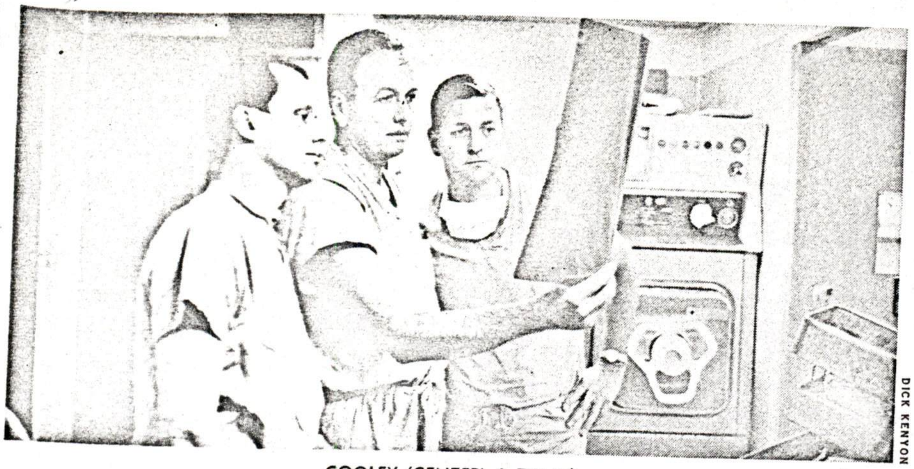
NATIONAL ACADEMY OF SCIENCES
2101 CONSTITUTION AVENUE
WASHINGTON, D.C. 20418

This latest information on the state of our knowledge in this critical element of human intelligence should be of interest to the Board Members in looking forward to the time when an effective functional linkage other than natural language and machine language might be established between the human brain and the electronic brain.

Warren


DICK KENYON

COOLEY (CENTER) & TEAM*
Technically less difficult than many other procedures.

SURGERY

The Hearts of Texas

Eight surgeons on four continents have now performed heart transplants, but the one who stepped most prominently last week from under the nonglare lights of his operating theater into the spotlight of world attention was a tall Texan, Denton Arthur Cooley, 47. The mere fact that Dr. Cooley did three heart transplants within five days was a notable achievement. To Cooley himself, this was incidental and to some extent accidental—the timing of transplants depends on having suitable donors and recipients available simultaneously. The operations, says Cooley, are technically less difficult than many other open-heart procedures, of which he has performed no fewer than 4,000.

Son of a Houston dentist, Cooley starred in basketball and made Phi Beta Kappa at the University of Texas. After getting his M.D. degree at Johns Hopkins University, he stayed on as an intern and resident at the Hopkins' University Hospitals and served as what he calls "a very junior assistant" to the great surgeon Alfred Blalock, who was soon to perform the world's first blue-baby operations. That association determined Cooley's future course, and he has been a heart man ever since.

Miniaturized Surgery. After a year in London working with Britain's noted heart surgeon Lord Brock, Cooley returned to his native Houston and was associated at Baylor University College of Medicine with Surgeon Michael E. DeBakey (TIME cover, May 28, 1965). The DeBakey-Cooley team at Methodist Hospital pioneered many innovations in heart surgery before Cooley moved next door to St. Luke's Episcopal Hospital, which is also affiliated with Baylor. There he has established an independent reputation as one of the greatest of heart surgeons and almost certainly the world's greatest in the incredibly difficult miniaturized surgery on hearts of infants. He has performed at least 1,000 open-heart operations on babies less than one year old.

Cooley is a demon for speed. In his first heart transplant, he performed the actual implantation of the donor organ in Everett C. Thomas' chest in 31 min. His second, for Recipient James B. Cobb, took 42 min. Cooley's third transplant, which took about 30 min., raised a legal question. The heart came from Clarence Nicks, 32, who died after being beaten in a barroom brawl. Nicks showed no brain-wave activity and had had no reflexes for hours before his doctors shut off the machine that had been oxygenating the blood in his lungs. There was, therefore, no question that Nicks was legally dead. But since he had been involved in what could become a prosecution for homicide, his body was technically evidence. In Texas, it is illegal to put "evidentiary material" beyond the reach of a prosecutor—and that would include Nicks's heart, which would certainly be beyond reach inside a transplant patient's chest. Anticipating the problem, Cooley had a talk with the county medical examiner, who finally agreed to take no action under this provision. Only then did Cooley give Nicks's heart to John Stuckwish, 62, of Alpine, Texas.

Of Cooley's three patients, Thomas continued to make good progress a week after his transplant; Stuckwish, at week's end, was still battling for life. Cobb died 2½ days after the operation, of obscure causes. But it was certainly not because his new heart had failed. It was in such good condition, said Cooley, that he would have transplanted it to a second patient if a suitable recipient had been available.

* Left, Dr. Grady L. Hallman Jr.; Right, Dr. Robert D. Bloodwell.

NEUROLOGY

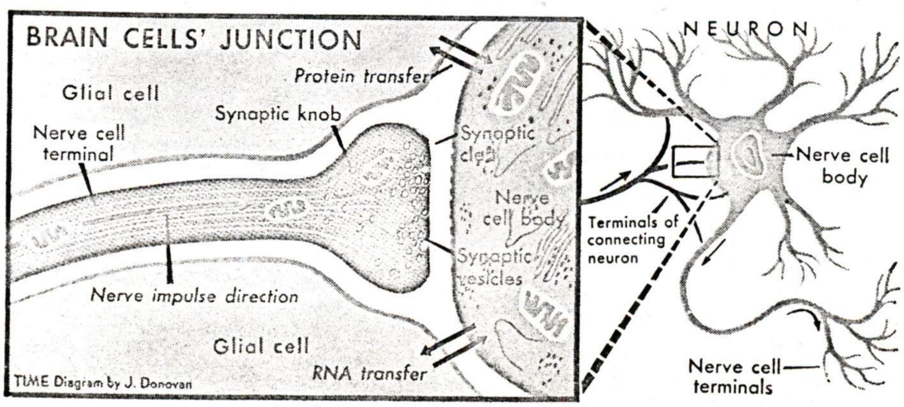
The Chemistry of Learning

Man has been developing his brain for a million years or more, but only in the past seven years has research into its workings assumed significant dimensions. Last week in Manhattan, 70 of the world's leading experts on brain processes met at a New York Academy of Medicine symposium sponsored jointly by the Manfred Sakel Institute* and the Foundation for Research on the Nervous System. In sum, what the researchers had to say was that when brains work, the reaction is chemical—and complex.

Study in man is vastly complicated by the fact that the human brain contains an estimated 10 billion nerve cells called neurons, and another 100 billion of a second type called glial cells. The fluid bath in which they are suspended is an important element in their electrochemical interactions. Moreover, said Sweden's Dr. Holger Hydén, one big neuron may have on its surface as many as 10,000 points of contact (synaptic knobs) with other neurons (*see chart*). But by means of exquisitely delicate instrumentation and an electron microscope, Dr. Hydén has discovered that when human neurons are stimulated, some of the millions of ribonucleic-acid (RNA) molecules inside them give orders to the glial cells to manufacture new proteins. The nature and pattern of these proteins contain an imprint of something that has been perceived, and may become a part of a memory.

Pecking Order. The reaction is more readily observable in animals, Hydén reported. When a normally lefthanded rat was forced to learn to use his right paw to get food out of a tube, cells in the most highly developed part of the brain (the cortex) produced a special kind of RNA as well as proteins. A similar thing happened in goldfish that were

* Named for the doctor who accidentally helped to open the door to research in brain chemistry in 1928 by discovering that overdoses of insulin can drastically alter the course of some mental illnesses.



forced to learn a new kind of swimming by having buoyant plastic foam stuck under their chins by Dr. Victor Shashoua of M.I.T. Fish that Dr. Shashoua made work just as hard swimming against a current, but without learning anything new, did not produce extra RNA.

Dr. Samuel Bogoch of Boston's Foundation for Research on the Nervous System taught pigeons to peck a particular button to get a kernel of corn from a machine. He found that the chemical brain reaction was not only the creation of new brain protein, but protein-sugar combinations (mucoids) as well. Until three years ago, said Dr. Bogoch, only 20% of the brain's proteins had been identified. This has now been raised to 60%, and those known are divided into 16 groups. Two of these groups show a marked, though brief, increase when a pigeon learns his pecking order; the increase in a third group lasts longer—from three to eleven months. From his observations, Bogoch postulates that memory is encoded in the protein-sugar combinations. As indirect proof, he has found that drugs that prevent the formation of body sugars also impair the memories of trained animals.

Nonsense Protein? Increasingly, researchers at the conference tended to make a sharp distinction between long- and short-term memory—in other words, the difference between a man's ability to remember a poem learned in grammar school and his inability, for the life of him, to remember the name of the fellow he met at lunch yesterday. Sweden's Dr. Hydén felt that the creation of protein (as in pigeons, rats and goldfish) is essential to man's formation of long-term memories. Human brain cells, said Hydén, seldom divide and replace themselves as do most other cells in the body. The neurons that a child has at six years must last him a lifetime. As he ages, some of them become damaged or die, so the brain's output of RNA in learning situations is decreased.

The brain's RNA and protein production are originally determined by deoxyribonucleic acid (the DNA of Biochemist James Watson's bestselling *The Double Helix*) that is established in the embryo by the sex cells at the time of conception. There is evidence, said Hydén, that the DNA in an old animal differs from that in a young one—and the same is true, presumably, in man. Here, Hydén opened the door a chink for a glimpse into an admittedly far-out future. If a reasonably pure extract of brain DNA is injected into some animals, he said, their protein synthesis doubles within an hour. But he was careful to insist: "This does not mean that an elixir of life has been found." Hard facts remaining to be determined, he said, are whether this is a "functionally valuable or a nonsense protein," and whether the effect will last for days, hours or years.

NOTES FROM THE GROVES OF ACADEME

[From the Bulletin of the American Association of University Professors]

III. THE INCIDENT OF MARCH 19, 1963

Prior to the formal call to order of the meeting of the Research and Computer Committee, there appears to have been some discussion of the academic degrees which, desirably, should be held by the Director of a contemplated Research Bureau in the Division. Apparently Professor Metzger advocated either a Ph.D. in Economics or a doctorate in Business Administration. Professor Metzger does not hold a doctor's degree; Professor Gregory has a doctorate in Education. These facts gave emotional coloring to the discussion but their force is not clear from the available evidence. In any event, the discussion of the same topic continued in the official session and at one point Professor Metzger walked around a table to show a college catalogue to Professor Gregory.

Gregory said to Metzger "stop this blah;" he may have said "stop this blah, blah, blah." Gregory then said to Metzger "sit down." Gregory alleges that Metzger replied "I'll knock you down." Metzger contends he said "I'll not sit down." Gregory said "hit me." Gregory stood up. The bodies of the two men were in contact with some degree of pressure at some point or points, but the situation is not clear because of contradictions, the differences of physical point of view of the witnesses, the difference of about five inches in the height of the principals (Metzger about five, ten—Gregory about six, three), and uncertainty as to whether the pressures exerted were intentional or caused by a crowded disposition of table and chairs in the area involved. A bow of Professor Gregory's glasses either was merely separated from the main frame or was separated and then also broken; the glasses became involved because Gregory took them off about the time he said "hit me," as a precaution, or as a challenge, or for some other reason. They then fell off a table where they had been put, or Professor Metzger accidentally or on purpose knocked them off the table. The testimony embodies some contradictions which are perhaps unresolvable.

Washington Post - 8/5/68. Page A-2.

Big Brother?

Privacy Guard Sought In National Data Bank

Associated Press

A House committee recommended yesterday that no work be done to establish a proposed national data bank until privacy protection is researched and guaranteed to the greatest extent possible to the citizens whose personal records would form its base.

"A suffocating sense of surveilance, represented by instantaneously retrievable, derogatory or noncontextual data is not an atmosphere in which freedom can long survive," the report says.

"While computerized data banks hold great promise, they must contain procedures which can assure the continuation of freedom of thought and action that is such a vital part of the American tradition," says a report released yesterday.

The report, "Privacy and the National Data Bank Concept," is based on a two-year study by the special subcommittee on invasion of privacy of the House Government Operations Committee, headed by Chairman Cornelius E. Gallagher (D-N.J.).

The report notes that the Budget Bureau has under consideration the establishment of a National Data Center whose use would be limited to compiling statistical aggregates.

Charles J. Zwick, the bureau's director, indicated recommendations to Congress may come next year.

The House committee said, however, studies and testimony indicate the Budget Bureau does not have well thought-out theoretical or practical procedures necessary to assure privacy.

Save for Trip to Calif

NATIONAL ACADEMY OF SCIENCES

2101 CONSTITUTION AVENUE
WASHINGTON, D.C. 20418

TO: Warren House

FROM: Tony Oettinger

DATE: November 19, 1968

I am enclosing a paper called "The 'Soft' Factors in Systems Studies" which I ran across in the Bulletin of the Atomic Scientists. I think you will find it fascinating. You should certainly send a copy to John Griffith and if you think it worthwhile also to the members of the Board.

js

Nov 26,1968

Tony,

Suspect this writer has a general proposition somewhat more strong than the support he marshalls for it. For example, his rather strictured definition of the reason for establishing NATO. He sounds a little bit like a man who read about that one, rather than lived through it. His paper is loaded with "invisible" assumptions similar to those he cites "systems" writers for having. However, he lifts the corners on several rugs in national decision making that ought to be lifted a bit further. Off we go to all Board members.

Warren...

The "Soft" Factors in Systems Studies

JAMES R. SCHLESINGER

The author discusses the fact that a number of U.S. policy failures may be attributable to the limitation of military systems studies and the manner in which policymakers use them.

Dr. Schlesinger is Director of Strategic Studies at The Rand Corporation, Santa Monica, California; an analyst of weaponry and defense management in the nuclear age; and a consultant to the Bureau of the Budget and other government agencies on certain aspects of national security programs. The author's views are his own.

Systematic use of quantitative analyses over the past six years has substantially enhanced the effectiveness with which resources are invested in U.S. military forces. In this limited sense, at least, there is little question that the usefulness of analytical techniques has been amply demonstrated. Yet, in this same period a number of prominent policy failures have occurred, and it is sometimes suggested that some of these failures are attributable to the narrow range of factors incorporated in military systems studies and to the single-mindedness with which the conclusions of such studies are implemented by policymakers. Inevitably the primary concern is with those "soft" social and political factors which admittedly are neglected.

We will deal with three major themes. First, in military systems studies the self-imposed limitation of playing down the broader political factors is defensible up to a point in the attempt to deal with a critical *portion* of the overall problem. Starting with the accepted "political wisdom" may so corrupt the analysis that one never understands some of the fundamentals. Second, the chief difficulties arise in the transition from these "suboptimized" analytical studies to decisionmaking. In this respect analysts may have been remiss in failing to appreciate the crucial role of bureaucratic structures. Third, all important system studies—even when stated to be limited and "suboptimized"—inevitably incorporate a number of non-technical assumptions, though typically in a tangential and implicit fashion. Without careful examination of the non-technical factors, adopting the conclusions of such specialized studies may be detrimental to national policy.

THE SEMI-ORTHODOX POSITION

Whenever one considers the entire complex of decisionmaking, it is apparent that everything is ultimately related to everything else: the ramifications of a single issue spread out to other issues. What appears at one level to be a precise and dominating objective becomes, as one moves to higher order problems, only one of several alternative inputs, and the choice among them becomes dependent on higher order objectives. The layering and tying of issues makes the *fully complete* analytical treatment of a policy problem infeasible, for there occurs an exponential growth in its complexity and cumbersomeness. In principle, policy formation would require the solution of an infinite number of simultaneous equations, a large proportion of which are unknowable and almost all of which must inevitably lie outside the attention span of a single human mind.

One cannot do everything at once. To attempt to do so is the road to analytical impotence. The point is to start somewhere: and the most productive place to start is with those elements which are fundamental to the final results and which are relatively easy to manipulate.

In analytical work this is taken to imply the so-called hard elements—hard in the sense of being susceptible to measurement rather than in the sense of being intractable. (In this latter sense the political or organizational factors are undoubtedly the most difficult of all.) One begins with the elements of technology, cost, and —admittedly inadequate—measures of output or effectiveness, for these provide an easy-to-grab handle to the problem. The underlying premise is that the economic factor—seemingly implicit in the phrase, cost-effectiveness—should outweigh political, social, and other factors.

Within the original scope of the analysis, these last are often given zero weight. While such a procedure is clearly acceptable for lower-order instrumental problems, it is apparent that for higher-order strategies or policies it becomes increasingly questionable. For higher-order problems the measure of effectiveness must be based on some broad strategic criteria, in which political or psychological assessments unavoidably play a role. And, even in straightforward hardware studies, the "effectiveness" concept is likely to be tainted by political estimates that make up the overall strategy. It is fervently, if secretly, hoped that these "soft" elements will have a minimum effect on the results.

It is not always recognized that the conventional procedure for delimiting the problem may also help to reduce the risk of gross error. Good reasons do exist for avoiding the soft elements at the outset. Political assessments, for example, are based on opinions which may fluctuate wildly with changes in fashion. What is worse, they may rest on the gossamer support provided by intuition, whose range and variety are limited only by the number of people involved. To the extent that intuitions converge, the focal point tends to be some sort of unchallengeable political myth—impervious to the adjustments required by changing circumstances.

Thus, aside from the difficulty of absorbing political factors into analyses, a powerful reason for exclusion in the early stages is the characteristically low quality of available political inputs. Not only is sophisticated political insight rare, it is usually unavailable to those doing the studies. What is available turns out, frequently as not, to be demonstrably wrong—despite the many evasive techniques used to rationalize past mistakes. When so-called political insight turns out to be a collection of Delphic utterances, subject to "reinterpretation" over time, it becomes a dubious foundation for analysis.

In the realm of the political myth, premature use of political inputs is likely to introduce the type of stodgy or obsolescent ideas produced by "wise men." The classic and frequently derided example is provided by "old China hands," but "old X hands" provides a better clue to the generic case. The underlying premise in such assessments is that the best guide to the future is some mild perturbation of previous experience, sometimes highly limited and subjective. But in a world characterized by high-speed communications, by the ability to mobilize resources rapidly, by changing technologies, and by the possibility of rapid development of impressive new capabilities, reliance on ossified "political wisdom" may lead to irrelevant, and possibly disastrous, conclusions.

The record of achievement by these means is very spotty indeed. To choose one of the most responsible and highly commended examples: the United States' decision to organize Nato was based on some rather obsolescent notions regarding the strength of the European nations and the direct contribution that they could make to the security of the United States. There was a striking failure to anticipate the revolutionary impact that nuclear forces would have on earlier beliefs regarding European defense. Not recognizing how dominant the strategic nuclear balance was to be in both American and European security, the United States attempted to organize European defense in the traditional pattern of the grand coalition. The need for free nations to "stand together" in a sacramental bond against tyranny had been learned by the United States in the two world wars.

Since imitation is the sincerest form of flattery, we may have been flattered by the Soviets' establishing a similar structure in the East, but it has become increasingly apparent that both alliances are façades, barely masking the overwhelming dominance of each by a single partner—a dominance which, in the Nato case, the prevailing political wisdom conspicuously failed to predict and still may fail fully to recognize. Putting aside Nato's political desirability, its military relevance is entirely different from what was anticipated. Over the years the total loss resulting from the misallocation of resources to and within Nato has been impressive, and the waste reflects in no small part the faulty original concepts. It is a striking case in which more effective forces could have been obtained at far lower cost—if there had been continuing force structure analyses that initially excluded the soft political factors and their accompanying shibboleths.

Though one may reasonably conclude from such experiences that the standard methodology—with its initial concentration on the hard elements—is defensible in principle, it should simultaneously be emphasized that the initial exclusion of the soft factors is not intended to lead to their permanent exclusion. Sensible analysts have always recognized that the deciding factors frequently go beyond those incorporated in the analysis and that the decisionmaker should therefore supplement the original analysis with the excluded considerations in reaching his decision. Analysts do recognize the limitations of analyses. That these limitations have not been typically stressed reflects a common conviction that the real world is overrun with political or bureaucratic pressures making it improbable that analytical efforts will be pushed too far without political review. The danger, it is believed, lies in analysis being ignored rather than sweeping all before it. That the defense may be justified, however, hardly contributes to the elimination of the problem.

BUREAUCRATIC BEHAVIOR

The assumption, made almost casually, that the appropriate adjustments will be done later does represent a serious pitfall in analytical work. There is some element of irresponsibility in ignoring how studies may subsequently be used or manhandled in the bureaucracy. While it is not their primary role, analysts must pay attention to organizational complexities. This might even lead to a more satisfactory accommodation between their own efforts and institutional reality.

There are pressing reasons for studying this problem. Most obvious, in light of the way bureaucracies work, a careful technical study is likely to become a departmental position. The department may regard its responsibilities as limited, and advocate a policy optimized solely for cost, economic, and technical factors. It then assumes that the responsibility for considering other elements lies with other departments. If the bureaucratic position of the first department is sufficiently powerful it may carry the day with its recommendation without receiving the review that the department itself considered necessary. Something of this sort seems to have occurred in the case of Skybolt, where the strongest forces that emerged supported a strictly technical analysis, with insufficient political coordination taking place after the decision.

Increasing the awareness of bureaucratic behavior is important for a more fundamental reason—one which transcends purely internal policymaking and bears upon the threats or the cooperation expected from other nations. In the bulk of systems-analytic work there has been an underlying premise that policy is determined by a single deciding unit. Yet, in developing alternatives for a large organization or in predicting the behavior of other organizations, the assumption is invalid. Within the government the unit to which advice is tendered will typically lack control over the resources included in the study—and may even lack knowledge of the activities and objectives of supposedly cooperating units. The results may be particularly deficient when the advice is tendered either directly or indirectly to a committee of equals or to an alliance. Given the resistance and the bargaining which is inevitable in light of the disparity of objectives, perspectives, and information, the results will diverge sharply from those anticipated on the basis of presumed rationality and single-minded efficiency.

It is remarkable how little serious work has been done on the bureaucratic aspects of national decision-making. On the level of political gossip, almost everyone accepts the importance of factional conflict; we associate particular causes with particular individuals and groups and carefully watch who is rising and falling. Yet, whenever an attempt at prediction is made, it becomes convenient, emotionally satisfying, and possibly bureaucratically rewarding to fall back on a monolithic interpretation of what that abstraction—"the government"—should or will do. This tendency is even more formidable for the other national actors on the international stage. Whatever their disciplinary backgrounds, analysts typically treat policymaking in other nations as if it were governed by a rational and unified deciding unit.

The reality is quite different. Decisions are nominally made by senior political figures who are harried, have insufficient time to study problems in detail, who are gripped by emotions of their youth or by prior experiences, and who are susceptible to claims made by subordinate groups which are couched in a way to appeal to their prejudices. Below them are a set of mutually jealous and warring bureaucratic groups, clamoring for resources and anxious to protect established preserves. To the extent that they are not closely watched, the subordinate bureaucratic groups will attempt to achieve their objectives quietly or even surreptitiously. Moreover, their capacity for resistance to high-level objectives enunciated from above, but to which they take exception, is breathtaking. Actual programs and allocative decisions will consequently diverge quite sharply from those that would be predicted on the assumption of a rational intelligence. Instead they will be strongly influenced by prejudice, incompetency, and by infighting, deviousness, and bootlegging within the bureaucracies. Changes which appear rational and desirable will be

> *"Since our last Conference, an historic treaty to guard against the further spread of nuclear weapons has been negotiated and signed by more than 80 nations. The factors that make the nonproliferation treaty so essential also indicate that we are about to derive benefits from the atom that were undreamed of when Enrico Fermi and his team started the first chain reaction. The advances being achieved today in the nuclear field can only have a salutary and exciting effect on this organization. During recent years, nuclear power plants have become commercially available in sizes up to 1,200 electrical megawatts capacity. Such units are being selected as additions to utility systems, both in the United States and in other countries."*
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> —Glenn T. Seaborg, chairman of the U.S. Atomic Energy Commission at the Twelfth General Conference, International Atomic Energy Agency, Vienna, September 25, 1968.

compromised half to death, and the compromises themselves will be slow in coming. Traumatic events—like Sputnik, an initial nuclear detonation, or the invasion of Korea—may speed up the process of change, but the capacity for resistance will remain formidable.

Statements on national policy provide only a superficial and basically misleading indicator of probable change. The decisive battleground in the competition between new proposals and continuing programs is not on the level of ideas but on the level of budgets. New ideas may be accepted in principle (to resist openly may be politically imprudent). The national leadership may believe it has endorsed a new concept and may believe that a program is being implemented. But the place for the established bureaucracies to cut ambitious new programs down to size is in the budgetary infighting. It is a truism that the demand for resources far exceeds the supply. Radical cuts in old programs are rare. In the face of the established programs, which may become masked under imitative labels, it is difficult for a new program to secure and expand upon its Darwinian niche in the budget structure. Even when a program is objectively obsolescent, its established position indicates that it satisfies some deep-seated emotion in the society. New, if fraudulent, stories can be cooked up to play on the old emotions—and thereby to preserve or expand an organization's historical share of resources. New growths find it tough going in a badly weeded garden.

