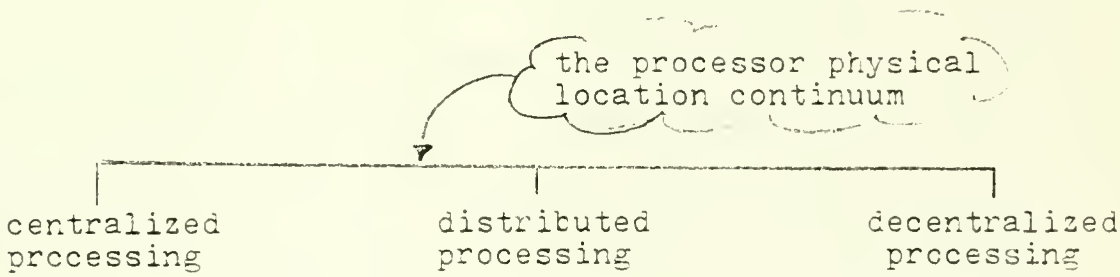

Figure II-2.

While perhaps the most obvious one, physical processor location is but one aspect of the C/DC/distributed processing question. In order to develop a more encompassing framework, we begin with Norton's subdivision of the activities associated

with a computer-based information system (CBIS):

- systems operations
- systems development
- systems management.[34]

Systems operations includes physical hardware, plus operations and maintenance personnel. Thus the physical location of processors, discussed above, falls within this category. Systems development involves the analysis, design and programming of new application systems as well as major updating and maintenance efforts associated with existing systems. Systems management is a mixed bag of planning and administrative tasks associated with the overall management of a CBIS. Included are activities such as EDP budget preparation, equipment selection, standards development, auditing, project control, and new application selection.

Following Rockart,[35] we now suggest that <u>each</u> of these categories may be centralized, distributed, or decentralized, <u>more or less independently of the others</u>. For example, it is quite common for a multi-division firm to have decentralized operations and systems development, with distributed systems management - each division has its own computer facilities and performs its own development work, but overall EDP management is shared between corporate headquarters and the divisional EDP groups. Another common pattern - typical of DP organization in the Canadian banks - involves centralized development and management, but distributed or decentralized operations.

Up to this point, we have concerned ourselves only with physical location as an indicator of the degree of centralization

of the three systems activities. A final differentiation should also be made between physical location and locus of control, or "logical" location. Here we are concerned with the difference between where a particular function is located and the way in which its activities are controlled and coordinated with those of other such functional sub-units. A couple of examples will help to illustrate the essential difference between physical and logical organization.

Consider first an automated plant, whose process is controlled by a network of minicomputers at different locations throughout the plant. Geographically (ie, physcially), this would be an example of distributed processing. Logically, however, such a system could be either centralized, distributed, or decentralized, depending on the locus of operations control: centralized in the case where all the process control decisions are made by a single "master" computer (with the peripheral computers sensing and editing input data and executing the control decisions); decentralized in the case where there is no master computer, and each mini attends to its part of the process with no outside directives (although data may be shared among the various controllers via the network); and distributed in the case where some decisions are made centrally, some within the local controller.

In the case of systems development, we could have development teams that generally live and work at a central site (a corporate DP center, typically), yet are fully under the control of the user group sponsoring their work. This would be a case of physical centralization but logical decentralization of systems

development. A more common pattern is the opposite, however, with development personnel located at the client site, but controlled centrally (through required adherence to centrally developed standards, or perhaps the necessity for integrated systems development under a corporate data base system, as well as simple superior-subordinate control).

If we assemble the foregoing arguments into one picture, we get something like Figure II-3 (the X's represent a possible positioning for a hypothetical firm).

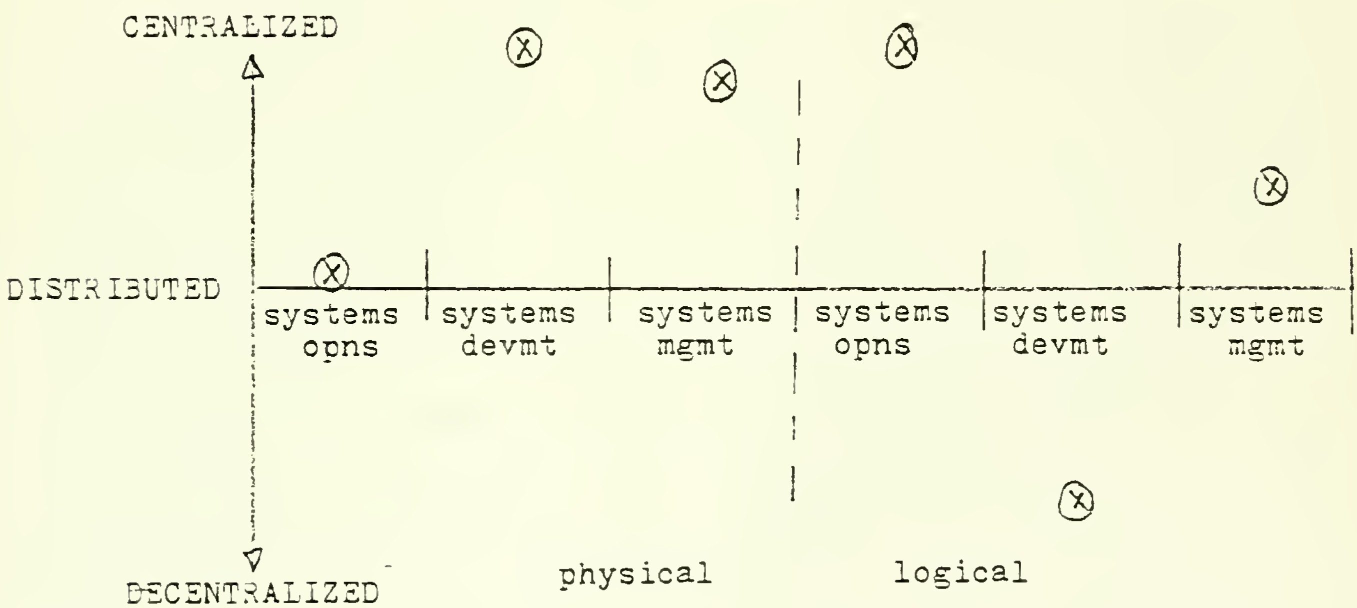

Figure II-3

We will refer to this factorization a number of times in the course of later arguments in this paper.

C. Factor Studies

It is instructive to review briefly the major arguments that have been forwarded on behalf of centralization or decentralization of CBIS's in the past. While the subject generally has received much attention in writing, there is a great deal of overlap among these various "factor" studies. Leventer has reviewed a considerable number of these studies and has compiled a table of factors cited as favoring one or more of the three alternatives.[26]

C.1 Economy of Scale Arguments

Probably the oldest living rule-of-thumb in the computer industry is Grosch's Law. Herbert Grosch carved a historic niche for himself in 1952 when he first put forth the argument that the operational performance (in terms of processor throughput) of a computer varied approximately as the square of its cost. This "law", if valid, is obviously a strong economic argument for centralization. Grosch's Law has been tested empirically for certain kinds of computers (the IBM System/360 series) and found to be valid, to a first approximation.[37]

Today some people argue that Grosch's Law is "dead",[42] killed off by the ever improving cost/performance characteristics of modern computer hardware, especially minicomputers. Not surprisingly, Grosch himself contends that his law still holds.[21] Unfortunately, such debates are largely meaningless today, as computers and CBIS's have become far too complex to be characterized by simplistic measures such as processor throughput. Even in the relatively "simple" case of a batch-oriented, stand-alone

maxicomputer, operating system overhead and multiprogramming interference greatly obscure any characterization of throughput. Nevertheless, the fact remains that most DP people still believe in the implications of Grosch's Law, even if they can't actually prove it. This is probably due, in part, to the psychological phenomenon termed "anchoring and adjustment": in the face of rapid environmental change, people tend to hold on to a fixed perspective for some time, and "update" their view of the world as infrequently as possible given the accumulated strength of argument against their view. As long as DP managers perceive the general economy of scale principle to be valid they will continue to make decisions and take actions as though it were.

The economy of scale principle involves more than just hardware cost. Other related factors include lower costs for overhead items such as floor space, electricity, air conditioning, etc. Centralized facilities also, it is argued, require fewer management staff overall than a collection of decentralized facilities. Furthermore, DP equipment can usually be more heavily utilized in a centralized environment; dedicated smaller computers often are underutilized. It should be noted, however, that this last argument may be valid in terms of utilization but not necessarily in economic terms. In fact, on the basis of a study of DP utilization, Wagner has proposed the following Principle of Decentralization:

> "If an organizational group, smaller than 30 people, requires computer assistance, it is better for the total enterprise that those people have exclusive use of their own computer - provided that the computer, big enough to do the job, properly, will be loaded to over 10% of its capacity." (41)

Until recently, no one tried framing an economic argument in favor of decentralization. However, the current, and projected future low prices for minicomputers (especially when purchased in quantities) together with the growing availability of high quality mini applications and systems software packages, have made dedicated mini systems an economically viable alternative in many (though not all) situations. The simplicity and reliability[1] of a dedicated minicomputer, coupled with its economic competitiveness, have become by far the single most important force for decentralization today.

C.2 Systems Development Arguments

Unlike systems operations, the development and maintenance of application and systems software is a labor intensive activity. Because personnel costs have risen much faster than other cost categories, notably those of computer hardware, there has been a significant shift of attention of DP managers away from control of hardware costs toward control of systems development and other labor intensive factors, as evidenced by development and adoption of efficiency-improving techniques such as structured design and structured programming, and by increasing specialization within the systems development activity in general. These techniques, however, are often cost justifiable only in large (ie, centralized) DP shops, which is an argument in favor of centralization.

Another popular argument related to systems development concerns the "drawing power" of large (centralized) versus small (decentralized) installations. DP staff are notoriously craft-oriented, as opposed to company-oriented. There is a considerable

prestige (not to mention resume-buoying) factor that most DP staff attach to working in a modern, high-powered installation with new, large computers. This is evidenced by higher turnover rates suffered by smaller installations generally. "Quality of life" and other such hygiene factors seem to carry less significance for most computer professionals. On the other hand, the once critical shortage of DP staff is now closing, with supply catching up to demand.[29] The notoriously high turnover rate of DP personnel will likely come down as this gap continues to close over the next few years.

The major systems development argument in favor of decentralization is really a particularization of the widely accepted general decentralization argument: local analysts are more attuned to, and more knowledgeable of, local needs. It is generally recognized that one of the major sources of failure of CBIS's is that the development team did not really understand the problem they were trying to solve, usually because they had developed only a cursory understanding of the operating environment within which that problem was imbedded. Therefore it makes sense that systems analysts who are functionally (and geographically) located within an organizational sub-unit would have a better general understanding of the needs, objectives and constraints of that sub-unit.

C.3 Systems Management Arguments

The major pro-centralization argument in this category concerns control of the EDP operations and budget. It is argued that having everything and everybody in one place allows DP

management to better control the equipment and systems on a day-by-day basis. The main reason (other than the controllability associated with proximity itself) is that centralized shops can support the overhead expense associated with special managerial staff such as project control specialists or budget analysts, not affordable by smaller decentralized groups. Also, the "flip side" of this argument is that decentralization leads to much wasteful duplication of systems development effort.

On the side of decentralization it is argued that divisional managers ought (in line with the general philosophy of decentralization) to have direct control over the activities of and expenses incurred by the DP function that serves their division. With local DP resources, division managers develop much better insight into the cost elements as well as the range of benefits available through the CBIS, and thereby provide better managerial direction for the effective utilization of these resources.

C.4 Other Factors

We have touched on most of the arguments that occur frequently in the C/DC literature. There are, however, some additional factors that may play a major role in determining the shape of a firm's DP organization, but which are seldom discussed. Chief among these are political considerations. Most important decisions within organizations result from complex processes, only a part of which involves "rational" debate.

Other components of such processes include human interactions, corporate power relationships, personality forces, and golf conversations. Categorizing such factors and linking them

with the "rational" C/DC arguments is difficult (not to mention distasteful to most people brought up in the management science tradition), and most writers on this subject tend to ignore them. An excellent example of one study in which such factors are the main subject of investigation is Demb's study of centralization of DP in an 11-campus public college system.(14)

Another factor that does not fall into one of the earlier categories concerns the security and reliability of a CBIS. Today most large organizations are deeply dependent upon their computer systems for their daily operations (computer-based banking operations are a prime example of this). In the on-going IBM antitrust trial, the chief government prosecutor argued recently that if IBM were to withdraw its customer service personnel for two weeks, the country's economy would rapidly grind to a halt. While perhaps a slight overstatement, nevertheless most large computer users today are very concerned about insuring their ability to keep operating in the face of computer failure. Decentralization and distributed processing offers the opportunity to share the "eggs" among a number of baskets and in so doing arrange the various systems so that they can back each other up in the event of a system failure. Considerable research is currently underway to investigate alternative arrangements for high reliability systems.(8)

D. Two Conceptual Models

While the main theme of this study concerns DP organization and the C/DC issue in a banking environment, a major objective is to assess two different conceptual models - the Rockart Framework, and the Nolan Stage Hypothesis - in light of the information obtained through site visits, interviews and other sources. At this point, then, we provide a brief overview of these two models. Further detail is available from working papers and published articles cited in the bibliography.

D.1 The Rockart Framework

The main impetus for the development of this framework has been the need for a managerially useful guide to assist in the centralization/decentralization decision-making process. The Rockart Framework definitely does not purport to provide "an answer" to this very broad and complex issue, but rather to provide relatively high-level guidance to DP managers in their assessment of the many factors involved and the tradeoffs among them, and especially to provide a useful context in which to view the entire C/DC question. The framework is thus more in the spirit of decision support than analytical problem solution.

The framework proposes an approach to systems design consisting of three primary parts:

a) Breaking down the information systems function into elements that may be treated independently in making the C/DC decision.

b) Applying a set of environmental and technical factors, to be assessed in relation to specific characteristics

and constraints of the application and the organization, in order to identify one or more feasible design alternatives.

c) Evaluating the alternatives identified along three different measures of performance.

Consider each of these parts in turn.

<u>Breaking Down the Information Systems Function</u>. The information systems function can be viewed along three dimensions:

(1) The organizational units - generally the divisions or departments of an organization. Because decision-making authority and responsibility in most organizations is structured in terms of these units, it makes sense in general to evaluate the C/DC decision separately for each. However, it is frequently possible or desirable to design applications that serve two or more such units together.

(2) The logical application group (LAG). A LAG is defined as a set of applications that deals with a logically separate, identifiable information processing task. A LAG is characterized by relatively intense transfer of information or data among its component subsystems or programs, with a relatively low level of information transfer between it and other LAGs. Examples of LAGs include (1) the order entry/shipping/accounts receivable LAG in a typical manufacturing firm, and (2) the deposit accounting systems in a banking firm.

(3) The three major functional processes that define the information systems function:

- systems development - the process of designing and implementing computer-based information systems;

- systems operations - the process of operating existing systems;

- systems management - the process of managing the overall information systems function, including strategy development, operational planning and budgeting, DP personnel management, etc.

