

**The Bell Canada CRISP Project:**  
**A Case Study of Migration**  
**of Information Systems Infrastructure**  
**for Strategic Positioning**

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**Abstract**

Bell Canada, faced with a number of challenges as a consequence of the changing marketplace, technological evolution, and changes in the Canadian telecommunications industry at large, is restructuring its IS architecture in an effort to meet customer demand better. Further, new products and services place new demands on IS capability.

In reacting to these pressures Bell is considering a massive redesign of parts of its IS infrastructure, despite the fact that immediate, tangible returns commensurate with the investment are not readily calculated.

**1. Introduction**

Bell, Canada's largest telecommunications provider, is engaged in a massive effort to reconfigure its information systems architecture. Although manageable when compared to Bell's annual revenues of better than \$6 billion or systems budget in excess of \$100 million, this architectural reconfiguration is estimated to cost over \$100 million<sup>1</sup>. One major undertaking in a series of projects, the Corporate Revenue Information System Plan (CRISP) will itself cost between \$30 million and \$40 million. No attempt has been made to do a formal cost benefit analysis for this project; rather, the work is being justified as *strategic positioning*. That is, the work is considered essential for Bell Canada's future viability.

The telecommunications industry in Canada is in a state of flux induced by changes in technology, the advent of a range of potential new products and services, and changes in the competitive nature of the environment. The architectural reconfiguration is one of the ways in which Bell is responding to the challenges posed by these developments.

In the face of rapidly changing environmental and market conditions, it is necessary to search for and to exploit effectively new opportunities

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<sup>1</sup> All amounts in this case are in Canadian dollars.

created by changes in demand, changes in competitive industry structure, and changes in technology. Bell is increasing its ability to do this by developing a flexible and competitive IS infrastructure. This is a *current* investment, which must be made to meet *future* needs.

Any project of this magnitude, undertaken to meet uncertain future needs, must involve a fair degree of risk. Moreover, the CRISP effort is aimed at meeting future requirements that marketing does not yet know, in support of products that do not yet exist, based on technology not fully in place. Planning has focused on reducing all forms of risk, including financial exposure associated with CRISP, the risk that the reconfiguration might fail to support unanticipated needs, and the risk that the project might be canceled prematurely for organizational reasons.

**2. Bell Canada**

Bell is a subsidiary of Bell Canada Enterprises, which was renamed BCE Inc. as of January 1, 1988. BCE was ranked the fourth largest company in Canada by a recent survey [3] on the basis of total revenues of \$13.9 billion for 1986<sup>2</sup> (General Motors Canada, Canadian Pacific, and Ford Canada respectively were ranked higher). It placed second on the basis of net income (\$1.023 billion), and first on the basis of its total assets of over \$23 billion. It has over 109,000 employees.

BCE has interests in a variety of industries ranging from telecommunications to printing, manufacturing, and development. The parent company owns a partial interest in several subsidiaries, including Northern Telecom (which is 52.3% owned, and in turn controls Bell-Northern Research and several other interests), Bell, BCE Development Corporation (65.8% owned), Maritime Telegraph and Telephone (32% owned), and TransCanada Pipelines (48.5% owned). The bulk of its revenues and profits have been from telecommunications services,

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<sup>2</sup> Source for financial data is the company's 10-K, 10-Q filings.

with a smaller portion from manufacturing; in 1987, 46% of sales and 69% of profits were from telecommunications, while manufacturing accounted for 44% and 23%, respectively. In 1987 65% of its revenues were from Canadian sources, and 31% from U.S. sources.

Bell has been the chief contributor to BCE's earnings, with over \$6.25 billion in revenues and \$711 million in net income in 1986. Its average monthly receivables are \$1 billion. Its total assets were over \$12.6 billion. In addition to its telecommunications services, Bell also holds minority interests in companies engaged in satellite communications and industrial development and research. The company has over 50,000 employees. The average annual growth rate between 1983 and 1987 was 8.1% in sales and 5.9% in net income.

Bell provides telecommunications service, including local loop and long distance, to half the population of Canada in the provinces of Quebec, Ontario and the Northwest territories. Twenty seven percent of its revenues comes from competitive markets, including equipment, private lines, data, and foreign exchange service<sup>3</sup>.