To ignore these realities of bureaucratic life will repeatedly lead the analyst into error. The excuse that "the best laid schemes of mice and men gang aft a-gley" seems singularly inappropriate; the neglect of the real character of the environment implies that the plans may be the worst laid. In this light one might consider a number of historical examples. One fascinating case was the attempt to extract expanded conventional forces from our European allies in the 1961–62 period—with little appreciation of the real structure of Nato or the divergency of interest and attitude among its members or their component bureaucracies including the U.S. military. In fact, given the need to obtain approval from the North Atlantic Council, even obtaining a *formal* change in Nato strategy involves far greater resistance than one would anticipate on the premise that the decision will reflect the members' collective interest.

Considerations of feasibility ought not lead into simple accommodation to the status quo. But analyses might prove to be more useful, if supplemented by an understanding of the organizational barriers to their implementation. Rational resource allocation may be the proper initial benchmark, but study variants should also be prepared which take organizational feasibility into account. Only in this way might one have some confidence in designing alternatives, which are both superior and feasible. The seemingly second-best solution may actually be the preferred one. Without organizational analysis the nominal best may remain the enemy of the good, for reasons more subtle than perfectionism.

OPPONENT RESPONSE

However strong the desire to minimize the role of soft factors, their introduction cannot be avoided in analyses at the highest strategic level. Some measure of effectiveness must be designed to compare alternatives, but any serious measure of effectiveness inevitably becomes tainted by the political or psychological assessments that make up overall strategy. Unless the system being dealt with is purely instrumental, overall systems effectiveness is dependent upon the response of the opponent. Instrumental capabilities are useful in certain specific roles, not in others. Unless an opponent can be disarmed or his powers of resistance crushed, this simple fact must be recognized: it will ultimately be necessary to have to have recourse to policy which, to turn Clausewitz on his head, is a continuation of conflict by other means.

Only when a disarming strategy is feasible, can the application of force remove most of the burden from policy and policy assessment. (Even in such cases there is no indication that to rely completely on force—unconditional surrender—is the wiser strategy; it is only a feasible one.) While such cases are never perfectly clear-cut, they are sufficiently different to be distinguishable from those in which policy assessment becomes the heart of the problem. To cite a straightforward example: in the fifties a nuclear war waged

A STAFF NOTE

A change in the managerial staff of the Bulletin under the overall direction of Eugene Rabinowitch, editor-in-chief, takes effect this month. Ruth Adams, editor, has resigned to join her husband, Robert McCormick Adams, Jr., on a long-term, anthropological expedition in the Middle East. Her duties at the Bulletin have been assumed by Richard S. Lewis, former science editor of the Chicago Sun-Times, who has contributed to the Bulletin as an author and as a member of the Editorial Board. Mrs. Adams has worked with Dr. Rabinowitch for the last fourteen years in developing the Bulletin as one of the world's most highly respected and often-quoted journals of science and public affairs. In terminating her duties as editor, however, Mrs. Adams has agreed to continue contributing to the Bulletin as a roving, international correspondent. She will report on trends in science and politics in Europe and Western Asia. The Bulletin's policies and standard of excellence will continue unchanged under the supervision of Dr. Rabinowitch.

against the Soviet Union might have sufficiently disarmed the Soviets that they would have become susceptible to our pressures. However, the buildup of Soviet forces in the sixties has been such that we must carefully consider how the Soviets might employ their residual forces. As a result, any projection of a nuclear war and any plan for conducting such a war must rest on a highly subjective assessment of enemy responses.

Of more immediate concern, in an engagement such as that in Vietnam, we should now be painfully aware that relying on military analyses which ignore the organization and psychology of the foe and of the population he desires to control is likely to be the basis of continuing self-deception. It has become almost a bromide that in Vietnam "the political factor is dominant." Yet, consider the unsatisfactory set of mechanical indicators of military performance—and the inconsistent way in which these mechanical criteria are applied.

To be sure, neither these specific criteria nor overall performance in Vietnam should be blamed on serious analytical efforts. Vietnam reflects more the *absence* than the *failure* of analysis. From the standpoint of systems analysis, it represents almost an anthology of classic errors. Sub-analytic urges of a highly traditional sort have encouraged conceptualizing the war as one of attrition—and of *manpower* attrition at that. The existing indicators reflect this faulty image. To choose a single example, the use of "body count" has been intended to provide hard evidence of enemy mortalities—though some question persists regarding the count's accuracy. (The circumstances are hardly such as to invite careful statistical procedures.) Nonetheless an estimate can be made of relative casualties, and this is presumed to be a revealing figure.

Several questions may be raised. First, why is the ratio of casualties supposed to be dramatically revealing, yet the ratio of costs (in Vietnam alone) has no significance at all? (On other issues such as ABM deployment, cost ratios are presumed to indicate what is worthwhile or not worthwhile for Americans or for Russians.) Currently in Vietnam cost ratios may favor our opponents at something like 15:1, a level which certainly has been regarded as precluding other lines of activity. While in this case we may prefer to ignore cost ratios, we would be ill advised to assume that other members of the international audience are similarly ignoring these unfavorable ratios.

Second, more is involved than sacrifices alone. It is apparent that when something is sufficiently important to us we are prepared to jettison calculations on cost ratios. Since their undertakings are important to them, our opponents in Vietnam may be equally prepared to disregard *casualty* ratios. They may be buoying up their spirits by contemplating cost ratios, and gloating over the number of dollars it costs us for each dollar that they invest. For example, a table which appears in *The People of Vietnam Will Triumph! U.S. Aggressors Will be Defeated!* (Peking: Foreign Languages Press, 1965) indicates the brilliant victories against the imperialists through the destruction of planes, ships, vehicles, trains, and structures. One moral is clear: the valuations placed by each side of the outcome are more important than ratios, per se. High valuation of an objective may make unfavorable cost ratios inconsequential, whereas low valuation may make the cost favorable ratios wholly unsatisfactory.

Third, ratios alone are a poor indicator of overall sacrifices. Even in terms of casualties it is scale rather than loss ratios that is critical. It is absolute losses that determine how long the insurgent forces can maintain the size, cohesion, and effectiveness of their units. To analyze staying power is a tricky problem involving estimates of motivation, dedication, and inherent capacity of enemy manpower. And these too are essentially soft factors.

Similar issues crop up with respect to European defense. Differences regarding strategies both within the United States and among the members of Nato reflect in large part different assessments of the potential foe. The present complacence in Europe reflects the position, held more strongly there than here, that the Soviets are just not very aggressive and the detente is here to stay. An earlier, widely advertised European opinion regarding a strategy of immediate nuclear response reflected a particular view of Soviet character and Soviet ambitions. It was held that the Soviets would put sufficient credence in the threat to be deterred. The Americans have been more inclined to fear that the Soviets could be adventurous, and, since this was a possibility, we are more eager to obtain capabilities that we would not be afraid to use or that would not necessarily crumble. Part of European resistance to the buildup of conventional forces, and European disinclination to accept American manpower and equipment estimates, reflect a vastly different picture of the consequences of an engagement in Central Europe. European experiences with multi-national forces have not been reassuring. Some Nato members recall that Allied forces on the Western front in 1940 were equal in number to the German forces, yet they were simply swept away. With basic disagreement regarding the potential of one's own side and the foe, it is hardly surprising that different strategic judgments are reached.

At a higher level of violence, suppose the United States were forced to consider retaliation against Soviet territory—because of an invasion of Europe, for example. Should a time-urgent attack be inaugurated against the main elements of the Soviet strategic forces or should one start with very modest, essentially demonstrative, attacks, hoping that the Soviets will cease their provocation? Perhaps the critical element is whether one believes that a heavy time-urgent attack would automatically trigger Soviet retaliatory forces against our cities—and whether a much lower-level attack would or would not elicit the same Soviet response. These questions are difficult, not only because Soviet intentions remain obscure and little light is shed on them by Soviet declarations, possibly issued with intent to deceive, but also because the Soviets themselves may not know how they should behave in such a contingency. Knowing your enemy becomes particularly challenging if the enemy does not know himself.

Strategy depends on the image of the foe. At one time the accepted image of the Soviets seemed close to "commie rats who only understand force." Since the Kennedy years it has become more fashionable to accept an image in which the Soviet opposite numbers of our more optimistic officials are just as urbane, as civilized, and as intent on the eradication of differences. Neither of these images, however, would seem fully to represent the character of Soviet society. Soviet behavior, no less than our own, is subject, not only to gradual alteration over time, but to oscillation as well. For the foreseeable future, we would be as ill advised to base our policies on the belief that the Soviets are inherently peace-loving, as on the premise that they are inherently and ideologically aggressive.

Such shifts in the assessment of the foe are likely to have considerable impact on decisions—even research and development decisions. For example, certain types of weapons development have been rejected because of the intuitive feeling of the decisionmaker that such capabilities would create arms control difficulties and intensify the arms race. There is, of course, nothing inherently wrong with basing decisions on such values. What is desirable, however, is that decisions not be made intuitively, and that political assumptions be analyzed explicitly—in relation to the relevant data and conditions—rather than accepted implicitly. Higher-level analytical efforts normally suggest specific decisions which should be scrutinized on the basis of their political implications. Yet, in moving from a technical analysis to a political decision, it is clearly desirable to go through additional stages of analysis. Before a class of capabilities is rejected as destabilizing, for example, careful analysis should convincingly demonstrate that the arms balance would indeed be upset.

There is a temptation to fuzz up analysis at such controversial points. In political debate one does not wish to admit the existence of speculative imponderables. One prefers to imply that one's opponents are committing incompetent errors because of an inadequate methodology. Unfortunately, systems analysis has provided something of a façade of pure objectivity for political debate. While insiders know better, systems analysis has been presented to the public as an instrument that somehow "solves" problems. The upshot has been to obscure the unavoidable role of political imponderables in decisionmaking, and to discourage analysts from dealing explicitly with these imponderables.

THE INHERENT RISKS

What this discussion has tried to establish is the expanding risk of applying the semi-orthodox methods of systems analysis as one moves up the ladder from low-level decisions and instrumental capabilities to problems which increasingly involve the total society. The chances that really excellent studies may result in misleading policy decisions increase greatly. But technical studies are not one's sole support; they ought to be fully supplemented by additional studies on policy issues taking into account a wider range of factors. The point of danger, the point to be carefully watched, but also the point of maximum opportunity, is the one at which the transition occurs from analytical studies to decisionmaking.

Even in this phase the role of traditional analysis is not negligible. Their function is to see that appreciation of the technical factors is not washed away in what may become the emotional catharsis of policymaking.

Nonetheless, there are dangers in a partial view, however well grounded in logic. On the big issues a society's response may be erratic, even compulsive, but the elements of change are likely to be interdependent. The analyst's habits of mind, stressing the disentangling or separating-out of supposedly independent factors, may here be irrelevant under conditions that the premise of *ceteris paribus* does not apply. Realism about policies frequently demands that we recognize when hypothetically separate elements are hopelessly entangled. At such times, the analytical intelligence may point to more options than really exist.

When the nation is caught in some situation, an analyst may study certain alternatives with the intent to improve our position—while assuming that we can back off, if the attempt fails. In such cases the analyst, in his search for options, both exaggerates flexibility and underestimates how the actual exercise of an option may reduce flexibility. When a nation is embarked on some course of action, the sucking-in process may be intensified by the search for improvements. Certain policies—the bombing of North Vietnam, for example—cannot be taken up and discarded on an experimental basis. These are not tools alone, but commitments that influence society's subsequent behavior.

That means and ends may be inseparably linked should come as no surprise to those who are as alert to the *systemic* as to the *analytic* aspect of systems analysis. That there is a momentum inherent in political processes is perhaps less obvious, but it illustrates the ultimate need for grappling with the soft elements. Happily, analysis remains in its infancy. There is much to be learned regarding how better to take the soft factors into account. To the extent that such factors cannot be taken directly into consideration, we are forced to reiterate the final dependence on the sophistication of those decisionmakers who eventually employ the analyses.

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August 19, 1969

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REPORT OF THE SUBPANEL ON COMPUTER TECHNOLOGY

SUMMER CONFERENCE ON COMPUTER EXPORTS

Woods Hole, Massachusetts

July 14-18, 1969

Gerald Mitchell, Chairman of Subpanel

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REPORT OF SUBPANEL ON COMPUTER TECHNOLOGY SUMMER CONFERENCE WOODS HOLE - 1969 - JULY 14 - 18

This Subpanel was a study group of the main Computer Export Panel. The members of this Subpanel are listed in Appendix A.

The group reviewed papers prepared by other groups listed in Appendix B. It was decided that this group should consider all of these but attempt to prepare a new approach rather than make minor modifications of previous studies.

ROUGH DRAFT

The panel considered the possibilities and probabilities of the Eastern European nations and Russia obtaining information necessary to build a high level computer technology. It was concluded that they will ultimately obtain this, particularly as Western European technology improves and our actions can only be to slow or impede while continuing to move ahead in our own technology. From this the following objectives were formulated.

Basic Objective: To limit Eastern Europe's and the Soviet Union's ability to mass produce reliable computer systems.

To implement this basic objective, we have developed the following guidelines to determine the items which should be restricted in export:

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1. Selling computers transfers some technology, particularly in design, but it is felt that the technology transferred by this means is not critical. This also applies to circuit components available on the open market.

2. Licensing (technical aid contracts and subsidary manufacturing agreements) represent the most important method for transfer of critical technology. Long term visitation and exchange for training are particularly vital in the process of transfer of technology.

3. While limiting licensing is desirable, licensing will occur. Therefore, critical technology should be withheld to the extent feasible.

ROUGH DRAFT

4. Technologies in fields other than computer manufacture may also be applicable to computers, i.e., telephone equipment, television, magnetic tape recording, etc. The constraints listed for computer technology should also apply where applicable.

5. We should maintain our present lead in computer technology. The committee adopted as its working hypothesis that processes, manufacturing equipment, testing equipment and quality control methods less than three years old should not be licensed

or sold. Manufacturing facilities older than three years may no longer be available (for sale) and create pressures for obtaining later equipment. Because of the time to deliver, install and make operational, the three-year-old equipment will represent four or five years delay in technology. The time from which the three years is measured is defined as the initial commercial production use of the manufacturing facility.

6. In view of the above items, the group recommends that the denial of critical processes relative to licensing, or technical aid control, be extended over as long a period as practical.

7. All equipment, processes and technologies used exclusively for production of military computer systems should be embargoed.

The group feels that an additional way to establish the technologies that are critical is to require that all technology and items listed above must be made available for licensing to all U. S. companies at the same time they are available to the Eastern European countries and Russia. This idea has not been fully considered, nor has it been examined for legal and other implications.

As Western Europe and Japan develop their indigenous computer technology, either through U. S. subsidiaries, licensing from U. S.

computer and component manufacturers, or their own research, control of the flow of technology will become increasingly difficult.

The group attempted to list those computer elements and technologies which should be considered. These were listed under the processors, memories, peripherals and manufacturing. For future reference these lists are shown under Attachment C.

Using the above objective and guidelines, all of the items on the lists were studied and it was decided that those items listed on Attachment D should not be licensed or the technology transferred by technical aid agreement.

Because of the rapid changes in advancing technologies, it is recommended that this list be reviewed and updated periodically.

G. A. MITCHELL
Chairman

APPENDIX A

Reports Studied

1. "Export Control of Data Processing Equipment to Bloc Countries"

   Paper IV Computer Technology Colloquium

   Matthew G. Degnen - Chairman, Institute for Defense Analysis

2. "Export Controls of Computers to the Soviet Bloc"

   R. A. Finkler - Institute for Defense Analysis

3. "An Economic Analysis of the Export Control of Computers and Computer Technology to Communist Countries"

   Rolf Piekarz - Institute of Defense Analysis

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APPENDIX B

LIST OF SUB-PANEL MEMBERS

Mr. Gerald A. Mitchell — Chairman
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APPENDIX B
(conti.)

Mr. William Lurie (part time, Wednesday)
General Electric Company

Mr. Kenneth Olson (part time, Wednesday)
Digital Equipment Company
Maynard, Massachusetts

APPENDIX C

Items Studied

Processors

1. Electronic Components

    Discrete

        Diodes

        Transistors

            Logic Type

            Power Type

    I/C

        Bipolar

            Saturating Types

            Non-Saturating Types

        MOS

        Gate Level

        Speed

        Diode Arrays

    Film

        Tantalum

            Resistors

            Capacitors

        Thin Film Techniques

        Thick Film Techniques

    Beam Lead Devices

2. Interconnections

Flip Chip

Beam Lead

Wire Bonds

Screened and/or Evaporated Ceramics

Plug-in Connectors

Single Layer and Multilayer Printed Wiring Boards.

Wire Wrap

Mass Soldering

Spot Welding

Ultrasonic Welding

Flat Cables

Power Bussing

3. Packaging

Thermal Dissipation

Conduction

Metal

Liquid

Convection

Evaporative

Structures

Ground Plane Systems

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Memory

All of items listed under processors plus:

- Components
  - Cores
  - Plated Wire
  - Magnetic Thin Film
  - Optical Stores
- Read Only Memory
  - Transformer's
  - MOS
  - Diodes
  - Capacitor
- Twistor
- Semi-conductor Memory Cell

Peripherals

- Extended Memories
  - Cores
  - Wire
  - Optical
  - Magnetic Tape
  - Drum
  - Disk
  - Magnetic Tape Strip

Input/Output Terminals

Teletype

Card Readers/Punch

Graphic Terminals

Plotters

Modems

Printers

Page Readers

Optical Character Readers

Paper Tape Reader/Punch

Film Input

Magnetic Tape

Convertors A/D and D/A

Transaction Terminals

Technology

Materials

Design

Manual

Automated

Processes

APPENDIX C
(conti.)

Manufacturing

Equipment

Material

Quality Control

Testing

Performance

Reliability

Equipment

Strategy

Diagnostics

Application Specifications

Methods or processes of developing applications, specifications and feedback to utilize new inventions and technologies in computer manufacture.

APPENDIX D

Items or technologies not to be licensed or technology transferred by technical aid agreements.

Beam lead manufacturing technology

Flip Chip manufacturing technology

Photo resist technology

"Fly's" eye lenses

Step and repeat machines

Computer controlled pattern generators, software and hardware

Mask making techniques and tools

Diffusion furnaces under three years old

Crystal pullers under three years old

Mask alignment tooling and machines under three years old

Evaporators under three years old

Sputtering machines under three years old

Chrome masks and chorme mask technology

FET I/C technology

Technology for semiconductor devices with $F_t > 1ghz$

Displays, oscilloscopes, recording or pulse generating equipment capable of resolving rise times of two nanoseconds to accuracy better than ± one nanosecond

SIN technology

Hermetic pellet technology

Software for computer controlled test sets

Tantalum thin film technology

Simultaneous multiple wire attachment technology

Ceramic board screening tighter than 8 mil lines with 8 mil spacing

Ceramic board multi-layer metalization

Photo-resist techniques for Ti-Au on ceramic boards

Multi-layer printed circuit board techniques or equipment

Software for automatic wire routing

Software for test pattern generation

Multi-layer metal technology on semiconductors

Random access memory technology with size/speed $\left(\frac{\text{capacity in bits}}{\text{access time in seconds}}\right)$ greater than 10^{10} bits/sec.

Random access memory systems with size/speed greater than 10^{11} bits/sec.

Computer quality magnetic tape manufacturing technology and tooling

Magnetic plated wire manufacturing and test technology

Magnetic tape head manufacturing and test technology

Magnetic drum manufacturing technology

Flying heads technology for disk and drums

Magnetic strip memory units and technology

Manufacturing technology on graphic high grade terminals including:

CRT's operating systems (O. S.) and electronics

Plotters capable of precision better than 2 mil per ft.

Automatic memory core testers

Testing techniques and machines for testing core arrays

Automatic equipment for assembling cores into an array before stringing

Techniques or machines for automatically stringing two or more wires through core arrays

Techniques for wire coating and corrosion protection on memories

Techniques for punching memory material in the unfired state

Critical technologies for the fabrication of plated wire magnetic memories:

1. Wire drawing and surface preparation equipment and techniques
2. Plating methods for attaining high-yield, low-magnetostriction alloys
3. Automatic plated wire testers
4. Wire-array testers
5. Techniques for inserting and attaching plated wire in arrays
6. In general restrict all plated wire technology for the next year or two

Magnetic Film Memories Technologies

1. Pure homogeneous magnetic materials, appropriately alloyed, for evaporation or sputtering

APPENDIX D
(conti.)
(page 4 of 4)

2. Technique for monitoring and controlling the depositor to attain non-magnetostrictive material

3. Temperature control specifications of the substrate

4. Techniques for fabrication of thin glass substrates

5. Techniques for deposition of pin-hole-free insulation

6. In general, all planar magnetic film technology should be restricted for the next two to four years.

Olsen

NATIONAL ACADEMY OF SCIENCES

Computer Science and
Engineering Board

Changes

by

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Hamblen

4/15

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The Numbers Problem

The first issue addressed was the numbers problem: How many and what kind of people do we need to educate? Two approaches were used in attacking this problem:

(1) extrapolation of equipment-support requirements.

(2) reasoning by analogy with other fields.

incorrect figure

The first approach assumed the existence of about 10,000 computers in the United States in the 1975-1980 period (these are machines that need the support of computer professionals). A further assumption was that the number of computers and the staff needed to support them would "plateau" thereafter. This provided a base for the manpower computation.

With due consideration for the "mix" of large, medium and small installations, a support group of about 600,000 professionals was deemed necessary. The long term, steady-state condition (about 30 years from now) assumed that these people will all be college trained. Then, assuming a working life of 30 years, the replacement rate will be about 20,000 per year.

The current college-educated "professional" population in the computer industry is believed to be about 100,000. This number is so far below that needed to competently staff the nation's computer installations that even a 30,000 per year influx of trained people would be desirable. Such a "production" rate, of course, is not currently possible. This number is presented only to support our contention that a 20,000 per year rate is a reasonable national goal.

The second approach to the "numbers game" adopted was to estimate the support population in relation to other, better understood and more mature, disciplines. Compared to the 40,000 engineering graduates per year (from all engineering disciplines) our chosen target of 20,000 per year seems reasonable.

Compared to the 10,000 medical doctors per year and the 20,000 nurses per year, the anticipated rate retains its plausibility.

We, of course, understand the fatuity of attempting to make these kind of predictions for periods beyond the next five years. Our chief concern is that we are not overstating the need. We believe we are not.

The Mix of Graduates

Twenty thousand graduates per year is the goal. What kind of training should they have? What is the "mix" of degrees? These were the next issues addressed.

Many factors influenced the assessment of the proper proportions. In net, it is the judgment that the 20,000 per year should be broken down as follows:

500	PhD's/year
3,500	Master's/year
16,000	Bachelor's/year

The Educational Path

As mentioned above, Computer Science is seen as a single, coherent academic discipline. We reject the notion that "theoretical" Computer Science and "practical" Computer Science are so different that they cannot share the same base. For that reason we recommend that there be, in any university, a single Computer Science "track". An undergraduate "core" curriculum (with electives) will produce a bachelor-level graduate who has a thorough grounding in the fundamentals of his field. Graduate study will lead, inevitably, to deeper understanding and greater accomplishment.

Single-tracking the Computer Science student creates a number of serious problems as to the content of the core curriculum. We understand the complexity of the issues raised and do not, here, propose or recommend any curriculum. We are convinced, however, that the benefit of not having a

5. It is recognized that the need for professionals in Computer Science is a national one and, therefore, all effort should be made to provide support for the development of bachelor's and master's programs with the widest possible geographical distribution.

6. In the rapidly changing field of Computer Science and computer related activities, up-to-date information on research is needed and is hard to get. Under NSF sponsorship, the Southern Regional Education Board has prepared surveys of college and university educational activity in the computing sciences, but apparently no agency is doing anything similar for research in this field. At the same time, graduate departments have a great need for, but possess very little information on what research in computing sciences is being sponsored; who does the research, who sponsors it, and at what levels.

In a relatively stable field like mathematics, a strong need has been felt for up-to-date information about the nature of education and research in the field, and the amounts and sources of its funding. These needs resulted in the NSF-sponsored Survey of Research Potential and Training in the Mathematical Sciences (c. 1957), and the reports of the Ford Foundation-sponsored Survey Committee of the Conference Board of the Mathematical Sciences (c. 1967). The latter committee apparently will maintain a continuous inventory from now on.

We recommend that support be provided for a continuing research and manpower committee whose mission would be to maintain a continuing national inventory of research activity and manpower needs in Computer Science.

Be consistent Computer Science not computing science.

2. The number of PhD's required to teach Computer Science courses can be estimated as follows. The term "unwashed" refers to students taking Computer Science courses who are not Computer Science majors. There are about 6,000,000 students enrolled in four year colleges and we assume that each of them will take at least one Computer Science course during their undergraduate years.

figures aren't consistent

a. ~~Unwashed~~ Non-majors $\frac{6,000,000}{8 \text{ sem} \times 150/\text{class}}$ = 5000 classes/year

b. BS $\frac{2 \times \sout{15,000}\ 16,000 \times 6 \text{ classes/yr}}{30 \text{ stud/class}}$ = ~~6000~~ 6400 (previous page) classes/year

c. MS $\frac{2 \times 3500 \times 8 \text{ classes/year}}{20 \text{ stud/class}}$ = 2800 classes/year

d. PhD $\frac{2 \times 500 \times 6 \text{ classes/year}}{20 \text{ stud/class}}$ = 300 classes/year

The total number of classes per year is 14,000 [14,500]. Assuming each faculty member teaches two courses per year, ~~7,000~~ 7,200 faculty are required in Computer Science.