These three processes are further broken down into sub-processes (tasks making up the process) and resources (commodities used to perform the process). The sub-processes and resources used by Rockart are those listed in Figure II-4 .

Process	Sub-processes	Associated Resources
Systems Development	Functional Design Detailed Specifications and Programming Implementation Maintenance	Development staff
Systems Operations	Edit and control Update Processing Reporting	Hardware and software Staff Data bases
Systems Management	Strategic planning Management control	--

Figure II-4

This breakdown of the information systems function is necessary for the identification of reasonably contained, manageable units about which a C/DC decision may be made in a more-or-less independent fashion. In deciding whether to centralize the systems development effort on the new order entry system for Beta division, say, the DP manager need not, in general, concern himself simulataneously with C/DC decisions relating to other functional processes, LAGs, or organizational units.

The Factor Table

The heart of Rockart's Framework is a collection of factors pertaining to the centralization/decentralization decision. Each factor has been assessed in terms of its direction (towards centralization, or towards decentralization) and strength (strong, or weak), for each sub-process and resource listed in Figure II-4. These assessments and the factors themselves, have been derived

from past empirical research, published information systems literature, and personal experience.

The entire collection of factors and their assessments is given in Appendix A. It should be noted that this Factor Table, while reasonably robust at this point, should not be considered a "finished product". Indeed, one of the goals of the present study is to seek to identify significant "missing factors", and more generally, to determine whether it makes sense to "tailor" the Factor Table to a specific industry such as the banking industry. These considerations are discussed further in Section IV.

Measures of Performance. Rockart suggests that each alternative configuration put forth for any particular C/DC decision ought to be assessed along three performance dimensions:

(1) cost of developing, operating and managing the configuration;

(2) time required to develop and implement the alternative;

(3) effectiveness of the particular alternative.

The framework does not explicitly specify how such evaluations ought to be conducted, but leaves such considerations as DP management prerogatives.

Applying the Rockart Framework. Rockart prescribes the following basic steps for applying the framework in an actual design consideration:

(1) Isolate the unit about which a decision is to be made.

(2) Determine which of the factors are applicable to the decision.

(3) Identify the dominant factors among those which are applicable.

(4) Identify the range of configurations determined by the factors for each subprocess and resource.

(5) Determine the decision yielding a managerially effective solution to the problem.

(6) Use the measures of performance to choose among the feasible specific alternatives.

These steps are fairly self-explanatory. Additional discussion of each step, together with examples of the framework "in action", are given in the references.[35]

D.2 The Nolan Stage Hypothesis

Stage theories have been used in many different fields (biological growth, economic development of nations, galactic change, etc.) to consolidate knowledge during their formative periods. Such theories presume that the elements of systems tend to move through a predictable and describable pattern of distinct stages over time. The embodiment of a stage theory then is the identification of these system elements, and the characterization of the growth pattern through time.

Richard Nolan, building on the earlier work of Churchill[9], has proposed a stage theory for the development and management of computer resources in organizations.[32] Nolan suggests that the EDP budget can be used as a surrogate for the growth phenomenon of the information systems function. On the basis of a sample of three firms, Nolan concluded that an S-shaped growth

curves most appropriately reflected the shape of EDP budget growth. Additional empirical study indicated the existence of four more-or-less distinct stages within the overall growth pattern, as illustrated in Figure II-5. Nolan named these four stages:

- Initiation (initial computer acquisition)
- Contagion (intense systems development)
- Control (proliferation of controls)
- Integration (user/service orientation).

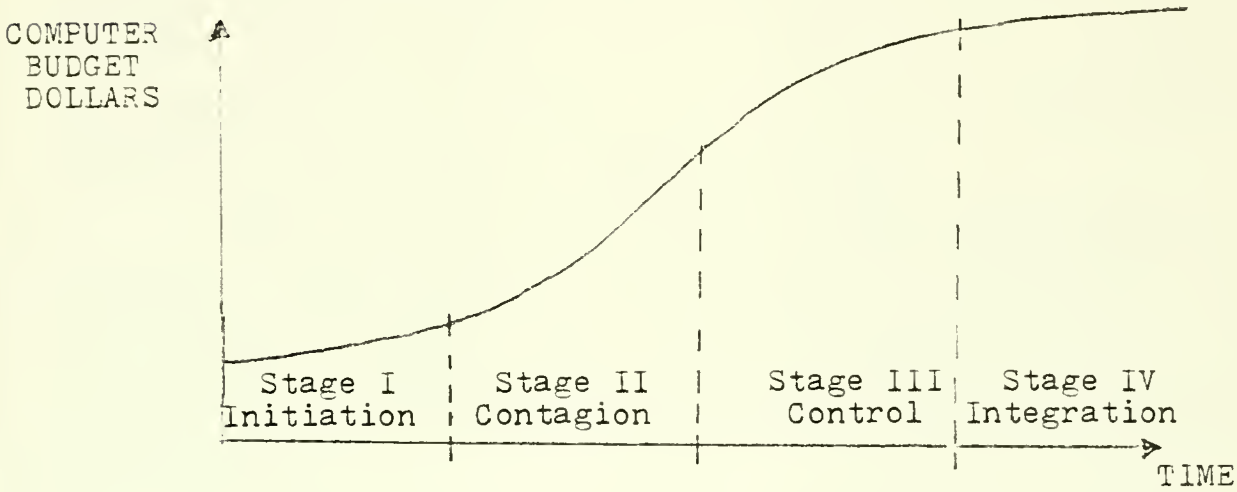

Figure II-5

Nolan outlines the key features of each stage as follows.

Stage I (Initiation). Stage I begins with the introduction of a computer into an organization, either for handling administrative or transaction-based processes more efficiently, or for computational requirements such as engineering calculations. While other, less "rational" reasons for acquiring a computer are sometimes used - such as prestige, desire to maintain a modern image, etc. - generally the overriding concern is cost savings. Two of the most important Stage I issues to be faced by company and DP management are:

- Fixing organizational responsibility for the computer. Often this responsibility goes to the accounting department, as the first area in the firm to use the computer.

- Alleviating initial disruptive impact, such as job displacement anxieties and fear of loss of personal identity.

Stage II (Contagion). The fact is that there are very few firms of any significant size today that are still in Stage I. Most firms passed through this stage in the early or mid-sixties. Rather, Stages II and III characterize the large majority of current-day DP operations. In particular, all the subject firms involved in this study fall in one of these two stages.

Stage II is a period of rapid expansion and growth of DP activity, often initiated by the desire to utilize excess hardware capacity acquired during Stage I, and fueled by the lure of broader and more advanced applications. Nolan describes Stage II as involving

> "a steady and steep rise in expenditures for hardware, software, and personnel. It is a period of contagious, unplanned growth, characterized by growing responsibilities for the EDP director, loose (usually decentralized) organization of the EDP facility, and few explicit means of setting project priorities or crystallizing plans.
> This stage often ends in crisis when top management becomes aware of the explosive growth of the activity, and its budget, and decides to rationalize and coordinate the entire organization's EDP effort. The dynamic force of expansion makes this a fairly difficult thing to do, however."(19)

Additional characteristics of this stage include:

- a tendency for both users and DP people to develop a fascination with the computer to the point that "criteria of economic justification and effective project implementation take a back seat";

- a cost instability arising from cycles of cost overruns, justifications for additional capacity, resulting in a

need for more personnel and projects to which the new capacity can be applied, leading to further cost overruns, etc;

- few specific guidelines or priorities imposed on the DP function by top management;

- little effective DP management control over the DP function (eg, standards for programming or systems development, computer and staff cost chargeout mechanisms, etc.).[20]

Stage III (Control). Stage III is usually begun out of a managerial crisis resulting from the rapid uncontrolled growth of DP costs during Stage II. As described by Nolan,

> "Management mobilizes a set of tasks to control expenditures for computing. Inefficiencies in computer applications are the most obvious and are usually the first target. Planning tasks are initiated in all aspects of the computing organization. A senior management steering committee is established to evaluate the systems plan and to establish priorities for future system development. Organization of the steering committee is accompanied by the increase responsibility of the EDP manager, which is often at the director or vice-president level. The tendency is to recentralize the computing activity... Budgetary controls and overall cost justification somewhat contain the competition. Nevertheless, the problem that prevails can only be accommodated by a higher level managerial committee for establishing priorities.
>
> Formal project management and management reporting systems are instigated during Stage III and provide for the beginning of effective management of the computer resource. The existence of these systems leads to the need and development of standards for programming, documentation, and operations. Often there is also a shift to a user charge-out system for computer services. In the extreme case, the computer organization may be assigned profit center responsibility. Stage III, characterized by a myriad of control devices, is often an overreaction, with strong forces toward centralization."[20]

Thus the emphasis in Stage III is on doing a "tight" job of managing the whole DP process. Key features are institution of formal DP planning, implementation of project control systems such as PERT, a strong tendency to centralize for control purposes, the development of user chargeout systems, institution of

formal standards and quality control mechanisms, and the development of the first real MIS applications. Nolan also suggests that the transition to Stage III occurs at a crisis point. As we will see shortly, these characteristics serve admirably, on the whole, to describe the growth process in each of the four banking organizations taking part in this study.

Stage IV (Integration). The transition from Stage III to Stage IV is usually less obvious than the earlier transitions, and may not occur as abruptly either. Computer budget growth is slower and more even than before, more in line with the firm's overall growth. The director of data processing has usually risen to the rank of Vice President or equivalent. The need for tight DP control is tempered with the growing realization that the end users of DP in the organization have suffered as a result of the earlier centralization efforts, and the result is often a move back toward decentralization or distribution of DP services throughout the firm. There will also be a strong commitment of DP management to formal planning.

Some investigators, including Nolan, have rhetorically asked themselves what comes after Stage IV. A variety of theories have been put forward, including arguments for a series of S-curves, and for a pattern of superimposed curves (see Figure II-6 a,b).[31,40]

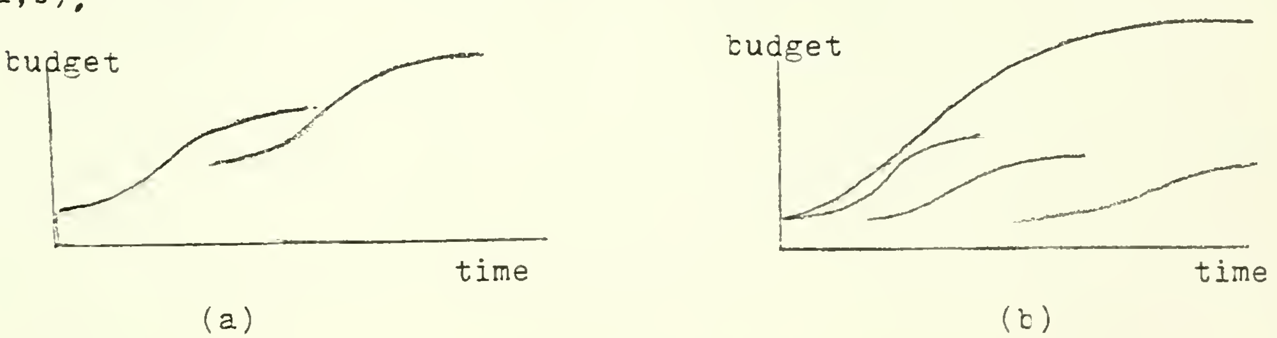

Figure II-6

None of these theories can be said to provide the explanatory power or insight of the original Stage model, however.

The Stage Theory suggests a temporal pattern of centralization and decentralization as illustrated in Figure II-7.

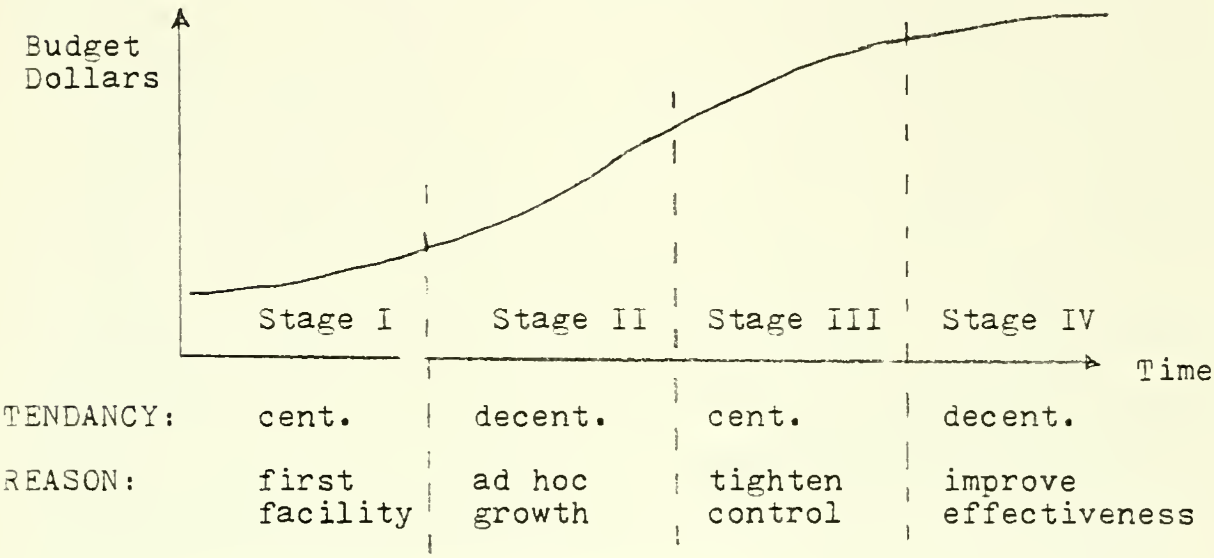

Figure II-7

These tendencies represent broad trends, not necessarily compelling rational argument in any individual case. Nonetheless, it would seem that, all other things being equal, a particular LAG would be more likely to be developed and run centrally by a firm in Stage III than one in Stage IV. This general line of argument will be revisited in Section IV when we analyze the results of the study of DP in the Canadian banks, the subject to which we now turn.

III Data Processing in the Canadian Banking Industry

The main objective of this section is to describe the important dimensions of data processing within the banking industry generally, and specifically within Canadian banking. We begin with a brief overview of typical computer applications found in most Canadian banking firms. A detailed description is then given of the background and operation of each of the four subject firms that took part in this study. These descriptions, drawn primarily from interview notes and references, serve as the setting out of which the suggestions and conclusions of the following sections are drawn.

A. Data Processing in Banks

It has been observed by Jay Forrester[15] and others that nearly 75% of North America is "on overhead", that is, does not directly contribute to the output of goods in the economy. After the government agencies, banks form the largest component of this service segment of our economy.

In many ways, banks are the quintessential "paper shufflers"; the volume of paper documents that flow through the banking system and its associated support organizations (eg, the Federal Reserve Board in the U.S.; the Bank of Canada in Canada) is, literally, mind-boggling. It would seem, therefore, that com-

puters and banks would form a natural marriage. Today, at least, this is only partially the case. It turns out that for a number of different reasons, computers have been less than completely successful in solving all of the paper-handling problems that banks face. This is not to say that computers have not had an impact; indeed, all of the Canadian banks interviewed during this study acknowledged that they would be forced to suspend their operations if faced with a prolonged loss of computer support.