### 3. Business Problems

The environment in the Canadian telecommunications industry is changing with the pressures generated by changing customer demand, deregulation and detariffing<sup>4</sup>, and the growth in technology that makes possible a variety of new services. Bell is affected by these pressures, and by the inadequacy of its present infrastructure to deal with them efficiently.

#### 3.1. Deregulation and Detariffing

Some markets for telecommunications services are already deregulated, but not all are likely to be equally threatened as a consequence of deregulation. Local loop service, for instance, is unlikely to be radically affected by deregula-

<sup>3</sup> *Foreign exchange* in the telecommunications industry does not refer to foreign currency operations. Rather, it refers to running a line from a telephone in one location to a central office (exchange) that is not the closest (rather, one that is foreign). This may be done so that customers in a city other than the one in which the company is located will be able to call as a local rather than as a toll call.

<sup>4</sup> Canadian regulators will probably never relax their regulatory grip as thoroughly as their U.S. counter-parts. More likely is *detariffing*, whereby companies are free to set their own rates, but still must file their floor price with the CRTC.

tion; with current technology it appears to be a natural monopoly. Although there are several different telephone companies providing local service, they tend to be local monopolies. There are close to a hundred independent telephone companies in Canada [1] providing local loop service, with about one-third of them in Ontario.

Deregulation of long distance service and the introduction of a variety of new products and services should be the primary concerns of Bell, and here the threats chiefly concern competition for the company's largest customers. Competitors are likely to go after the biggest customers and the most profitable routes, the ones with the highest traffic. A major portion of telecommunications revenues are due to about two to three hundred very large customers. As a consequence, the factor of overriding importance is the ability to develop the flexibility to address the unique needs of these large customers.

Bell currently has 70% of the Canadian long distance market. Other major players in the long distance market include British Columbia Telephone Company and Manitoba Telephone System, but this market today is largely segmented geographically, and Bell occupies the highest traffic regions. Private line, data, and foreign exchange markets were deregulated in 1979-80, when CNCP moved into these areas<sup>5</sup>. The market for terminal equipment was deregulated in 1982.

Deregulation of long distance service would permit competition, which is expected to focus on the most profitable regions and most active customers. The important competitor for long distance service is CNCP, and potential new entrants may come from cable TV. CNCP spent between a hundred and two hundred million dollars to lay a transcontinental fiber network in rail beds during 1984-86. While the CRTC (Canadian Radio-television and Telecommunications Commission) rejected CNCP's application in 1985 to provide long distance service, it did so only on the grounds of insufficient business merit [5]. In the process, the CRTC reaffirmed the idea of the value of competition. A link between Rogers Cable and Cantel threatens the formation of a third long-distance network.

According to Mr. Uwe Natho, Assistant Vice-President in the Bell Comptroller's office, as more businesses are deregulated or detariffed, revenues from regulated businesses could be reduced from the present 75% to less than a third within five years: "Bell is rapidly evolving towards a competitive environment." He went on to point out the need for action, adding "Seventy percent of the revenue base is

<sup>5</sup> CNCP is a joint venture of Canadian National and Canadian Pacific Railroads, using their existing rights of way to launch a long distance network to compete with Bell Canada.

going to be under the gun! I can't keep up with the revenue generating ideas from marketing today, when only one fourth is under competition. We've got to do things ten times faster, or the competition will beat us every time!" "Prior to 1982", he continued, "the product life cycle was 10 to 12 years. Now 'boom', we buy a whole bunch of Korean sets and start selling them the next day!"

Calls for change in telecommunications policy continue in Canada, and the issues involved are complex and often misunderstood. Businesses want lower costs and more choice in the market, but the general public often views deregulation negatively [2]. In the area of telecommunications policy, the division of responsibility between the Canadian Federal Government and each province is not clear. An agreement is being sought currently between the various governments in an attempt to rationalize policy [4]. The role of the CRTC in the past has been strongly regulatory and non-competitive.

