INTRODUCTION

A dominant trend in the computer business is the growth of data processing systems which are involved with data communications. It is estimated that by 1980 70 percent of all computers will use communications. Many organizations are now using or planning the use of teleprocessing systems. For those with such systems in operation, the experience has been one of rapid expansion and growth as the organization learned to appreciate and use them.

This rapid growth has increased the complexities of planning both for teleprocessing systems in general and for the data communications subsystem in particular. Data communications is now the most dynamic activity of once placid telecommunications groups in large organizations, and indeed, is now often the object of reorganization efforts generated by the problems of such a rapid rate of change. Rapid growth, the relatively long lead time for implementing changes, and the large investment and operating costs of data communications have caused heavy emphasis to be placed on the advanced planning function. Any data communications support group that has felt the wrath of users when experiencing an unanticipated increase in response time of an inquiry system, for example, will be determined not to be caught flatfooted again.

This paper will present a conceptual framework for thinking about planning problems which I found useful in recent consulting assignments in data communications planning for large organizations. This conceptual framework has been tested in the last year on three major organizations: a large diversified financial conglomerate, a major manufacturer, and a high technology oriented government agency. In each case, the contribution of the conceptual framework has been to provide a way of thinking about planning problems that provides insight into their interrelationships. The framework is divided into a data communications process, a planning process, and organizational considerations. Some typical data communications planning problems encountered are also discussed.

THE DATA COMMUNICATIONS PROCESS

Figure 1 is conceptual view of the data communications process. Process simply means all those organizational activities that concern managing the data communications subsystems which are part of larger teleprocessing data processing systems. This includes both day-to-day activities concerned with operation of inplace systems, and all future oriented planning activities. The process primarily consists of the interaction of the following elements.

Tools

Tools are the individual technical skills, techniques and knowledge that are found in the data communications environment—software, telecommunications, simulation, statistics, etc. These tools are necessary no matter what the time orientation of any task is—short or long range.

The user

Every data communications support group has a user. The ultimate user may be, for example, the major lines-of-business divisions in a large multimarket company. Or, more often, the practical “user” may be a surrogate for the ultimate user; for example, the applications programming groups typically found in the line divisions. These data processing groups act as interpreters of requirements between the business user and the various technical system support staffs.

Other system processes

Data Communications is only a sub-system of a larger data processing system. Depending on the task and relevant time frame, the data communications process needs knowledge about, and must interact with, other systems processes. For example, system response time is affected by both the data communications sub-system and by the CPU sub-system.

The data communication process interacts with these elements with an intensity that is proportional primarily to the time frame relevant to the problem or task that is being “processed”. Specifically:

<table>
<thead>
<tr>
<th>Time Frame</th>
<th>Element</th>
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<tbody>
<tr>
<td>Short Term:</td>
<td>Tools</td>
</tr>
<tr>
<td>Medium Term:</td>
<td>Tools and User</td>
</tr>
<tr>
<td>Long Term:</td>
<td>Tools, User and Other Sub-systems</td>
</tr>
</tbody>
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To see this more clearly, the data communications process must be viewed with respect to the planning process discussed below. A major thesis discussed later is that it is very sensible for the data communications staff to do their own short range planning, but that medium range planning requires interaction with user planning activities, and that long range planning only makes sense from a total systems standpoint.

THE PLANNING PROCESS

The planning process has been arbitrarily divided into short range, medium range, and long range. A case could be made for combining the latter two, but I believe there is a significant shift of emphasis. The three different planning processes can be usefully characterized by differences in data communications element interactions, goals, degree of uncertainty, constraints, and technology.

Short range

1. Process Interaction. The primary element involved here is the use of tools to solve very specific, limited tasks involving day-to-day operations.
2. Goal. The goal is narrow, simply to make the system work.
3. Uncertainty. Relatively little. No system or structural changes. Dealing with well defined parameters.
4. Constraints. Highly constrained; few alternatives. At most, a process of “fine tuning”, eg: changing a few lines in the network, software maintenance, etc.
5. Technology. Technology well in hand; at most, unit substitutions possible, eg: a new modem.

Medium range

1. Process Interaction. Now problems are beginning to be anticipated, and more interaction with the user element is required. For example, traffic volumes are increasing. The user is the best judge of “how much”
2. Goal. Here the goal is to keep the system working under the stress of change. Changes confined to subsystem optimization and cost minimization, no major system capabilities altered.
3. Uncertainty. Since we are now looking ahead, solutions must be examined for sensitivity to changes in assumptions. What if traffic grows faster than anticipated? What will be the actual costs of a new device one year from now?
4. Constraints. More choices possible, perhaps some intersub-system optimization possible. For example, use of higher speed lines would result in cheaper networks which could be traded against possible new terminals. However, no major system changes likely.
5. Technology. Now feasible to examine technological change. For example, the use of concentrators in the network, or a communications front-end at the CPU.

Long range

1. Process Interaction. Now not only the user and tools are involved, but heavy interactions with all other subsystems is required. Consideration must be given to the tradeoffs and optimizations viewed from the end-to-end system as a whole.
2. Goal. Here the goal is not only maintenance and cost minimization, but can include benefits expected from major data processing architectural developments expected. View is data processing system oriented rather than data communications, operating system, etc.
3. Uncertainty. High. Planning consists of projecting numerous alternative scenarios. Each sub-system technology regards developments in every other subsystem as more uncertain than their own. Business intangibles must be considered.
5. Technology. Limited only to the degree to which the state-of-the-art is pursued. System design must consider all meaningful developments in each subsystem, their interactions, and architectural consequences.