To obtain an initial perspective on what computers are typically used for in these organizations, we will describe the major applications common to the four subject banks. First, and foremost, is the set of systems that handle deposits, withdrawals, and payment transfers among accounts - both chequing and savings accounts, for both private individuals and corporations. Included within this system is the subsystem for clearing cheques - referred to as the "transit" system in the local parlance. While conceptually rather simple, a major proportion of each bank's total DP effort is associated with the deposit accounting and transit operations, and small increases in efficiency often translate into large dollar gains.

A second major application area, or LAG, focuses on loan accounting. Most Canadian banks are involved in the usual range of loan activity, including various types of consumer loans, mortgages, auto loans, and industrial loans.

General ledger accounting and other central account/administrative systems comprise a third major LAG. The primary purpose of these systems is to consolidate the accounts of the

various branches together with those of the head office.

A fourth major applications area is that of charge card processing. Each of the chartered banks operates its own charge card clearing operation, similar to those of many U.S. banks. The primary functions provided here include source data entry, billing, payment processing, and on-line inquiry from retailers.

Finally, each bank has a mixed bag of other application systems, for tasks such as: operating expense reporting, balance sheet and P & L reports for branches, divisions and corporate, financial asset management (bank-owned stocks and bonds, mostly), physical asset management (buildings, equipment), payroll (both bank employees and client contracts), personnel recordkeeping and retrieval, international banking systems, and automatic payment exchange. Some of these, notably the last mentioned, will be elaborated upon below.

One rather surprising feature of the array of DP activities in all four organizations is the nearly total lack of real "management information systems". Data processing, while extensive, is almost entirely directed at transaction processing and recordkeeping functions, with essentially no support for managerial planning or decision making. For example, one common decision support computer application found in most major U.S. banks is that of computer-assisted credit scoring. Despite the fact that packaged software is readily available for this function, [2] none of the Canadian banks were using such a system. Similarly, no planning applications were in evidence, although computer-assisted planning is becoming quite popular in the general banking com-

munity. Certain reasons for this lack of interest in exploiting the computer for MIS-like activities became evident during the interviews, and will be discussed further in the next section.

We begin with a quick scan of the Canadian banking and "near-banking" community.[3] The center of the financial system is the Bank of Canada, which plays a role similar to, but more constrained than the FRB in the U.S. Its two most important functions involve paper money issue and the sale and management of Government of Canada bonds. By far the most important financial intermediaries are the chartered banks. At the present time there are ten such banks in Canada, five of which (The Toronto Dominion Bank, the Bank of Montreal, The Bank of Nova Scotia, The Royal Bank and The Canadian Imperial Bank of Commerce) dominate the scene. The first three of these five chartered banks were subject banks in this study. The next most important group of intermediaries are the trust companies and credit unions. The former provide a variety of executor, administrator and trustee services. They are unique in this respect because chartered banks and other financial institutions are not permitted to act in a fiduciary capacity. This is in direct contrast to the prevailing situation in the U.S. The Canadian trust companies have expanded their originally circumscribed limited role, and today offer many of the same services available through the chartered banks, including standard chequing and savings account facilities and various types of consumer and commercial loans.

The Canadian credit union movement was begun in 1900 by Alphonse Desjardins in Levis, Quebec.[(41)] The movement flourished

in Quebec (where the credit unions are called "Caisse Populaires"), and grew less quickly in the English speaking provinces. The central concern of the caisse populaire and credit unions is on banking and other financially-related services for the "common people"; as Desjardins himself put it,

> "...the people's bank is above all an institution aimed at the betterment of its members rather than at mere profits - an association of honest individuals rather than one of mere funds like a joint-stock company." (30)

The fourth subject firm for this study is the Quebec Caisse Populaire group - a remarkable organization in many ways, not the least of which is their DP system. However, the Caisse Populaire are significantly different from the chartered banks in many ways, including a smaller asset base, a much smaller reach (essentially Quebec only, as opposed to nation-wide), and a different fundamental "raison d'etre". Comparisons between the DP operations between the Caisse Populaire organization and the other subject firms can only be made with these differences in mind.

For completeness, Canada also has a variety of other financial institutions, mostly special-purpose, including: insurance companies, a few savings banks, private bankers, building societies and mortgage loan companies, investment trust companies, consumer loan companies, mutual funds, and government intermediaries.(16)

At this point we shall describe each of the subject organizations - in particular, their DP operations - in some depth.

B. <u>The Toronto-Dominion Bank</u>

The TD bank is the smallest of the three chartered banks in the study. It was formed out of a merger of the earlier Bank of Toronto, and The Dominion Bank, in 1959. It manages about 12% of the total chartered bank assets, which amounted to about

$14 billion as of 1975. The TD Bank currently has about 1000 branches in all provinces of Canada, with the bulk of these in and west of Ontario.

The data processing operation resides within the Corporate Operations group, headed by General Manager P. Cooper. Cooper's immediate superior is a senior V.P. of the bank, although up until last year he reported one organizational level below that. Cooper's background is banking operations and methods study, not data processing; his DP training has come from an IBM training course and "on-the-job" experience.

The bank is organized primarily on a geographical basis. Canadian operations are split into ten regions, and the branch managers report to a regional general manager, who in turn reports to a Corporate V.P. Certain activities, such as international banking, large commercial loans, and personnel work are organized as separate functions within corporate headquarters. However, the large majority of activity, both financial and human, is connected with the geographically oriented branch banking operations.

One interesting result of this organization is that the user-system bonds for the bank's most important DP systems (DDA, savings, loans) are largely nonexistent. As Mr. Cooper put it, "nobody 'owns' DDA." This fact, we will argue later, has an important bearing on TD's present and expected future systems configuration.

The DP group reporting to Cooper is broken down into three sub-units: systems operations, systems development, and DP plan-

ning and support (the actual terms used are slightly different, but the meanings are these). In fact, this type of functional breakdown is common in the banking industry as well as others, and closely parallels the "operations-development-management" division used in the Rockart framework.

The major mission of the operations group is to run the computer facilities and associated tasks such as cheque encoding, cheque sorting, data entry, on-line operations, and Chargex Centre operations (charge card inquiry and processing). The Superintendent of Operations is G. Stevenson, whose history with the TD bank is much like Mr. Cooper's - line banking experience, followed by work in the methods engineering, then into data processing after a 10-week IBM course. Reporting to Stevenson are the data center managers and the manager of the central computing facility.

The systems development group has primary responsibility for development and maintenance of software. The group is headed by Bob Simpson, and includes about 100 systems analysts and programmers. The major software systems developed to date include:

- term deposits ("DDA", or "demand deposit accounting") and transit
- savings deposits
- loan accounting
- Chargex processing and inquiry
- general ledger consolidations
- mortgages
- personnel
- payroll (in-house, and as a client service)

The most important of these systems are described in more detail below.

The planning and services group was recently (about one year ago) established, under the direction of Bill Nelson. The major goals of Nelson and his staff (3 people) are to improve the DP planning function generally, especially the budgeting process; to work toward the development of DP standards and other quality control measures; and, most importantly at this time, to manage "Project Move". TD Bank's central computing facility is outgrowing its available office space, and is unable to secure additional room nearby in the same building. The bank recently negotiated to buy an older building located about one mile from their present site, and plans to move their entire operations group to that new site in about two years. Nelson and his staff have spent most of their time since the creation of their group working on this project.

The TD Bank, like the other banks in this study, has been using computers in its operations for only about 10 years. They began in 1966 with an NCR 315 in Toronto, doing batch cheque processing and DDA for about 50 Toronto and vicinity branches.

In order that what follows is clear, we will pause here for an explanation of how this function operates. In terms of effort and cost, the cheque clearing and demand deposit accounting functions are the heart of the bank's daily operations, so a clear understanding of their details is important.

Because the number of deposit-taking institutions in Canada is quite small - over 95% of the cheques processed on a given day

are drawn on about 20 banks/trust companies/credit unions - cheque sorting and transit operations are reasonably straightforward. No massive central clearinghouses exist as in the U.S.; rather, most cheque clearing takes place in the major bank branches in various metropolitan centers across the country. A network of messengers, plus the mail service and private courier vehicles, form the links for moving documents both within and between bank branches. For the sake of economy, smaller offices will often contract for cheque clearing services through larger branches.

Prior to computerization, cheque sorting was performed on a semi-automated basis using operator-keyed mechanical sorters. Sorted bundles of cheques would then move through the transit network to their final destination, the bank branch upon which they were drawn. The so-called "on-us" cheques had the shortest movement. These are cheques drawn upon, and deposited in the same branch, either by the same person (a cash withdrawal) or by two different people. These cheques would simply go from the sorting operation to the chequing department to be posted to the individual account ledger cards, using standard key-driven mechanical posting machines.

Cheques drawn on other branches of the same bank in the same region would usually be isolated and hand-delivered to thise branches for posting. Other cheques drawn on the same bank would be bundled and delivered to a central clearing point, usually a major branch in one of the ten or so regions across the country. At these points, all incoming cheques are re-sorted into regional groups, and each regional group delivered, by air mail or courier,

to its regional clearing branch. Then the cheques are sorted once more, back into smaller bundles for individual branches or local groups of branches. The same process is carried out once more, if necessary, at the local level, until all cheques reach their final posting destination.

Thus, even if we ignore the interactions among the chartered banks and the other non-bank institutions, it is obvious the clearing network is rather dense. Nonetheless, conceptually at least, it is a straightforward operation.

Now, enter the computer. Initially, computers were used for two different functions in the DDA/transit operation. First, they were used to raise the level of automation of the cheque sorting process at the regional centers. Two steps were involved here. First, the cheques are made computer-readable through a MICR (magnetic ink character recognition) encoding process. Cheques are individually passed through MICR encoding stations, wherein an operator keys certain information from the cheque (eg, account number, date, dollar amount) onto the MICR keyboard. This information is then written onto the cheque with magnetic, machine-readable ink by the MICR unit. The cheque is then ready for automatic sorting, which is where the early computers entered the scene. By interfacing the computer to an automatic (but mechanical - ie, no programmable logic) cheque sorter, a cheque sorting program could read the MICR data on each cheque, generate a transaction log on magnetic tape, and also send a signal to the sorter to set the appropriate mechanical gates so that the cheques were deposited in a preselected pocket in the sorter. The major ad-

vantages of the computer in the sorting operation were its flexibility (by changing the program parameters, the sorting operation could be easily and quickly modified) and its ability to capture the MICR-encoded data for further processing.

The other half of the initial DDA system involved a standard batch-style, transaction-updated processing system for chequing accounts. Initially, a group of branches in a region agreed to go "on the system". All the chequing accounts in each such branch were entered into a master file (originally tape-based). Then, cheques drawn against these accounts were isolated from the transaction file generated during the sorting process, and electronically posted to their appropriate accounts in a daily batch update run. A printed report would be produced for each branch on the system, and delivered to the branch before opening time the next day, together with the sorted cheques. The mechanical posting job was thereby eliminated in these branches, although each branch was still supposed to verify cheques (examine the signatures) drawn against its accounts. Since the sorted cheques themselves had to be delivered to each branch anyway, there was little increase in cost of courier service.

The difficulty with this approach to mechanization was that it emphasized the regionalization of the branches. Since the cheques drawn on any one bank did not all pass through one clearing point, the system described above had to be duplicated in each regional office. Even if all cheques were available at one point, the large geographical distances involved would make it very expensive to operate such a system, distributing daily

DDA reports across the country from one site.

What in fact happened is that similar, albeit smaller scale, DDA operations sprang up in other regional processing centers such as Montreal, Ottawa, Calgary, Regina, Edmonton and Vancouver. Each center operated in a stand-alone, independent fashion, with little coordination from the head office. In the early stages no corporate DP function existed, and the regional data centers reported to the regional general manager.

Partly because of the lack of central control, there was very little commonality among TD's various data centers. Equipment included NCR 315's, IBM 360/30's and /40's, NCR Century 50's, IBM System 3's, etc. Furthermore, considerable duplicated effort apparently took place to develop essentially the same application system for each computerized region in turn, largely because of dissimilarity of the various computers (assembly language was commonly used).

A variety of ad hoc arrangements also arose for load balancing at TD, some of which persist today. For example, some DDA tapes are carried from Edmonton to Calgary, processed on the Calgary computer, and the resulting updated master file and reports are then shipped back to Edmonton, for further distribution to the regional branches. Similar sharing occurs between Ottawa and Montreal, although the transaction data is telecommunicated rather than being transported by mag tape. An IBM System 3 in Regina performs the cheque sorting function but has not been used to automate the DDA function to date. It is, however, used as an RJE link to the central facility in Toronto.

As the processing load on the Toronto regional data center continued to grow in the late 60's, the decision was made to have IBM take over part of the processing in their huge Toronto data center (at that time containing three 360/65's, one 360/195, and assorted smaller machines). Shortly thereafter the decision was made by the TD bank management to start developing an on-line capability with IBM support. The initial effort was aimed at the savings accounts rather than demand deposit accounts, under the assumption the former would be less complicated and an easier entry path into the world of on-line processing. With considerable help from IBM Canada, an on-line savings account system was developed and began operation out of the IBM data center. Branches were phased onto the system gradually, and today there are about 350 on-line savings branches (out of a total projected of 750 by 1981).

As the IBM bills rose with the introduction of the on-line savings system, the decision was reached to develop a complete computer facility within the bank. In 1972 two 370/158's were leased and the IBM-based systems were brought in-house. Shortly thereafter a third 370/158 was obtained for the Chargex charge-card inquiry and processing center. Following this large augmentation of Toronto-based processing capacity, the DDA work that had previously been carried out in the regional data centers was consolidated at Toronto (except for the Vancouver and Calgary regions, which still operate in a largely independent fashion). DDA is still run as a batch job today, in fact several batch jobs. Seven separate DDA runs are done each night in the Toronto central

computer facility, one for each region, processing the DDA activity for all those branches on the system except for Calgary and Vancouver region branches, which are processed at those regional data centers.

Parenthetically, it is interesting that the banking industry has "natural" load levelling built into its inherent demand for computer processing. A large proportion of the batch-type processing is most effectively done in the evening after the branches close, since the cheque-encoding clerks work from about 2:00 PM to about 11:00 PM. The demand for on-line services is, of course, highest during the hours 10:00 AM to about 3:30 PM at any one locality. Geographical spread helps level the on-line demand even further. The net result is that the amount of computing power such a bank requires is quite predictable, an accurate function of number of accounts, on-line accounts, geography, and batch loading.

It is therefore somewhat surprising that the TD operations people misjudged their processing requirements in 1974, so that they were forced to re-contract with IBM Canada to share the processing load for the Toronto region. At the present time, about one-half the Ontario DDA and savings load is handled by the IBM data center, the rest by the TD facility. Tapes are exchanged between the two centers for updating the batch files each night, and for producing consolidated reports off the on-line files.