Bell considers itself a very efficient network relative to the competition. It has so far absorbed successive reductions in long-distance rates totalling 34% and still remains profitable. Further, Bell is in the process of "rate rebalancing," restructuring its rates in order to reduce the long distance subsidy of local service. The principle of rate rebalancing has been approved by the CRTC<sup>6</sup>. Mr. Robin Hamilton Harding, Vice-President and Comptroller for Bell Canada, feels that at present his company can be more efficient than its competition even with the obligations of universal service. Competitive advantage of new entrants through lower costs is not yet evident.

However, Bell's present information systems infrastructure is not well positioned to facilitate billing of special services nor to evaluate new market opportunities. This is the area in which Bell would be most vulnerable to competition, and is the area that CRISP is primarily intended to address. As Mr. Harding said, "It is not a question of the degree of complexity. It is a question of 'customer leverage.'" This is low for individuals, but high for large customers who have the power to demand special services. Special arrangements like volume discounts, services like nationally consolidated invoices for companies, and machine-readable and on-demand invoicing are of great importance to the customers. As an example of special services, MCI has developed the capacity to provide detail reporting for 800 number customers; AT&T has

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<sup>6</sup> As in the United States, artificially high long distance toll charges have been used to subsidize, and reduce the costs, of local residential service. Although this has been politically popular, it is difficult for Bell to continue to subsidize its local operations when competing long distance carriers provide no such subsidies.

responded, but Bell Canada still does not offer this service.

### 3.2. Technology

The development of new technology plays a major role in changing the nature of competition. Previously, services were essentially limited to local and toll voice communication; now, a rapidly increasing number of new services are becoming available. In general, technology is decreasing barriers to entry in the industry, and consequently increasing competitive pressures. In turn, increasing levels of competition induce even more rapid advances in technology.

In particular, Integrated Services Digital Networks (ISDN) will support a wide variety of future offerings. These networks are *dynamically reconfigurable*, meaning that a customer may choose between a few wide bandwidth pathways for data or video, or numerous more narrow pathways for voice traffic as immediate conditions require, and may make changes to the company's network configuration instantly, without involving Bell's service personnel. Additionally, new *out of channel* signalling systems enable the identification of incoming calls. Applications of this range from efficient provision of Emergency 911 service, through the forwarding of calls from previously identified important clients, to the rapid routing of service inquiries to account representatives based on identification of the account through the number from which the call originates.

At present, many of Bell's systems are not capable of dealing adequately with marketing the variety of new and emerging services thus enabled, or of dealing with the billing issues these new services raise. It is likely that the pressure of technology alone, even in the absence of deregulation, would contribute significantly to the need to restructure the IS architecture.

### 3.3. Operation and Maintenance

Bell is faced with an aging applications base. In the revenue accounting area, although many systems were developed in the early 1980s, many applications are 10, 15, even 20 years old. It is often the case that data must be manually re-entered two or three times, either to bridge incompatible systems or because procedures have not been fully mechanized. Growth has not been planned -- applications were custom designed rather than data driven, and often created on an *ad hoc* basis. Projects typically required 50+ man-months and needed between 6 and 15 months to be implemented, thus severely limiting the flexibility and quick turnaround time that are necessary.

The large, complex, and non-modular systems that resulted imposed an overhead that might

not be burdensome in a slowly changing environment, but would certainly be a handicap in today's dynamic marketplace. As an example, a change in tax rate involves changes to up to twenty different systems.

As measures of complexity, the present primary system has over 5,000 program modules, 2.7 million lines of code, and 270 major files. In addition, it is composed of several different hardware and database systems, some of which are incompatible. The current revenue accounting data environment is made up entirely of first and second generation files (i.e., stand-alone files or application databases).

Several difficulties were identified and evaluated during the CRISP study:

- o Maintenance: there was a large backlog of user requests. The complexity of the present architecture made the task more difficult. The cost of maintaining the present system was over \$8 million per year.
- o Data Integrity: duplication of data was fairly common, and as a result there was a high risk of loss of consistence among the multiple copies.
- o Incompatible systems: the hardware and software supporting current systems were different, and often stand-alone.
- o Production Schedule: owing to the presence of several manual interfaces where data had to be re-keyed by hand, and to the proliferation of systems, report production was lengthy and time-consuming. Productivity also suffered as a consequence.
- o Management Reports: apart from certain standard, regularly scheduled reports, it was difficult to service requests for information, especially *ad hoc* and unanticipated queries.
- o Performance and profitability measurement: key shortcomings lay in the present systems' inability to perform flexible analyses, and to track revenues and costs by customer or product line to evaluate profitability and productivity. Clearly there were no great pressures to do this in a regulated environment, but the capability to evaluate cost centers, business units, product lines, or customers could be vital for effective management and marketing feedback in a competitive environment.