3. We next compared Computer Science with mathematics. Currently, mathematics is producing about 1000 PhD's per year and most of them are absorbed (with great difficulty) by universities and colleges. If we estimate that in the future two to three times more students will be taking mathematics courses rather than Computer Science courses, we conclude that we should be producing 300-400 Computer Science PhD's per year to maintain the Computer Science faculty. This would suggest that the average production of PhD's should be from 600-800 per year.

4. We calculate the yearly dollar cost to educate all students in Computer Science as follows.

20 (previous page

a.	Unwashed hours = (100 batch)	~~$10~~ 20/year	(6,000,000/4) 1.5M	$ ~~15M~~ 30M
b.	Bachelor (CS) hours = 25_b + $(1 - \alpha)100_t$	$1000/yr	(3 x ~~15K~~ 16K) 45K	$ 4~~5~~9M
c.	Master (CS) hours = 10_b = $(1 - \alpha)200_t$	$2000/yr	(2 x 3500) 7K	$ 14M
d.	PhD (CS) hours = 20 machine	$4000/yr	.5K (500 x 2) / 2	$ ~~76M~~ 2M
				94M

This section should be clarified.

should be available which are specifically planned to provide the knowledge necessary to carry out these computer system design activities. By analogy with the engineering situation, it seems clear that these educational programs should be at the graduate level, leading to a master's degree; that they should build on a relevant bachelor's level education; they should be specifically planned delete ~~as terminal,~~ professional master's programs; and that they should consist of courses at the level of scientific generality offered to beginning doctoral candidates, i.e., should not be vocational type courses. Initially, the bachelor's level education of those entering this master's program will probably consist of a degree in engineering, physics, mathematics, etc. with a minor in Computer Science. As the number of Computer Science baccalaureates increases, a larger proportion of the students entering the master's program will have a deeper preparation in Computer Science that will bring about improvements in the quality of the program.

It is recognized that there may be a master's program in other academic areas which accent computers and their applications. It is felt that these programs should be designed by and largely be manned from within these academic areas. The Computer Science faculty should be used to teach the Computer Science courses included in these applied programs.

Attention was turned to a different view again: what sort of person does an employer look for and hire? We listed these specifications:

1) A certain gleam in the eye, vaguely defined as motivation.

2) Some knowledge of the mechanics of computing; e.g., the applicant has run some computer programs.

3) Problem solving adaptability.

4) Communications skills (in both directions)

5) Ability to be self-critical.

6) Elementary knowledge of statistics (this last is weak, or optional)

<u>Resources</u> (A.J. Perlis, J. Giese, B. Gilchrist, J.W. Graham, J. Rowe)

We have a number of figures and tables which might be of interest. In education, the University of Waterloo has chosen to commence with the Bachelor of Science program in Computer Science and to develop from that upward to the MS and PhD programs. In the United States development in the opposite direction has generally been followed. It is recognized by Waterloo that the first approach is a somewhat more difficult path to follow, it being more difficult to upgrade a bachelor's program than to downgrade a PhD program.

This committee strongly feels, and this is the first recommendation, that major educational efforts should be spent in the development of Bachelor of Science programs in Computer Science in the USA over the next few years. Furthermore, the committee concurs with the Waterloo experience that the program should include significant amounts of practical, hands-on experience with real computer systems problems. Hence the committee feels, and this is a second recommendation, the BS program will be greatly aided by and should include laboratory courses and/or cooperative ventures with industry and government during the school semesters or over summer periods. <u>The committee does not feel that the development of MS programs has the same priority as the two extremes, BS and PhD.</u> Indeed, the MS program contains material only superficially different from the BS program and serves mostly as a springboard for those switching fields and as consolation prizes for those unable to complete PhD programs. The committee next considered the needs of the non-computer scientist being educated in the universities, since

Inconsist PhD should go about same level.

it became clear it would not be feasible to educate as many specialists as one might need in this field in the next 10 years.

The first calculation we made we call the Waterloo computation. At Waterloo there is an IBM 360/75, costing 125K per month. Student jobs account for 1/10 of the system time on that machine or if you will costing about 12.5K per month. Considering cost in the support or overhead equal to that of hardware we have a cost of $25,000 a month for student jobs. For that cost the productivity is 5,000 runs a day or 100,000 runs per month. Considering a productivity of four cracks at the machine per problem, this means that that system is capable of absorbing 25,000 problems per month. Consequently, given a student population size and a number of problems one can come up with various estimates as to what it costs to provide undergraduate computer experience for the non-computing specialist, i.e., someone who does problems of a relatively small size. We came up with one figure assuming 25,000 students in the university of one dollar per problem per student per month. The size of those problems is such that their programs are limited to one second of cpu time and the students are not charged for disc file time but they generally do not include much file work.

Over a ten month academic year a system of this kind could support students giving them 10 problems over an academic year at a cost of 10 dollars per student per year in a 25,000 student population which almost reaches the student population of the largest universities we have in the United States today. Now this figure is substantially below the figure in the Pierce report which runs closer to 50 or 60 dollars per year. That means if we wish to attain the Pierce report figure we could have the student doing 50 problems per year, which is probably much too heavy a load for non-computing specialists!

For the Master of Science program, a figure of 5 million dollars per year in hardware costs was obtained.

The total cost in hardware is 29 million dollars per year. One of the figures that we used was that the EDP industry would be taking in about 100,000 people per year. What percentage of these should be PhD's? Figuring that one percent should be PhD's we get a desirability of producing a thousand PhD's a year. Our feeling on the matter was that by 1975 we might be able to produce 1000 PhD's in Computer Science, but that we would not be able to produce 5000? 1000 PhD's per year by 1975. If you can get up to about 300 by 1975 this would be about what we could expect. It seems to double about every two years.

From whence comes this figure of 15,000 BS students per year? Is it attainable? At the present time in engineering and mathematics the output per year is of the order of 50,000. Now assuming there is no major change in size of total undergraduate enrollment in engineering and science schools but that quality Computer Science undergraduate programs do come into being, how many of the 50,000 per year could we expect to prefer an education in Computer Science? We believe that without a great deal of heavy advertising or pressure of any sort, 20-30% of the undergraduate enrollment in mathematics and engineering programs would shift into Computer Science programs, if there were existing quality undergraduate programs in Computer Science. Furthermore, the percentage is probably conservative. That means of the 100,000 per year that are required in the EDP area, 85,000 are probably going to have to remain or be non-Computer Science baccalaureates. We also made an estimate of Computer

4. Conservatism of this estimate.

   a. The assumed static "CS" employee pool is about $\frac{500,000}{200,000,000} = 0.25\%$ of the total U.S. population.

   b. 19,000 graduates per year is about half the number of engineering grads (40,000) per year. That doesn't sound unreasonable. Computer technology should be about as widely appliable as engineering.

   c. For comparative purposes consider the fraction of our manpower resources devoted to medicine and associated subjects. We produce about 9,000 physicians per year. They must be backed up or supplemented by about 18,000 (40,000 need [illegible]) nurses, technicians, dentists, and various forms of physiologists, etc. As a guess, about 27,000 graduates per year are devoted to problems to health.

   You might argue that since medicine absorbs a fairly small fraction of our economic output, and since computing is (or will be) involved in all of man's activities, including medicine, perhaps the output of Computer Science graduates could safely be increased to the level of medicine (and associated graduates) or 27,000 eventually.

   d. Some Computer Science enthusiasts assert that the growth of Computer Science may be 100,000 per year.

   In a steady state process, with a thirty-year working life, this would lead to a CS employee-pool of

$$30 \times 100,000 = 3,000,000$$

What is a graduate?

The above programs were influenced by the "Preliminary" recommendation of the ACM Curriculum Committee but not by their final report "Curriculum 68". However, if we assume that there has been a linear increase in the number of degree programs, we get the following estimates for majors and graduates for June 30, 1969.

	Computer Science
# programs	49
# majors	3000
(1968-69) # graduates	750

Shortages of faculty candidates have no doubt slowed the development and initiation of many planned programs.

Because of one or two very well advertised bachelor's degree programs in small institutions, some have begun to believe that there are many such programs being attempted at such institutions. This is definitely not the case. In fact only 7 of the estimated 83 bachelor's programs (of all types) in operation as of June 30, 1967 were in institutions which did not offer at least a master's degree and had at least 10,000 students enrolled.

Of the 30 bachelor's degree programs reported in Computer Sciences going as of June 30, 1967, 23 different states are represented. Approximately two out of three of these programs are housed in a Computer Science Department or a joint department (with Computer Science) in its name (e.g. Information and Computer Science). In 1970 there are approximately 40 Computer Science Departments. Almost without exception these are located at well-known state and private universities.

Possible Trends in Bachelor's Programs in Computer Sciences. The ACM Curriculum Committee did not address itself to how the "Curriculum 68" recommendations could be used to structure a degree program for those who will work in the business community. This was deliberate. At the time it was felt that the needs of the "data processor" were incompatible with those of the "computer scientist" or at least that the intersection of the needs and interests was very small. It is quite possible that the recent developments which have led to much more complex hardware, and consequently software, systems have greatly expanded the intersection of interests. At least that was the feeling of some who participated in the conference whereas others maintained that all previous discussion (and the conference included) had not come to grips with the needs of the large majority of computer personnel who work in the business area.

To this end still another committee of ACM was appointed in 1965 to study and make recommendations for Computer Education for Information Processing Systems in Organizations. Dr. Dan Teichroew, University of Michigan is Chairman of this committee. A preliminary report is expected to be published in 1970. The activities of this committee ~~is~~ are supported by an NSF grant to the Association for Computing Machinery.

A proposed undergraduate Computer Science program was presented at the conference by Dr. Alan Perlis of Carnegie-Mellon University, which looks promising and is one of the first attempts to satisfy this "need of the majority" within a Computer Science framework. The main "different" features of this proposed program are that three courses in Operations Research and a course in Administration and Finance are required.

Computer Science at the University of Waterloo * (J.W. Graham)

History and Philosophy. Computer Science courses have been taught at the University of Waterloo since the academic year 1959-60. They were actually taught before the university installed its first computer. It was not until 1964 that a program in Computer Science and a philosophy of operation of that program became evident in any formal sense.

At the present it is felt that although Computer Science is starting to get as a coherent body of knowledge it is still not at the stage where it can be taught as a complete undergraduate discipline and be considered as a basic body of knowledge such as mathematics. It is felt by the Faculty at Waterloo and by many others in the field [4] that

I don't think reference supports statement should be deleted or revised

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* Numbers in square brackets, e.g. [6] , refer to references found at the end of this subsection.

much info should be in tabular form

A Professional Master's Program at Stanford University (E.J. McCluskey)

In response to the demand for a professional degree for students interested in the design of hardware-software computer systems, a special degree program has been devised. Students may enroll in either the Computer Science or Electrical Engineering Department. For Computer Science students the degree obtained bears the designation Master of Science in Computer Science: Computer Engineering. In Electrical Engineering, the degree designation is Master of Science in Electrical Engineering: Computer Engineering. Students should indicate a preference for this degree when applying for admission.

A program in Computer Engineering should include 42 units of work, of which at least 36 must be graded. These will normally come from the following courses: CS 135 Numerical Methods (or both CS 137 and 138 Numerical Analysis), CS 109 Assembly Language Programming, CS 111 (EE 181) Introduction to Computer Organization, CS 112 (EE 182) Digital Computer Organization (or both EE 281 Theory of Switching and EE 282 Logic Design), CS 140A, B (EE 286A,B) Systems Programming, CS 144A Data Structures, CS 246 (EE 386) Operating Systems, CS 206 Computing with Symbolic Expressions, CS 150 Introduction to Combinatorial Theory (or CS 155 Concrete Mathematics, or some course in discrete mathematics), OR 252 Operations Research, CS 298 Software Engineering Laboratory (or 6 units of CS 293 Computer Laboratory or 6 units of EE 390 Special Studies), and EE 380 Seminar on Digital System.

This program is open to students with a scientific bachelor's degree (a BS in Mathematics, Statistics, Physics, or Engineering); or with a degree having a mathematical background (courses in calculus, a knowledge of linear algebra, and probability). Some knowledge of programming will be required.

Should be replaced with newer version.

Computer Science and Related Degree Programs in U.S. Higher Education (J.W. Hamblen)

The number of institutions reporting various degree programs, their total faculty, numbers of majors, both undergraduate and graduate, and the number of degrees awarded during 1966-67 are reported in Table 1. These numbers were obtained in an inventory conducted by the Southern Regional Education Board (SREB). Best estimates for each heading are also given. These estimates were obtained by applying the overall extrapolation ratio of 1.25 to the reported totals. This is probably a little high for the higher degree levels but the estimates are likely to be within 10% of the true values on the high side.

In 1964-65 the institutions of higher education projected that they would have 18,807 undergraduate majors and 5318 graduate majors during the academic year 1968-69. However, the estimates from Table 1 show that by 1967-68 the undergraduate figures had already been exceeded (22,161) and that the number of graduate majors (4936) was fast approaching the 1968-69 projections. These comparisons are summarized in Table 2. along with data gathered by the Southern Regional Education Board (SREB) on the number of students actually enrolled in 1964-65.

Table 3 provides a comparison with the population estimates of going programs during 1964-65, those projected by the institutions for about 1967-68, and the 1966-67 estimates. This table shows that except for the associate degree programs, which had already in 1966-67 exceeded the projected figure (188) for 1967-68, the numbers of new degree programs were lagging behind the numbers projected by the institutions. It follows then that the programs in existence during 1966-67 were accomodating many more majors than was originally anticipated by the institutions when they made their projections for 1968-69.

Robin: for distribution to the Board.

Book Reviews

Outside the Laboratory

The Politics of Pure Science. DANIEL S. GREENBERG. New American Library, New York, 1968. xiv + 303 pp. $7.95.

The dramatic success of the mobilization of science led by Vannevar Bush in World War II brought about a striking change in the status of science as a component of our culture. In the following two decades the investment of the federal government in the application of science to national needs bloomed, and the United States became the technological giant of the world. Concurrently, federal support for the general advancement of the sciences followed a corresponding pattern of growth. Through numerous agencies and various methods designed to protect the traditional freedom of the investigator, the federal government became the patron of "pure" scientific research on an unprecedented scale.

Few would question that this new relationship between the government and scientists in the private domain was responsible for the remarkable flowering of research in the United States and the consequent emergence of this country to a preeminent position in science. Nevertheless, the very success has brought with it some complex problems. What is a rational basis for dividing limited funds among the worthy disciplines? Which giant accelerator for modern particle physics should be built? Where should it be installed? How can definitive contracts be reconciled with flexibility to exploit unexpected opportunities? These are examples of questions which demand the highest statesmanship in their resolution.

As its title implies, *The Politics of Pure Science*, by Daniel S. Greenberg [news editor of *Science*], attempts to deal with the ways in which such questions have been addressed rather than with the substance of science itself.

The first chapter describes the makeup of the "scientific community" in this country. At the outset the author expresses his view that emphasis on the existence of an elite scientific "establishment" can mislead more than enlighten. Having offered this view, he thereafter adopts the contrary position. The transition is made quickly.

> Therefore let us begin with a paradox: There is no American Scientific Establishment. Yet Harvard, MIT, Caltech, and the University of California are its Oxbridge. Two World War II research centers, the MIT Radiation Laboratory and the Los Alamos Scientific Laboratory, of radar and atom bomb fame, respectively, are its Eton. The Cosmos Club in Washington is its Athenaeum, the physicists are its aristocracy. The National Academy of Sciences is its established church, and the President's Science Advisory Committee is its Privy Council.

The financial resources, personnel, and institutions making up the community are then enumerated.

All responsible professions seek to maintain their standards, protect their values from uninformed attack, and present their cases to the public. Journalism's spirited defense of the essential importance of the freedom of the press is an outstanding example. The second chapter of this book is devoted to these aspects of "pure" science. It is entitled "Chauvinism, xenophobia, and evangelism," words which the author uses liberally throughout the text. Such unfortunate hyperbole, which beclouds objectivity, tends to characterize the book.

The third chapter recalls the financial poverty of science and the lack of interest on the part of the government prior to World War II. Chapter 4 describes the embryogenesis of the Office of Scientific Research and Development and of research on the atomic bomb in the early days of the war. Next is a short chapter on the mobilization and activities of the OSRD. The author notes that, "Since the work of OSRD was climaxed by victory in the greatest of wars, events took on the effect of ratifying the wisdom of the manner in which OSRD operated. OSRD could look back over its incredible five-year history and pick out examples of brilliant performance and foresight." However, he accompanies this statement with this footnote:

> There were a few dissenters, but their voices were poorly heard and the validity of their plaints is difficult to assess. For example, two months after the war ended, a group of Minnesota researchers declared, "When the true record is written, the waste, inefficiency, ignorance, and obtuseness in utilizing scientific knowledge in the recent war will be apparent to all." (*Hearings on Science Legislation*, Subcommittee of the Senate Committee on Military Affairs, 1945, p. 963.) The record, as written so far, fails to substantiate this doleful prophecy; nevertheless, it is not unlikely that the official OSRD histories, as well as the memoirs of OSRD's figures, tend to pass over whatever blemishes did exist.

This technique of accompanying a statement with a contrary footnote is used frequently in the book. The purpose of this device is not clear, but if the goal was balance, it was not successfully achieved.

Chapter 6 reviews the efforts, during the transition to peace, to establish a central agency for government support of basic research. These foundered on the issue of control by scientists versus the accountability of the government for the management of public funds. The gap was filled by the military—most notably the Navy, through the Office of Naval Research. In the following chapter, the author discusses activities and events concerned with the development of the relationship between the government and the private scientific community in the decade following the war. The patterns established during that period have, by and large, continued to the present. The author refers to these patterns and mechanisms as the "government of science," and the next chapter is headed by that title. It is devoted almost exclusively to the plaint arising from the chemists in the early 1960's about the neglect of their field, which led to considerable activity within the National Academy of Sciences, culminating in the Westheimer report.

There follow three chapters devoted to what might be considered case studies selected to illuminate the operation of this "government of science." The first of these is entitled "Mohole: The anatomy of a fiasco." The project to drill a hole through the earth's crust was hardly a model of careful planning, wise decision-making, or good management. The author devotes somewhat more than 10 percent of his book to a detailed revelation of the project from its whimsical beginning as an offshoot of the activities of the American Miscellaneous Society, through early progress, complex and contentious troubles, and final collapse. For one wishing to prove that the "government of science" is not without its imperfections, a more devastating story could not have been chosen, and no opportunity was lost in this telling.

The next two chapters, together making up just under 20 percent of the book, might have been one, since they really tell one story. Their titles, "High energy politics" and "MURA's last stand," indicate the subject. They examine how the questions of what and where have been resolved in the field of high energy physics in the past several years, presenting details of the story of the partnership of the Midwestern Universities Research Association and the Congressional delegations from its region, aimed at saving their plans for a very large installation. Included is a highly intimate and revealing scene in the White House.

The book ends with a chapter entitled "The new politics of science." Using as case studies the increasingly restrictive conditions being placed on recipients of NIH grants by pressure from Congress, and the events leading to the decision to place at Weston, Illinois, the 200-Bev accelerator designed by the Lawrence Radiation Laboratory at Berkeley, the author describes the new atmosphere developing in federal support of science. This climate is one in which emphasis is placed on greater relevance to national goals and practical needs, tighter controls by the government on detailed accountability of expenditures, more concentration in full-time government employees of the power of detailed selection of research activities and objectives, and increased attention to the distribution of the funds throughout the nation.

At the close Greenberg asks a question: "In a world plagued by misery, is it decent for fine minds and great wealth to be dedicated to the interior of the atom and the mysteries of the planets? Or, as the ideologists of pure science would contend, does the unfettered spirit of inquiry provide the surest way to knowledge and salvation?" The gist of the book is that a simple "yes" in response to both parts of this question would merely demonstrate the responder's "chauvinism, xenophobia, and evangelism."

The reviewer finds it difficult to give an overall description of the book. It is not a very careful history which avoids presumptive interpretation. Neither is it a deeply penetrating and constructive critical essay. Perhaps it might be best described as a historical novel, written in the reportorial style, with titillating tidbits liberally dispersed among important facts. The cast is drawn from the roster of prominent men in the councils of science. Not only are the actions of the characters chronicled, but they are given the opportunity, here and there, to place their wit before their wisdom. By implication they are also provided with emotions and motivations. All this lends the book a lively and interesting readability. But assessing motives on the basis of actions is a hazardous business at best, and the reviewer found himself disturbed by a style that seemed to suggest the least generous interpretation. For example, the author uses the term "machinations" repeatedly to describe the successful advocacy of a presumably worthy cause. It must be assumed that he is aware that the word connotes crafty planning of evil schemes. The overall effect is to demean, and few men or institutions went into this book but came out poorer.

FRANK T. MCCLURE
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Pacific Anthropology

Polynesian Culture History. Essays in Honor of Kenneth P. Emory. GENEVIEVE A. HIGHLAND, ROLAND W. FORCE, ALAN HOWARD, MARION KELLY, and YOSIHIKO H. SINOTO, Eds. Bishop Museum Press, Honolulu, Hawaii, 1967. xx + 594 pp., illus. $16.50. Bernice P. Bishop Museum Special Publication No. 56.

The essays collected in this festschrift address a very wide variety of subjects in the general topical area of Polynesian anthropology and display a range of methodological approaches. There is a certain broad uniformity of outlook as a result of the fact that the contributors represent a kind of general grouping in Polynesianist circles, holding in common a collection of general attitudes on a number of points of theory and interpretation. Many distinguished academic Polynesianists are not to be found among the contributors.

The organizational scheme of the volume utilizes two major but not mutually exclusive principles: one set of papers is grouped according to anthropological subdisciplines (linguistics and archeology), and the remainder according to the geographical subdivision of Polynesia to which they refer (General, East, West, Hawaii, and Outliers). While this scheme reflects the disciplinary interests and the geographical areas in which K. P. Emory has worked, it does not facilitate use of the volume.

The majority of papers are of a descriptive or analytic nature, dealing with narrowly defined aspects of specific Polynesian cultures or pan-Polynesian traits. For example, there are a discussion of the bird-man motif in Polynesian material culture by Barrow, one of sea creatures and spirits in Tikopia by R. Firth, and a well-written survey of Polynesian-origin theories by Howard. These are contributions of the type normally found in the *Journal of the Polynesian Society* or similar regionally oriented publications.

Contributions possessing clear implications for anthropological method and theory are the all-too-brief paper by Finney on Polynesian navigation and the linguistic papers by Elbert, Grace, and White. Finney's field experiments on Polynesian navigation techniques are a welcome indication of unorthodox and highly practical thinking in an area of specialization not noted for innovation. His work has produced the best data yet on a subject that has suffered from repeated rehash of the same tired historical material. The test analyses presented by Elbert and Grace, and White's study of the word *tabu*, clearly illustrate the hazards involved in utilizing quantitative linguistic techniques.

Other contributions are light-weight, low-powered, or misleading. Mead's impressionistic piece on hypertrophy and heterogeneity in Polynesian culture might have been stimulating 30 years ago. Sinoto, perhaps Emory's closest associate, has contributed an archeological article on fishhooks that contains little information he has not presented in better form and detail elsewhere. Those familiar with the literature on Polynesian origins will note, in Green's article on that subject, that concepts and theories, initially anathematized, become suddenly attractive once they can be credited to the right people.

THE NEW YORK TIMES, SATURDAY, MAY 18, 1968

Sing Sing Holds 'Commencement' for 13 Inmates

By JOSEPH NOVITSKI
Special to The New York Times

OSSINING, N. Y., May 17—The big, black-on-white sign draped over the front of the Sing Sing prison auditorium stage said "Commencement." It marked a new beginning for 12 inmates graduating today from a computer programming course taught within the walls.

"This is the first time I've ever had a profession," said Marion S., the 39-year-old valedictorian.

The graduation ceremoney in the dun-brown prison auditorium was not constricted by bars or prison regulations.

"We broke a lot of rules today," Warden John T. Deegan said. Mr. Deegan permitted women, almost all relatives of the day's graduates, inside buildings within the walls of Sing Sing for the first time, and opened his baseball field for the prison's first helicopter landing.

Javits and Cooke Attend

It was the first time Marion S. had seen his wife, except through the wire screen that separates inmates from visitors, since he had entered Sing Sing.

The helicopter flight brought Senator Jacob K. Javits, the keynote speaker, and the Most Rev. Terence J. Cooke, Archbishop of New York, to the 55-acre complex rising on the bluffs above the Hudson River for the ceremonies.

News photographers and cameramen were also permitted for the first time in Sing Sing's history to take pictures of consenting inmates' full faces. But reporters were requested not to question the inmates on their criminal backgrounds, and the last names of prisoners present were not released.

The warm spring sunlight came through the high auditorium windows, almost hiding the bars. The prison band played "My Mother's Love" for the occasion, and a buffet for 150 persons was served. An inmate called the ceremonies "boss."

"We won't eat this well until we graduate," he explained.

7 Graduates Take Jobs

Two of the twelve graduates of the seven-month pilot program, conducted by the Electronic Computer Programming Institute, a computer training school with headquarters in New York, were released on parole recently and left the graduation for programming jobs.

The remaining ten inmates are all eligible for parole within a year, and they will be given computer programs to write at Sing Sing for the state while serving their sentences.