To add to the confusion, TD is in the midst of converting its on-line systems to IBM's new SNA-based product group, including virtual operating systems, VTAM, 3705 control units, and 3600

system financial terminal configurations (including the 3601 local programmable control units, 3604 keyboard display unit, and 3611 passbook printer). There are at present about 30 branches connected to the SNA network, 320 branches on the older, non-SNA network. As new 3600-style equipment arrives from IBM, branches are being converted from the older to newer network.

At the same time, experimentation is underway with on-line DDA. Currently about 12 branches are connected to a test inquiry-only system. Development of a full-fledged inquiry/update DDA system based on SNA technology is underway, with TD staff receiving considerable help from IBM personnel.

Although investigatory resources were not sufficient to study all the TD systems in great detail, nonetheless a fairly clear overall picture is evident: (1) The TD computer-based operations comprise a rather confusing, somewhat uncoordinated collection of equipment (IBM and non-IBM, older and new); (2) TD seems to be moving in a variety of different directions in terms of technology: batch systems and on-line systems; real-time update (the on-line savings system) and "edit-post" style (the test DDA system); distributed processing <u>power</u> but little actual distributed <u>processing</u> (regional computers used as RJE terminals and for cheque processing only).

As for centralization versus decentralization, it is worth noting that nearly two years ago (in conjunction with the turn to SNA technology for on-line systems) some TD systems staff wrote a report recommending complete centralization of all bank computer operations. Little coordinated action has yet been taken

regarding the report's recommendations, and in fact the entire report is slated for review, in light of some of the recent widely publicized moves toward decentralization in both banking and non-banking industries.[16, 18]

There are a number of forces that seem to be contributing to the direction being taken by TD management for their future plans:

(1) The centralization plan is still alive, but under re-examination in light of recent experiences of other organizations.

(2) Physical security and room for growth is leading them to a large, Toronto-based, physically secure building for their computer operations.

(3) Concern over reliability in face of major catastrophe is driving them to consider two or three major processing centers rather than just one.

(4) Although TD has experimented with non-IBM equipment more than the other firms in this study, the TD system is essentially an IBM system, especially in light of the SNA commitment they appear to have made. Therefore the inherent implications of "going SNA"[25] will be strongly in evidence in the future.

(5) TD's systems management, being less deeply knowledgeable of the intracacies of DP technology, is more dependent on assistance from other parties, as well as more open to outside suggestion. IBM support staff will continue to exert a strong influence on TD's future directions.

There are also some other factors that bear on TD's future systems development, that will be brought out in the next section, since they are particularly interesting when compared with parallel factors in the other subject organizations.

C. <u>The Bank of Nova Scotia</u>

The Bank of Nova Scotia (or BNS) is number four of the "big five" chartered banks, with assets of about $18 billion in 1976. It has branches in all provinces, with about 1200 branches altogether. The firm is regionally organized, with ten regions across Canada, and a corporate head office in Toronto (in the same office complex as the TD Bank).

As at TD, each region is, in theory, a profit center. In practice the regional general managers have very little control over the key determinants of profit - primarily the general economic climate, general interest rates (controlled by the Bank of Canada), and branch deposits and loans. The regional organizations function more as administrative support staff than as direct line decision makers.

The BNS DP organization has a history similar in some ways to that of the TD Bank. Its original entry into computerization was through regional automation of the cheque sorting process. Just as with TD, BNS began in an uncoordinated fashion, with multiple free-standing small computers of various types processing cheques and running various other small systems. BNS originally went more for Honeywell equipment than anything else, but has also had small 360's and Burroughs and NCR equipment at

various times.

BNS's systems growth paralleled that of TD until 1972. At that time a major systems study was unde taken by BNS, with a key role played by the consulting firm Booz, Allen, Hamilton & Co. The study came down firmly in favor of complete centralization of essentially all banking systems. Also as a result of this study, the top management of the computer systems group (at that time consisting of old line bankers, much as is TD's management today) was replaced with younger people possessing stronger DP backgrounds. John Crean was hired to manage the systems function and implement the centralization plan. A number of other people were hired from outside the firm to manage parts of the computer function under Mr. Crean, including Eric Sorenson (Director of Systems Development), Bob Sydia (Director of Systens Planning) and Mike Taylor (Supervisor of Computer Operations).

The main recommendations of the 1972 study were implemented the following year. The miscellany of regional computers was sold, and IBM 360/20's were installed, one in each regional data center. Starting in 1974, a one-by-one upgrading of regional equipment to 370/115's began, and is still in process. Each regional computer has been programmed to execute only one program - the cheque sorting/DDA data capture routine. All the other systems that had been implemented in the various regions were either eliminated or gathered together centrally for examination and possible system-wide implementation.

Meanwhile, the BNS staff and IBM personnel were collaborating on the development of BNS's on-line banking system. As at TD, the initial effort was directed at the savings accounts, and an

on-line savings system was up and running in mid-1975. Unlike TD, BNS developed their initial system based on the new IBM 3600-series Financial Terminal hardware, together with IBM's SNA support network hardware and software. Thus BNS is not faced with a conversion from older equipment (eg, IBM 1970 terminals) as is TD. New branches are being converted to the on-line savings system directly from the pre-computer (essentially manual) system, rather than via an intermediate batch computer phase. At this time there are about 650 branches using the on-line savings system, and usage is projected to reach 90% of all branches by the end of 1978. Certain outlying branches will probably never go on-line, as the data transmission costs would far exceed the benefits to be gained.

BNS's other core systems are its DDA system and its Scotia-Plan Loans (consumer loans of numerous types) system. Both are batch oriented, with processing driven by files of daily transactions. The DDA system is very similar to TD's, described earlier. The input transaction files are captured in the regional data centers, transmitted to the central computing facility (CCF) and processed against the existing DDA master files. Batch reports are transmitted back to each region and printed there, for distribution by courier to the various regional branches. There are currently about 660 branches using the DDA batch system. Additional branches are being added, but not very rapidly, for two reasons. First, geographical location imposes certain constraints not encountered in on-line systems. In particular, there must be sufficient time between report printout at the regional data

center and branch opening for a courier to deliver the reports. In the case of some remote midwestern branches, this requirement translates into a need for report printout by, say, 3:00 AM, when the earliest possible turnaround time (due to scheduling and processing requirements at the central computer) has the report printed by 4:00 AM. In such a case, the branch would not be brought onto the system, but would remain "manual" until the on-line DDA system is operational. The other reason for not bringing certain "feasible" branches (ie, branches for which the first constraint is not binding) onto the batch DDA system is courier cost. Courier costs are becoming an increasingly important factor in the overall cost of computerization. Of course, some courier cost was incurred before any computers were used; however, data entry and report delivery have increased these costs substantially in the last few years. Although in a sense all the Canadian chartered banks tend not to be very cost conscious (discussed further in the next section), in fact rising courier costs are a key justification for moving to on-line systems.

BNS's batch consumer loan accounting system is also slated for going on-line, beginning in 1978. There are no particular complicating factors in the current batch approach, as it is not deemed crucial that daily updated reports be available, as in the case of DDA. Nonetheless, loan accounting presents a considerable volume of paper shuffling between the branch office and the CCF for data capture purposes, which an on-line scheme will eliminate. On-line loan accounting will also place the cost and responsibility of accurate data capture directly in the source

branch, where it belongs, rather than in the CCF.

BNS also has a compliment of other batch systems run at their CCF, including:

- corporate loan accounting (underdevelopment)
- head office accounting and corporate
- forward budgeting (pro forma balance sheets and income statements)
- corporate stock management
- internal reconciliations.

Like TD and the other chartered banks, BNS takes part in the payment exchange system (automatic payments). Also, BNS will have a SWIFT terminal in its head office when the SWIFT network is operational in North America.[4]

There are some interesting features of BNS's systems function that sets it apart from that of TD. First of all, John Crean is a strong believer in the advantages of formal planning, in spite of the fact that the top corporate management of BNS are generally not planning-oriented (some are even said to be anti-planning, according to reports of BNS staff. Crean's planning orientation is manifested in, among other things, the "Project Development Methodology" - a set of guidelines for the staged development of new projects. While not exactly a new idea, it should be noted that, among the other subject firms, only the Bank of Montreal indicated evidence of a development methodology nearly as well articulated as BNS's. Along this same dimension, BNS has had a planning group functioning within the Systems Department for three years, with a Director (Bob Sydia) plus ten staff people. However, to date most of this group's activity

has not involved planning as such, but mostly aspects of systems development control ("tuning" of the Project Development Methodology, creation of standards, etc.) and user interfacing (training for users of the on-line systems, dealing with special systems requests, etc.).

A very strong felt need to control the growth, development, and ongoing use of the BNS computer-based systems pervades the thinking of Crean and his group. For example, design options that involve requiring non-computer field personnel to be involved with the systems equipment, even slightly, are generally not considered. As an argument to support his perspective, Crean points out that at one time during the early testing of the IBM 3600 financial terminal equipment, BNS tried locating certain of the 3601 cluster control units within major branch banks. A typical control unit would support the terminal equipment in four or five medium-sized branches. Theoretically all that had to be done with these controllers was to have someone turn them on and off at appropriate times. However, during testing the controllers occasionally crashed (they are, of course, just specialized processors, and so are susceptable to software failure). and required human intervention to restart. Restarting involved interpreting the cause of failure, which was transmitted to the user/operator via a hexidecimal light display on the control unit panel. The staff technicians tried to guide untrained personnel through the restart steps over the telephone, but the apparent complexity of the whole affair overwhelmed the nontechnical field personnel. In the end, technicians had to fly from Toronto to North Bay

(about 400 miles) to restart the controller, about a ten minute procedure for a trained operator. As a result of this debacle, Crean decided to "undistribute" the control units, remiving them from the branch banks and placing groups of 3601's in each regional data center.

While admitting that any one of such problems could be solved with proper training of user personnel or through other methods, Crean believes that their persistent occurrence presents a strong case for keeping as much as possible of the bank's hardware and software in a small number of geographical locations.

Crean's penchant for control extends to the systems development and management tasks as well. He argues that it is not at all clear who the end user actually is with regard to most of BNS's computer-based systems, so that the question of providing more effective end user support is not really an issue. The point is that, like the other subject firms in this study, a large proportion of the effort of BNS's systems group has, and is continuing to be directed into automation of operational, transaction-oriented clerical tasks, with little time or money left over to spend on "higher level" systems that are more directly aimed at supporting decision making or other such managerial activities. Thus, in a sense BNS is climbing Nolan's growth curve faster in terms of technical expertise than in terms of user/effectiveness orientation. This comment will be amplified further in the next section.

BNS, like TD, has developed a close working relationship with IBM Canada over the last few years. They are completely

an "IBM shop" now, and do not foresee any change in that state in the near future. Like TD, the BNS systems staff has cooperated with IBM specialists in the development of banking oriented software, specifically the COLBS database/data communication transaction processing system.[5] IBM's service record is viewed as excellent by Crean and his staff. In their eyes, no other vendor can begin to match IBM's ability to support their systems and equipment.

BNS, according to Eric Sorenson, is a firm believer in buying packaged, pre-designed software packages and modifying them for in-house use. However, he pointed out that they have occasionally tried too hard to follow this strategy. For example, they acquired a mortgage accounting and reporting system from a life insurance company for a few thousand dollars, but ended up spending over one million to modify it for their own purposes. However, Sorenson did admit that this case was an anomaly, and that they have often saved money by buying packages. He said that over 60% of their software systems are modifications of programs acquired outside the bank.

D. <u>The Bank of Montreal</u>

The Bank of Montreal is the largest of the four firms involved in this study. Currently its depositor and other assets total $27.5 billion. B of M has about 800 branches across the country, with its corporate head office in Montreal. The main offices of the data processing staff are split between Montreal and Toronto, with the DP headquarters being in Montreal but the CCF

in Toronto. B of M's data processing operation is particularly interesting, partly because of its unusual history of develop ment and partly because it combines some unusually advanced features with other surprisingly primitive ones.

While the Canadian chartered banks are a close, "clubby" group, B of M is perhaps the closest thing to a black sheep in this family. In terms of innovation, new techniques, new ways of doing things, most of the banks are followers; B of M is often a leader. Leaders and innovators have a greater propensity for falling on their faces however, and B of M is no exception. Their approach to automating bank operations over the past ten years is a perfect example of this, and is a classic illustration of the dark side of the "total systems approach".

Prior to 1966, B of M's computer-based systems were very primitive, small, regionally organized, and uncoordinated - much like the other banks at that time. In that year, the fledgling systems group, which up to that time had followed the standard path of regional, stand-alone systems development similar to both TD and BNS, came under the direction of Mr. James MacDougall. Mr. McDougall, as it happened, was a forceful, dynamic leader and a very powerful figure in the B of M management ranks. He also was a firm believer in the "total systems approach", so popular in computing and management science circles at that time. McDougall's expressed goal was to build and implement a total on-line real-time information system for the bank. The idea was to put just about everything in sight "on the computer", and to build all of the key operational systems (DDA, savings accounts,

loans, intra-branch transfers, etc.) as on-line access/on-line update (ie, "on-line real-time") systems. Furthermore, this grand scheme was to be designed, built and implemented as one gigantic system. While today information system designers are fully aware of the extremely low likelihood of success faced by this kind of approach, ten years ago the total systems appraoch was the most magical catch-phrase of all. People's fascination with this concept, especially when strongly espoused by a recognised management leader, quickly took hold. B of M began a tremendously ambitious plan to fully computerize essentially all of its branches within a four year period. The project was referred to as "mech", short for mechanization (something of a misnomer).

The tale that followed is one that has been told before.(4) A huge development team was assembled (with considerable hiring from the U.K. and Europe, where bank systems are more highly developed than in North America) and began work on what was envisioned to be one gigantic, all-singing all-dancing software system. Without going into great detail, the inevitable occurred: initial phases were not completed on time. To save time, testing was reduced (in some cases completely eliminated). Work proceeded on later phases that depended on the completion and integrity of earlier phases. Delivery dates were put back, first by three months, then six months more, and finally a total of 18 months. All this time the pressure exerted by McDougall on the development team grew. Turnover rose rapidly, exacerbating the problem. The development budget had long since been thrown out, leading to growing skepticism and disbelief on the part of corporate management.

Eventually, without ever achieving an acceptable level of operation of any "mech" subsystem, the entire project was halted. With much wailing and teeth-gnashing, the DP group was completely reorganized. McDougall was shifted to a R&D function, and Tom Harker took over as V.P. Information Systems. Many members of the "mech" development team were released, and the remaining staff were totally reorganized. As discussed below, the new DP staff organization is rather unique, and strongly reflects the lessons learned during the "mech" experience.