The difficulties associated with the operation and maintenance of the current system by themselves contribute heavily to the need for a simpler, more flexible architecture.

It is clear that the environment is becoming more complex and uncertain. Strategies now need to be more consciously customer oriented. It is now necessary to respond to customer

preferences quickly, and to develop targeted marketing techniques. As deregulation, technological change, and competitive pressure increase, there is a growing need for Bell's products and services to be differentiated and customizable. The resulting uncertainty about future offerings in turn leads to the need for increased information processing capability, with the correct and timely processing of market data becoming increasingly crucial for survival and growth. It is precisely these needs that Bell is addressing in evolving its IS architecture.

#### 4. CRISP -- Scope and Objectives

CRISP was Bell's response to the strains on its Revenue Accounting information infrastructure caused by an aging applications base, changes in technology, and increasing marketing pressures. The objectives of this effort can be classified into four areas:

- o ability to adapt rapidly and cost-effectively to changing business conditions and new technology
- o ability to provide enhanced marketing information
- o ability to provide flexible information services to customers
- o ability to market information services products

##### 4.1. Flexibility in Adapting to Future Changes

Clearly, the rate of change in the technology and in the business environment will not soon abate. It is essential that the infrastructure put in place be able to adapt to these future changes, since these changes cannot be predicted with any accuracy.

To a large extent, this flexibility is being built into the Revenue Billing systems through rationalization of data structures and processing, as well as the use of advanced database management and development technology. In particular, four architectural principles guided the restructuring effort, to reduce maintenance and development costs and improve flexibility:

- o Programs are grouped by data used, but are designed to be independent of the data as much as possible. Parameterization versus customization will be considered in the design of each module.
- o Validation and correction of data should be performed as early in the processing cycle and as close to the source as possible.
- o Replication of data should be reduced as much as possible. Redundant data should be controlled to assure consistency.

o Data should be kept as long as possible in the original, disaggregate form. Necessary calculations and data reductions should be performed *just-in-time*, only when needed.

Even with these design principles and advanced productivity tools, flexibility is inherently limited by decisions made in the level of detail and structure of the data. Therefore, the Revenue Billing Systems seek to preserve flexibility by storing data in full detail to the extent feasible. The availability of disaggregate data allows unanticipated aggregation and relationships to be established at a later date, when the need arises.

#### 4.2. Marketing Information

Technological advances coupled with increasing competition are greatly expanding the range and complexity of products that can be offered. Increasingly, products and pricing must be tailored to individual customers, particularly large, high volume users likely to be targeted by competitors. In this environment it is critical to know the profitability of products and customers. This is essential for determining the range of products to offer and the pricing. Current systems do not provide this information.

As Mr. Hamilton Harding asks,

"How can anyone market, let alone sell, without knowing what is being sold? Marketers need to know what their deals mean."

Also,

"How can you cut a dollar of expense if you don't know whether it generates one dollar of revenue or two?"

CRISP addresses these needs by providing revenue information by both products and customers. An important aspect of this is establishing customers as a data entity independent of services. Currently, customers are identified primarily by telephone number. This prevents the aggregation of activity by customer when there are multiple accounts. Moreover, this prevents accumulation of history for analysis purposes, since telephone numbers are subject to change.

CRISP projects will not provide full reporting of contribution to profits, since it does not include cost information. To a large extent this is a question of priority. The cost system is plagued by conceptual and organizational problems with assignment of joint and common costs. These problems are being addressed, but meaningful cost information will take some time to develop. On the other hand, with revenue information, it is possible to perform marginal contribution analysis to support decisions.

Moreover, restructuring the revenue system enables flexible billing and reporting to customers. These information services to customers can have an immediate impact on the market. For these reasons, the cost component of the infrastructure is receiving a lower priority.