The graduates, who wore prison-gray pants, white shirts and black ties—except for the two parolees, who wore business suits—were watched by 20 inmates chosen to begin the second computer course tomorrow. Sixty-seven relatives friends and guests, sat on the wooden pews of the auditorium.

"Today is a very wonderful and historic day," said Archbishop Cooke, as he delivered the benediction closing the ceremony.

Started Last November

Computer programming instruction at Sing Sing began last November when 14 inmates were selected from 33 applicants to take the weekly Saturday classes given by instructor Michael Cappi after they had passed a three-part aptitude test. All had to have completed high school. Since the course began, one inmate was transferred to another prison and one dropped out.

Sydney Davis, president of the programming institute, explained that the idea of teaching programming to convicts came to him when he read of the many high school educated inmates in the country. New York State Correction Commissiner Paul McGinnis and Warden Deegan agreed to try the program, and both said they were pleased with the results.

"What happened here at Sing Sing can have an explosive impact," Senator Javits told the graduates, "I hope every man here will consider himself an apostle of the new way."

The Washington Post Real Estate
SECTION C SATURDAY, APRIL 13, 1968

Computer Answers to Realtors

Photo by Warren Mattox

Jane Rose Instructs Realtor Group in Computer Techniques

Looking around to buy a home in Northern Virginia? Are you tired of driving around to see what resale houses are on the market? Does looking at a file of Multiple Listing Service cards confuse you?

Well, the millennium may not be here but the Northern Virginia Board of Realtors is investing $108,000 a year to give buyers and sellers the services of a talking computer.

Simply, the new computer service doesn't do anything that a prospective home buyer or real estate sales person couldn't accomplish by looking at thousands of multiple listing cards. But the computer does it faster and saves all the card flipping.

Northern Virginia Realtors, now tuned into a computer in suburban Detroit, can dial a push-button telephone — with the aid of all sorts of code numbers — and come up with the listed houses that satisfy the cranked-in (by code, again) requirements of any particular buyer.

For instance, those requirements might include a split-level style, priced about $38,000, with four bedrooms in the Annandale area, plus a basic stipulation for quick occupancy, a basement, central air conditioning, a separate dining room and a fireplace.

If one or more houses fill that bill, within a few thousand dollars of the price, the code numbers come back on the telephone hookup and the Realtor or his sales person can look up the specific houses on a master book of current listings published in the Multiple Listing Service of Northern Virginia.

"This is the first computerized multiple listing service in the eastern region and only the second in the country, outside the Detroit area," said Edward R. Briggs, president of the NVBR. He pointed out that the computer service now is available to 385 brokers in 164 member firms with a total of more than 1400 sales persons.

Currently, the Northern Virginia group has listings of 3000 houses. These multiple listings usually peak at about 3500 in June and slack off to about 2500 in some midwinter months.

"We are tuned into a Realtron Corp. computer in Detroit," said Robert J. Salem, chairman of the NVBR computer committee for three years. "Now our people can use any touchtone telephone to feed a home buyer's requirements into the computer and get the answers from the IBM 7770 audio response unit. If the requirements cannot be matched with an available house, the computer tells us that too."

Jane Rose of Realtron was on hand this week to explain the new computer system to groups of Northern Virginia sales persons. Mrs. Rose pointed out that the computer service works in tandem with multiple listing cards and normally can bring back a maximum of 10 responses.

"This is only a tool," she emphasized, "and it does not replace the sales person. But it is designed to save time of both the sales agent and the prospective buyer.

"For instance, if the buyer wants a $40,000 house and the available listings can fulfill all his requirements except the exact price, we will get answers that refer our sales persons to cards of houses priced anywhere from about $36,000 to $46,000. In that event, it becomes a matter of compromise for the buyer. He can revise his requirements downward or his price upward — if no $40,000 or less house is available."

Altogether, there are 10 telephone lines plugged into the computer from the Northern Virginia area. Getting the answer takes only a few seconds. It was estimated that 44 calls can be handled at the same time and 8000 calls were handled in one recent day.

So far, the Northern Virginians are the only Realtors in this area to adopt the computer adjunct to multiple listing. But there is the possibility that the Boards in Montgomery and Prince George's County may follow suit. Since the Washington Board does not have a multiple listing service, it is not likely to become a part of the computer hookup.

"One of our area's top

See COMPUTER, C2, Col. 1

INVESTMENT

Talking Machine Serves Salesmen

COMPUTER, From C1

sales persons was frankly skeptical of the new service," pointed out Salem, "but she was won over quickly on an actual test in which she listed a buyer's requirements for a house that she was not able to supply. The system came up with an answer by turning up a house that she did not know to be listed."

To keep the information current, Virginia Realtors will update information daily — adding houses newly listed or taking out those that have been sold. "Another service," added president Briggs, "is that the computer can quote comparable prices for the preceding 12 months, based on area and similarities of other houses sold, to assist sellers in pricing their properties consistent with accurate market conditions."

By that Briggs was saying that the seller who thinks he should get $40,000 for his home because a neighbor advertised his house a few months earlier for about $40,000 and sold it, may be unaware that the seller accepted an offer considerably lower. The computer will have the actual sale price of the comparable home — not the asking price.

Northern Virginia Realtors admitted that the new computer service has some bugs that are being killed from day to day. But they all seem to be happier than a three-year-old child with a new toy. And they value their new computer more than a toy because they are confident that it will help them to sell more houses faster and make more money.

JACK BROOKS, TEX., CHAIRMAN
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CAPITOL 5-3252

NINETIETH CONGRESS

Congress of the United States
House of Representatives

GOVERNMENT ACTIVITIES SUBCOMMITTEE
OF THE
COMMITTEE ON GOVERNMENT OPERATIONS
RAYBURN HOUSE OFFICE BUILDING, ROOM B350-B
WASHINGTON, D.C. 20515

December 5, 1967

The Honorable Charles L. Schultze
Director, Bureau of the Budget
Washington, D. C. 20503

Dear Charlie:

The Subcommittee is proceeding with the evaluation of the hearings on Government management of data processing held in July. Because of the complexity of the matters under consideration, a further period will be required to prepare the Subcommittee's report. Meanwhile, certain facets of data processing usage merit immediate attention, not only by appropriate officials of the Government, other large users, but by the data processing manufacturing industry as well:

1. There is a need for specific problem definition in the data processing standardization effort.

During our hearings, practically every witness agreed to the vital importance of "compatibility and standardization." Over the years, this term has achieved almost universal usage to describe a hazy, uncharted problem area in computer usage stemming from differences in data system design and manufacture. Within the perimeter of this almost meaningless term lie countless problems of differing character and importance to which the term "standardization" has varying meaning and application.

We have followed, up to this point, a "grab bag" approach in attempting to deal with these problems. While we have identified certain areas of difficulty that compromise computer usage, the order and magnitude of our effort has not been controlled by a disciplined order of priority. Nor are we exacting in the definition of the terms we use or of the ultimate goal we seek to achieve. We have assumed without sufficient basis that "standardization" -- whatever this term may mean -- is an overall solution to this entire problem area, although this approach might be either difficult, impossible, or outweighed by some more acceptable, more practical solution.

It follows then that our efforts to increase data processing effectiveness and efficiency require:

(a) Appraisal of the entire computer environment to identify as best we can those aspects of computer systems where variances in design or usage compromise utilization;

(b) defining as specifically as possible the ultimate objective sought to remedy these specific problems;

(c) defining the term "standardization" as this concept may apply to these varying problems;

(d) inclusion within the standardization concept of some practical means of evaluating the need for and the economic value of software and hardware developments that would alter previously adopted standards or affect data processing compatibility;

(e) determining whether "standardization" is essential, simply desirable, or undesirable as a means of solution, and considering possible alternative courses of action as a more practical means to achieve the objective sought.

2. The standardization effort must be altered to optimize results.

The data processing standardization effort operates within the traditional concept followed by American industry for decades. In most instances, in other areas the standardization effort consists merely of recognition of what has already, through usage, become a de facto standard.

In data processing, the principal thrust should be to determine and develop standards in anticipation of usage. In most instances, in data processing, the potential for benefit has passed by the time a de facto standard exists.

Considering the structure of the standardization effort, as well as the intricate network of organizations with varying interests which are often in conflict, it is understandable why there are problems in achieving results sufficiently early in any particular phase of the "state of the art" so that users, as well as manufacturers, can receive some benefit from them.

Whatever the cause, the standardization effort is "cresting" too late to meet demand. The delays are unacceptable no matter how understandable their causes may be.

A critical reevaluation of the entire standardization effort must be made to invigorate and speed up the process so that the effort can be as effective as possible in the solution of those problems that can be properly and practically dealt with through standardization.

3. Independent criteria identifying the characteristics of a new generation common computer language must be developed.

IBM has announced PL/1 will receive primary support in future company software development -- COBOL and FORTRAN only to the extent necessary to maintain industry-accepted standards. There is considerable sentiment among those well-versed in COBOL and FORTRAN and not in the employ of IBM that there is little value in PL/1. IBM claims the need for a machine-independent language that will also lessen the demand for programmers. To those uninitiated into the complexities of COBOL data handling, PL/1 has a definite charm in its relative simplicity despite the fact that, at least at present, there may be no advantage in compiling and operating time -- the basic measures of language efficiency.

Because of IBM's dominant position and the fact that new users most likely will accept the apparent advantages of PL/1 (compatibility and standardization problems normally are not as apparent in the initial stages of data processing usage), it is reasonably predictable that in the absence of any forceful, affirmative effort, PL/1 could, by default, become the de facto language of the next generation even though it may be less than the best.

USASI has undertaken a pre-standardization effort regarding PL/1. But, such efforts are premature for there is no general independent criteria reflecting user requirements and computer capabilities within the "state of the art" to use as a measure in evaluating the acceptability of this as a new generation language.

Comparisons with COBOL and FORTRAN are not sufficient. Although advantages may be shown, these may not be of a nature or degree sufficient to qualify PL/1 as the next generation language. Furthermore, to the extent that any language can be machine-independent, this quality in PL/1 remains to be proved. Other preliminary questions must be answered; for example, the existence of effective alternatives to standardization, whether the next common language (assuming the applicability of the standardization concept) should and can be of a higher order of standard COBOL and FORTRAN, or whether optimum user benefit requires adoption of a fundamental new approach to language development.

Assuming the validity of applying the standardization concept to computer languages and following development of general criteria necessary or desirable in a new generation language, then a truly effective and meaningful evaluation could be made of PL/1 as well as any other proposed languages or combinations thereof. Under these circumstances, it would then be reasonable to expect IBM, under improved USASI procedures, to adopt changes in PL/1 (including the name of the language) deemed necessary to meet the general criteria. Also, other manufacturers, as well as principal user groups, could be expected to either participate in this standardization effort or accept whatever conclusions that may be reached.

It is unlikely that development of language criteria can take place within the structure of USASI, the National Bureau of Standards, or any of the manufacturer or user oriented organizations. For optimum results, a more detached approach would probably be best. Second, the effort should attract the best minds in the entire data processing community. All of the key people that are needed are not included in the membership of these organizations. For this reason, the Executive Branch should determine the feasibility of establishing a quasi-formal working group or, in the alternative, solicit the interest of some organization such as the National Academy of Sciences to participate in the identification of new generation language criteria.

4. <u>The Bureau of the Budget must push completion of the Federal Government's software inventory.</u>

It has been assumed for years that standardization would bestow countless benefits upon the Federal Government, particularly in the software area. Superficially, at least, the possibility of broad interchange of programs and data offers considerable promise. Undoubtedly, there would be advantages. But, their nature and scope have not been authoritatively determined. A comprehensive inventory of Government-owned software is essential in making any meaningful evaluation in this area.

In addition, an inventory of Government software is needed as a data base for Federal Government policies relating to the procurement of next generation languages. Economically, it may well be that despite the availability of a more effective, modern language, numerous applications in the Government would for years be best served through maintenance of older generation languages. But to make the necessary cost analyses, we must know what software we now have. Therefore, development of the Government's software inventory as part of our data processing information system should be given the highest priority.

In varying degrees, work is under way on many aspects of these problems. In some areas, however, little if anything is being done. Our purpose is to emphasize and invigorate these efforts in a more orderly manner. Literally billions in capital investment and in operational efficiency are at stake. And, we must do the very best we can to provide for optimum data processing usage, not only in the Federal Government, but throughout the national economy. In July, 1966, the President stated the problem in these words:

> "Computers will enable us to achieve progress and benefits which a decade ago were beyond our grasp. The technology is available. Its potential for good has been amply demonstrated, but it remains to be tapped in fuller measure."

This effort towards optimum utilization of data processing has the strong unyielding support of the President and the mandate of Congress. We believe it merits the support of the entire data processing community.

Sincerely,

Jack Brooks
Chairman

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D. C. 20554

FCC 66-1004
90954

In the Matter of)
)
Regulatory and Policy Problems Presented by the Interdependence of Computer and Communication Services and Facilities)

DOCKET NO. 16979

NOTICE OF INQUIRY

By the Commission: Commissioner Wadsworth absent.

I. Preliminary Statement

1. The modern-day electronic computer is capable of being programmed to furnish a wide variety of services, including the processing of all kinds of data and the gathering, storage, forwarding, and retrieval of information -- technical, statistical, medical, cultural, among numerous other classes. With its huge capacity and versatility, the computer is capable of providing its services to a multiplicity of users at locations remote from the computer. Effective use of the computer is therefore becoming increasingly dependent upon communication common carrier facilities and services by which the computers and the user are given instantaneous access to each other.

2. It is the statutory purpose and responsibility of the Commission to properly regulate interstate and foreign commerce in communications so as to make available to all the people of the United States a rapid, efficient, nationwide and worldwide communications service with adequate facilities at reasonable charges (See Section 1 of the Communications Act of 1934, as amended). Thus, the Commission must keep fully informed of developments and improvements in, and applications of, the technology of communications and of related fields. (See Section 218). Moreover, the growing convergence of computers and communications has given rise to a number of regulatory and policy questions within the purview of the Communications Act. These questions require timely and informed resolution by the Commission in order to facilitate the orderly development of the computer industry and promote the application of its technologies in such fashion as to serve the needs of the public effectively, efficiently and economically. To this end, the Commission is undertaking this inquiry as a means of obtaining information, views and recommendations from the computer industry, the common carriers, present and potential users, as well as members of the interested public. The Commission will then be in a position to evaluate the adequacy and efficacy of existing relevant policies and the need, if any, for revisions in such policies, including such legislative measures that may be required. It will also enable the Commission to ascertain whether the services and facilities offered by common carriers are compatible with the present and anticipated communications requirements of computer users. The Commission will then be in a position to determine what action, if any, may be required in order to insure that the tariff terms and conditions of such offerings are just and reasonable and otherwise lawful under the Communications Act. (See Section 201(b) and Section 202(a).)

II. Emerging Computer Enterprises

3. A brief review of the more important types of computer enterprises now emerging will serve to illustrate the growing convergence and interdependence of communication and data processing technologies.

4. First of all, there is the so-called in-house use of computers. Banks, aircraft manufacturers, universities and other types of institutions frequencly own or lease computers primarily for their own use. In the past, the batch processing technique has generally been employed to satisfy the needs of the in-house users. Recently, however, time-sharing systems have been installed, particularly at universities and hospitals following the example of pilot Project MAC at the Massachusetts Institute of Technology. Because more than enough capacity exists to satisfy normal in-house needs, be they mathematical computation, data processing, simulation, or storage and retrieval, the idle or excess capacity is readily saleable to others. Banks and aircraft manufacturers have already made such time available to persons outside the enterprise. Economies of scale may well lead to larger and larger machines with consequent incentive for in-house computer owners to sell computer time to the general public. Efficient utilization of these computers implies organization of time-sharing systems. It likewise implies increased use of communication channels obtained for the most part from communications common carriers pursuant to tariffs filed with this Commission or state regulatory commissions, depending upon the intrastate or interstate nature of the channel.

5. Secondly, several of the major computer manufacturers maintain computer service bureaus. They sell computer time to customers and usually operate on a batch process basis. However, conversion to time-sharing is proceeding rapidly. The potential for providing the computer with general economic data to compliment specific company or industry data, has led to the establishment of data banks which can be used for such purposes as economic forecasting, product marketing analysis, and more specialized uses such as legal and medical reference library services. Multiple access to such data banks is again dependent on communications links obtained from common carriers under applicable tariffs.

6. Additionally, there are hundreds of non-manufacturing firms which offer a wide range of data processing and specialized information services. These services may be provided on either a batch processing or time-sharing basis. Many of these concerns are local in scope, but others are equipped with multiple access computers and are endeavoring to develop national time-sharing systems of which communication channels will be an integral part.

7. Finally, there are some very highly specialized computer services currently being offered. An example is the stock quotation service. For a number of years, brokers and financial institutions throughout the country have been supplied with up-to-the-minute prices and quotations on securities and commodities through central real-time computers. The service enables a broker to query the computer's store of market data and receive the information on a print-out or visual display device. It has been proposed that the computers be programmed to provide capability for storing and processing buy and sell orders between individual brokers. In both instances, private line circuits leased from common carriers under applicable tariffs supply the connecting link between the computer and the brokers.

8. Other specialized computer services combining data processing and communications include a hospital information service, a coordinated law enforcement service utilizing computers to tie together the law enforcement efforts of a number of local authorities, and various kinds of reservation services.

9. Most, if not all, of the major computer manufacturers offer for sale or lease computers which can be programmed for message and circuit switching in addition to their data processing functions. There are a number of operational computerized message switching systems owned by large corporations in diverse fields. Most of these systems replaced electro-mechanical switching units provided by the communications common carriers. Motivations of increased business efficiency and maximization of the capabilities of the computer are apparently leading toward the acquisition by large corporations of computer systems. These systems permit data processing and message switching to be effectively combined with communication channels linking remote locations to form a real-time data processing and communications system.

III. Computers and the Common Carriers

10. The communications common carriers are rapidly becoming equipped to enter into the "data processing" field. Common carriers, as part of the natural evolution of the developing communications art, are making increased use of computers for their conventional services to perform message and circuit switching functions. These computers can likewise be programmed to perform data processing functions. For example, Western Union is establishing computer centers, not only for its public message and Telex systems, but eventually to provide as well a variety of data processing, storage and retrieval services for the public. The first such computer centers, planned by the company as part of its "national information utility" program, was opened

March 16 of this year in New York City. This center, and others to be established in key cities, will be programmed to offer time-sharing, information processing and data-bank services. Western Union's planning looks to the establishment, through a national, regional and local network of computers, of a gigantic real-time computer utility service which would gather, store, process, program, retrieve and distribute information on a broad scale. This company will also arrange to design, procure and install all necessary hardware for fully integrated data processing and communications systems for individual customers, and provide the total management service for such systems.

11. The Bell System has not yet indicated any plan to provide a similar information service, or to offer local data processing services to the public. However, it is implementing a program to convert all central offices from electro-mechanical switching systems to electronic switching. Similar conversion programs are being undertaken by other carriers in the industry. Interface, terminal and outstation equipments are being developed by the industry to match computer systems with communication channels. It might be observed here, that the Touch-Tone telephone instrument has significant potential as a computer input device, utilizing the telephone switched network. After a connection to a multiple access computer is completed in the regular manner, the same buttons can be pressed to enter information into the computer or to query the computer and get back a voice answer. A number of systems of this type are now in service.

12. International carriers have recently proposed new computer message switching and data processing services. One such carrier offers a service to air lines under which it switches messages between and among the various leased circuits connected to its computer. In addition, it plans to employ the same computer to store and supply up-to-the-minute seat inventory information with respect to flights of those air lines subscribing to this additional service, through communication facilities connected to air line offices and agencies on an on-line real-time basis. Other carriers plan to introduce similar service offerings.

IV. Discussion of the Problems

13. The above review, although by no means exhaustive, is illustrative of the convergence and growing interdependence of the computer and communications. This convergence takes a variety of different forms and applications thereby making it difficult to sort them into simple discrete categories. It is impossible at this time to anticipate fully the nature of all of the policy and regulatory problems that future developments may generate. Nevertheless, it is desirable to focus on those problems that are presently definable within the existing state of this burgeoning industry.

14. Communication common carriers, whose rates and services are subject to governmental regulation, are employing computers as a circuit and message switching device in furtherance of their undertakings to provide communication channels and services to the general public. There is now evidence of a trend among several of the major domestic and international carriers to program their computers not only for switching services, but also for the storage, processing and retrieval of various types of business and management data of entities desiring to subscribe therefor in lieu of such industries providing this service to themselves on an in-house basis or contracting with computer firms for the service.

15. Accordingly, we find communication common carriers grafting on to their conventional undertaking of providing communication channels and services to the public various types of data processing and information services. One such carrier has, in fact, committed its future to using its combined resources of computers and communication channels to meet the information requirements of the business community and other professional and institutional segments of our society by the establishment of a national and regional centralized information system. As a consequence, common carriers, in offering these services, are, or will be, in many instances, competitive with services sold by computer manufacturers and service bureau firms. At the same time, such firms will be dependent upon common carriers for reasonably priced communication facilities and services.

16. As previously indicated, a large number of non-regulated entities are employing computers to provide various types of data processing and specialized information services. The excess capacity of the in-house computer is made available for a charge to others; in other instances computer service bureaus sell computer time to a number of subscribers on a shared-time basis; and in still other instances, highly specialized information and data bank services are provided. At an ever increasing rate, with the development of time-sharing techniques, remote input and output devices of the users are linked to the computer by communication channels obtained from common carriers. The users located at the remote terminals are served so rapidly that each is under the illusion that he alone has access to the central processor. The flexibility of the computer makes possible, in addition to data processing services, message switching between various locations of the same customer, or between several different customers. This allows the data processing industry to engage in what heretofore has been an activity limited to the communications common carrier.

17. Common carriers have thus far taken different approaches to the question of the applicability of the regulatory provisions of the Communications Act to their computer service offerings. Notwithstanding that various aspects of such offerings appear to involve activities, such as message switching, which historically have been regarded as common carrier activities subject to regulation, no consistent policy

is established and followed with respect to the filing of tariffs by carriers to cover those offerings. This is understandable considering the competitive activities of a similar nature by non-regulated entities as well as the apparent difficulties in classifying the various elements of a computer service into discrete communication and non-communication compartments.

18. From the common carriers' standpoint, regulation should extend to all entities offering like services or to none. It is urged that the ability to compete successfully depends on the flexibility required to meet the competition; and that the carriers would be deprived of this flexibility if they alone were restricted in their pricing practices and marketing efforts by the rigidities of a tariff schedule. Thus, we are confronted with determining under what circumstances data processing, computer information and message switching services, or any particular combination thereof -- whether engaged in by established common carriers or other entities -- are or should be subject to the provisions of the Communications Act. We expect this inquiry to be of assistance to the Commission in evaluating the policy and legal considerations involved in arriving at this determination.

V. Communication Tariffs and Practices

19. The interdependence between data processing and communication channels is bound to continue under the impetus of remote processing in combination with the growth of time-shared computer systems and services. In the past, the relationship between the relative cost of the two segments was of little concern. Data processing was expensive and in a relative sense higher than its communication counterpart. The trend toward lower EDP costs resulting from larger computer systems, has tended to shift the relative cost positions. Indeed, there is some indication that in the near future communication costs will dominate the EDP-communications circuit package. It is natural, then, that the computer industry finds its attention devoted increasingly to communication tariffs and regulations, in its search to optimize the communication segment of the package. In fact, fears are expressed that the cost of communications may prove to be the limiting factor in the future growth of the industry.

20. While the charges of the carriers are of prime importance, including the question of minimum periods of use, other tariff provisions and restrictions should also be scrutinized. Such tariff provisions as those relating to shared use and authorized use may well be in need of revision in light of the new advanced technology. Likewise, any restriction on the use of customer owned or provided equipment, including multiplexing equipment, must be reviewed for their effects on a burgeoning industry

21. This then is another area of concern. Are the service offerings of the common carriers, as well as their tariffs and practices, keeping pace with the quickened developments in digital technology? Does a gap exist between computer industry needs and requirements, on the one side, and communications technology and tariff rates and practices on the other?

VI. The Problem of Information Privacy

22. The modern application of computer technology has brought about a trend toward concentrating commercial and personal data at computer centers. This concentration, resulting in the ready availability in one place of detailed personal and business data, raises serious problems of how this information can be kept from unauthorized persons or unauthorized use.

23. Privacy, particularly in the area of communications, is a well established policy and objective of the Communications Act. Thus, any threatened or potential invasion of privacy is cause for concern by the Commission and the industry. In the past, the invasion of information privacy was rendered difficult by the scattered and random nature of individual data. Now the fragmentary nature of information is becoming a relic of the past. Data centers and common memory drums housing competitive sales, inventory and credit information and untold amounts of personal information, are becoming common. This personal and proprietary information must remain free from unauthorized invasion or disclosure, whether at the computer, the terminal station, or the interconnecting communication link.

24. Both the developing industry and the Commission must be prepared to deal with the problems promptly so that they may be resolved in an effective manner before technological advances render solution more difficult. The Commission is interested not only in promoting the development of technology, but it is at the same time concerned that in the process technology does not erode fundamental values.