The "mech" project was not completely scrapped, but rather scaled way back to a manageable size, re-budgeted, planned more carefully, and continued. Unfortunately, many earlier decisions made during the "total systems" phase are impacting the development work today. For example, it was decided by MacDougall years ago to commit the "mech" system to IBM 2970 banking terminals. However, the "off-the-shelf" model 2970 was deemed not suitable, and IBM was contracted to produce a specialized version just for B of M. Over 2000 of these special terminals have been purchased. These terminals are not "intelligent", as are the new IBM 3600 devices, and by today's standards are quite limited. They also require specialized teleprocessing support facilities (eg, they are not compatable with modern protocols such as SDLC). However, because of their special tailoring to B of M's specifications, their salvage value is nearly zero today. The fallacy of sunk costs notwithstanding, B of M's systems development group is now constrained to employ these terminals in whatever new banking systems they design, so the bank may obtain some payback for their in-

vestment in hardware. Also, they are effectively required to continue using older software in support of these devices. For instance, the IBM Basic Direct Access Method (BDAM) is in use to provide file accesses for the present on-line network; the more sophisticated COLBS cannot be used since it is not compatable with their special terminals.

After the reorganization of the "mech" project in 1973, the development effort was directed towards the demand deposit accounting (DDA) component. All the work that had been accomplished to that time on the other components (savings accounting, loans, mortgages, general ledger, etc.) was placed "on the shelf", for possible future use. The DDA system finally became operational in January 1975, and branches were placed on-line beginning in 1976. At this time over 400 branches are on the DDA system, with a current conversion rate of about 6 branches per week.
A maximum of about 650 branches (over 2000 workstations) are expected to be operational by the end of 1977.

Supporting the DDA and the other batch systems are three 370/168 computers in the Toronto CCF. One of these machines is dedicated to B of M's charge card inquiry and processing system (B of M is the sole bank supporting a Canadian version of Master Charge - all the others support either their own card or else some other international card, principally BankAmericard). A second 168 is used for daytime batch, testing, and development work. The third supports the DDA network during daytime hours, using an extensively modified form of the IBM package CICS ("Customer Information Control System") - a popular data base/

data communications package.[(10)] However, peak transaction rates on the network are currently approaching the saturation level of 60 per second, and consequently plans are underway to add a fourth 168 to meet the demand. The saturation problem is only partly CPU saturation, however; channel I/O activity to the on-line data base is also nearing saturation. Addition of another computer will create some technical problems, since both machines will have to share the same central files. Primarily for this reason, Harker and his staff are examining the possibility of splitting the present DDA database and setting up a second computer center, probably in the western part of the country. Besides providing the capability of coping with the peak transaction rate, this approach would provide some valuable security-related features as well. However, it would entail a major increase in problems of complexity and operational control just at a time when these factors are finally being mastered. For this reason the suggestion has met considerable scepticism to date from B of M top management. Other technical solutions that would not require a second CCF are available also, but these generally fail to provide the same security benefits. It is also important to note that, during MacDougall's tenure, his prestige and powerful personality were sufficient to obtain top management approval for just about any scheme he desired, especially since they had not yet been "burned". Today the leadership of the DP function is more shared than it was under MacDougall, and major decisions are no longer made unilaterally. Top management is also much more aware of what the DP people are up to and have a better grasp of

the rough feasibility of DP plans. Innovation, while certainly not dead, is being assessed much more carefully today than in the past.

Out of the "mech" ashes has risen a fairly sophisticated approach to the control of system development activities. The new systems development organization, shown in Figure III-1, centers around four control groups. Architechture & Design, headed by Brian Broad, serves the dual role of creating the broad outlines for new DP systems and interfacing the entire range of DP activities with the user community within the bank. This is intended to insure a responsiveness to user requirements and, to some extent, "user-driven" systems design.

Control Services (CS) forms the heart of the systems development organization. CS staff coordinate design and development work through the Systems Design and Development (SD&D) group, and coordinate programming activities through the Software group. A variety of project control and scheduling techniques - including both PERT/COST and Critical

Path (updated weekly) - are used by the CS group. This group schedules formal weekly review sessions for all systems under active development. Detailed costing studies are also carried out by CS staff specialists in cost assessment.

Once a system has been designed and programmed, control for its testing and implementation phases passes to the Systems Test (ST) and later to User Acceptance Test (UAT) departments, as shown below. It is argued that, by having control over testing and user implementation under a separate group from that of design and development, there is less chance of having "bad" systems put into production use; uncoupling of testing from development serves a "checks and balances" purpose.

Brian Broad has pointed out that this thoroughgoing approach to systems development control adds about 30% overhead to the straight development task, but he feels that it is worth every penny and more to avoid costly disasters such as "mech".

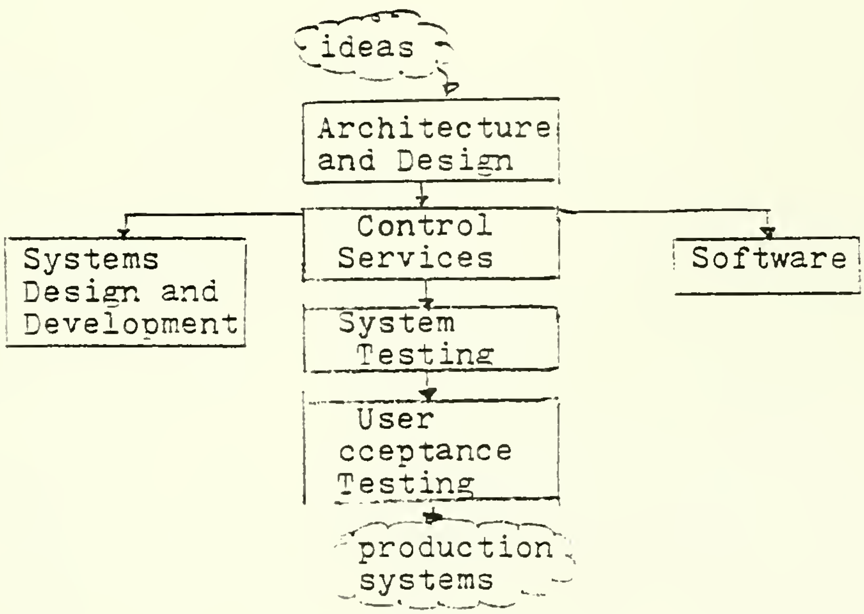

Figure III-1

Undoubtedly, this tight control on new systems has come primarily as a conservative backlash to the earlier "mech" problems, and is not necessarily indicative of innovations in the field of project planning and control. In particular, despite the attention being given to "doing things right the first time" today, newer techniques for improving the quality of software such as structured design, structured programming, and HIPO are not being used, although they are under study. "Mech" has had a lasting impact on the role of the computer at B of M, and it may be some time before this firm takes the lead in banking systems innovation again.

E. The Caisse Populaire Desjardins

The final subject organization in this study is the Caisse Populaire Desjardins (CPD) of Quebec. It's organization is quite unlike the other three banks, and requires some background explanation.

First of all, the name: Alphonse Desjardins was a legislative journalist in Quebec around 1890. He became interested in the financial plight of the poor, especially their difficulties in obtaining credit from capitalist organizations. Desjardins' study led him to the conclusion that such people could only resolve their problems by collective action - by joining together to establish savings and credit institutions of which they would be both owners and users. His creation was based on the U.S. mutual savings bank model, with some significant differences to meet the social and cultural requirements of rural Quebec. The

first Caisse was established under his direction in 1900 in Levis, a small town near Quebec City.(41) Levis eventually became the formal headquarters of the Caisse Populaire "Movement", as it is called in Quebec, and remains so today (even though most of the central operations are based in Montreal).

Today there are over 1200 individual Caisses in the Federation, and over 70% (!) of French-speaking Quebecois are members (over three million accounts). Each Caisse provides a variety of account types to its customers, including the equivalent of "true savings" accounts, and savings accounts with chequing priviledges similar to the recently developed U.S. "NOW" accounts. Caisses provide mortgage, personal and other types of loans (although few loans to larger, private organizations). Federation assets total over five billion dollars today bout 60% of these assets are in the form of outstanding loans, the rest are invested in Quebec and Canada bonds.

While some of the above figures indicate that the Federation de Caisse Populaires is not an insignificant operation, still it comes as something of a surprise that a provincial cooperative credit union should have perhaps the most sophisticated and well run data processing operation of all Canadian banking organizations - certainly of those included in this study!

The organizational structure of the Federation of Caisse Populaires is a straightforward three-level hierarchy, with the Federation headquarters at the top, so-called Regional Unions in the middle (there are 10 such regions) and the individual Caisses at the bottom. The key difference between this organization and

that of the chartered banks concerns reporting relationships. The individual Caisses are voluntary members of the Federation, and do not think of themselves as branches of a bank (in fact, the use of the French equivalent to "branch" is taboo). Policy decisions are made through a group of committees consisting primarily of Caisse managers. The usual information/decision flow of typical corporations has been turned on its head, as illustrated in Figure III-2:

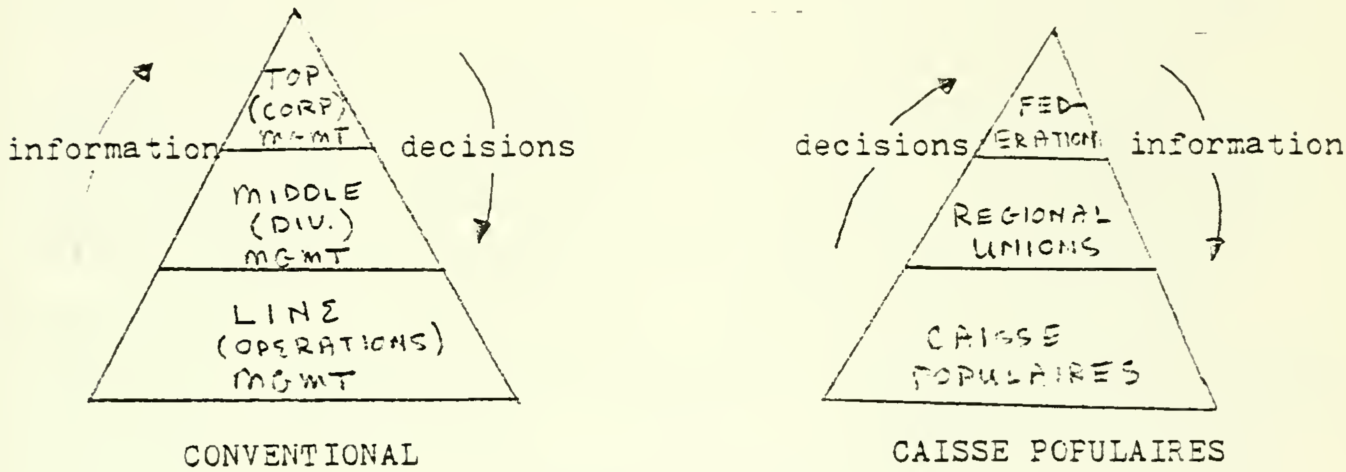

Figure III-2

In practical terms, officers and staff at the Regional and Federation headquarters have a significantly different outlook on what they are doing and for whom they are doing it, as compared to the chartered banks. In particular, the information systems staff are more strongly user-and service-oriented than are their counterparts in the other banks. This does not mean, however, that every whim of the 1200 Caisse managers is quickly accommodated. In fact, just the opposite may be true. Proposals for new systems or changes to existing systems from Caisse managers or officers at the Regional Unions or the Federation Headquarters are thoroughly scrutinized to insure that they are appropriate for all Caisses. Failing this, the request will probably be

turned down, on the grounds that it would not be universally beneficial. At this point, an individual Caisse manager has the recognised option of choosing to implement his suggestion unilaterally. This choice has,in fact,been made on a few past occasions. However, the credibility of the central DP group is very high - they are seen as respected professionals within the Caisse Populaire Federation. It has been uncommon for Caisse personnel to "overrule" their judgment to any significant extent.

Because of this emphasis on meeting user needs, the DP function at the CPD is organized somewhat differently than the other banks (more like B of M than TD or BNS). Most systems work originates with, or enters the group, via the End User Department, headed by Mr. Andre Bejais. The major function of this department is interfacing users and DP, and includes tasks such as user training and education, "marketing" DP services (note: no Caisse is <u>required</u> to take part in any DP system, or to use any reports; those who do so act voluntarily, to better meet their own goals), implementation of new computer-based systems, administration of the chargeout scheme, and generally attending to user problems. The End User Department is viewed as the most important department within the systems group, according to both Bejais (who has only headed this department for a few weeks) and also the other department managers. Of over 180 DP staff, nearly 50 work in this department.

Except for this department, the functional organization of the DP group is ordinary. There are separate groups doing new systems development work, operations work, and "Operations Technical

Support". The latter group primarily perform minor software fixes and other kinds of systems maintenance work; major changes to existing systems are handled by the Systems Development group. In organization chart terms, the End User department is "equal" to the other three, but in practice it is "first among equals", especially in terms of shaping the broad outlines of new systems design and implementation (see Figure III-3).

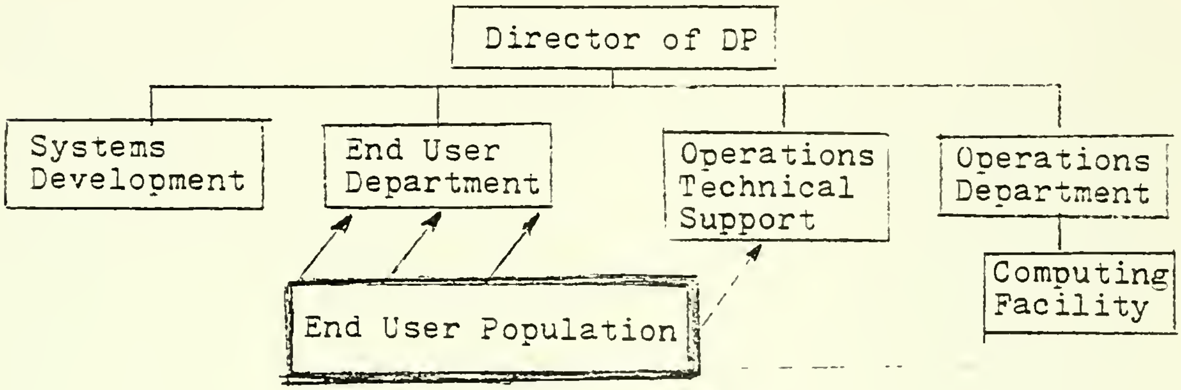

Figure III-3

The Caisse Populaire has no actual DP planning group as such. Apparently planning and general DP policy issues are handled by an advisory committee of about 10 Caisse managers from the largest Caisses together with the DP department managers. In fact, Mr. Bejais and the other DP managers indicated that very little formal planning of anything over one year into the future has been done to date. One of their goals for 1977 is to establish a formal planning function, with initially two or three full-time staff, to report to Bejais.

The Caisse Populaire's in-house computer facility actually

only began in January of 1974. Up to that point IBM had been contracted to handle all computer functions through their Montreal data center. In 1969, IBM developed the first major Caisse application system, an on-line system for handling savings and savings/chequing accounts for the major Caisses in the Montreal and Quebec City area. This system was implemented on a few Caisses in 1970, and more were added over the next three years. It used older 2970 hard-wired terminal hardware and a central 360/65 computer. Interestingly, IBM was originally contracted to develop both the on-line system (for the major Caisses) and a batch processing system that would handle deposit accounting for most of the smaller Caisses. The batch system was developed in parallel with the on-line system, but never implemented; the latter worked well, was popular, and also became something of a prestige symbol. What self-respecting Caisse manager wanted to settle for the inelegant batch technology when, for just pennies more a month,...