#### 4.3. Flexible Information Services to Customers

Technology is enabling and competition is enforcing an increase in information services provided to customers as part of telecommunications services. These services include flexible, on-demand access to billing information, user determined account reporting, and, eventually, user determined service configurations. Potential competitors, with systems designed around current technology, can offer these services, while Bell, with its existing infrastructure, is limited in its ability to respond.

Again, detailed accounting for incoming calls with 800 service is an important example of a service that cannot presently be offered by the established long distance companies like Bell and AT&T, but which can be offered by new entrants like MCI with their newer infrastructures.

CRISP architectural recommendations should allow Bell to offer information services by pushing data and processing down towards the customer. This will be particularly useful in support of future telecommunications technology, which allows the customer to determine communications requirements and configure communications networks, without intervention of Bell sales or installation personnel. As Mr. Natho states,

"Under CRISP, if the customer wants it we can do it. We can provide the underlying telecommunications service cheaper. At worst we get parity. At best we have differentiation."

#### 4.4. Information Services Products

Bell already offers some information services products related to the operation of its own telecommunications business. Its billing system exhibits extremely high reliability, at very attractive cost. As Mr. Natho explains,

"Third party billing services generally cannot handle our volume, and cannot touch us on cost. They don't want our high volume business. They want highly profitable, one-off accounts."

In fact, rather than use third party billing services, Bell Canada provides such services, handling the billing for smaller telecommunications companies.

CRISP must facilitate provision and expansion of new services like data networks and terminal

access to databases, which will be offered to business customers. Such offerings may require very different billing properties from existing telecommunications services.

## 5. CRISP: The Decision Process

The problems with Bell's aging infrastructure have been recognized within the company for some time. According to Mr. Hamilton Harding, many of the ideas associated with CRISP have been discussed within the industry and within the company for four or five years.

The current effort was begun on the joint initiative of Mr. Hamilton Harding and the Systems Group. In 1984, the comptroller's office initiated a review of the revenue infrastructure. This *Revenue Application Plan* provided the conceptual foundation for a more detailed CRISP study begun in 1986 and completed in 1987, resulting in the blueprint for the Revenue Billing Systems. Costing \$612,000 and consuming almost 120 man months of effort, this study sought to define the future business needs of the company and to design the necessary data and applications architecture to address these needs.

Mr. Hamilton Harding recognized that CRISP would have considerable impact on many different areas of the organization and would strongly influence Bell's ability to compete in the future. The initial study was conducted by interdepartmental teams of managers with detailed knowledge of the business requirements, supported by analysts competent in systems planning. While a redesign of much of the systems infrastructure could not have been attempted without the detailed business knowledge of the line managers, this collaborative approach was also important in building a wide consensus behind the CRISP effort. As Mr. Hamilton Harding notes, "CRISP is more of a means of communication than a path to some goal."

The rebuilding of Bell's systems infrastructure is not being managed as a massive revolutionary change. CRISP is only a part of broader restructuring of systems that includes cost accounting, and is itself only the blueprint for the incremental evolution of the revenue infrastructure. Mr. Hamilton Harding expects CRISP to ultimately involve 15 to 20 specific projects, with an average cost of around \$2 million. Some of these projects will be ongoing maintenance and enhancement efforts, on which "an additional 35% is tacked on to make them consistent with CRISP." Other projects are new or substantially restructured systems focused primarily on achieving the goals of CRISP.

This incremental approach greatly reduces the risk of the undertaking. Each piece of the CRISP migration is relatively small, averaging \$2 million, reducing the exposure, the level of

complexity, and the magnitude of organizational change that must be managed at any one time. The process can adapt to experience and changes in the business environment. Of course, the decrease in risk is paid for by an increase in costs, as interfaces between old and new applications and databases must be programmed and operated (c.f. appendix B for more on implementation).

At this point only four major CRISP-related projects have been taken into the project flow, although actual implementation has begun on only one (BRIP):

- i) Accounts Receivable: this project rationalizes data and processing for tracing bills and cash receipts that are currently spread over many discrete systems.
- ii) Customer Invoicing: this project integrates charges by customer and allows flexible timing and customer-defined account structures. The low level revenue data from this sub-system will provide product level and account level revenue information for marketing and internal management.
- iii) Billed Revenue Information Process (BRIP): This system provides reporting of revenue by product and account.
- iv) Customer Special Rating: This project migrates current discounting plans for toll from the current invoicing system to a separate sub-system and will put in place the basic architecture for this function.