VII. Items of Inquiry

25. In view of the foregoing, it is incumbent upon the Commission to obtain information, views and recommendations from interested members of the public in order to assist the Commission in resolving the regulatory and policy questions presented by this new technology. Accordingly, such information, views and recommendations are requested in response to the following items of inquiry:

A. Describe the uses that are being made currently and the uses that are anticipated in the next decade of computers and communication channels and facilities for:

1. Message or circuit switching (including the storage and forwarding of data);

2. Data processing;

3. General or special information services;

4. Any combination of the foregoing.

B. Describe the basis for and structure of charges to the customers for the services listed in A above.

C. The circumstances, if any, under which any of the aforementioned services should be deemed subject to regulation pursuant to the provisions of Title II of the Communications Act.

1. When involving the use of communication facilities and services;

2. When furnished by established communication common carriers;

3. When furnished by entities other than established communication common carriers.

D. Assuming that any or all of such services are subject to regulation under the Communications Act, whether the policies and objectives of the Communications Act will be served better by such regulation or by such services evolving in a free, competitive market, and if the latter, whether changes in existing provisions or law or regulations are needed.

E. Assuming that any and all of such services are not subject to regulation under the Communications Act, whether public policy dictates that legislation be enacted bringing such services under regulation by an appropriate governmental authority, and the nature of such legislation.

F. Whether existing rate-making, accounting and other regulatory procedures of the Commission are consistent with insuring fair and effective competition between communications common carriers and other entities (whether or not subject to regulation) in the sale of computer services involving the use of communications facilities; and, if not, what changes are required in those procedures.

G. Whether the rate structure, regulations and practices contained in the existing tariff schedules of communications common carriers are compatible with present and anticipated requirements of the computer industry and its customers. In this connection, specific reference may be made to those tariff provisions relating to:

1. Interconnection of customer-provided facilities (owned or leased) with common carrier facilities, including prohibitions against use of foreign attachments;

2. Time and distance as a basis for constructing charges for services;

3. Shared use of equipment and services offered by common carriers;

4. Restrictions on use of services offered, including prohibitions against resale thereof.

H. What new common carrier tariff offerings or services are or will be required to meet the present and anticipated needs of the computer industry and its customers.

I. The respects in which present-day transmission facilities of common carriers are inadequate to meet the requirements of computer technology, including those for accuracy and speed.

J. What measures are required by the computer industry and common carriers to protect the privacy and proprietary nature of data stored in computers and transmitted over communication facilities, including:

1. Descriptions of those measures which are now being taken and are under consideration; and

2. Recommendations as to legislative or other governmental action that should be taken.

26. Accordingly, there is hereby instituted, pursuant to the provisions of Sections 4(i) and 403 of the Communications Act of 1934, as amended, an inquiry into the foregoing matters.

27. In view of the scope and complexity of the matters involved, it appears desirable that interested persons be afforded an opportunity to suggest additions to and modifications or clarifications of the items of inquiry specified above. To this end, all interested persons are invited to submit appropriate recommendations in this regard on or before December 12, 1966. The Commission will thereupon issue such supplement to this Notice of Inquiry as may be warranted and will then specify a date by which written responses to said Notices shall be required.

28. All filings in this proceeding should be submitted in accordance with the provisions of Sections 1.49 and 1.419 of the Commission's Rules (47 CFR 1.49, 1.419).

FEDERAL COMMUNICATIONS COMMISSION

Ben F. Waple
Secretary

Adopted: November 9, 1966

Released: November 10, 1966

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DRAFT

19 April 1968

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COUNTING THE NUMBER OF DOCUMENTS PUBLISHED IN 1966 IN THE FIELD OF INFORMATION SCIENCE AND TECHNOLOGY

Philip R. Bagley

CONFIDENTIAL

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INFORMATION ENGINEERING
3401 MARKET STREET
PHILADELPHIA, PENNSYLVANIA 19104

Summary. A systematic count was made of documents published in 1966 concerning information science and technology. The count was based on abstracts and reviews appearing in six major sources. Counts are tabulated by major subject categories. Breakdowns are given by source and by number of sources. The total number of abstracts and reviews processed was 15,555. These represented a total of 10,947 different documents plus 1431 patents.

Objective and scope of survey. The objective of the survey* reported here is to provide reliable data concerning the current rate of publication of documents in the field of information processing. This was done by counting as far as practical the number of documents published in 1966. The publication year of 1966 was chosen because it was the latest year for which reasonable abstract coverage was available. (For example, Information Processing Journal completed its coverage of material published in 1966 with its Vol. 5, No. 4, which appeared in March, 1968.)

The count was based on collecting relevant abstracts and reviews from six major sources:

Computer Abstracts
Computing Reviews
Information Processing Journal
Documentation Abstracts
Referativnyj Zhurnal
U.S. Government Research & Development Reports

This report documents how the survey was conducted and tabulates the counted results.

Conclusions. If our count of 10947 documents represents the extent of the literature, then the percentage of the total that each source covers is as follows:

Information Processing Journal	37%
Referativnyj Zhurnal	35%
Computer Abstracts	27%
Computing Reviews	13%
Documentation Abstracts	7%
U. S. Gov't. R & D Reports	6%

These percentages total 125%, which means that the redundant coverage is

*This study was sponsored by the American Federation of Information Processing Societies, and monitored by its ad hoc Committee on Abstracts.

25%. Two obvious conclusions stand out:

1. No single source is doing an adequate job of covering the AFIPS field of interest.

1. Each of the sources has its own idea of what is important and relevant, for only one-quarter of the documents represented was covered by more than 1 source.

Categorization scheme. The abstracts covered by the survey are classified into major subject categories. The categories are given in Table 1, together with brief lists to suggest the scope of each category. This set of categories is based on those used by the journal sources used in the survey, and reflects modifications contributed by members of the AFIPS Abstracts Committee. Individual categories have been assigned individual letter codes for convenient reference. The scheme is hereinafter referred to as "AFIPS Categories."

This categorization scheme attempts to show the major subject areas of concern to AFIPS. Like all such schemes it has deficiencies; in particular, the dividing lines between categories are not always clear-cut. The most obvious overlap is between Computer Applications on the one hand and almost any of the other categories on the other hand. The policy used was that where a particular technique was stressed in a document concerning a computer application, the abstract was put in the appropriate technique-oriented category; applications documents which did not stress techniques were put in Computer Applications.

The categorization scheme served reasonably well. In the Appendix is a more detailed discussion of it, its use, its deficiencies, and a recommendation that it be revised for future use.

Results of counting. The raw results of counting are given in the following tables:

Table 2. No. of abstracts/reviews by source.

Table 3. No. of documents covered by pairs of sources (totals for all categories).

Table 4. No. of documents by number of sources, showing the amount of duplication of coverage by the various sources.

Table 5. No. of documents covered by pairs of sources, broken down by category.

Table 1. MAJOR CATEGORIES FOR INFORMATION SCIENCE AND TECHNOLOGY

A. ARTIFICIAL INTELLIGENCE; includes pattern recognition, game playing, theorem proving, and studies of the human brain and nervous system.

C. CIRCUITS, CIRCUIT COMPONENTS, AND PHYSICAL PHENOMENA; includes semiconductors, integrated circuits, physics of electrical and magnetic substances, design and fabrications of small components.

D. DEVICES AND LOGICAL DESIGN; includes computer components such as storage, input-output, arithmetic units; codes and coding; error detection and correction; man-machine communication.

E. EDUCATION; includes training of computer personnel, texts and training aids, computer science curricula.

F. THEORETICAL FOUNDATIONS; includes switching and automata theory, formal language and logic, algorithmic theory.

G. MANAGEMENT OF DATA PROCESSING; includes installation management, personnel, marketing, system analysis, computer selection, data preparation.

H. HUMAN COMMUNICATION AND LANGUAGE; linguistic analysis and machine translation.

I. INFORMATION SYSTEMS AND SERVICES; includes information analysis, storage, and retrieval; technical information centres and libraries; publishing and reproduction; abstracting, indexing, and classification.

L. GENERAL; includes history, conferences, reference works, general surveys, professional and legal matters, and fiction.

M. MATHEMATICS AND OPERATIONS RESEARCH; includes numerical analysis, integrals, differential equations, algebra, graph theory, probability and statistics, combinatorial and discrete math, mathematical programming, number theory, and specific mathematical algorithms.

N. ANALOG AND HYBRID COMPUTERS; includes analog-digital converters.

P. COMPUTER PROGRAMMING AND PROGRAMS; includes techniques, languages, processors, documentation, testing, data representations.

S. SIMULATION AND MODELING; methodology and applications stressing the methodology.

T. DATA COMMUNICATION; includes data transmission concepts and standards; for devices see category D.

X. APPLICATIONS OF COMPUTERS

Y. COMPUTERS AND COMPUTER SYSTEMS; includes computer design, fabrication and testing; does not include analog and hybrid computers.

Z. MISCELLANEOUS; uncategorizable and irrelevant material.

Table 2. NO. OF ABSTRACTS/REVIEWS BY SOURCE

AFIPS CATEGORY		COMPUTER ABSTRACTS	COMPUTING REVIEWS	DOCUMENTATION ABSTRACTS	INFORMATION PROCESSING JOURNAL	REFERATIVNYJ ZHURNAL	U.S. GOV'T. R&D REPORTS	TOTALS
A.	INTELLIGENCE	109	41	10	168	28	19	375
C.	CIRCUITS	110	18	0	182	241	14	565
D.	DEVICES	386	54	9	290	614	51	1404
E.	EDUCATION	43	34	31	20	63	5	196
F.	FOUNDATIONS	121	99	6	244	258	26	754
G.	MANAGEMENT	70	22	3	71	20	21	207
H.	LANGUAGE	33	36	17	59	110	10	265
I.	INFO SYSTEMS	62	94	584	118	1087	163	2108
L.	GENERAL	63	97	33	21	147	33	394
M.	MATHEMATICS	450	386	0	804	198	20	1858
N.	ANALOG	81	27	1	126	181	13	429
P.	PROGRAMMING	298	142	11	152	350	97	1050
S.	SIMULATION	37	22	0	37	49	9	154
T.	COMMUNICATION	25	9	1	30	8	2	75
X.	APPLICATIONS	855	253	10	1244	108	86	2556
Y.	COMPUTERS	162	34	6	133	255	46	636
Z.	MISCELLANEOUS	12	76	84	382	113	61	728
	TOTALS	2917	1444	806	4081	3830	676	13,754

Note: These figures do not include abstracts of patents. There were a total of 1801 abstracts of patents covered by Computer Abstracts, Information Processing Journal, and Referativnyj Zhurnal.

TABLE 3. DOCUMENTS COVERED BY PAIRS OF SOURCES (ALL CATEGORIES)

	COMPUTING REVIEWS	DOCUMENTATION ABSTRACTS	INFORMATION PROCESSING JOURNAL	REFERATIVNYJ ZHURNAL	U.S. GOV'T. R&D REPORTS
Computer Abstracts	583	36	1137	392	256
Computing Reviews		57	357	166	20
Documentation Abstracts			43	122	20
Information Processing Journal				373	226
Referativnyj Zhurnal					9

TABLE 4. NO. OF DOCUMENTS BY NO. OF SOURCES

AFIPS CATEGORIES		Number of sources covering same document						
		1	2	3	4	5	6	TOTALS
A.	INTELLIGENCE	220	53	16	1			290
C.	CIRCUITS	390	47	23	3			463
D.	DEVICES	911	135	63	9			1118
E.	EDUCATION	137	20	5	1			163
F.	FOUNDATIONS	434	77	36	12	2		561
G.	MANAGEMENT	100	37	7	3			147
H.	LANGUAGE	172	33	6	1	1		213
I.	INFO SYSTEMS	1576	189	42	6			1813
L.	GENERAL	318	24	8	1			351
M.	MATHEMATICS	1021	218	111	17			1367
N.	ANALOG	244	60	19	2			325
P.	PROGRAMMING	454	130	89	41	1		715
S.	SIMULATION	69	23	13				105
T.	COMMUNICATION	35	17	2				54
X.	APPLICATIONS	1654	345	63	6			2068
Y.	COMPUTERS	373	69	28	9	1		480
Z.	MISCELLANEOUS	700	14					714
	TOTALS	8808	1491	531	112	5		10947

Note: These figures do not include abstracts of patents. There were a total of 1431 different patents covered by Computer Abstracts, Information Processing Journal, and Referativnyj Zhurnal.

TABLE 5. DOCUMENTS COVERED BY PAIRS OF SOURCES, AND BY CATEGORY

Abbreviations: CA = Computer Abstracts, CR = Computing Reviews, DA = Documentation Abstracts IP = Information Processing Journal, RZ = Referativnyj Zhurnal, US = U.S. Gov't. R & D Reports.

CAT. A	CR	DA	IP	RZ	US
CA	14	3	38	3	16
CR		1	12	1	0
DA			3	0	0
IP				2	8
RZ					0

CAT. C	CR	DA	IP	RZ	US
CA	11	0	35	33	4
CR		0	6	3	0
DA			0	0	0
IP				36	6
RZ					0

CAT. D	CR	DA	IP	RZ	US
CA	36	4	115	71	22
CR		2	20	9	1
DA			1	2	0
IP				75	19
RZ					1

CAT. E	CR	DA	IP	RZ	US
CA	9	0	11	4	2
CR		0	4	4	0
DA			0	3	0
IP				2	2
RZ					0

CAT. F	CR	DA	IP	RZ	US
CA	44	1	80	27	18
CR		1	41	19	4
DA			2	1	0
IP				23	15
RZ					1

CAT. G	CR	DA	IP	RZ	US
CA	8	1	31	4	12
CR		1	3	3	1
DA			0	0	0
IP				3	9
RZ					0

CAT. H	CR	DA	IP	RZ	US
CA	5	2	22	4	4
CR		2	3	7	0
DA			3	5	1
IP				3	5
RZ					1

CAT. I	CR	DA	IP	RZ	US
CA	7	11	24	5	38
CR		38	9	17	6
DA			17	98	17
IP				4	57
RZ					2

CAT. L	CR	DA	IP	RZ	US
CA	8	2	12	6	5
CR		1	4	4	0
DA			1	4	0
IP				6	1
RZ					0

CAT. M	CR	DA	IP	RZ	US
CA	199	0	195	53	6
CR		0	117	28	1
DA			0	0	0
IP				47	6
RZ					0

CAT. N	CR	DA	IP	RZ	US
CA	21	0	36	19	8
CR		0	12	2	2
DA			1	0	0
IP				24	4
RZ					0

CAT. P	CR	DA	IP	RZ	US
CA	82	7	150	94	71
CR		4	50	49	3
DA			7	3	1
IP				87	43
RZ					2

CAT. S	CR	DA	IP	RZ	US
CA	10	0	20	11	2
CR		0	9	1	0
DA			0	0	0
IP				7	1
RZ					1

CAT. T	CR	DA	IP	RZ	US
CA	4	0	11	0	1
CR		1	2	2	0
DA			0	0	0
IP				1	1
RZ					0

CAT. X	CR	DA	IP	RZ	US
CA	98	2	290	26	25
CR		3	56	8	1
DA			2	2	0
IP				24	32
RZ					0

CAT. Y	CR	DA	IP	RZ	US
CA	25	3	63	32	22
CR		3	9	9	1
DA			3	3	0
IP				26	17
RZ					1

CAT. Z	CR	DA	IP	RZ	US
CA	2	0	4	0	0
CR		0	0	0	0
DA			3	1	1
IP				3	0
RZ					0

Sources. The sources of abstracts and reviews used were the six journals listed in Table 6. The table shows which sections of the journals were used, and which issues were scanned. The coverage of Referativnyj is unavoidably incomplete: the issues for 1966 and 1967 that are not listed were not available, and were omitted from the survey by agreement with the sponsor. For this reason the counts applying to Referativnyj must be taken as indicative only.

Remarks on relevance. There were a number of topics represented by the source material which in my opinion does not fall within AFIPS' area of interest. Specifically these topics are:

telemetry

automatic control

signal transmission

speech processing

statistical communication theory

linguistic matters not closely related to machine translation

In general, abstracts and reviews in these areas were put in AFIPS category Z (miscellaneous). In Referativnyj Zhurnal, a fair amount of material falling in AFIPS category I (information systems and services) seems of little relevance: this dealt with conventional publication equipment and processes such as xerographic and offset printers. Abstracts and reviews dealing with bibliographies not in AFIPS' area of interest, and with other office machines such as typewriters and dictation equipment was moved to category Z whenever it was recognized.

Information Processing Journal had a large number of abstracts in the mathematical area. I am not fully qualified to judge the number of these which are not truly relevant to computer-oriented mathematics, but I strongly suspect a significant portion are not.

Remark on a source of error. Information Processing Journal cites documents abstracted in USGR&D Reports. Unfortunately the date appearing in the IPJ abstract is not the date of publication of the document but the publication date of the abstract in USGR&D Reports. We selected the IPJ abstracts on the basis of the date 1966 appearing in them. The result was the inclusion of some abstracts of documents actually published before 1966 and the omission of some abstracts of documents published in 1966 which appeared in USGR&D Reports in early 1967. The net result is a minor error in the counts involving IPJ.

TABLE 6. SOURCES OF ABSTRACTS AND REVIEWS

Journal	Sections	Issues Scanned	
Computer Abstracts	All sections	1966: Jan.-Dec.	1967: Jan.-July
Computing Reviews	All sections	1966: Ja/Fe-No/Dec	1967: Ja/Fe-Se/Oc
Information Processing Journal	All sections	Vol. 5, Nos. 1-4 (publ. 1967-68)	
Documentation Abstracts	All sections	Vol. 1, Nos. 1-4; Vol. 2, Nos. 1-2	
U.S. Government Research and Development Reports	5B - Documentation and Information Technology 9B - Computers	1966: Nos. 1-24	1967: Nos. 1-24
Referativnyj Zhurnal	(Cybernetics) a. programming and mathematical machines b. mathematical problems of semiotics	1966: Nos. 7-12	1967: Nos. 1-6, 8
	(Automation, Remote Control, and Computing Techniques) Part 2, computing machinery and technology	1966: Nos. 7-12	1967: Nos. 1-7, 9-11
	(Scientific and Technical Information) All sections	1966: Nos. 5-6	1967: Nos. 8-10

Completeness. A question not technically within the scope of the present study is: What percentage of the relevant documents published in 1966 were covered by the 6 sources surveyed? At the present moment I can do little more than give an opinion. I am in the process of making a small investigation which will give a partial answer. Preliminary results indicate that the regular open literature in technical and semi-technical publications is fairly well covered, as is the publicly-available government report literature. The types of documents which have received little or no coverage are:

Bulletins and newsletters of ACM special interest groups, e.g., ALGOL Bulletin
Manufacturers' publications, e.g., IBM manuals
Company reports not sponsored by government funds, and therefore not reported in USGR&D Reports, e.g., technical reports from IBM Research Center
Independently-authored chapters of books, e.g., Wegner, P., ed., Introduction to systems programming
Notes issued in summer session courses
Theses and dissertations (Computing Reviews has recently begun systematic coverage of dissertations)
Technically pertinent journal articles which appear in unusual places, e.g., Proceedings of the American Philosophical Society
Classified and unclassified government-sponsored reports which have some distribution restriction, and therefore which do not appear in USGR&D Reports.

APPENDIX

General processing procedures. The general procedure used was as follows:

1. Borrow 1966 and 1967 issues of journal.

2. Scan for first occurrence of abstract or review of document published in 1966; xerox from this point forward.

3. Scan the xerox copies, crossing out abstracts and reviews for documents not published in 1966. Copy on each remaining abstract the classification code assigned by the journal.

4. Cut out the abstracts using a trimming board. Mount each 1966 abstract on a 3 x 5 index card with double-coated scotch tape.

5. File abstracts in author file by personal author if there is one, otherwise by first significant word of title, in title file. As multiple abstracts of the same published document are found, clip them together with a paper clip.

6. When all journals have been thus processed, sort the abstracts (keeping clipped ones clipped together) into major subject categories, by chart if possible, otherwise by professional judgment. In each category the abstracts are further separated into seven groups: 6 groups of individual abstracts from the 6 sources, and a seventh group consisting of all packets of more than one abstract clipped together. Abstracts of patents were culled out at this stage.

7. Manually count the individual abstracts, obtaining a count for each source in each of the 17 categories.

8. Keypunch an IBM card for each pakcet, as follows: Let each of the six sources be assigned a unique one of the first six columns of the card. Punch a "1" in those columns corresponding to the sources of abstracts in a packet. Further, punch a card column with the total number of abstracts in the packet. Use a card sorter to obtain the counts for each category by pair of sources and by number of sources.

9. Compute totals.

Counting policies. Some documents were published in two different forms (e.g., as report and as journal article): we regarded these as identical documents. Some documents appeared in more than one language; as these occurrences were rare and not easily detected, these were treated as different documents. Some documents appeared in multiple parts; where these were abstracted or reviewed individually, they were counted separately. Some sources covered the same document more than once; such duplications were ignored and counted as one.

<u>Detailed definition of the categorization scheme.</u> The abstracts and reviews covered by the survey are classified into major categories briefly described earlier in this report. The categorization scheme is repeated here and explained in more detail. The subheadings are indicative but necessarily complete. A further indication of scope is given by small sets of typical actual titles.

GENERAL (L)
- history
- meetings
- conferences
- reference works
- glossaries
- bibliographies (broad)
- biographies
- professional aspects
- legislation, regulation
- implications and effects
- predictions
- surveys (broad)
- organization
- standards (general)

Typical titles:
- Computer Technology in Communist China
- Russian-English Dictionary of Cybernetics and Computer Technology
- Project MAC Progress Report III

MANAGEMENT OF DATA PROCESSING (G)
- project estimating
- feasibility studies
- system selection and evaluation
- installation management
- salary scales
- data preparation
- economics
- computer personnel
- systems analysis
- marketing

Typical titles:
- Computer Analysis and Thruput Evaluation
- On use of Air Force ADP Experience to Assist Air Force EDP Management
- How to Estimate the Investment Cost of EDP Equipment

EDUCATION AND TRAINING (E)
- curricula
- personnel training and testing
- texts and training aids

Typical titles:
- Computer Science in High School Mathematics
- Computers and Education: the IBM Approach--A Report and an Evaluation
- Digital Computer Users Manual for E E Students and Faculty

COMPUTERS & COMPUTER SYSTEMS (Y)
- (stressing design and performance)
- computer descriptions
- computer installations
- computer networks
- system design
- fabrication, manufacturing
- reliability, maintenance, and testing
- standards
- special purpose computers
- machine organization
- time sharing systems

Typical titles:
- An Approach to the Design of a University Computer Center in the Beginning of the 1970's
- The Design of an Airborne Computer: A Case Study in Minimizing Noise Levels in Digital Integrated Circuit Systems
- Distributed Executive Control in a Class of Modular Multi-processor Computing Systems via a Priority Memory
- Time-sharing in the IBM System/360: Model 67
- On Computer Self-diagnosis Part 1- Experimental Study of a Processor

DEVICES & DEVICE LOGIC (D)
(includes logical design as applied)
supplies and accessories
storage
input-output
displays
arithmetic and logical units
processors, controllers
data communication equipment
checking and error detection
codes and coding
counters
man-machine communication
character recognition

Typical titles:
Real-time I/O Techniques to Reduce System Costs
A Decoder-Driver System for Magnetic Core Memories Using a 64-Position Switch Tube
A Ferrite Core Memory Seen as a Transmission Line
The IBM 2560 Multi-function Card Machine
Graphics as Computer input and Output

CIRCUITS AND CIRCUIT COMPONENTS (C)
includes:
semiconductor devices
integrated circuits
magnetic devices
design and fabrication of components
physical phenomena

Typical titles:
Hall Effect in Adaptive Threshold Logic
Integrated Circuit Logic Cards-Why Buy and What's Available
Superconducting Thin-film Technology and Applications
High Speed Tunnel Diode Transistor Micrologic Circuits
Plated Wire Magnetic Logic Using Resistive Coupling

ANALOG AND HYBRID COMPUTERS (N)
(stresses design)
simulation applications, see SIMULATION
analog computers
hybrid computers
interface components (e.g. a-d converters)

Typical titles:
A High Resolution Sin/Cosine Function Generator
A Time-shared Hybrid Simulation Facility
An Operational Transistor Amplifier Without Automatic Drift Correction
Research and Development of Analog Models

DATA COMMUNICATION (T)
equipment, see DEVICES
data transmission
networks
standards

Typical titles:
Efficiency and Error Control in Data Communications
Connection of the Minsk-1 Computer to a Telegraph Channel
On Teleprocessing System Design: Part V--A Technique for Estimating Channel Interference

COMPUTER PROGRAMMING AND PROGRAMS (P)
programming techniques
programming languages, including simulation languages
programming systems and aids
programming language processors
data representations, structures, files
program documentation, flow diagrams
program testing
standards
microprogramming

Typical titles:
An Interpreter for 'Iverson Notation'
Over 1000 Systems Men Evaluate COBOL
GIS and File Management
The Functional Structure of OS/360. Part III--Data Management
A Problem in Static Storage Allocation

THEORETICAL FOUNDATIONS (F)

logical design methods
switching theory
automata theory
information theory, coding
algorithm theory
control theory
formal language and logic
programming theory

Typical titles:

On the Length of Programs for Computing Finite Binary Sequences
On the Linearity of Sequential Machines
Turing Machines With Restricted Memory Access
Ambiguity in context Free Languages
Synthesis of Switching Functions by Threshold Elements

ARTIFICIAL INTELLIGENCE (A)

pattern recognition
adaptive systems
cybernetics
bionics
problem solving, game playing

Typical titles:

Some Recent Work in Artificial Intelligence
Semantic Memory
Mathematical Studies for Self-Organizing Systems
A FORTRAN IV General-Purpose Deductive Program
Pattern Recognition With Three Added Requirements

MATHEMATICS AND OPERATIONS RESEARCH (M)

numerical analysis
integrals
differential equations
algebra, graph theory
probability and statistics
combinatorial and discrete mathematics
mathematical programming, including linear and dynamic programming
number theory and number systems
queueing
optimization
mathematical algorithms

Typical titles:

A New Method of Solving Second-Order Differential Equations When the First Derivative is Present
Concerning Damping in Minimization Methods
Pseudo-Runge-Kutta Methods Involving Two Points
A General-Purpose Multiple Regression Programme for the IBM 7090
Complex Zeros of Cylinder Functions

HUMAN COMMUNICATION AND LANGUAGE (H)

linguistic analysis
translation

Typical titles:

Computation in Linguistics: A Case Book
The Tabular Parser: A Parsing Program for Phrase Structure and Dependency
Realization of Machine Algorithm for the Detection in Text of Object Names

INFORMATION SYSTEMS AND SERVICES (I)

information analysis, storage, and retrieval
technical information centers
library automation
publishing and reproduction
information generation, dissemination and collection
abstracting
indexing and classification

Typical titles:

Content Analysis, Specification and Control
Indexing Physics Papers
Problems of Recording Text Information in Machine Form for Use in a Scientific Information Communication Network
Computer-Based Composition at Chemical Abstracts Service
Breaking the Cost Barrier in Automatic Classification

APPLICATIONS OF COMPUTERS (X)
See elsewhere when technique is stressed
business, e.g.:
manufacturing
publishing
insurance
transportation
natural sciences, e.g.:
astronomy
biology
chemistry
earth sciences
physics
engineering, e.g.:
aeronautics
civil eng.
electrical eng.
mechanical eng.
social and behavioral sciences, e.g.:
education
law
medicine
sociology
programmed instruction
applications-oriented algorithms
humanities, e.g.:
art
literature
music
language, See Human Communication
military

Typical titles:
Digital Computers in Control System Design
Computer Method for Wind Tunnel Data Analysis
Das Datenverarbeitungssystem als Hilfsmittel im Börsengeschäft
Introductory Physics Experiments Using a Digital Computer

SIMULATION AND MODELING (S)
(methods in general)
languages, See Computer Programming

Typical titles:
The Parameter Estimation Problem in Model Checking

[SIMULATION AND MODELING (S)
Typical titles: continued]
The Use of a Computer in Simulation Studies
Leviathan: An Experimental Study of Large Organizations With the Aid of Computers
The Methodology of Modeling

MISCELLANEOUS (Z)
(uncategorizable, irrelevant)

Typical titles:
Trade Names in Common Use
Development Plan of the National Economy as Illustration of a Model in Social Sciences
A Statistical Theory for Pert Critical Path Analysis
Central Dictating Systems
Glossary of Oceanographic Terms

Initial categorization procedure. It was not reasonable within the limits of the original budget to reclassify each abstract individually according to the AFIPS categorization scheme. We made correspondence charts to show the AFIPS category for each classification code assigned by the editors of the source journals or by the abstractors. Correspondence charts for the following sources are given in the succeeding Tables A-E: Computer Abstracts, Computing Reviews, Information Processing Journal, Documentation Abstracts, and the Scientific and Technical Information section of Referativnyj Zhurnal. The abstracts from these five sources were manually assigned to AFIPS categories using these correspondence charts.