The original IBM software system was based on their COLT system (Canadian On-Line Teller system), a predecessor to the COLBS package discussed earlier. However it differed from standard COLT in certain ways, most notably that it was folio-oriented rather than account-oriented. Since the Caisse Populaires are organized on a co-operative basis, each individual using a Caisse must buy a membership (price: $2.00). No matter how many different accounts he may arrange, in one or more Caisses, all of his accounts are organized under one common "folio", with a corresponding common identification number. Thus the internal ac-

counting is organized on a "customer" basis rather than an account basis - the latter being the pattern in all the other banks. At the present time the entire Federation contains over 3.2 million folios - almost 80% of the Quebec adult population. The original target for the IBM-operated on-line system was 500,000 folios, which has long since been met and surpassed.

The folio organization provides a number of benefits to the Caisse DP operation. For example, planning is made considerably easier since number of folios is a fairly accurate surrogate for data processing load, and this can be predicted for the future quite accurately. In fact, capacity sizing efforts during the most recent computer acquisition were conducted directly in terms of folios: the upper limit was determined by estimating Quebec population growth over the next ten years, and assuming, simply, maximum number of folios = Quebec population. Using a folio organization has also made possible certain computer-based services that would otherwise be difficult or impossible to implement, such as the Inter-Caisse facility discussed below. However, the folio organization has also come to restrict DP options in other ways, especially with respect to decentralization. The folio organization strongly implies a centralized computer facility; more on this later.

In 1974, an IBM contract re-pricing led the Federation to bring all of its DP activities in-house. They were able to purchase two 370/158 computers at very favorable prices from an insurance company. They also assembled an exceptionally well trained staff in a short time. The strong French Canadian orien-

tation of the Federation, together with the scale and sophistication of their DP activities, give them the "pick of the crop" of French-speaking computer systems analysts and programmers. This, together with the Federation's propensity for hiring top quality staff,[6] has provided them with an exceptionally technically competent DP group.

Currently then have three 370/158 machines. One is used mostly for batch systems (payroll, bond accounting, file backup, personnel, statistical analysis for Caisses, etc.), and for new system development and testing. The other two are both dedicated to operation of their on-line operations. One of these handles the network of 2970 terminals, the other handles the 3600 network. CPD is converting Caisses from the former to the latter at the rate of about four per week. Each system operates stand-alone under the MVS operating system, and they both access a common shared disk database. There is some problem in terms of system balance at this time; in a tour of the computer room, it was observed that the 3600-network machine was visibly in the "wait" state a significant portion of the time. As more Caisses are converted to 3600 equipment this unbalance will shift to the other machine. Operations manager Marc-Andre Trembley pointed out that they were willing to accept this under-utilization of computing power as a reasonable price to pay for the security of having the two networks on fully separated machines: down-time on one has no effect on the other. In fact, up-time on both machines has been over 99% so far, with a MTBF of over two months - considerably better than for the other banks.

Their on-line banking system itself is quite different from those of the other banks. In a sense, CPD took the total systems ideas of B of M., trimmed them back somewhat by eliminating the less useful appendages, designed and built their system upon the solid base provided by the operational IBM-owned system, and did the whole thing carefully and well. The end result is a well-integrated system, reasonably modular and flexible, all coded in assembler, quite efficient, and well received by the Caisse managers and their staff. Rather than develop separate systems and networks for savings, chequing, loans, general ledger, etc. as have the other banks, the CPD system performs all these functions out of a single integrated set of programs, some on-line and others batch. In fact, although their on-line network is modern and versatile, they actually do not keep their master file of folio accounts on-line. Rather they do a conventional edit-post procedure, keeping a static copy of the master file on-line during the day, logging transactions against the static file, and update the tape-held master at night in a regular batch run (one for each network). They are thus the only one of the four organizations studied to base their accounts recordkeeping systems on a tape master file. However, they claim to have given up very little in the way of flexibility for this, and have saved substantial monthly disk rental in return. Since they do not have to load the entire contents of the master file for on-line operations - a "skeleton file" is sufficient for daily transaction logging - they can do without about twenty (they estimate) additional 3330 disk drives.

Individual Caisse managers can select a variety of periodic and aperiodic reports, each priced separately, to augment standard use of the on-line system. A number of other reports are produced for the Regional Unions and the Quebec Federation, such as trial balances and general ledger reports. The teller terminals themselves can also be used to query the folios' database directly.

As with the other subject firms, CPD has developed little of what is conventionally referred to as management information systems. They have directed all their resources into developing a high quality operations management and recordkeeping system, but little of this is oriented toward support of managerial decision-making or planning. There are a few signs that they may start moving toward MIS development soon, however. Recently, Mr. Bejais authorized purchase of a "mini TP/database system", as he described it, from the Computer Science group at Laval University. He said this package will be set up so that ad hoc reports may be quickly generated from the various databases as needed. Mr. Bejais hoped this would help solve the problem of economically satisfying the growing number of special requests being received from the unions and headquarters for such special processing. They are also planning to establish a few RJE and terminal links to other parts of the province so that various inquiries and report requests may be generated, submitted and answered locally. They expect to name small groups (2 to 5 people) of DP staff grow up in each of the Regional Union headquarters to service special managerial DP needs. Mr. Bejais did not feel these local

staffs would seriously compromise central control of the vital systems, especially since, at least initially, all remote access will be funnelled through "Tele-Laval", the TP/database package, and hence can be monitored and controlled as closely as necessary. Initially Tele-Laval would operate in the third 370/158, and would not provide update facilities on the "live" databases, thereby,maintaining a high level of both machine and database integrity for the on-line network.

The Caisse Populaire Desjardins, like the other banks, is very closely tied to IBM for new equipment and hardware/software support. As Marc-Andre Trembley pointed out, "who but IBM would have a customer engineer available in Chicoutimi at thirty minutes notice."

Although they have made some minor steps toward non-IBM peripherals for the sake of economizing in non-critical areas (Memorex add-on core, for example) they have not seriously considered any significant alternatives that would conflict with IBM's "view of the world", either in terms of hardware, systems software or network structures.

Mr. Bejais pointed out that they have not experienced any problems with placing 3601 controllers in certain Caisses (TD Bank and BNS both have refrained from doing this, fearing problems of having banking staff deal with stalled controllers). CPD has experienced no particular problems in this regard to date.

However, as yet only Caisses in Montreal and Quebec City are on the 3600 network. As additional conversions are made, their experiences may dictate some changes to this policy. They are using the programmability and floppy disk storage capability of the 3601's to perform simple validity checking at the terminal. Contemplated for development is terminal journaling, which would represent a significant step toward off-loading the central machines. Under this scheme, folio transactions would be held in floppy disk edit files during the day. Folio inquiries would require central database access plus local access, while updates of the central files would be performed only once (or perhaps a few) times per day from the edit file. According to Mr. Bejais, the main reason they might develop this kind of system would be to avoid having to make a major upgrade in central computer power. There would be no significant savings in teleprocessing costs from such a scheme, and the fixed TP lines that would otherwise be in place would probably not be altered.

The CPD have no plans to develop additional data centers at this time (not counting the proposed RJE terminals mentioned previously). Physical security is viewed as an important factor, as with the other banks, and Mr. Bejais admitted that if they were to lose all their current capacity they would have no recourse (ie, their DP requirements are far too great to be able to "borrow" slack computer time from other firms). Nonetheless they do not view that as a strong reason for distributing their current processing operations to two or more centers. Another argument Mr. Bejais sees in favor of centralization concerns the advant-

ages of a central database. Their recently completed "Inter-Caisse" facility allows Caisse members to perform most of the standard types of transactions on their folios from any Caisse, regardless of which Caisse they actually belong to. While this option may not seem very significant in usual banking contexts, it must be remembered that the Caisses are like independent banks under an association, not like branches of one large bank. The development of the Inter-Caisse facility was complicated because speical care had to be taken to avoid usurping individual Caisse rights, and to maintain clear accounting of "who was doing what to whom" for both informational and computer services billing purposes. Once the facility had actually been designed and made operational, a major implementation effort still was required to convince as many Caisses as possible that the system would benefit them without forcing them to give up part of their independence. Mr. Bejais indicated that the Inter-Caisse facility has now become very popular, and nearly 90% of the Caisses currently on the network have opted to take part. The credibility of the DP group is at an all-time high as a result of this success. Bejais feels that the Inter-Caisse facility would not have been feasible economically had the database of folios been split into two or more data centers. This has strengthened his belief that centralization is best for the CPD.

This concludes the description of the DP operations of the subject firms in this study. While space does not permit more than a relatively cursory examination of each firm, it is hoped that the foregoing provides sufficent insight into the DP operations of these firms to motivate the analysis and conclusions presented in the following two sections.

IV Analysis in Terms of Rockart's Framework

It is appropriate at this point to re-state the two basic objectives of this study:

> (1) To examine empirically the nature of data processing in certain Canadian banking institutions, in order to learn firsthand both "what they are doing today" and "what they are moving toward for the future"; to look for similarities and differences among the DP practice of the four subject firms; and to seek to identify and understand the important forces that are today, and may tomorrow, impact these and similar institutions in the area of data processing.
>
> (2) To interpret that which was learned in (1) in the contexts of two different conceptual models of DP process and structure: Rockart's Distributed Processing Framework, and Nolan's Stage Hypothesis.

Section III of this report provides the empirical data that may be used in addressing the first of the above objectives. In this section we pull much of this data together in a set of key issues, and discuss these issues both generally and specifically for what they have to say about the Rockart model. In the following section we examine Nolan's model in light of the information provided by the study.

DP Control. In all four firms, the need to better control DP operations and development was deemed vital. The systems are large, with many "arms and legs", and each bank's ability to function is closely tied to the proper functioning of its DP operation. It is not very surprising that each DP Director lives under ongoing pressure to insure his operation is "under control".

In two of the four firms - BNS and the Caisse Populaire - the importance of control was clearly seen by their top DP staff

as the <u>most</u> important factor in making DP design decisions. In the other two firms tight control, while still important, was not seen as nearly so crucial. These differences of opinion are borne out in terms of the degree of centralization of the four DP operations. The author's subjective ranking places CPD as most centralized, followed fairly closely by BNS. B of M is third, and TD is least centralized. The conclusion is simply that there exists a high correlation between felt need for DP operational control and extent of DP centralization. What is more surprising is that, in the most centralized firms, this felt need for control definitely dominated the other, more "conventional" considerations that most researchers and writers in this field have held up as paramount (see Sections I and II).

The difficulty with this argument lies in capturing the meaning of "felt need for control" in some recognisable and comparable fashion. While the importance of centralization to control did emerge during the course of our interviews, it generally did not come out in response to leading questions such as "is control of DP operations important?", but in a less direct fashion. In order to effectively use "need for control" as a determinant in the C/DC equation, a verifiable method for measuring this attribute and comparing it among similar firms would be required.

There is also a strong connection between the "need for control" attribute and the stage of DP development. This connection will be elaborated in the next section.

<u>Cost</u>. As discussed earlier, for many years cost has been assumed to be a crucial factor in favor of centralization. Grosch's Law is a cost/performance argument with widely accepted validity. Technological changes over the past few years have impacted this argument but are far from unseating it.

There is a fundamental, unstated assumption underlying the "cost implies centralization" argument, namely, that cost is itself an important concern. Now, standard economic theory argues that, <u>under perfect competition</u>, cost-inefficient organizations will, over the long run, be weeded out of an industry by more efficient entering firms. However, basic economics can also be applied to the other extreme - the case of monopoly - and in this case economic equilibrium occurs at a less-than-perfectly-efficient operating point. Under monopoly conditions, higher costs relative to output are to be expected; cost minimization does not occur.[23]

The banking industry in Canada is notoriously non-competitive. There are very great barriers to entry in the form of initial capitalization and attainment of government charter (only one new charter has been granted since 1952). The federal and provincial banking lobbies are among the most powerful. Also there is a widely recognised "clubbiness" among the top managers in the chartered banks. None of the major chartered banks have failed to make a profit since the second World War, and profits have climbed quite steadily since that time. All in all, this industry is quite close to the monopolistic end of the economic spectrum.

The implications of this show up in various ways in the data processing area. The general attitude of most of the banking DP officials is typified by the comment of Bert Napier of TD Bank: "if in doubt, buy another 168". In other words, the general tendancy in these firms has been to spend the extra money necessary to avoid having to make potentially risky design decisions. There has been little budgetary pressure on the top DP people to squeeze more performance out of a given level of funding. The result is that DP design choices are generally dictated by factors other than cost.

Another way of viewing this situation is in terms of "organizational slack". This highly descriptive term was introduced by Cyert and March in their studies of organizations,(11) and refers to the short-run difference between resources available to an organization and the necessary payments to maintain the organization. Essentially, there is a fairly high level of organizational slack within these banks generally, and within their DP operations in particular. Resource allocations are guided by considerations other than cost minimization.

The net result of the above is that, in firms such as these where substantial organizational slack exists, it is not so much a question of whether or not Grosch's Law is still valid, but rather whether the level of implied costs has any real effect on the viability of alternative DP system designs.

A different but closely related issue concerns the level of understanding of data processing that exists within the top management ranks. The less that top management knows, or cares,

about the DP function, the less capable it is of challenging DP spending and inefficiency. These firms are, by and large, run from the top by "old line bankers" - ie, men who have risen through the ranks of the organization and are broadly experienced in the various line banking functions, but who generally know almost nothing about computers or data processing. While they would have a quite accurate understanding of what it would cost to open a new branch, say, they have no informed judgment as to whether the DP shop really needs a fourth 370/158. Recognising this, they are generally content to leave such decisions in the hands of their DP specialists. There are, however, limits to this laissez-faire attitude, as exemplified by the top management "crackdown" at BNS five years ago which resulted in major staff, management and technical changes there. It is worth noting, however, that the cause of the BNS crackdown was not top management concern over DP costs, but rather a growing concern over lack of effective control and organization of the DP function.

In summary, then, C/DC cost considerations - the current and future status of Grosch's Law - is of little concern to firms with considerable organizational slack, especially if that is compounded with a "DP-ignorant" top management group.

Vendor Influence. Perhaps the least satisfying feature of the literature on C/DC and distributed processing is its inherent rational, objective flavor. Occasionally a few words are included about such inherently non-rational (probably non-objective would be a better description) aspects as "political considerations", but the focus is almost always on costs, service levels, efficiency, etc.

One such non-rational factor in the present context is vendor influence. Now, it is very apparent that IBM strongly dominates the market for computer banking systems in Canada. All the major chartered banks, and most of the smaller banks and near-banks are IBM customers. When asked about IBM dominance in the industry, some of the DP managers pointed out that they were using non-IBM add-on memory, or perhaps even a non-IBM small regional computer. However, it is abundantly clear that other vendors really do not have much of a chance against IBM here.