The ordering of projects has been determined by economic, organizational, and practical considerations. Accounts receivable has concrete and highly visible economic benefits and is expected to have significant effects on collections and cash flow. The economic impact is coupled with relatively low risk. Similarly, invoicing will be extremely visible. These "back-end" functions are basically contained within the revenue function, minimizing the interfaces with and disruption of other parts of the organization. Success in these projects will establish an experience base and track record that should benefit the approval and implementation of future projects.

Customer invoicing also provides the basic data for revenue reporting. Although the benefits of BRIP are less tangible, this project has high visibility and support within the organization, particularly in Marketing.

Each project within CRISP must be approved by the Executive Officers and the VPs from all business areas. Bell expense allocation procedures provide for three stages of review and

approval: Proposal, Feasibility, and Completion; additionally, review is required if there is a deviation. Projects are categorized as *Operational Requirement*, *Corporate Mandatory*, or *Strategic Requirement*. Operational Requirements generally require economic justification. Corporate Mandatory projects are required by regulation or legislation and thus require no economic justification. Strategic Requirements also require no economic justification, but the Executive Officers must be convinced the project is necessary for business reasons.

The first three CRISP projects presented so far have been approved as Strategic Requirements. No attempt was made to estimate return on investment or payback. Quantified economic analysis played no part in the decision process.

Mr. Hamilton Harding thinks there are several reasons for the Executive Officers' approval in the absence of demonstrated hard economic benefits. Chief among these is the general support built in the organization prior to submitting specific projects. All affected business units were intimately involved with the development of the plan. Moreover, Mr. Hamilton Harding consciously sought support for the projects prior to embarking on the approval process.

While the Comptroller's success at building organizational consensus is based largely on perseverance, diplomacy, and vision in his role as champion of CRISP, he is quick to point out that his position as Comptroller provided him with the base from which to seek consensus.

CRISP has been planned and funded out of the Comptroller's and Systems' budgets for the benefit of all functional departments. Mr. Hamilton Harding feels that this reduced the potential for in-fighting and turf battles among the functional areas. Similar efforts at rebuilding infrastructure have in many instances failed in the U.S. RBOCs, largely, in his opinion, since the ideas were proposed by marketing for their own good. Moreover, before Robin Hamilton Harding worked to gain organizational support for the idea among his fellow vice presidents, support had already been developed among operational personnel in affected functional areas like marketing by his people.

Another critical factor in the Executive Officers' support of the CRISP effort is the incremental approach taken. Each specific project within CRISP was designed to be relatively small, with clear objectives and expected benefits (even though these were not quantified). At any point, the risk and cost of the next step are low and the process allows feedback from the previous steps to shape future directions. Additionally, the steps attempted first are the most visible, which develops momentum for the project as it proceeds.

Mr. Natho points out that to some extent, the ease of selling CRISP as a strategic requirement

is a function of the current profitability of Bell. In the 1983 to 1985 period the company concentrated on operational projects with a short payback period; i.e., one to three years. He suggests that, in that environment, CRISP recommendation would not have been approved without more analysis. If that is true, a future downturn in profitability could make approval of CRISP projects more difficult.

It is extremely important to note that, although no formal analysis was performed on risks, costs, and benefits, this does not mean that the project does not have concrete payback. CRISP projects are expected to yield tangible benefits in the form of operational savings and reduced time and cost of future development. These benefits can reasonably be estimated. In fact, the Comptroller's office has performed some analysis on these savings and estimates that the CRISP projects will reduce future development costs by as much as 40%.

According to the Comptroller, these hard benefits are not sufficient to justify the investment and, in fact, were not used to sell the idea to the rest of the organization. Instead the idea was sold based on the soft benefits of improved marketing capability for new products and services, and enhanced flexibility in meeting future business needs. Such soft benefits are notoriously difficult to estimate and no attempt was made to do so. As David Craig, Director of Data Administration, asks,

"At what point does marketing start to get value? When the first module goes up? When CRISP is finished? When we first realize that a favorite product is unprofitable?"