Although we had originally planned to make correspondence charts for all of the abstract sources, it was not possible to do so for the USGR&D Reports and some sections of Referativnyj Zhurnal. In the case of USGR&D Reports, there was no further classification within the two sections chosen. In the case of the sections from Automation, and from Cybernetics, series of Referativnyj Zhurnal, we expected to to be able to find a correspondence between the UDC numbers on each abstract and the AFIPS categories. Unfortunately, the UDC numbers were found to be unsatisfactory for this purpose. As a consequence, we had to classify individually all the abstracts from these sources just named. The assignment of categories was done largely on the basis of title, with reference to the text of the abstract or review in cases of uncertainty. Several thousand abstracts were wholly in Russian; processing these required the services of a person who knew both Russian and computers.

TABLE A. CORRESPONDENCE CHART FOR COMPUTER ABSTRACTS

1. General	–
2. Computer Theory	F
3. Logical Design	D
4. Artificial Intelligence	A
5. Pattern Recognition	A
6. Mathematics	M
7. Techniques	–
8. Programming	P
9. System Design	Y
10. Digital Circuits and Components	C
11. Data Storage	D
12. Input/output	D
13. Data Transmission	D
14. Specific Digital Computers	Y
15. Analogue Computers	N
16. Hybrid and Other Computers	N
17. Education and Personnel	E
18. Applications	
.1 Aerospace	X
.2 Business	X
.3 Chemical	X
.4 Communications	–
.5 Control—General Systems	X
.6 Control—Production and Process	X
.7 Education	X
.8 Electronics	X
.9 Engineering, Civil	X
.10 Engineering, Electrical	X
.11 Engineering, Mechanical	X
.12 Engineering, Structural	X
.13 Information Retrieval	I
.14 Linguistics	H
.15 Medical	X
.16 Military	X
.17 Nuclear	X
.18 Physics	X
18.19 Miscellaneous	X
.20 Control—Machine Tool	X
.21 Meteorology	X
.22 Mining	X
.23 Transport	X
19. Books	–

TABLE B. CORRESPONDENCE CHART FOR COMPUTING REVIEWS

1. GENERAL TOPICS AND EDUCATION	
1.0 General	L
1.1 Texts; Handbooks	E
1.2 History; Biographies	L
1.3 Introductory and Survey Articles	L
1.4 Glossaries	L
1.5 Education	
1.50 General	E
1.51 High School Courses and Programs	E
1.52 University Courses and Programs	E
1.53 Certification; Degrees; Diplomas	E
1.59 Miscellaneous	E
1.9 Miscellaneous	L
2. COMPUTING MILIEU	
2.0 General	L
2.1 Philosophical and Social Implications	
2.10 General	L
2.11 Economic and Sociological Effects	L
2.12 The Public and Computers	L
2.19 Miscellaneous	L
2.2 Professional Aspects	L
2.3 Legislation; Regulations	L
2.4 Administration of Computing Centers	
2.40 General	G
2.41 Administrative Policies	G
2.42 Personnel Training	E
2.43 Operating Procedures	G
2.44 Equipment Evaluation	G
2.45 Surveys of Computing Centers	G
2.49 Miscellaneous	G
2.9 Miscellaneous	L
3. APPLICATIONS	
3.0 General	X
3.1 Natural Sciences	X
3.10 General	X
3.11 Astronomy; Space	X
3.12 Biology	X
3.13 Chemistry	X
3.14 Earth Sciences	X
3.15 Mathematics; Number Theory	M
3.16 Meteorology	X
3.17 Physics; Nuclear Sciences	X
3.19 Miscellaneous	X
3.2 Engineering	
3.20 General	X
3.21 Aeronautical; Space	X
3.22 Chemical	X
3.23 Civil	X
3.24 Electrical; Electronic	X
3.25 Engineering Science	X
3.26 Mechanical	X
3.29 Miscellaneous	X
3.3 Social and Behavioral Sciences	
3.30 General	X
3.31 Economics	X
3.32 Education; Welfare	X
3.33 Law	X
3.34 Medicine; Health	X
3.35 Political Science	X
3.36 Psychology; Anthropology	X
3.37 Sociology	X
3.39 Miscellaneous	X

3.4 Humanities	X
3.40 General	X
3.41 Art	X
3.42 Language Translation and Linguistics	H
3.43 Literature	X
3.44 Music	X
3.49 Miscellaneous	X
3.5 Management Data Processing	
3.50 General	X
3.51 Education; Research	X
3.52 Financial	X
3.53 Government	X
3.54 Manufacturing; Distribution	X
3.55 Marketing; Merchandising	X
3.56 Military	X
3.57 Transportation; Communication	X
3.59 Miscellaneous	X
3.6 Artificial Intelligence	
3.60 General	A
3.61 Induction and Hypothesis-formation	A
3.62 Learning and Adaptive Systems	A
3.63 Pattern Recognition	A
3.64 Problem-solving	A
3.65 Simulation of Natural Systems	A
3.66 Theory of Heuristic Methods	A
3.69 Miscellaneous	A
3.7 Information Retrieval	I
3.70 General	I
3.71 Content Analysis	I
3.72 Evaluation of Systems	I
3.73 File Maintenance	I
3.74 Searching	I
3.75 Vocabulary	I
3.79 Miscellaneous	I
3.8 Real Time Systems	
3.80 General	X
3.81 Communications	X
3.82 Industrial Process Control	X
3.83 Telemetry; Missiles; Space	X
3.89 Miscellaneous	X
3.9 Miscellaneous	X

4. PROGRAMMING

4.0 General	P
4.1 Processors	P
4.10 General	P
4.11 Assemblers	P
4.12 Compilers and Generators	P
4.13 Interpreters	P
4.19 Miscellaneous	P
4.2 Programming Languages	P
4.20 General	P
4.21 Machine Oriented Languages	P
4.22 Procedure and Problem Oriented Languages	P
4.29 Miscellaneous	P
4.3 Supervisory Systems	P
4.30 General	P
4.31 Basic Monitors	P
4.32 Multiprogramming; Multiprocessing	P
4.39 Miscellaneous	P
4.4 Utility Programs	P
4.40 General	P
4.41 Input-Output	P
4.42 Debugging	P
4.43 Program Maintenance	P
4.49 Miscellaneous	P

5. MATHEMATICS OF COMPUTATION

5.0 General	M

5.1 Numerical Analysis	M
5.10 General	M
5.11 Error Analysis; Computer Arithmetic	M
5.12 Function Evaluation	M
5.13 Interpolation:; Functional Approximation	M
5.14 Linear Algebra	M
5.15 Nonlinear and Functional Equations	M
5.16 Numerical Integration and Differentiation	M
5.17 Ordinary and Partial Differential Equations	M
5.18 Integral Equations	M
5.19 Miscellaneous	M
5.2 Metatheory	F
5.20 General	F
5.21 Formal Logic	F
5.22 Automata; Turing Machines	F
5.23 Mechanical and Algorithmic Languages	F
5.24 Theory of Programming	F
5.29 Miscellaneous	F
5.3 Combinatorial and Discrete Mathematics	M
5.30 General	M
5.31 Sorting	M
5.32 Graph Theory	M
5.39 Miscellaneous	M
5.4 Mathematical Programming	M
5.40 General	M
5.41 Linear and Nonlinear Programming	M
5.42 Dynamic Programming	M
5.49 Miscellaneous	M
5.5 Mathematical Statistics; Probability	M
5.6 Information Theory	F
5.9 Miscellaneous	M

6. DESIGN AND CONSTRUCTION

6.0 General	D
6.1 Logical Design; Switching Theory	F
6.2 Computer Systems	Y
6.20 General	Y
6.21 General Purpose Computers	Y
6.22 Special Purpose Computers	Y
6.29 Miscellaneous	Y
6.3 Components and Circuits	
6.30 General	C
6.31 Circuit Elements	C
6.32 Arithmetic Units	D
6.33 Control Units	D
6.34 Storage Units	D
6.35 Input/Output Equipment	D
6.36 Auxiliary Equipment	D
6.39 Miscellaneous	Z
6.9 Miscellaneous	Z

7. ANALOG COMPUTERS

7.0 General	N
7.1 Applications	N
7.2 Design; Construction	N
7.3 Hybrid Systems	N
7.4 Programming; Techniques	N
7.9 Miscellaneous	N

TABLE C. CORRESPONDENCE CHART FOR INFORMATION PROCESSING JOURNAL

A. GENERAL	
A1 History of Information Processing	L
A2 Significance of Information Processing	L
A4 Information Processing in Specified Countries	L
A7 Sources of Information	L
7.1 Introductory Materials	E
7.2 Textbooks and Treatises	E
7.5 Reference Works; Bibliographies	L
A8 Information Processing Standards	L
B. COMPUTER MATHEMATICS	M
C. NUMERICAL ANALYSIS	M
CO General	M
C1 Basic Concepts of Numerical Analysis	M
C2 Computation of Functions	M
C3 Approximations, Curve Fittings	M
3.0 General	M
3.1 Basic Concepts	M
3.2 Interpolation and Extrapolation	M
3.3 Minimax (Chebyschev) Approximations	M
3.4 Least Squares Approximations	M
3.5 Stochastic Approximations	M
3.6 Nonlinear Curve Fitting	M
3.8 Curve Smoothing	M
D. MATHEMATICAL (SYMBOLIC) LOGIC AND SWITCHING THEORY	
DO General	F
D1 Mathematical Logic	F
D2 Switching Functions	F
2.0 General	F
2.1 Representation of Switching Functions	F
2.4 Simplication (Minimization Decomposition) of Switching Functions	F
2.8 Boolean Equations	F
2.9 Realization of Switching Functions	F
D3 Combinational Contact Switching Theory and Networks	F
D6 Iterative Switching Theory and Networks	F
D7 Mathematical Automata	F
D8 Sequential Switching Theory and Networks	F

E. ALGEBRA, TOPOLOGY, GEOMETRY, AND NUMBER THEORY	
E1 Theory of Sets; Permutations, Combinations and Counting	M
E2 Classical Algebra; Matrix Theory and Theory of Equations	M
2.0 General	M
2.2 Polynomials and Polynomial Equations	M
2.3 Single Algebraic Equations	M
2.4 Matrix Theory	M
2.5 Systems of Linear Equations	M
2.6 Systems of General Equations	M
E3 Abstract (Modern) Algebra	M
E4 General (Point-Set) Topology	M
E5 Algebraic Topology	M
E6 Graph Theory	M
E7 Geometry	M
E9 Number Theory	M
F. MATHEMATICAL ANALYSIS	
F1 Calculus	M
1.1 Infinite Series	M
1.2 Fourier Series and Orthogonal Functions	M
1.3 Differentiation of Scalar Functions	M
1.4 Integration of Scalar Functions	M
1.8 Operational Calculus	M

F2 Calculus of Variations — M

F3 Integral Transforms — M

F5 Complex Analysis — M

F6 Functional Analysis — M

G. DIFFERENTIAL AND INTEGRAL EQUATIONS

G2 Ordinary Differential Equations — M

2.1 Properties of Ordinary Differential Equations and Their Solutions — M

2.2 Special types of Problems Associated With Ordinary Differential Equations — M

2.3 Methods of Solving Ordinary Differential Equations — M

2.4 Special Types of Ordinary Differential Equations — M

2.5 Solutions of Specific Ordinary Differential Equations — M

2.6 Systems of Ordinary Differential Equations — M

2.7 Linear Systems — M

G3 Partial Differential Equations

3.1 Properties of — M

3.2 Special Types of Problems — M

3.3 Methods of Solving — M

3.4 Types — M

3.41 First Order — M

3.42 Elliptic — M

3.43 Parabolic — M

3.44 Hyperbolic — M

3.46 Nonlinear — M

3.47 Coupled — M

3.5 Solution of Other Specific — M

3.6 Systems of Partial Differential Equations — M

3.9 Machine Solutions to — M

G4 Integral Equations — M

G5 Integro-Differential Equations — M

H PROBABILITY AND STATISTICS

H1 Basic Probability Concepts — M

1.5 Random Numbers — M

1.6 Random Variables and Functions — M

1.7 Functions of Random Variables — M

1.9 Monte Carlo — M

H2 Univariate Statistics (One Dimensional Probability) — M

H3 Multivariate Statistics (Multidimensional Probability); Factor Analysis — M

H4 Random Process — M

H5 Random Sampling Statistics — M

H6 Statistical Inference — M

6.1 Statistical Estimation — M

6.2 Tests of Statistical Hypothesis — M

6.4 Design of Experiments — M

6.5 Theory of Measurements — M

H8 Statistical Decision Theory — M

H9 Applications of Probability and Statistics — --

J. OPERATIONS RESEARCH AND RELATED SUBJECTS

J0 General — M

J1 Mathematical Programming — M

1.1 Linear Programming — M

1.2 Nonlinear Programming — M

1.5 Network Programming — M

J2 Dynamic Programming — M

J3 Queueing Theory — M

J4 Mathematical Theory of Games — M

J5 Mathematical Modeling — M

J9 Applications for Operations Research Techniques — M

K. INFORMATION THEORY AND NOISE

K0 General — F

K1 Noise (Interference) — F

K2 Detection Theory; Recovery Signals from Noise — F

K3 Transmission Theory; Communication Channels — F

K4 Coding Theory; Decodability	F
K8 Error Detecting and Correcting Codes	F
K9 Digital Filters	F

L. COMPUTER ELECTRONICS (HARDWARE)

L0 General	C
L1 Circuit Considerations	C
L2 Specific Devices and Circuits	C
2.1 Electromechanical and Passive Circuits	C
2.2 Fluid and Pneumatic Devices	C
2.5 Semiconductor Devices and Circuits	C
2.5.2 Diodes	C
2.5.3 Transistors	C
2.5.4 Microelectronic Devices	C
2.6 Cryogenic or Superconductive Devices and Circuits	C
2.7 Magnetic Devices and Circuits	C
2.8 Optical Devices and Circuits	C
L4 Combination Logic (Gating) Circuits	C
L5 Regenerative Circuits	C
L6 Converters; Coders/Decoders	C
L7 Arithmetic Circuits	C
7.1 Counters	C
7.2 Registers	C
7.3 Address and Subtractors; Comparators	C
7.4 Multipliers	C
7.5 Dividers	C
7.7 Digital Integrators	C
L9 Auxiliary Systems	C

M. STORAGE

M0 General	D
M1 Storage Organization	D
M2 Static Magnetic Random Access/Storage	D
M3 Static Non-Magnetic Random Access/Storage	D
M4 Dynamic Random Access/Storage	D
M5 Read-Only Storage	D
M6 Sequential Access Storage in Fixed Media of Elements	D
M8 Storage on Moving or Removable Media	D
M9 Specific Storage Systems	D

N. PERIPHERAL EQUIPMENT

N1 Input Devices	D
N2 Input-Output Media Devices and Systems	D
N3 Media Converters	D
N4 Output Devices; Permanent Media (Printers)	D
N5 Man-machine Query Systems; Momentary Media	D
N6 Man-Machine Communications; Digital Data Transmission	D
N7 Instrument-Machine Communications Telemetry	D
N8 Other Data Handling Equipment and Communications Systems	D

P. DIGITAL COMPUTERS AND SYSTEMS

P0 General	Y
P1 System Design and Machine Organization	Y
P2 Applied Logic Design	D
P3 Digital Arithmetic Methods and Systems	D
P4 Error Detection and Correction	D
P5 Reliability, Production, Test and Mechanical Design	Y
P6 Special Types of Digital Systems	Y
P7 Special Purpose Digital Systems	Y
P8 General Purpose Digital Systems	Y
P9 Computer Installations	Y

Q. ANALOG AND HYBRID COMPUTERS

Q0 General	N
Q1 Analog Computer Organization and Methods	N
Q2 Analog Computer Components	N
Q3 Analog Computers and Systems	N
Q4 Applications of Analog Computers (Simulation)	N
Q5 Hybrid Computer Organization and Methods	N
Q6 Hybrid Computer Components	N
Q7 Hybrid Analog-Digital Computers and Systems	N

R. PROGRAMMING

R0 General	P
R1 Basic Principles of Programming	P
R2 Program Organization	P
2.0 General	P
2.1 Addressing	P
2.2 Data Format	P
2.4 Subroutines	P
R3 Programming Techniques	P
3.1 Sorting and Merging	P
3.3 Storage Allocation	P
3.5 Programming of Files	P
3.6 Program Debugging	P
3.7 Program Efficiency	P
3.8 Real Time Programming	P
R5 Linguistics of Formal Languages	F
5.1 Canonical Forms	F
5.3 Grammars	F
5.5 Properties	F
R7 Programming Languages	P
R8 Programming Systems; Software; Automatic Programming	P
8.4 Assemblers and Translators	P
8.5 Compilers	P
8.6 Interpreters	P
8.7 Supervisory Programs	P
8.9 Specific Programming Systems	P
R9 Programming Specific Computers	P

S. PROGRAMS, ALGORITHMS AND SIMULATIONS

S1 Programs	P
S2 Algorithms	–

U. ARTIFICIAL INTELLIGENCE

U0 General	A
U2 Components and Systems for Simulating Intelligence	A
U3 Pattern Recognition	A
3.1 Principles	A
3.2 Techniques and Methods	A
3.3 Adaptive (Learning) Pattern Recognition	A
3.4 Recognition of Spatial Characters	A
3.6 Recognition of Signal Sequences	A
3.8 Recognition and Production of Speech Patterns	A
3.9 Applications	A
U5 Thinking	A
U6 Theorem Proving	A
U7 Problem Solving	A
U8 Game Playing	A
U9 Man-Machine Relations	A

V. NATURAL LANGUAGES; COMPUTER APPLICATIONS IN THE SOCIAL SCIENCES AND HUMANITIES

V1 Computational Linguistics	H
V2 Mechanical Translation	H
V4 Human Communication Patterns	H
V5 Documentation; Information Storage and Retrieval Libraries	I
V7 Computer Applications in the Social Sciences	X
7.1 Psychology and Psychiatry	X
7.3 Anthropology	X
V8 Economics	X
V9 Computer Applications in the Fine Arts	X

W. COMPUTER APPLICATIONS IN THE LIFE SCIENCES

W1 Computer Applications in Medical Research	X
W2 Computer Applications in Aviation, Space and Plep Sea Medicine	X
W3 Computer Applications in Clinical Medicine	X
W6 Computer Applications in Public Health	X
W7 Computer Applications in Biology	X

X. COMPUTER APPLICATIONS IN THE PHYSICAL SCIENCES AND ENGINEERING

X0 General	X
X1 Physics (General)	X
X2 Electrical and Magnetic Science and Engineering; Electronics	X
2.1 Electromagnetics	X
2.2 Physical Electronics	X
2.4 Electrical and Mechanical Properties of Materials	X
2.5 Electronic Devices	X
2.6 Circuit Theory	X
2.8 Electrical Power	X
2.9 Applied Electronics	X
X3 Optical Science and Engineering; Lasers	X
X4 Mechanical Science and Engineering; Civil Engineering	X
4.1 Mechanics and Particles and Rigid Bodies	X
4.2 Fluid Mechanics (Including Aerodynamics) and Hydro-dynamics	X
4.4 Solid Mechanics	X
4.5 Vibrations; Acoustics	X
4.7 Mechanical Design	X
4.8 Structural Analysis	X
4.9 Civil Engineering	X
X5 Thermodynamics and Heat Engineering	X
5.1 Thermodynamic Theory	X
5.2 Thermal Measurements	X
5.3 Heat Transfer and Distribution	X
5.9 Other Thermal Topics	X
X6 High Energy Physics; Nuclear Science and Engineering	X
6.1 High Energy Physics	X
6.2 Nuclear Physics	X
6.3 Transport of Nuclear Particles	X
6.6 Instrumentation	X
6.8 Nuclear Reactors	X
X7 Chemistry and Chemical Engineering; Metallurgy	X
7.0 General	X
7.1 Molecular Structure	X
7.2 Instrumentation and Analysis (Including Spectroscopy)	X
7.3 Physical Chemistry	X
7.5 Chemical Reactions	X
7.8 Chemical Engineering; Chemical Processes	X
7.9 Metallurgy	X
X8 Earth and Space Sciences	X
8.1 Geography; Cartography	X
8.2 Geology	X
8.3 Oceanography	X
8.6 Atmospheric Physics	X
8.8 Astronomy	X
X9 Transportation and Space Engineering	X
9.1 Engines; Turbines	X
9.4 Naval Engineering	X
9.5 Aeronautics	X
9.8 Rockets and missiles	X
9.9 Spacecraft; Astronautics	X

Y. AUTOMATIC CONTROL APPLICATIONS OF COMPUTERS	X

Z. MANAGEMENT APPLICATIONS OF COMPUTERS

Z0 General	X

Z1 Computer Applications in Management Science	X
1.1 Systems Analysis and Simulation	S
1.3 Management Decision Making	X
1.4 Management Information Systems	X
1.5 Project Control	X
1.6 Management of Materials	X
1.7 Management of Research	X
1.9 Management of Automatic Data Processing	G
Z2 Business Data Processing (EDP, ADP) Techniques	X
2.2 Programming for Business Data Processing (COBOL)	X
2.3 Records	X
2.5 Auditing and Accounting	X
2.6 Billing and Mailing	X
2.7 Sales and Merchandizing	X
2.8 Advertising; Marketing	X
2.9 Inventory; Stock Control	X
Z3 Industrial Engineering and Production Techniques; Automation	X
3.0 General	X
3.1 Job and Production Scheduling	X
3.2 Quality Control and Inspection	X
3.3 Industrial Process Control	X
3.4 Numerical Control Machine Tools	X
Z4 Computer Applications in Manufacturing Organizations	X
Z5 Computer Applications in Service Organizations	X
5.0 General	X
5.1 Financial	X
5.2 Utilities	X
5.6 Warehousing and Distribution	X
Z6 Computer Applications in Transportation	X
6.1 Universal Aspects of Transportation	X
6.2 Automobiles; Highways	X
6.3 Railroads	X
6.5 Aviation	X
Z7 Military Applications of Computers	X
Z8 Computer Applications in Government, Politics and Law	X
Z9 Computer Applications in Education	X