It is generally recognised that IBM has a tremendous stake in the continued acceptance of centralized computer systems. Throughout the past twenty years of its history, it has been very slow to adopt distributed or decentralized approaches.(2) Since so much of its revenue comes from the large computer market, this attitude is not very surprising. Today however the general movement away from full centralization has grown to the point that, like it or not, IBM has had to get into the opening markets. Many of its various efforts in this direction have been combined together and coordinated under the umbrella of SNA: Systems Network Architecture. The central tenet of the SNA philosophy is the notion of a hierarchical network, with a large central computer guiding, directing and controlling the overall activities of the network. With SNA IBM has managed to join, if not lead, the parade toward decentralization and distributed processing without giving up its long-held attachment to large central computers.

The really important effect of vendor influence of which we speak here is not of the "you ought to buy IBM equipment" variety, but rather the much subtler and farther-reaching "this (SNA) is what a distributed network ought to look like". For example, if IBM had come out in favor of, say, ring-type networks of medium-scale processors over the last few years, there is little doubt that some, if not all, these banks would have 370/148's in four or five centers across Canada, linked together in a ring perhaps providing much greater levels of security and load balancing than can a hierarchical system. If the commitment of these firms to IBM's systems world view has been made consciously, well and good. Unfortunately, in a market so much dominated by this one vendor as is the Canadian banking industry, it is quite conceivable that they have, in a sense, let IBM do their thinking for them, and came to adopt IBM's approach by default. This is what is meant by vendor influence, and at least in the present case it is a major determinant of each firm's posture toward distributed processing. It should, therefore, occur as a variable in models that attempt to explain or determine such posture.

<u>History</u>. The conceptualization and design of nontrivial computer-based systems does not occur in a vacuum. Of the many factors that influence this process, one of the most important is the skill and knowledge base that has been established within individual systems staff members, and within the systems design group generally, as a result of previous work experience. A natural human tendency exists to try to orient new work in such a way that this well of knowledge can be most directly brought to bear;

and, on the other hand, to try to avoid the higher risk and effort level that is involved in straying too far afield from past areas of expertise.

One aspect of this has been incorporated into Rockart's factor table: current centralization (or decentralization) of data processing is presumed to strongly imply centralization (or decentralization) of new application systems or LAGs. What we are saying here, though, is slightly different. As well as considering the current orientation of DP within a firm, one must also consider the "mental history" of DP practice in the minds of the individuals involved. In many cases these will be essentially the same. It is quite conceivable, though, that they might not be - for example, following a major staff change such as occurred at the Bank of Montreal in 1973.

It might be argued that "current orientation" exerts a normative force on the design process, while "mental history" does not. This is too simplistic a view, however. The opportunity for a design team to play upon strengths of skill and knowledge surely is a normative determinant. The problem (as always) is one of trade-offs: eg, "if we design this application in a distributed fashion, it will probably cost less to operate and will meet the users' needs better, but we will be on shakier ground both technically and in terms of implementation than if we were to go with a centralized system."

<u>Physical Security</u>. There is a rapidly escalating concern in DP circles today over security issues of all kinds, ranging from inadvert nt data base loss of integrity to malicious operating

system penetration.[34] Because of their fund handling capacity, banks are particularly concerned. However, in all four firms studied, physical security of computers and related equipment was in fact the most prominent of all security/integrity/reliability matters.

The fact that hardware, software, and systems staff are all quite highly centralized in each firm reduced concern over malicious activities by in-house staff. Since all the key equipment and staff are located in close proximity, there is less chance of one or a few staff undertaking to compromise any of the computer-based systems without being detected. Furthermore, none of the banks has a great proliferation of different files or data bases. A large proportion of computer-related activity centers on a small number of files (DDA, Savings, and loan files). Because these are so important, and also few in number, it is feasible for each firm to carefully back up each file and maintain a full ongoing transaction log; thereby reducing the risk of data loss through system malfunction (eg, accidental erasure) or external accident (eg, disk head crash). Finally, although each bank operates hundreds of on-line teller terminals, these are passive terminals only - ie, they cannot be used to access programs or unauthorized data. They can, of course, be used incorrectly, such as entering the wrong amount for a deposited cheque. However this is no different from pre-computer paperwork errors, and can be traced back through the paperwork system for reconciliation. But each firm has only a few <u>active</u> ports into its computer system, such as TSO terminals or RJE stations.

These are the sensitive points from the viewpoint of computer abuse.

Thus we see that these security factors tend to encourage centralization, since they are perceived to be more controllable under a centralized organization. However, they are also perceived to be of secondary importance in these firms relative to physical security. The real nightmare that these managers share is that of a terrorist group taking over and destroying their computer center, of an earthquake or some such major natural disaster, or possibly of a Bell telephone strike. While arguably unlikely these are the kinds of security problems they are really concerned about. And these concerns, unlike those mentioned earlier, tend to encourage <u>decentralization</u> of their computer-based systems. All four banks are currently exploring the possibility of multiple major data centers, and in all cases the key reason given was to promote better physical security and backup alternatives in the face of a major disaster at one center.

The moral then is that, at least in organizations such as these banks, need for physical DP security tends to drive towards decentralization, while concern for security of software, access, development and testing, etc. drives toward centralization. The net effect will depend on which need is perceived to be greater.

<u>Geography</u>. The literature on computer networks usually implicitly assumes a user population that is reasonably diffused over the geographical area that the proposed network is to serve. In such cases, most of the common network structures - hierarchical,

ring, multi-star, etc. - are equally suitable in terms of servicing the population without incurring undue communications line charges. However the Canadian population generally, which is, roughly speaking, the user population for each major chartered bank, is far from evenly diffused throughout the country (see Figure IV-1).

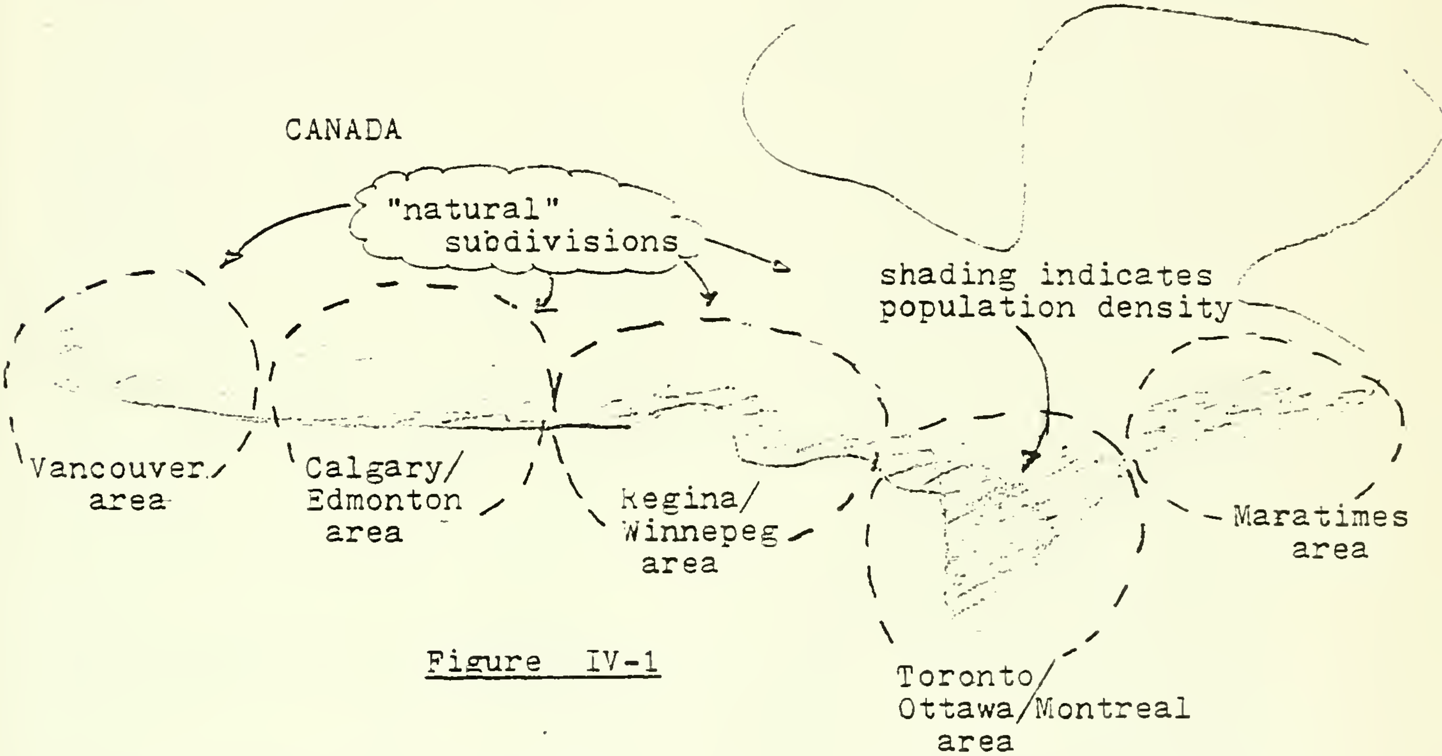

Figure IV-1

The user population is seen to be strung out across the bottom portion of the country. The implications of this are twofold. First, regionalization of the user population follows obvious natural groupings: Vancouver, Calgary/Edmonton, Regina/Winnipeg, Ottawa, Toronto, Montreal, Maritimes. Each chartered bank has in fact established regional data centers in each of these areas, although the functions performed by a typical data center varies among the banks (BNS uses them for cheque processing, and remote

data entry and printing, B of M primarily for concentration of asynchronous messages from local teller terminals, TD for a combination of the above).

The second implication concerns network structure. Since the different data center regions are geographically collinear and span the entire country, ring-type or general topological networks make little economic sense, because the redundant communications lines they would require would be so expensive. A simple hierarchy (as they all have now), or possibly a multi-star arrangement with two or three major data centers (as they are all considering for the future) seem naturally most appropriate in this geographical context. The point to be made is that the geographical arrangement of the user population may be a relevant variable (or, more accurately, constraint) in guiding decentralization and distribution decisions, and is a variable that is often not explicitly considered in the literature on this subject.

Application-User Segmentation. What is the appropriate unit of analysis in the centralization/decentralization decision problem? Rockart argues convincingly that, in most cases, this ought to be the LAG/organizational subunit, but that in certain types of well-defined, easily standardized cases (such as payroll) it makes sense to take the unit of analysis as the LAG (across the entire organization).

In trying to apply this thinking to the Canadian banks, certain complications arise. For one thing, each of the three chartered banks has an "official" profit center structure, organized on a regional basis. However, in fact these sub-units

are profit centers in name only (perhaps because a profit center form of organization is viewed as more "sophisticated"), and in terms of controllable variables actually function as cost centers. Regional managers try to meet performance expectations at minimum cost using the resources provided to him by the corporate headquarters. These regional managers do not have anything approaching the independence of action that a "real" profit center manager would have. In particular, with the exception of the CPD, they do not have the alternative of obtaining DP services from alternative sources if they are unhappy with the central DP group. In this sense, therefore, the LAG/subunit is probably a less appropriate unit of analysis for C/DC decisions in these banks than is the LAG alone. The nominal form of organizational structure (profit centers) is quite misleading here.

There is another related consideration that we might call the "end-user identification problem". An important assumption underlying the Rockart framework and much of the other literature in this area is that the end users of a particular system under study are (a) clearly identified ("we're designing this system for the personnel department of XYZ Division...") and (b) clearly represented ("...and if we do a poor job, the manager of that department will be on our doorstep"). In the Canadian banking context, it is the case that, for some of the most important computer-based systems, neither of these assumptions is met. For instance, if BNS did not have computerized DDA, Savings and Consumer Loans systems they could throw away 2½ of their three 370/158's. Yet none of these systems has a recognised "client"

in that organization, outside of the computer systems department. As John Crean put it, "nobody 'owns' DDA". Now, it might be argued that the real end user of, say, the DDA system is the floor teller who uses the terminal (of whom there are thousands in BNS); or perhaps the head tellers, or branch managers; or even the banking customer. Since DDA is really a bedrock-like transaction processing system, it is rather futile to try to say exactly who the end user is. Furthermore, since the end user group is so difficult to identify, it's not surprising that there is no one individual or committee to take user responsibility for the system.

Because of its co-operative structure, CPD is a somewhat different case. Caisse managers <u>are</u> effective end users, since they see the Caisse Populaire computer systems group as providing a service at a fair price, and since they have the option of not partaking of that service if it does not meet their needs. They are also represented, in the form of the End User department within the CPD Systems Group. As a result there is a quite different attitude present among the CPD systems people. They have a fairly clear, "up front" picture of who the end users are, and who their representatives are, and as a result end-user needs are better factored into the design of their systems.

In cases like BNS where end users are not clearly recognised or represented, there is a strong tendency to develop centralized systems. Decentralization usually follows user demands for more effective systems service. If that demand is

not present, or is present but not given expression, most systems staffs will tend to design and build centralized systems. Furthermore, even if it has been decided that a particular LAG ought to be decentralized (for other reasons), the chances of failure are undoubtedly higher when the end user clientele is poorly identified and/or represented. This factor ought, therefore, to be carefully considered in the C/DC decision process.

Bandwagon Effects. We pointed out in Section III the generally conservative bias of top management groups in the Canadian banking industry. Each of these firms is usually very hesitant to be the first to adopt new methods. However, once one bank has committed itself to some new way of doing business - especially if the change is "consumer-visible" - the other banks are usually quick to follow with similar steps of their own. Examples include the fact that all five chartered banks developed on-line banking systems within a two-year period, and that all five adopted money cards within a 14-month period. The Caisse Populaire is not so closely in step, and has been well out in fromt with certain methods (witness its integrated on-line banking system) but behind, or not interested, in others (CPD has no money card, and plans none).

In short, the chartered banks tend to be a closed group, inward-looking and somewhat competitive among themselves, but far from quick to test out new ideas. This fact acts like a "soft" constraint on the range of designs considered for new DP systems in any one bank. That is, particular unconventional approaches are implicitly considered riskier, and therefore less

likely to be adopted, if they have not been implemented in any other banks (Canadian banks, that is; there seems to be only a very weak connection to U.S. or European banking experience). On the other hand, simply the announcement of some new scheme in one bank may very well set the others off in pursuit, if indeed they were not already aware of the coming announcement via the banking grapevine. This phenomenon was clearly illustrated in the recent development of Automatic Teller Machines (ATMs) by BNS. Although their introduction of ATMs came as a surprise to the other banks, within six months TD and the Royal Bank had operational ATMs of their own.

A natural consideration at this point is the role of formal planning in these firms. Surely an organization with a competent planning group would not continually operate in a "react" mode as described here. Well, the fact is that these banks (the three subject chartered banks) not only do not have corporate planning functions, but at least in two cases actively oppose formal planning. Their basic argument is simple: "we've always done well without planning, so why start? Furthermore, you can't really plan in the banking business anyway, since so many key variables - the economy, interest rates, exchange votes - are highly uncertain." This discovery came as something of a surprise during the interviews, especially since the DP groups in each bank had a functional planning sub-group. In practice however it turned out that most of the work done by these planning groups was not planning at all, but rather tending to immediate or short-run concerns.