ORGANIZATIONAL CONSIDERATIONS

When considering the technical planning process, it would be insufficient to address only technological issues, for the process is really a highly interdependent relationship of technology and organizations. Weakness in either area can cause planning to be ineffective.

Technical planning can be thought of as the application of technological tools to problems through organizational design.

Technology
—Provides tools for analysis
—Provides methodology for applying tools

Organization
—Provides structure for applying tools and methodology to problems.
Indeed, organizational design can significantly influence whether problems are diagnosed or identified at all.

The broad question of how to organize the data processing function in organizations has been treated elsewhere. The viewpoint taken here is that of a data processing technical support group organized as a service function serving line business operations. Such an arrangement is common in large multidivisional companies. Figure 2 illustrates this type of relationship. Within this support group are found the technical subsystem specialties necessary to support the broad data processing function, including the data communications specialty. Such an organizational approach enhances communications among the subsystem technicians, but creates barriers between these specialties and the user. These barriers are a major cause of difficulties in planning.

Thompson has shown that most organizational designs manifest one characteristic in common. They establish special organizational units to deal with the major business environmental contingencies. More generally, organizations faced with heterogeneous task environments seek to identify homogeneous segments and establish structural units to deal with each. Thus, an effective method bridging the barriers created by one way of organizing the data processing support function is the creation of ad hoc methods of communication directly between technical subsystem specialists and the user. Special service representatives, committees, and lunch conversations are all used for this purpose. The surmounting of the barriers between support groups and the user is a primary necessity for effective medium and long range planning.

**DISCUSSION**

With the above framework for analysis in mind, some problems relating to planning that have been found to be common in numerous organizations are discussed below.

**Short range: Tools**

1. **System Models.** Amazing as it may seem, many organizations operating large, expensive, and complex teleprocessing systems and networks have no useful quantitative understanding of how their systems work and where bottlenecks will occur with rising transaction volumes. Often the lack of a model results from inappropriate attempts to build one. Advanced planning requires the ability to examine many assumptions, yet many complex teleprocessing system modeling efforts misuse simulation techniques, resulting in unwieldy and unusable models. An adroit blend of simulation and analysis usually yields better results.

2. **Operating statistics.** The problem with most attempts to collect statistics on the operation of teleprocessing systems is that they generate an overabundance of irrelevant information. The idea seems to be that of creating an infinite pool of data into which a manager could dip and find any information he wants. It is more often a pool in which he drowns. Before any statistics are collected, an explanatory model of the decision process and the system involved in it must be constructed and tested.

3. **Systems Engineering Methodology.** In spite of the profuse occurrence of the term “systems analysis” in the data processing environment, I have found that a fundamental barrier to success in planning has been the lack of appreciation of real systems engineering methodology. The systematic consideration and analysis of total system alternatives is an underdeveloped skill in data processing, particularly in the non-engineering environments of banks, insurance companies, and the like. Sometimes this occurs because of the isolation of the teleprocessing subsystem technicians from each other that can occur in a large organization. Two instances have occurred recently in which the splitting of a massive 370-165 data base into two CPU’s was averted at the last minute, after considerable effort had gone into the procurement process, by improving the response time of the data communications subsystem. This allowed easing of the CPU delay requirement and thus achieved more throughput with much less cost and complexity.

A related problem is the tendency to allow equipment vendors to do systems planning by default. Hardware vendors sell their own hardware, they are not oriented to, or capable of objectively identifying with the user’s goals. For organizations operating large and extensive systems to ask hardware vendors to propose system designs, as is often done, is to transfer the most crucial systems decisions to a party least capable of making them.

![Figure 2—Typical data processing support organization](From the collection of the Computer History Museum (www.computerhistory.org))
Medium range: The user

1. User Interaction. The ability to anticipate user requirements and developments rather than simply react to them depends, to a large degree, on a sophisticated understanding of the user business and data processing environment by the data communications staff. (Of course, the same is true for the other subsystem specialties, but because of its nature, the data communications subsystem is usually the most dynamic, and thus, needs to be more closely attuned to the user.) This understanding can only be obtained by the personal interaction of the data communications staff with users. Functional isolation and the lack of a broad user viewpoint are deadly to medium and long range planning.

2. Full Costing of Teleprocessing Systems. In a recent situation it was endlessly argued as to what the system response time should be, and it was simply arbitrarily set. Then it was noticed that operators paced their data input by the response time of input edit messages. Full cost analysis of the system showed that an improvement in the data communications network response time was paid many times over by the reduced operator costs associated with higher throughput per operator.

Long range planning

As previously mentioned, it makes little sense to talk about data communications long range planning, because data communications is just one subsystem of a larger data processing system. Effective long range planning must consider so many broad areas of uncertainty that it can only be effectively carried out on an overall systems basis.

In essence long range planning consists of projection and evaluation of possible future data processing architectural postures, given expected developments in: multiprocessing, limits of large processor architecture, operating systems, file management, multi-site operations, resource sharing networks, and business developments. Thus, long range planning for data communications (or any other subsystem) cannot be addressed out of the context of advanced planning for the data processing system in general. And data processing planning is only effective to the extent it is integrated with broad business planning.

As discussed under organizational considerations, ad hoc devices for crossing organizational boundaries are necessary to bring user and technician together for effective long range planning. A common error, however, is to assign the planning function to a special staff who then makes planning recommendations to operating managers. In my experience the success of a planning effort is inversely proportional to the autonomy of the planning staff. The value of planning to managers is more in their participation in the process than consumption of the product.

REFERENCES