TABLE D. CORRESPONDENCE CHART FOR DOCUMENTATION ABSTRACTS

1. INFORMATION SCIENCE – DOCUMENTATION

1.0	General Aspects	I
1.1	Conferences, Publications, Bibliographies	L
1.2	Education and Training	E
1.3	Professional and Organizational	L
1.4	Social and Economic Implications	L
1.5	Legal Aspects – Copyright	L

2. INFORMATION CENTERS AND SPECIAL LIBRARIES

2.0	General Considerations	I
2.1	Operations – Conventional	I
2.2	Operations – Mechanized	I
2.3	Planning and Administrative	I

3. SPECIALIZED INFORMATION SERVICES AND SYSTEMS

3.0	General Aspects	I
3.1	Tests and Evaluations	I
3.2	Government Sponsorship – Nationwide Networks	I
3.3	Secondary Publications	I

4. INFORMATION GENERATION, DISSEMINATION, COLLECTION

4.0	General	I
4.1	Writing and Recording of Information and Data	I
4.2	Editing	I
4.3	Disseminating and Announcing	I
4.4	Primary Sources	I

5. INFORMATION PUBLISHING AND REPRODUCING

5.0	General Aspects	I
5.1	Printing – Conventional	I
5.2	Printing – Mechanized	I
5.3	Full-sized Copying Methods	I
5.4	Microreproduction	I

6. INFORMATION IDENTIFICATION AND TRANSLATION

6.0	General Aspects	H
6.1	Translating – Conventional	H
6.2	Translating – Mechanized	H
6.3	Character and Spoken Word Recognition	A

7. ANALYSES OF INFORMATION

7.0	General Analysis	I
7.1	Indexing	I
7.2	Classifying	I
7.3	Cataloging	I
7.4	Coding	I
7.5	Abstracting	I
7.6	Authority Files	I

8. STORING AND RETRIEVING OF INFORMATION

8.0	General Aspects	I
8.1	Storing and Updating of Information and Data	I
8.2	Searching, Search Strategy and Retrieval	I
8.3	File Structures	P
8.4	Associative Techniques	I
8.5	Display of Stored Information and Data	I

9. UTILIZATION OF INFORMATION

9.0	General Considerations	I
9.1	User Studies and User Surveys	I

10. SUPPORTING RESEARCH

10.0	General	L
10.1	Computers – Hardware and Software	L
10.2	Linguistics	H
10.3	Mathematics and Mathematical Logic	F
10.4	Specialized Equipment	D
10.5	Social Sciences	I

TABLE E. CORRESPONDENCE CHART FOR REFERATIVNYJ ZHURNAL,
Series on Scientific and Technical Information

GENERAL DIVISION

General Questions of Informational Theory and Practice	I
The Use of Informational Materials	I
History	I
Personnel	I
Conventions, Congresses, Conferences, Symposiums, Exhibits, Chronicle	L
Guidance, Textbooks, Reference Books, Monographs, Bibliography	E

DOCUMENTAL SOURCES OF INFORMATION

General and Theoretical Questions	I
Primary Documents	I
Secondary Documents	I
Tertiary Documents	I

INFORMATIONAL ANALYSIS

Classification and Systematization	I
Transformation of Primarily Documented Information	I

TRANSLATION OF SCIENTIFIC-TECHNICAL TEXTS

Translations Done Without Machines	H
Machine Translation	H

INFORMATION SEARCH

General and Theoretical Questions	I
Informational Languages	I

DOCUMENTARY INFORMATION-SEARCHING SYSTEMS

Factographical Information-Searching Systems	I
Technical Means for Informational Searches	I

PROGRAMMED INSTRUCTION — E

REPRODUCTION OF DOCUMENTS

Copied Documents	I
of the Reproduction of Documents	I
Auxiliary Means	I

ORGANIZATION OF INFORMATIONAL ACTIVITIES

International Informational Agencies	L
Organization of Informational Activities in the USSR	L
Organization of Informational Activities Abroad	L
Other Questions of Organizations of Informational Activities	L

TRAINING SPECIALISTS — E

Reassignment of abstracts to categories. A final editorial check of the correctness of the assignment of abstracts to categories was not originally planned. As the project progressed it became apparent that such a check would be advisable. As a result of this check a number of reassignments were made. These reassignments are tabulated in the Table F, which gives totals for the singly-covered abstracts and for the 1313 multiply-covered abstracts which had no conflicts in their assignments by chart. The 827 abstracts which had conflicting assignments via the charts were assigned to their final categories by professional judgment and thus reassignments of these would not occur.

This table shows that a total of 1149 reassignments of all types were necessary. Of these 529 were reassigned to category Z (miscellaneous) as being probably irrelevant. The conclusion is that the categorization by charts was fairly good. However, in view of the fact that the final editorial check reviewed the category assignment of every abstract and review individually, the categorization by chart could have been dispensed with entirely.

TABLE F. REASSIGNMENTS OF CATEGORIES
OF DOCUMENTS WITH SINGLE COVERAGE AND OF DOCUMENTS WITH
MULTIPLE COVERAGE BUT NO CONFLICT IN ASSIGNMENT BY CHART

OLD CATEGORY	NEW CATEGORY																	
	A	C	D	E	F	G	H	I	L	M	N	P	S	T	X	Y	Z	TOTALS
A																		0
C			19						1		10							30
D	2	26			1	2				5		3	4	16	6	5	18	88
E						5			2	1		1				1	1	11
F	1	1	4	1				1		2		4		1	1		108**	124
G			1							1					1	1		4
H	1		1		2			7	1			1					2	15
I	9		6	1	1	2			6			8			14	7	91	145
L		1	2	2		6	1	206*		3		4				4	16	245
M	3								1		1	1			1		1	8
N																1	1	2
P					2	4			3	1				1		4		15
S				1		1		1		1					1		1	6
T																		0
X	16	1	11	5	1	22	10	15	9	14	12	5	9	2		8	290***	430
Y	1		10			8						6		1				26
Z																		0
TOTALS	33	29	54	10	7	50	11	230	23	28	23	33	13	21	24	31	529	1149

* 188 of these are from Ref. Zh., probably indicating a defect in the categorization chart.

**107 of these are on statistical communication theory covered by IPJ.

*** 163 of these are on automatic control covered by IPJ and 28 of these are on automatic control covered by CR.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D. C. 20554

FCC 66-1004
90954

In the Matter of)
)
Regulatory and Policy Problems Presented)
by the Interdependence of Computer and)
Communication Services and Facilities)

DOCKET NO. 16979

FOR INFORMATION

NOTICE OF INQUIRY

By the Commission: Commissioner Wadsworth absent.

I. Preliminary Statement

1. The modern-day electronic computer is capable of being programmed to furnish a wide variety of services, including the processing of all kinds of data and the gathering, storage, forwarding, and retrieval of information -- technical, statistical, medical, cultural, among numerous other classes. With its huge capacity and versatility, the computer is capable of providing its services to a multiplicity of users at locations remote from the computer. Effective use of the computer is therefore becoming increasingly dependent upon communication common carrier facilities and services by which the computers and the user are given instantaneous access to each other.

2. It is the statutory purpose and responsibility of the Commission to properly regulate interstate and foreign commerce in communications so as to make available to all the people of the United States a rapid, efficient, nationwide and worldwide communications service with adequate facilities at reasonable charges (See Section 1 of the Communications Act of 1934, as amended). Thus, the Commission must keep fully informed of developments and improvements in, and applications of, the technology of communications and of related fields. (See Section 218). Moreover, the growing convergence of computers and communications has given rise to a number of regulatory and policy questions within the purview of the Communications Act. These questions require timely and informed resolution by the Commission in order to facilitate the orderly development of the computer industry and promote the application of its technologies in such fashion as to serve the needs of the public effectively, efficiently and economically. To this end, the Commission is undertaking this inquiry as a means of obtaining information, views and recommendations from the computer industry, the common carriers, present and potential users, as well as members of the interested public. The Commission will then be in a position to evaluate the adequacy and efficacy of existing relevant policies and the need, if any, for revisions in such policies, including such legislative measures that may be required. It will also enable the Commission to ascertain whether the services and facilities offered by common carriers are compatible with the present and anticipated communications requirements of computer users. The Commission will then be in a position to determine what action, if any, may be required in order to insure that the tariff terms and conditions of such offerings are just and reasonable and otherwise lawful under the Communications Act. (See Section 201(b) and Section 202(a).)

II. Emerging Computer Enterprises

3. A brief review of the more important types of computer enterprises now emerging will serve to illustrate the growing convergence and interdependence of communication and data processing technologies.

4. First of all, there is the so-called in-house use of computers. Banks, aircraft manufacturers, universities and other types of institutions frequency own or lease computers primarily for their own use. In the past, the batch processing technique has generally been employed to satisfy the needs of the in-house users. Recently, however, time-sharing systems have been installed, particularly at universities and hospitals following the example of pilot Project MAC at the Massachusetts Institute of Technology. Because more than enough capacity exists to satisfy normal in-house needs, be they mathematical computation, data processing, simulation, or storage and retrieval, the idle or excess capacity is readily saleable to others. Banks and aircraft manufacturers have already made such time available to persons outside the enterprise. Economies of scale may well lead to larger and larger machines with consequent incentive for in-house computer owners to sell computer time to the general public. Efficient utilization of these computers implies organization of time-sharing systems. It likewise implies increased use of communication channels obtained for the most part from communications common carriers pursuant to tariffs filed with this Commission or state regulatory commissions, depending upon the intrastate or interstate nature of the channel.

5. Secondly, several of the major computer manufacturers maintain computer service bureaus. They sell computer time to customers and usually operate on a batch process basis. However, conversion to time-sharing is proceeding rapidly. The potential for providing the computer with general economic data to compliment specific company or industry data, has led to the establishment of data banks which can be used for such purposes as economic forecasting, product marketing analysis, and more specialized uses such as legal and medical reference library services. Multiple access to such data banks is again dependent on communications links obtained from common carriers under applicable tariffs.

6. Additionally, there are hundreds of non-manufacturing firms which offer a wide range of data processing and specialized information services. These services may be provided on either a batch processing or time-sharing basis. Many of these concerns are local in scope, but others are equipped with multiple access computers and are endeavoring to develop national time-sharing systems of which communication channels will be an integral part.

7. Finally, there are some very highly specialized computer services currently being offered. An example is the stock quotation service. For a number of years, brokers and financial institutions throughout the country have been supplied with up-to-the-minute prices and quotations on securities and commodities through central real-time computers. The service enables a broker to query the computer's store of market data and receive the information on a print-out or visual display device. It has been proposed that the computers be programmed to provide capability for storing and processing buy and sell orders between individual brokers. In both instances, private line circuits leased from common carriers under applicable tariffs supply the connecting link between the computer and the brokers.

8. Other specialized computer services combining data processing and communications include a hospital information service, a coordinated law enforcement service utilizing computers to tie together the law enforcement efforts of a number of local authorities, and various kinds of reservation services.

9. Most, if not all, of the major computer manufacturers offer for sale or lease computers which can be programmed for message and circuit switching in addition to their data processing functions. There are a number of operational computerized message switching systems owned by large corporations in diverse fields. Most of these systems replaced electro-mechanical switching units provided by the communications common carriers. Motivations of increased business efficiency and maximization of the capabilities of the computer are apparently leading toward the acquisition by large corporations of computer systems. These systems permit data processing and message switching to be effectively combined with communication channels linking remote locations to form a real-time data processing and communications system.

III. Computers and the Common Carriers

10. The communications common carriers are rapidly becoming equipped to enter into the "data processing" field. Common carriers, as part of the natural evolution of the developing communications art, are making increased use of computers for their conventional services to perform message and circuit switching functions. These computers can likewise be programmed to perform data processing functions. For example, Western Union is establishing computer centers, not only for its public message and Telex systems, but eventually to provide as well a variety of data processing, storage and retrieval services for the public. The first such computer centers, planned by the company as part of its "national information utility" program, was opened

March 16 of this year in New York City. This center, and others to be established in key cities, will be programmed to offer time-sharing, information processing and data-bank services. Western Union's planning looks to the establishment, through a national, regional and local network of computers, of a gigantic real-time computer utility service which would gather, store, process, program, retrieve and distribute information on a broad scale. This company will also arrange to design, procure and install all necessary hardware for fully integrated data processing and communications systems for individual customers, and provide the total management service for such systems.

11. The Bell System has not yet indicated any plan to provide a similar information service, or to offer local data processing services to the public. However, it is implementing a program to convert all central offices from electro-mechanical switching systems to electronic switching. Similar conversion programs are being undertaken by other carriers in the industry. Interface, terminal and outstation equipments are being developed by the industry to match computer systems with communication channels. It might be observed here, that the Touch-Tone telephone instrument has significant potential as a computer input device, utilizing the telephone switched network. After a connection to a multiple access computer is completed in the regular manner, the same buttons can be pressed to enter information into the computer or to query the computer and get back a voice answer. A number of systems of this type are now in service.

12. International carriers have recently proposed new computer message switching and data processing services. One such carrier offers a service to air lines under which it switches messages between and among the various leased circuits connected to its computer. In addition, it plans to employ the same computer to store and supply up-to-the-minute seat inventory information with respect to flights of those air lines subscribing to this additional service, through communication facilities connected to air line offices and agencies on an on-line real-time basis. Other carriers plan to introduce similar service offerings.

IV. Discussion of the Problems

13. The above review, although by no means exhaustive, is illustrative of the convergence and growing interdependence of the computer and communications. This convergence takes a variety of different forms and applications thereby making it difficult to sort them into simple discrete categories. It is impossible at this time to anticipate fully the nature of all of the policy and regulatory problems that future developments may generate. Nevertheless, it is desirable to focus on those problems that are presently definable within the existing state of this burgeoning industry.

14. Communication common carriers, whose rates and services are subject to governmental regulation, are employing computers as a circuit and message switching device in furtherance of their undertakings to provide communication channels and services to the general public. There is now evidence of a trend among several of the major domestic and international carriers to program their computers not only for switching services, but also for the storage, processing and retrieval of various types of business and management data of entities desiring to subscribe therefor in lieu of such industries providing this service to themselves on an in-house basis or contracting with computer firms for the service.

15. Accordingly, we find communication common carriers grafting on to their conventional undertaking of providing communication channels and services to the public various types of data processing and information services. One such carrier has, in fact, committed its future to using its combined resources of computers and communication channels to meet the information requirements of the business community and other professional and institutional segments of our society by the establishment of a national and regional centralized information system. As a consequence, common carriers, in offering these services, are, or will be, in many instances, competitive with services sold by computer manufacturers and service bureau firms. At the same time, such firms will be dependent upon common carriers for reasonably priced communication facilities and services.

16. As previously indicated, a large number of non-regulated entities are employing computers to provide various types of data processing and specialized information services. The excess capacity of the in-house computer is made available for a charge to others; in other instances computer service bureaus sell computer time to a number of subscribers on a shared-time basis; and in still other instances, highly specialized information and data bank services are provided. At an ever increasing rate, with the development of time-sharing techniques, remote input and output devices of the users are linked to the computer by communication channels obtained from common carriers. The users located at the remote terminals are served so rapidly that each is under the illusion that he alone has access to the central processor. The flexibility of the computer makes possible, in addition to data processing services, message switching between various locations of the same customer, or between several different customers. This allows the data processing industry to engage in what heretofore has been an activity limited to the communications common carrier.

17. Common carriers have thus far taken different approaches to the question of the applicability of the regulatory provisions of the Communications Act to their computer service offerings. Notwithstanding that various aspects of such offerings appear to involve activities, such as message switching, which historically have been regarded as common carrier activities subject to regulation, no consistent policy

is established and followed with respect to the filing of tariffs by carriers to cover those offerings. This is understandable considering the competitive activities of a similar nature by non-regulated entities as well as the apparent difficulties in classifying the various elements of a computer service into discrete communication and non-communication compartments.

18. From the common carriers' standpoint, regulation should extend to all entities offering like services or to none. It is urged that the ability to compete successfully depends on the flexibility required to meet the competition; and that the carriers would be deprived of this flexibility if they alone were restricted in their pricing practices and marketing efforts by the rigidities of a tariff schedule. Thus, we are confronted with determining under what circumstances data processing, computer information and message switching services, or any particular combination thereof -- whether engaged in by established common carriers or other entities -- are or should be subject to the provisions of the Communications Act. We expect this inquiry to be of assistance to the Commission in evaluating the policy and legal considerations involved in arriving at this determination.

V. Communication Tariffs and Practices

19. The interdependence between data processing and communication channels is bound to continue under the impetus of remote processing in combination with the growth of time-shared computer systems and services. In the past, the relationship between the relative cost of the two segments was of little concern. Data processing was expensive and in a relative sense higher than its communication counterpart. The trend toward lower EDP costs resulting from larger computer systems, has tended to shift the relative cost positions. Indeed, there is some indication that in the near future communication costs will dominate the EDP-communications circuit package. It is natural, then, that the computer industry finds its attention devoted increasingly to communication tariffs and regulations, in its search to optimize the communication segment of the package. In fact, fears are expressed that the cost of communications may prove to be the limiting factor in the future growth of the industry.

20. While the charges of the carriers are of prime importance, including the question of minimum periods of use, other tariff provisions and restrictions should also be scrutinized. Such tariff provisions as those relating to shared use and authorized use may well be in need of revision in light of the new advanced technology. Likewise, any restriction on the use of customer owned or provided equipment, including multiplexing equipment, must be reviewed for their effects on a burgeoning industry

21. This then is another area of concern. Are the service offerings of the common carriers, as well as their tariffs and practices, keeping pace with the quickened developments in digital technology? Does a gap exist between computer industry needs and requirements, on the one side, and communications technology and tariff rates and practices on the other?

VI. <u>The Problem of Information Privacy</u>

22. The modern application of computer technology has brought about a trend toward concentrating commercial and personal data at computer centers. This concentration, resulting in the ready availability in one place of detailed personal and business data, raises serious problems of how this information can be kept from unauthorized persons or unauthorized use.

23. Privacy, particularly in the area of communications, is a well established policy and objective of the Communications Act. Thus, any threatened or potential invasion of privacy is cause for concern by the Commission and the industry. In the past, the invasion of information privacy was rendered difficult by the scattered and random nature of individual data. Now the fragmentary nature of information is becoming a relic of the past. Data centers and common memory drums housing competitive sales, inventory and credit information and untold amounts of personal information, are becoming common. This personal and proprietary information must remain free from unauthorized invasion or disclosure, whether at the computer, the terminal station, or the interconnecting communication link.

24. Both the developing industry and the Commission must be prepared to deal with the problems promptly so that they may be resolved in an effective manner before technological advances render solution more difficult. The Commission is interested not only in promoting the development of technology, but it is at the same time concerned that in the process technology does not erode fundamental values.

VII. <u>Items of Inquiry</u>

25. In view of the foregoing, it is incumbent upon the Commission to obtain information, views and recommendations from interested members of the public in order to assist the Commission in resolving the regulatory and policy questions presented by this new technology. Accordingly, such information, views and recommendations are requested in response to the following items of inquiry:

A. Describe the uses that are being made currently and the uses that are anticipated in the next decade of computers and communication channels and facilities for:

1. Message or circuit switching (including the storage and forwarding of data);

2. Data processing;

3. General or special information services;

4. Any combination of the foregoing.

B. Describe the basis for and structure of charges to the customers for the services listed in A above.

C. The circumstances, if any, under which any of the aforementioned services should be deemed subject to regulation pursuant to the provisions of Title II of the Communications Act.

1. When involving the use of communication facilities and services;

2. When furnished by established communication common carriers;

3. When furnished by entities other than established communication common carriers.

D. Assuming that any or all of such services are subject to regulation under the Communications Act, whether the policies and objectives of the Communications Act will be served better by such regulation or by such services evolving in a free, competitive market, and if the latter, whether changes in existing provisions or law or regulations are needed.

E. Assuming that any and all of such services are not subject to regulation under the Communications Act, whether public policy dictates that legislation be enacted bringing such services under regulation by an appropriate governmental authority, and the nature of such legislation.

F. Whether existing rate-making, accounting and other regulatory procedures of the Commission are consistent with insuring fair and effective competition between communications common carriers and other entities (whether or not subject to regulation) in the sale of computer services involving the use of communications facilities; and, if not, what changes are required in those procedures.

G. Whether the rate structure, regulations and practices contained in the existing tariff schedules of communications common carriers are compatible with present and anticipated requirements of the computer industry and its customers. In this connection, specific reference may be made to those tariff provisions relating to:

1. Interconnection of customer-provided facilities (owned or leased) with common carrier facilities, including prohibitions against use of foreign attachments;

2. Time and distance as a basis for constructing charges for services;

3. Shared use of equipment and services offered by common carriers;

4. Restrictions on use of services offered, including prohibitions against resale thereof.

H. What new common carrier tariff offerings or services are or will be required to meet the present and anticipated needs of the computer industry and its customers.

I. The respects in which present-day transmission facilities of common carriers are inadequate to meet the requirements of computer technology, including those for accuracy and speed.

J. What measures are required by the computer industry and common carriers to protect the privacy and proprietary nature of data stored in computers and transmitted over communication facilities, including:

1. Descriptions of those measures which are now being taken and are under consideration; and

2. Recommendations as to legislative or other governmental action that should be taken.

26. Accordingly, there is hereby instituted, pursuant to the provisions of Sections 4(i) and 403 of the Communications Act of 1934, as amended, an inquiry into the foregoing matters.

27. In view of the scope and complexity of the matters involved, it appears desirable that interested persons be afforded an opportunity to suggest additions to and modifications or clarifications of the items of inquiry specified above. To this end, all interested persons are invited to submit appropriate recommendations in this regard on or before December 12, 1966. The Commission will thereupon issue such supplement to this Notice of Inquiry as may be warranted and will then specify a date by which written responses to said Notices shall be required.

28. All filings in this proceeding should be submitted in accordance with the provisions of Sections 1.49 and 1.419 of the Commission's Rules (47 CFR 1.49, 1.419).

FEDERAL COMMUNICATIONS COMMISSION

Ben F. Waple
Secretary

Adopted: November 9, 1966

Released: November 10, 1966

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D. C. 20554

FCC 66-1004
90954

In the Matter of)
)
Regulatory and Policy Problems Presented) DOCKET NO. 16979
by the Interdependence of Computer and)
Communication Services and Facilities)

NOTICE OF INQUIRY

By the Commission: Commissioner Wadsworth absent.

I. Preliminary Statement

1. The modern-day electronic computer is capable of being programmed to furnish a wide variety of services, including the processing of all kinds of data and the gathering, storage, forwarding, and retrieval of information -- technical, statistical, medical, cultural, among numerous other classes. With its huge capacity and versatility, the computer is capable of providing its services to a multiplicity of users at locations remote from the computer. Effective use of the computer is therefore becoming increasingly dependent upon communication common carrier facilities and services by which the computers and the user are given instantaneous access to each other.

2. It is the statutory purpose and responsibility of the Commission to properly regulate interstate and foreign commerce in communications so as to make available to all the people of the United States a rapid, efficient, nationwide and worldwide communications service with adequate facilities at reasonable charges (See Section 1 of the Communications Act of 1934, as amended). Thus, the Commission must keep fully informed of developments and improvements in, and applications of, the technology of communications and of related fields. (See Section 218). Moreover, the growing convergence of computers and communications has given rise to a number of regulatory and policy questions within the purview of the Communications Act. These questions require timely and informed resolution by the Commission in order to facilitate the orderly development of the computer industry and promote the application of its technologies in such fashion as to serve the needs of the public effectively, efficiently and economically. To this end, the Commission is undertaking this inquiry as a means of obtaining information, views and recommendations from the computer industry, the common carriers, present and potential users, as well as members of the interested public. The Commission will then be in a position to evaluate the adequacy and efficacy of existing relevant policies and the need, if any, for revisions in such policies, including such legislative measures that may be required. It will also enable the Commission to ascertain whether the services and facilities offered by common carriers are compatible with the present and anticipated communications requirements of computer users. The Commission will then be in a position to determine what action, if any, may be required in order to insure that the tariff terms and conditions of such offerings are just and reasonable and otherwise lawful under the Communications Act. (See Section 201(b) and Section 202(a).)

II. Emerging Computer Enterprises

3. A brief review of the more important types of computer enterprises now emerging will serve to illustrate the growing convergence and interdependence of communication and data processing technologies.

4. First of all, there is the so-called in-house use of computers. Banks, aircraft manufacturers, universities and other types of institutions frequencly own or lease computers primarily for their own use. In the past, the batch processing technique has generally been employed to satisfy the needs of the in-house users. Recently, however, time-sharing systems have been installed, particularly at universities and hospitals following the example of pilot Project MAC at the Massachusetts Institute of Technology. Because more than enough capacity exists to satisfy normal in-house needs, be they mathematical computation, data processing, simulation, or storage and retrieval, the idle or excess capacity is readily saleable to others. Banks and aircraft manufacturers have already made such time available to persons outside the enterprise. Economies of scale may well lead to larger and larger machines with consequent incentive for in-house computer owners to sell computer time to the general public. Efficient utilization of these computers implies organization of time-sharing systems. It likewise implies increased use of communication channels obtained for the most part from communications common carriers pursuant to tariffs filed with this Commission or state regulatory commissions, depending upon the intrastate or interstate nature of the channel.