To summarize this point, then, an important determinant of general adoption of new computer-based techniques in this industry is the willingness of at least one firm to try them out. This is then a kind of unstable situation: if one bank makes a significant innovation, the chances are high that all will follow, but without the "trigger", nothing happens. It is fairly easy to identify the trigger banks, too, on the basis of past performance. The Bank of Montreal plays this role most often, and BNS somewhat less often. The other chartered banks tend to be the followers. These triggering and bandwagon effects, while perhaps not as decisive as some of the previously mentioned forces, undoubtedly play a role in shaping data processing innovations in the banking community.

<u>Summary</u>. We have addressed seven broad issues that were determined to be of central importance on the basis of observations and interviews with DP personnel in the Canadian banks: Control, Vendor Influence, History, Geography, Application-User Segmentation, and Bandwagon Effects. Each issue involves one or more aspects of the general centralization/decentralization decision problem that are missing, to varying degrees, from the current form of the Rockart Framework. Some of the issues are specific to the Canadian banking industry (eg, Geography), while others are of universal importance (eg, Vendor Influence). It is hoped that the validity and managerial usefulness of the Rockart Framework may be enhanced by "squaring" it with these issues in the future.

V Analysis in Terms of Nolan's Stage Hypothesis

In the previous section we examined a variety of issues related to Rockart's Framework that arose from the data gathered during this study. At this point we shall assess Nolan's model- the so-called Stage Hypothesis - in a similar fashion. The empirical and conceptual arguments underlying Nolan's model of DP growth and change were presented and discussed generally in Section II -D.2.

The intent of our analysis here is to assess the strengths and weaknesses of Nolan's model as a device for describing and predicting the DP growth and change patterns in this particular industry.

Given that Nolan's hypothesis arose from a study of budgetary growth pattens, it would have been nice if we could have obtained DP budget data over the past few years for each firm.[7] Unfortunately they were not so accommodating, being concerned about proprietary matters presumably. However, it is our contention that the real value of this model is not whether DP budgets tend to follow an S-curve, but rather the applicability of the stage characteristics and their usefulness in DP planning.

Figure V-1 contains eleven important indicators that Nolan suggests are related to the stage of operation of a firm's DP function. The status of each subject firm's DP group has been empirically assessed, basically using the interview data, for each indicator. In some cases the judgments are quite rough and include some subjective perceptions picked up during the site

Indicator	TD	BNS	B of M	CPD
Extent of Planning	weak II	strong III	strong III	very weak II
Software development control system	weak II	medium II+	strong III	weak II
User connection	weak II	medium II+	medium-strong III	strong III+
Co-ordination of development efforts	weak II	strong III	medium II+	medium II+
Chargeout	no II	partial II+	partial II+	yes III
Extent of MIS	some II+	some II+	considerable III	little II
Centralization for control of operations	weak II	strong III	medium II+	fairly strong III
Level of top EDP manager in organization	VP-2 II	VP-1 IIII	VP-1 III	VP-1 equivalent III
Vendor dependence	high II	medium-high II+	medium III	high II
Stage 2- Stage 3 Crisis	no II	yes III	yes III	no II
Steering committee	ineffective II	somewhat effective II+	somewhat effective II+	quite effective III

Figure V-1

visits. On the whole, however, we believe the assessments fairly represent each firm. Beside each attribute assessment is the number of the stage implied by that assessment. In all cases the implied stage was taken to be either II or III. This is not too surprising, since each firm's DP operation is clearly well out of the Stage I era, and none of the four groups have existed long enough (maximum is 11 years) to gain the maturity characteristic of Stage IV under normal growth and development patterns. Furthermore, all four groups have much in common, including tenure, so the fact that there exists as much spread as there does is surprising.

What does Figure V-1 say about the Stage Hypothesis? Our main conclusion is direct: in three of the four firms studied, the ability of this model to predict related characteristics was very strong indeed. While we obviously do not have a sufficient number of observations to calculate even coarse measures of statistical association, a glance at the table suffices.

In the case of TD Bank, nearly every attribute pointed to Stage II. For BNS and B of M, most attributes pointed to Stage III, with a few "in between". The only really ambiguous case was the Caisse Populaire, with a range of attributes from clearly Stage II to Stage III +.

Consider some of the indicators individually. Probably the most interesting one is #10, the occurrence or non-occurrence of a transitional "crisis". The crises experienced by BNS and B of M were described in Section III in detail. Neither TD nor CPD has experienced anything remotely resembling the top manage-

ment shakedown that Nolan argues will usually occur to mark the transition from Stage II to III. The implication for TD management (both DP and top management) is very clear: seek ye now to avoid such a crisis. Unfortunately, as indicated in #1, the planning function in that firm is relatively weak - both in DP and the corporation generally - so it is unlikely that the message will get through. The phenomenon is self-fulfilling!

An interesting question at this point is, why did TD not "advance" as rapidly in the development of its DP function as did, say, BNS, when these two banks are quite similar in most other respects? The differential factor that stands out above all others involves the background and training of the top DP managers. In TD, these people are bankers with some ad hoc DP training; in the other banks the DP staff have been exposed to computers and DP during their formal education, and have learned the banking business in on-the-job fashion. Also the top DP managers in TD are considerably older than in the other firms, but that is probably symptomatic of the previous difference rather than causal in nature. Finally, there is a significant difference in attitude towards DP skill level and general professionalism that came out during the interviews, which is characterized by the comment of one of the TD top DP managers to the effect that "we would much prefer to hire (into the DP group) somebody with banking experience and give them a two-week course in COBOL. Prior DP experience is not necessary, nor even desirable." The other two banks, as well as the CPD, were much more interested in hiring real "DP professionals".

While it is impossible to identify causal connections to the stage differential identified above, it seems likely that these factors play an important role.

Finally it is also important to investigate the question of why the Caisse Populaire does not seem to fit the stage pattern very well. On most accounts we would argue that their DP operation is functioning in Stage III. Yet they have very little formal DP planning, quite weak DP development control systems, very little in the way of management information systems (relative to the other banks), a high level of vendor dependence, and have experienced no "growth crisis". All these facts suggest that in some ways their DP function really falls in Stage II. What is going on here?

This "misfit" to the Stage Theory can be partially explained in terms of some recently suggested modifications to this theory. Observations in other DP organizations have led some investigators to conclude that under certain circumstances - usually characterized by the injection of sophisticated outside assistance (extensive consulting advice, widespread adoption of high-quality purchased software, etc.) - it is possible for a DP group to "skip" a stage of its development along some of the dimensions within the Stage Theory. This has occurred at the CPD: IBM developed their basic systems and associated administration then turned the whole package over to the in-house group set up in 1973. This fact gave DP a kind of "flying start". Also, the unique requirements of the Caisse Populaire led to the early development of certain advanced techniques such as user chargeout, strong user connections, and an effective

steering committee. The other important factor is the average skill level of a CPD DP professional. As explained in Section III-E, CPD has the pick of the crop in terms of DP staff, and has undoubtedly the strongest staff of the four subject firms. These factors have combined together so as to guide this group's development along a unique path not characterized very well by the stage hypothesis.

In conclusion, the stage theory, in three of the four cases described here, provides a surprisingly accurate reflection of DP growth and development. Its usefulness as an aid to DP planning is most evident in the case of TD Bank, which by most accounts may face some major problems in the near future as it moves into Stage III. For the other firms, the stage theory provides general direction for some of the changes (eg, improved user connections, stronger MIS focus) that they <u>ought</u> to begin considering in order to maintain continuing development of their own effectiveness in their respective firms.

VI Conclusions.

This study, in the very broadest sense, has been concerned with the function and structure of data processing operations within a larger organizational context. We have focussed on two specific issues: centralization vs. decentralization, and growth/change dynamics. These issues were addressed primarily in the context of the Rockart Decision Assistance model, and Nolan's Stage Hypothesis, respectively.

The empirical content of this study was derived from a series of site visits and interviews at four Canadian banking firms. The DP operations within these four firms have provided an interesting set of comparisons. Our observations were generalized in a set of seven issues pertaining to the C/DC question. These issues provide grounds for extensions or modifications of the Rockart Framework, and represent a possible area for future work. Also, Nolan's Stage Hypothesis was found to be both (reasonably) internally consistent, and of considerable usefulness in conceptualizing the growth dynamics of data processing organizations. The connections between the C/DC issues and the Stage Theory suggested in Section II-D.2 were found to hold reasonably well in the case of these firms.

The Decision Assistance model and the Stage Theory are both valuable and useful conceptual models that give strong insight into the data processing function.

APPENDIX A

The Rockart Factor Table

	FACTOR	IMPLIES direction	IMPLIES strength	SYSTEMS DEVELOPMENT subprocesses: func. des.	det. specs.	implement.	maint.	res.: staff	SYSTEMS OPERATIONS subprocesses: edit & control	update	processing	reporting	res.: h/w, s/w & staff	data base	SYS. MGT. subpr.: strat. plan.	mgt. control
Organizational Unit	GENERAL															
	-decentralized organization	decent.	strong	□	□	□	□	□	□	□	□	□	□	□	□	□
	-uniformity of planning & control system & other rpts	cent.	weak	∘	∘	∘	∘	∘		∘	∘				∘	∘
	-multiproduct/multitechnology/multimarket/multinational	decent.	strong	□	□	□	□	□	□	□	□	□	□	□	□	□
	DATA PROCESSING															
	-currently centralized	cent.	strong	○	○	○	○	○	○	○	○	○	○	○	○	○
	-currently decentralized	decent.	strong	□	□	□	□	□	□	□	□	□	□	□	□	□
	-demonstrated dependability	cent.	strong	○	○	○	○	○		○	○		○	○	○	○
	-accessible to user	cent.	strong	○	○	○	○	○		○	○		○	○	○	○
	-demonstrated expertise	cent.	strong	○	○	○	○	○		○	○		○	○	○	○
Subunit	NATURE OF TASK															
	-highly specialized	decent.	strong	□		□			□	□	□	□		□		□
	-independent	decent.	weak	▫	▫	▫		▫	▫	▫	▫	▫	▫	▫		
	-change/uncertainty	decent.	strong	□		□	□		□	□	□	□	□	□		□
	-fast growth	decent.	weak	▫		▫			▫	▫	▫	▫		▫		
	-entrepreneurial	decent.	weak	▫		▫			▫	▫	▫	▫		▫		▫
	-high technology/knowledge workers	decent.	weak	▫		▫			▫			▫		▫		▫
	OTHER FACTORS															
	-geographically separate	decent.	weak	▫		▫			▫			▫	▫	▫		
	-political considerations	decent.	strong	□	□	□	□	□	□	□	□	□	□	□		□
	-organizational size-small	cent.	strong	○	○	○	○	○	○	○	○	○	○	○		
	-depth of mgt. talent avail.	decent.	strong	□	□	□	□	□	□	□	□	□	□	□		
	[illegible]	decent.	weak													

Logical Application Group			SYSTEMS DEVELOPMENT					SYSTEMS OPERATIONS					
			subprocesses				res.	subprocesses				res.	
FACTOR	IMPLIES direction	strength	func. des.	det. specs.	implement.	maint.	staff	edit & control	update	processing	reporting	h/w, s/w & staff	data base
NATURE OF APPLICATION													
-strategic planning	cent.	strong	◯		◯		◯		◯	◯		◯	◯
-management control	cent.	weak	○		○		○		○	○		○	○
-operational control	decent.	weak	▫		▫		▫	▫			▫	▫	▫
-process control	decent.	strong	☐		☐		☐	☐	☐	☐	☐	☐	☐
-highly sensitive & critical for subunit	decent.	weak	▫		▫	▫		▫			▫	▫	▫
-high degree of involvement from subunit management	decent.	weak	▫		▫			▫			▫		▫
-specific to subunit	decent.	weak	▫		▫			▫			▫		▫
-intention to consolidate/ integrate the function	cent.	strong	◯		◯		◯		◯	◯		◯	◯
SPECIFIC REQUIREMENTS													
-high degree of DP expertise required	cent.	weak	○	○	○	○	○		○	○		○	○
-sophisticated technology/ processing	cent.	weak	○	○	○	○	○	○	○	○	○	○	
-reliability or lack of vulnerability critical	decent.	strong						☐	☐	☐	☐	☐	☐
-response/turnaround time critical	decent.	strong						☐	☐		☐	☐	☐
-adaptability to rapid change critical	decent.	weak	▫		▫	▫	▫	▫	▫		▫		
-integration with files from other LAGs	cent.	strong	◯	◯	◯	◯	◯		◯	◯		◯	◯
-special equipment required	decent.	weak	▫		▫	▫		▫	▫	▫	▫	▫	

Logical Application Group	FACTOR	IMPLIES direction	IMPLIES strength	SYSTEMS DEVELOPMENT subprocesses: func. des.	det. specs.	implement.	maint.	res.: staff	SYSTEMS OPERATIONS subprocesses: edit & control	update	processing	reporting	res.: h/w, s/w & staff	data base
	PROCESSING REQUIREMENTS													
	-task complex	cent.	weak	○					○	○	○	○	○	○
	-custom tailoring required	decent.	weak	□		□			□			□	□	
	-use of data base technology	cent.	weak	○		○				○	○		○	○
	-large memory required intermittently	cent.	strong						◯	◯	◯	◯	◯	◯
	-data communication errors critical	decent.	strong						☐	☐	☐	☐	☐	☐

Key:
◯ Centralized, strong i.e. complete decentralization is undesirable.
○ Centralized, weak.
☐ Decentralized, strong i.e. complete centralization is undesirable.
□ Decentralized, weak.

NOTES

1. While certainly not conclusive evidence, it is the case that at M.I.T. the two large central computing systems - one an IBM 370/168 running under OS, the other a Honeywell Multics system - average a Mean Time Between Failures (MTBF) of around 24 hours, while the Prime minicomputer in the Sloan School of Management presently enjoys a MTBF of over two weeks!

2. One popular credit scoring system is the Automatic Applications Processing Software sold by CCSS Inc., the leading U. S. vendor of consumer credit scoring systems. Reference 5 contains additional information of this package and its use in a large American bank.

3. In Canada, non-chartered financial institutions such as trust companies, mortgage lending firms, etc., are referred to as "near banks".

4. SWIFT is an acronym for Society for Worldwide Inter-bank Financial Telecommunications, a fledgling international computer network for currency exchange, based in Brussels. For further information, see Reference 1.

5. COLBS stands for Canadian On-line Banking System, a special-purpose database/telecommunications package developed originally by IBM Canada for use in its client banks. It has since been extensively modified, and adopted by financial institutions in Canada.

6. Top quality data processing staff is not a particularly high priority in all Canadian banks. For instance, Norm Van Malder, Coordinator of Manpower Development at the TD Bank, (in what may have been a slight exaggeration) pointed out that he was quite happy to hire new programming staff who had no previous programming or computer-related experience, give them two weeks of COBOL training, and turn them loose.

7. In a recently published study,[27] Lucas and Sutton showed that DP budget growth in California county governments in fact did not follow an S-curve very well. They hastened to point out that this observation does not cast doubt on the Stage Theory per se, only that DP budget growth may not be the best basis for stage formalization in some instances.

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