A large scale rebuilding of basic systems infrastructure is subject to considerable risk. The systems put in place will have far reaching impacts that cut across established functional and business lines, and that may change the way business is conducted. Moreover, the design decisions made now will constrain how the organization can react to future changes, which may be totally unanticipated. Bell is cognizant of these risks and is taking steps to minimize them.

The risk of "missing" future requirements is being addressed by careful involvement of all affected users in the design process, implementation of a flexible architecture, and incremental development. The Comptroller's group has established liaison positions with the major functional and business groups. As Mr. Natho notes, "If we miss Marketing's requirements, the company is in big trouble. Because of Yvonne Allen's role, the chance of missing Marketing's current requirements is zero and the chance of missing future requirements is remote."

The new architecture is designed to put a premium on flexibility. Relational database technology is being used to facilitate control

over and flexible access to data. Data is being kept in a disaggregated form to allow "just-in-time" computation and determination of relationships. Moreover the incremental development approach is viewed as reducing the risk of missing future requirements.

While Bell does not consider the probability of missing future requirements as being significant, they are more worried about the human and organizational element in the change process. Mr. Natho notes that although the CRISP effort has strong organizational backing, the process involves technical and organizational change on a larger scale than ever attempted before by the company.

As with benefits, no formal evaluation of risk has been performed. For example, the incremental development approach trades off risk for additional cost of interfacing old and new systems. Similarly, there is generally a tradeoff between flexibility and costs. These tradeoff decisions have been made judgmentally.

## 6. Summary

CRISP represents an important phase in an effort to rebuild the information systems infrastructure at Bell. This is a significant undertaking with far-reaching effects on the organization today and its ability to compete in the future. Currently, no part of the project has actually been implemented, so a detailed evaluation is not yet possible. However, the process followed may offer a model of how to manage decisions to invest in strategic infrastructure.

In general, investments in infrastructure are fraught with uncertainty. It has been suggested that such investments frequently involve "betting the company." The Bell case indicates this may not always be true. An incremental and evolutionary approach may be viable as a way to accommodate the risk and manage the process of organizational change. The crucial factor enabling an incremental approach is timing. In Bell's case, the firm is in a strong competitive position. Over 70% of revenues are protected by regulation and the company has a significant short term cost advantage over potential new entrants. Should deregulation and detariffing develop more rapidly than anticipated, the incremental approach may need to be re-evaluated.

Another aspect of the Bell investment in CRISP projects is the lack of formal economic analysis and economic justification, despite the rigorous requirements analysis performed. Much has been written about the difficulty of making investment decisions in projects subject to a high degree of uncertainty and with costs and benefits that are not easily quantifiable. The additional risk caused by lack of analysis is somewhat mitigated by the incremental invest-

ment approach, but there is no evidence that this tradeoff is optimal in the long run.

Organizational factors are likely to be very important in any major redesign of infrastructure. So far Bell has avoided major turf battles through careful consensus building, at the operational level and among officers. Organizational problems and potential areas of conflict may not appear until CRISP migration is further along and it is clear which organizational units will have their power increased under the new architecture and which, if any, will feel their influence or control is reduced.

Finally, CRISP is part of a larger effort, a repositioning of Bell through redesign of information systems infrastructure. This may ultimately cost in excess of \$100 million, and is expected to produce future benefits, meeting uncertain future needs. Given the size of the investment required, and the uncertainty involved, Bell has been careful:

- o to reduce exposure at each step through incremental development of small pieces
- o to minimize political risk by developing consensus, by doing the most visible stages first, and by avoiding making unnecessarily detailed promises that can be "nickel and dimed" during the decision process
- o to minimize risk of missing needed future functionality through liaison with affected functional areas, use of high level database management systems, implementation of a modular architecture, and maintenance of full, disaggregate data where ever possible

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## Appendix A: System Architecture

### A.1. Major Modules

The planned architecture restructures the existing systems into nine major systems and 40 subsystems. The nine systems are:

- o Customer Charge Calculation: this includes all systems and functions to calculate equipment and services (except network access charges). These calculations are currently performed on several different systems in complex and laborious ways. The new scheme also lays the groundwork for rate rebalancing and for an ISDN rating scheme.
- o Customer Contract Charge Calculation: this contains the systems needed to calculate charges for customers with individual contracts. Most of these functions are currently handled manually, and the large user contract is not required. The future system allows for much flexibility in setting up and modifying different contract arrangements.
- o Usage Charge Calculation: this system performs validation and charge calculation for network usage. The new system will partition voice and data network charges into several customized streams depending on the type of service, and will result in a more flexible, responsive system.
- o Special Rating: special rating is to apply special rates or discounts for products. This is presently not run on a single system. The new system will separate the high volume from the low volume functions, and will allow Marketing to introduce new, cheaper alternative rating schemes.
- o Revenue Settlement: this addresses the process by which amounts owed by different telephone companies to each at the end of a billing month are settled among themselves. At present, this functionality is distributed over twenty systems, several of which are incompatible. As a consequence, much information has to be manually reentered.
- o Third Party: calculates third party charges, which are the charges billed to the customer by the billing company on behalf of another company. It also calculates commissions. Third party functions are now integrated with other individual Bell systems. The new scheme removes and groups similar systems, so that changes and eliminations can be made without affecting the Bell products base. Bell views the third party system as being potentially strategic since it could possibly attract new customers and retain present ones through the value-added billing service.

- o Customer Invoicing: different invoicing systems are now used to invoice different voice and data services. The new system will allow for integrated invoicing, on-demand billing, flexible timing, customer-defined account structures, and low level revenue data for internal use.
- o Accounts Receivable: the present accounts receivable systems are resident on different systems, and the cash system requires extensive manual entry. The proposed system permits the daily update of records (allowing for on-demand billing, one of the company's stated objectives), provides a base for analysis for marketing, and permits the breakdown of charges to Bell tariff, Bell non-tariff, and third party charges.
- o Revenue Accounting: currently, journal maintenance and financial reporting of corporate revenues requires extensive manual reentry of information since incompatibilities between systems exist, and several processes have not been mechanized. The new system will be mechanized and interface directly with the general ledger.

### A.2. Entities and Data Relationships

Data can be divided into different categories: individual accounts, independent companies, other telecommunications companies, and third party. For example, provision is made (through the Contract Charge and the Special Rating information) to create and change unique billing relationships with individual large-volume customers. This arrangement also allows for better management of revenues from services rendered to them or jointly offered with them. The fewer, high-volume accounts are far more complex to process than the numerous, low-volume ones. As a consequence, they are placed on different systems to achieve greater efficiency. Each customer account is serviced by one part of the organization, thereby allowing for the creation of responsibility centers for internal management use.

A charge is always associated in the system with a product, network usage, contract account, or account receivable. By doing this, it is possible to identify and track recurring charges, non-recurring charges, and revenues from each product, thus allowing for product and service performance analyses.

## Appendix B: Implementation Migration Strategy

The CRISP implementation strategy is expected to be completed in October or November 1988. In general, projects are being implemented "outside-in," beginning with accounts

receivable and invoicing. Sequencing of projects is based on several considerations:

- o Projects with concrete and highly visible payoffs are being implemented as early as possible.
- o Core systems that feed revenue reporting are given high priority. Much of the organizational support for the project is based on the revenue reporting capability. There is a desire to show results in this area as soon as possible.
- o Projects with minimal organizational disruption are given priority.

Wherever possible, the current base of applications will be exploited to achieve the migration with minimum effort. Special programs will be written to interface the new applications with old applications.

It is extremely difficult to migrate on a module by module basis, either when changing hardware or when replacing earlier file-based data management with database management systems. In the CRISP project the organization of data will change: a large number of separate, overlapping files will be replaced with a single interconnected relational database with many relations and even more relationships. Modules will be combined and modular boundaries may change, to accommodate requirements and the greater capabilities of today's technology. The functions of several modules will be combined, and the functions of a few poorly organized modules may now be split among others. This class of migration is *not* like doing routine maintenance on a car; it is more like attempting to migrate from a 1968 Chevy to a 1988 Ford, a few parts at a time.

Migration in CRISP is being facilitated through the use of bridging programs. These programs will take the file-based data produced by the interior CRISP modules that have not been converted, and produce the relational data required by exterior CRISP modules being converted first.

Evaluation of the plan is expected, in light of changing market dynamics and technology, and assessment of progress is to be done at least yearly.