5. Secondly, several of the major computer manufacturers maintain computer service bureaus. They sell computer time to customers and usually operate on a batch process basis. However, conversion to time-sharing is proceeding rapidly. The potential for providing the computer with general economic data to compliment specific company or industry data, has led to the establishment of data banks which can be used for such purposes as economic forecasting, product marketing analysis, and more specialized uses such as legal and medical reference library services. Multiple access to such data banks is again dependent on communications links obtained from common carriers under applicable tariffs.

6. Additionally, there are hundreds of non-manufacturing firms which offer a wide range of data processing and specialized information services. These services may be provided on either a batch processing or time-sharing basis. Many of these concerns are local in scope, but others are equipped with multiple access computers and are endeavoring to develop national time-sharing systems of which communication channels will be an integral part.

7. Finally, there are some very highly specialized computer services currently being offered. An example is the stock quotation service. For a number of years, brokers and financial institutions throughout the country have been supplied with up-to-the-minute prices and quotations on securities and commodities through central real-time computers. The service enables a broker to query the computer's store of market data and receive the information on a print-out or visual display device. It has been proposed that the computers be programmed to provide capability for storing and processing buy and sell orders between individual brokers. In both instances, private line circuits leased from common carriers under applicable tariffs supply the connecting link between the computer and the brokers.

8. Other specialized computer services combining data processing and communications include a hospital information service, a coordinated law enforcement service utilizing computers to tie together the law enforcement efforts of a number of local authorities, and various kinds of reservation services.

9. Most, if not all, of the major computer manufacturers offer for sale or lease computers which can be programmed for message and circuit switching in addition to their data processing functions. There are a number of operational computerized message switching systems owned by large corporations in diverse fields. Most of these systems replaced electro-mechanical switching units provided by the communications common carriers. Motivations of increased business efficiency and maximization of the capabilities of the computer are apparently leading toward the acquisition by large corporations of computer systems. These systems permit data processing and message switching to be effectively combined with communication channels linking remote locations to form a real-time data processing and communications system.

III. Computers and the Common Carriers

10. The communications common carriers are rapidly becoming equipped to enter into the "data processing" field. Common carriers, as part of the natural evolution of the developing communications art, are making increased use of computers for their conventional services to perform message and circuit switching functions. These computers can likewise be programmed to perform data processing functions. For example, Western Union is establishing computer centers, not only for its public message and Telex systems, but eventually to provide as well a variety of data processing, storage and retrieval services for the public. The first such computer centers, planned by the company as part of its "national information utility" program, was opened

March 16 of this year in New York City. This center, and others to be established in key cities, will be programmed to offer time-sharing, information processing and data-bank services. Western Union's planning looks to the establishment, through a national, regional and local network of computers, of a gigantic real-time computer utility service which would gather, store, process, program, retrieve and distribute information on a broad scale. This company will also arrange to design, procure and install all necessary hardware for fully integrated data processing and communications systems for individual customers, and provide the total management service for such systems.

11. The Bell System has not yet indicated any plan to provide a similar information service, or to offer local data processing services to the public. However, it is implementing a program to convert all central offices from electro-mechanical switching systems to electronic switching. Similar conversion programs are being undertaken by other carriers in the industry. Interface, terminal and outstation equipments are being developed by the industry to match computer systems with communication channels. It might be observed here, that the Touch-Tone telephone instrument has significant potential as a computer input device, utilizing the telephone switched network. After a connection to a multiple access computer is completed in the regular manner, the same buttons can be pressed to enter information into the computer or to query the computer and get back a voice answer. A number of systems of this type are now in service.

12. International carriers have recently proposed new computer message switching and data processing services. One such carrier offers a service to air lines under which it switches messages between and among the various leased circuits connected to its computer. In addition, it plans to employ the same computer to store and supply up-to-the-minute seat inventory information with respect to flights of those air lines subscribing to this additional service, through communication facilities connected to air line offices and agencies on an on-line real-time basis. Other carriers plan to introduce similar service offerings.

IV. Discussion of the Problems

13. The above review, although by no means exhaustive, is illustrative of the convergence and growing interdependence of the computer and communications. This convergence takes a variety of different forms and applications thereby making it difficult to sort them into simple discrete categories. It is impossible at this time to anticipate fully the nature of all of the policy and regulatory problems that future developments may generate. Nevertheless, it is desirable to focus on those problems that are presently definable within the existing state of this burgeoning industry.

14. Communication common carriers, whose rates and services are subject to governmental regulation, are employing computers as a circuit and message switching device in furtherance of their undertakings to provide communication channels and services to the general public. There is now evidence of a trend among several of the major domestic and international carriers to program their computers not only for switching services, but also for the storage, processing and retrieval of various types of business and management data of entities desiring to subscribe therefor in lieu of such industries providing this service to themselves on an in-house basis or contracting with computer firms for the service.

15. Accordingly, we find communication common carriers grafting on to their conventional undertaking of providing communication channels and services to the public various types of data processing and information services. One such carrier has, in fact, committed its future to using its combined resources of computers and communication channels to meet the information requirements of the business community and other professional and institutional segments of our society by the establishment of a national and regional centralized information system. As a consequence, common carriers, in offering these services, are, or will be, in many instances, competitive with services sold by computer manufacturers and service bureau firms. At the same time, such firms will be dependent upon common carriers for reasonably priced communication facilities and services.

16. As previously indicated, a large number of non-regulated entities are employing computers to provide various types of data processing and specialized information services. The excess capacity of the in-house computer is made available for a charge to others; in other instances computer service bureaus sell computer time to a number of subscribers on a shared-time basis; and in still other instances, highly specialized information and data bank services are provided. At an ever increasing rate, with the development of time-sharing techniques, remote input and output devices of the users are linked to the computer by communication channels obtained from common carriers. The users located at the remote terminals are served so rapidly that each is under the illusion that he alone has access to the central processor. The flexibility of the computer makes possible, in addition to data processing services, message switching between various locations of the same customer, or between several different customers. This allows the data processing industry to engage in what heretofore has been an activity limited to the communications common carrier.

17. Common carriers have thus far taken different approaches to the question of the applicability of the regulatory provisions of the Communications Act to their computer service offerings. Notwithstanding that various aspects of such offerings appear to involve activities, such as message switching, which historically have been regarded as common carrier activities subject to regulation, no consistent policy

is established and followed with respect to the filing of tariffs by carriers to cover those offerings. This is understandable considering the competitive activities of a similar nature by non-regulated entities as well as the apparent difficulties in classifying the various elements of a computer service into discrete communication and non-communication compartments.

18. From the common carriers' standpoint, regulation should extend to all entities offering like services or to none. It is urged that the ability to compete successfully depends on the flexibility required to meet the competition; and that the carriers would be deprived of this flexibility if they alone were restricted in their pricing practices and marketing efforts by the rigidities of a tariff schedule. Thus, we are confronted with determining under what circumstances data processing, computer information and message switching services, or any particular combination thereof -- whether engaged in by established common carriers or other entities -- are or should be subject to the provisions of the Communications Act. We expect this inquiry to be of assistance to the Commission in evaluating the policy and legal considerations involved in arriving at this determination.

V. Communication Tariffs and Practices

19. The interdependence between data processing and communication channels is bound to continue under the impetus of remote processing in combination with the growth of time-shared computer systems and services. In the past, the relationship between the relative cost of the two segments was of little concern. Data processing was expensive and in a relative sense higher than its communication counterpart. The trend toward lower EDP costs resulting from larger computer systems, has tended to shift the relative cost positions. Indeed, there is some indication that in the near future communication costs will dominate the EDP-communications circuit package. It is natural, then, that the computer industry finds its attention devoted increasingly to communication tariffs and regulations, in its search to optimize the communication segment of the package. In fact, fears are expressed that the cost of communications may prove to be the limiting factor in the future growth of the industry.

20. While the charges of the carriers are of prime importance, including the question of minimum periods of use, other tariff provisions and restrictions should also be scrutinized. Such tariff provisions as those relating to shared use and authorized use may well be in need of revision in light of the new advanced technology. Likewise, any restriction on the use of customer owned or provided equipment, including multiplexing equipment, must be reviewed for their effects on a burgeoning industry

21. This then is another area of concern. Are the service offerings of the common carriers, as well as their tariffs and practices, keeping pace with the quickened developments in digital technology? Does a gap exist between computer industry needs and requirements, on the one side, and communications technology and tariff rates and practices on the other?

VI. The Problem of Information Privacy

22. The modern application of computer technology has brought about a trend toward concentrating commercial and personal data at computer centers. This concentration, resulting in the ready availability in one place of detailed personal and business data, raises serious problems of how this information can be kept from unauthorized persons or unauthorized use.

23. Privacy, particularly in the area of communications, is a well established policy and objective of the Communications Act. Thus, any threatened or potential invasion of privacy is cause for concern by the Commission and the industry. In the past, the invasion of information privacy was rendered difficult by the scattered and random nature of individual data. Now the fragmentary nature of information is becoming a relic of the past. Data centers and common memory drums housing competitive sales, inventory and credit information and untold amounts of personal information, are becoming common. This personal and proprietary information must remain free from unauthorized invasion or disclosure, whether at the computer, the terminal station, or the interconnecting communication link.

24. Both the developing industry and the Commission must be prepared to deal with the problems promptly so that they may be resolved in an effective manner before technological advances render solution more difficult. The Commission is interested not only in promoting the development of technology, but it is at the same time concerned that in the process technology does not erode fundamental values.

VII. Items of Inquiry

25. In view of the foregoing, it is incumbent upon the Commission to obtain information, views and recommendations from interested members of the public in order to assist the Commission in resolving the regulatory and policy questions presented by this new technology. Accordingly, such information, views and recommendations are requested in response to the following items of inquiry:

A. Describe the uses that are being made currently and the uses that are anticipated in the next decade of computers and communication channels and facilities for:

1. Message or circuit switching (including the storage and forwarding of data);

2. Data processing;

3. General or special information services;

4. Any combination of the foregoing.

B. Describe the basis for and structure of charges to the customers for the services listed in A above.

C. The circumstances, if any, under which any of the aforementioned services should be deemed subject to regulation pursuant to the provisions of Title II of the Communications Act.

1. When involving the use of communication facilities and services;

2. When furnished by established communication common carriers;

3. When furnished by entities other than established communication common carriers.

D. Assuming that any or all of such services are subject to regulation under the Communications Act, whether the policies and objectives of the Communications Act will be served better by such regulation or by such services evolving in a free, competitive market, and if the latter, whether changes in existing provisions or law or regulations are needed.

E. Assuming that any and all of such services are not subject to regulation under the Communications Act, whether public policy dictates that legislation be enacted bringing such services under regulation by an appropriate governmental authority, and the nature of such legislation.

F. Whether existing rate-making, accounting and other regulatory procedures of the Commission are consistent with insuring fair and effective competition between communications common carriers and other entities (whether or not subject to regulation) in the sale of computer services involving the use of communications facilities; and, if not, what changes are required in those procedures.

G. Whether the rate structure, regulations and practices contained in the existing tariff schedules of communications common carriers are compatible with present and anticipated requirements of the computer industry and its customers. In this connection, specific reference may be made to those tariff provisions relating to:

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H. What new common carrier tariff offerings or services are or will be required to meet the present and anticipated needs of the computer industry and its customers.

I. The respects in which present-day transmission facilities of common carriers are inadequate to meet the requirements of computer technology, including those for accuracy and speed.

J. What measures are required by the computer industry and common carriers to protect the privacy and proprietary nature of data stored in computers and transmitted over communication facilities, including:

1. Descriptions of those measures which are now being taken and are under consideration; and

2. Recommendations as to legislative or other governmental action that should be taken.

26. Accordingly, there is hereby instituted, pursuant to the provisions of Sections 4(i) and 403 of the Communications Act of 1934, as amended, an inquiry into the foregoing matters.

27. In view of the scope and complexity of the matters involved, it appears desirable that interested persons be afforded an opportunity to suggest additions to and modifications or clarifications of the items of inquiry specified above. To this end, all interested persons are invited to submit appropriate recommendations in this regard on or before December 12, 1966. The Commission will thereupon issue such supplement to this Notice of Inquiry as may be warranted and will then specify a date by which written responses to said Notices shall be required.

28. All filings in this proceeding should be submitted in accordance with the provisions of Sections 1.49 and 1.419 of the Commission's Rules (47 CFR 1.49, 1.419).

FEDERAL COMMUNICATIONS COMMISSION

Ben F. Waple
Secretary

Adopted: November 9, 1966

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Before the
FEDERAL COMMUNICATIONS COMMISSION
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In the Matter of)
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by the Interdependence of Computer and)
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NOTICE OF INQUIRY

By the Commission: Commissioner Wadsworth absent.

I. Preliminary Statement

1. The modern-day electronic computer is capable of being programmed to furnish a wide variety of services, including the processing of all kinds of data and the gathering, storage, forwarding, and retrieval of information -- technical, statistical, medical, cultural, among numerous other classes. With its huge capacity and versatility, the computer is capable of providing its services to a multiplicity of users at locations remote from the computer. Effective use of the computer is therefore becoming increasingly dependent upon communication common carrier facilities and services by which the computers and the user are given instantaneous access to each other.

2. It is the statutory purpose and responsibility of the Commission to properly regulate interstate and foreign commerce in communications so as to make available to all the people of the United States a rapid, efficient, nationwide and worldwide communications service with adequate facilities at reasonable charges (See Section 1 of the Communications Act of 1934, as amended). Thus, the Commission must keep fully informed of developments and improvements in, and applications of, the technology of communications and of related fields. (See Section 218). Moreover, the growing convergence of computers and communications has given rise to a number of regulatory and policy questions within the purview of the Communications Act. These questions require timely and informed resolution by the Commission in order to facilitate the orderly development of the computer industry and promote the application of its technologies in such fashion as to serve the needs of the public effectively, efficiently and economically. To this end, the Commission is undertaking this inquiry as a means of obtaining information, views and recommendations from the computer industry, the common carriers, present and potential users, as well as members of the interested public. The Commission will then be in a position to evaluate the adequacy and efficacy of existing relevant policies and the need, if any, for revisions in such policies, including such legislative measures that may be required. It will also enable the Commission to ascertain whether the services and facilities offered by common carriers are compatible with the present and anticipated communications requirements of computer users. The Commission will then be in a position to determine what action, if any, may be required in order to insure that the tariff terms and conditions of such offerings are just and reasonable and otherwise lawful under the Communications Act. (See Section 201(b) and Section 202(a).)

II. Emerging Computer Enterprises

3. A brief review of the more important types of computer enterprises now emerging will serve to illustrate the growing convergence and interdependence of communication and data processing technologies.

4. First of all, there is the so-called in-house use of computers. Banks, aircraft manufacturers, universities and other types of institutions frequencly own or lease computers primarily for their own use. In the past, the batch processing technique has generally been employed to satisfy the needs of the in-house users. Recently, however, time-sharing systems have been installed, particularly at universities and hospitals following the example of pilot Project MAC at the Massachusetts Institute of Technology. Because more than enough capacity exists to satisfy normal in-house needs, be they mathematical computation, data processing, simulation, or storage and retrieval, the idle or excess capacity is readily saleable to others. Banks and aircraft manufacturers have already made such time available to persons outside the enterprise. Economies of scale may well lead to larger and larger machines with consequent incentive for in-house computer owners to sell computer time to the general public. Efficient utilization of these computers implies organization of time-sharing systems. It likewise implies increased use of communication channels obtained for the most part from communications common carriers pursuant to tariffs filed with this Commission or state regulatory commissions, depending upon the intrastate or interstate nature of the channel.

5. Secondly, several of the major computer manufacturers maintain computer service bureaus. They sell computer time to customers and usually operate on a batch process basis. However, conversion to time-sharing is proceeding rapidly. The potential for providing the computer with general economic data to compliment specific company or industry data, has led to the establishment of data banks which can be used for such purposes as economic forecasting, product marketing analysis, and more specialized uses such as legal and medical reference library services. Multiple access to such data banks is again dependent on communications links obtained from common carriers under applicable tariffs.

6. Additionally, there are hundreds of non-manufacturing firms which offer a wide range of data processing and specialized information services. These services may be provided on either a batch processing or time-sharing basis. Many of these concerns are local in scope, but others are equipped with multiple access computers and are endeavoring to develop national time-sharing systems of which communication channels will be an integral part.

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is established and followed with respect to the filing of tariffs by carriers to cover those offerings. This is understandable considering the competitive activities of a similar nature by non-regulated entities as well as the apparent difficulties in classifying the various elements of a computer service into discrete communication and non-communication compartments.

18. From the common carriers' standpoint, regulation should extend to all entities offering like services or to none. It is urged that the ability to compete successfully depends on the flexibility required to meet the competition; and that the carriers would be deprived of this flexibility if they alone were restricted in their pricing practices and marketing efforts by the rigidities of a tariff schedule. Thus, we are confronted with determining under what circumstances data processing, computer information and message switching services, or any particular combination thereof -- whether engaged in by established common carriers or other entities -- are or should be subject to the provisions of the Communications Act. We expect this inquiry to be of assistance to the Commission in evaluating the policy and legal considerations involved in arriving at this determination.

V. Communication Tariffs and Practices

19. The interdependence between data processing and communication channels is bound to continue under the impetus of remote processing in combination with the growth of time-shared computer systems and services. In the past, the relationship between the relative cost of the two segments was of little concern. Data processing was expensive and in a relative sense higher than its communication counterpart. The trend toward lower EDP costs resulting from larger computer systems, has tended to shift the relative cost positions. Indeed, there is some indication that in the near future communication costs will dominate the EDP-communications circuit package. It is natural, then, that the computer industry finds its attention devoted increasingly to communication tariffs and regulations, in its search to optimize the communication segment of the package. In fact, fears are expressed that the cost of communications may prove to be the limiting factor in the future growth of the industry.

20. While the charges of the carriers are of prime importance, including the question of minimum periods of use, other tariff provisions and restrictions should also be scrutinized. Such tariff provisions as those relating to shared use and authorized use may well be in need of revision in light of the new advanced technology. Likewise, any restriction on the use of customer owned or provided equipment, including multiplexing equipment, must be reviewed for their effects on a burgeoning industry

21. This then is another area of concern. Are the service offerings of the common carriers, as well as their tariffs and practices, keeping pace with the quickened developments in digital technology? Does a gap exist between computer industry needs and requirements, on the one side, and communications technology and tariff rates and practices on the other?

VI. The Problem of Information Privacy

22. The modern application of computer technology has brought about a trend toward concentrating commercial and personal data at computer centers. This concentration, resulting in the ready availability in one place of detailed personal and business data, raises serious problems of how this information can be kept from unauthorized persons or unauthorized use.

23. Privacy, particularly in the area of communications, is a well established policy and objective of the Communications Act. Thus, any threatened or potential invasion of privacy is cause for concern by the Commission and the industry. In the past, the invasion of information privacy was rendered difficult by the scattered and random nature of individual data. Now the fragmentary nature of information is becoming a relic of the past. Data centers and common memory drums housing competitive sales, inventory and credit information and untold amounts of personal information, are becoming common. This personal and proprietary information must remain free from unauthorized invasion or disclosure, whether at the computer, the terminal station, or the interconnecting communication link.

24. Both the developing industry and the Commission must be prepared to deal with the problems promptly so that they may be resolved in an effective manner before technological advances render solution more difficult. The Commission is interested not only in promoting the development of technology, but it is at the same time concerned that in the process technology does not erode fundamental values.

VII. Items of Inquiry

25. In view of the foregoing, it is incumbent upon the Commission to obtain information, views and recommendations from interested members of the public in order to assist the Commission in resolving the regulatory and policy questions presented by this new technology. Accordingly, such information, views and recommendations are requested in response to the following items of inquiry:

A. Describe the uses that are being made currently and the uses that are anticipated in the next decade of computers and communication channels and facilities for:

1. Message or circuit switching (including the storage and forwarding of data);

2. Data processing;

3. General or special information services;

4. Any combination of the foregoing.

B. Describe the basis for and structure of charges to the customers for the services listed in A above.

C. The circumstances, if any, under which any of the aforementioned services should be deemed subject to regulation pursuant to the provisions of Title II of the Communications Act.

1. When involving the use of communication facilities and services;

2. When furnished by established communication common carriers;

3. When furnished by entities other than established communication common carriers.

D. Assuming that any or all of such services are subject to regulation under the Communications Act, whether the policies and objectives of the Communications Act will be served better by such regulation or by such services evolving in a free, competitive market, and if the latter, whether changes in existing provisions or law or regulations are needed.

E. Assuming that any and all of such services are not subject to regulation under the Communications Act, whether public policy dictates that legislation be enacted bringing such services under regulation by an appropriate governmental authority, and the nature of such legislation.

F. Whether existing rate-making, accounting and other regulatory procedures of the Commission are consistent with insuring fair and effective competition between communications common carriers and other entities (whether or not subject to regulation) in the sale of computer services involving the use of communications facilities; and, if not, what changes are required in those procedures.

G. Whether the rate structure, regulations and practices contained in the existing tariff schedules of communications common carriers are compatible with present and anticipated requirements of the computer industry and its customers. In this connection, specific reference may be made to those tariff provisions relating to:

1. Interconnection of customer-provided facilities (owned or leased) with common carrier facilities, including prohibitions against use of foreign attachments;

2. Time and distance as a basis for constructing charges for services;

3. Shared use of equipment and services offered by common carriers;

4. Restrictions on use of services offered, including prohibitions against resale thereof.

H. What new common carrier tariff offerings or services are or will be required to meet the present and anticipated needs of the computer industry and its customers.

I. The respects in which present-day transmission facilities of common carriers are inadequate to meet the requirements of computer technology, including those for accuracy and speed.

J. What measures are required by the computer industry and common carriers to protect the privacy and proprietary nature of data stored in computers and transmitted over communication facilities, including:

1. Descriptions of those measures which are now being taken and are under consideration; and

2. Recommendations as to legislative or other governmental action that should be taken.

26. Accordingly, there is hereby instituted, pursuant to the provisions of Sections 4(i) and 403 of the Communications Act of 1934, as amended, an inquiry into the foregoing matters.

27. In view of the scope and complexity of the matters involved, it appears desirable that interested persons be afforded an opportunity to suggest additions to and modifications or clarifications of the items of inquiry specified above. To this end, all interested persons are invited to submit appropriate recommendations in this regard on or before December 12, 1966. The Commission will thereupon issue such supplement to this Notice of Inquiry as may be warranted and will then specify a date by which written responses to said Notices shall be required.

28. All filings in this proceeding should be submitted in accordance with the provisions of Sections 1.49 and 1.419 of the Commission's Rules (47 CFR 1.49, 1.419).

FEDERAL COMMUNICATIONS COMMISSION

Ben F. Waple
Secretary

Adopted: November 9, 1966

Released: November 10, 1966

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D. C. 20554

FCC 66-1004
90954

In the Matter of	)	
	)	
Regulatory and Policy Problems Presented	)	DOCKET NO. 16979
by the Interdependence of Computer and	)	
Communication Services and Facilities	)	

NOTICE OF INQUIRY

By the Commission: Commissioner Wadsworth absent.

I. Preliminary Statement

1. The modern-day electronic computer is capable of being programmed to furnish a wide variety of services, including the processing of all kinds of data and the gathering, storage, forwarding, and retrieval of information -- technical, statistical, medical, cultural, among numerous other classes. With its huge capacity and versatility, the computer is capable of providing its services to a multiplicity of users at locations remote from the computer. Effective use of the computer is therefore becoming increasingly dependent upon communication common carrier facilities and services by which the computers and the user are given instantaneous access to each other.

2. It is the statutory purpose and responsibility of the Commission to properly regulate interstate and foreign commerce in communications so as to make available to all the people of the United States a rapid, efficient, nationwide and worldwide communications service with adequate facilities at reasonable charges (See Section 1 of the Communications Act of 1934, as amended). Thus, the Commission must keep fully informed of developments and improvements in, and applications of, the technology of communications and of related fields. (See Section 218). Moreover, the growing convergence of computers and communications has given rise to a number of regulatory and policy questions within the purview of the Communications Act. These questions require timely and informed resolution by the Commission in order to facilitate the orderly development of the computer industry and promote the application of its technologies in such fashion as to serve the needs of the public effectively, efficiently and economically. To this end, the Commission is undertaking this inquiry as a means of obtaining information, views and recommendations from the computer industry, the common carriers, present and potential users, as well as members of the interested public. The Commission will then be in a position to evaluate the adequacy and efficacy of existing relevant policies and the need, if any, for revisions in such policies, including such legislative measures that may be required. It will also enable the Commission to ascertain whether the services and facilities offered by common carriers are compatible with the present and anticipated communications requirements of computer users. The Commission will then be in a position to determine what action, if any, may be required in order to insure that the tariff terms and conditions of such offerings are just and reasonable and otherwise lawful under the Communications Act. (See Section 201(b) and Section 202(a).)

II. Emerging Computer Enterprises

3. A brief review of the more important types of computer enterprises now emerging will serve to illustrate the growing convergence and interdependence of communication and data processing technologies.

4. First of all, there is the so-called in-house use of computers. Banks, aircraft manufacturers, universities and other types of institutions frequencly own or lease computers primarily for their own use. In the past, the batch processing technique has generally been employed to satisfy the needs of the in-house users. Recently, however, time-sharing systems have been installed, particularly at universities and hospitals following the example of pilot Project MAC at the Massachusetts Institute of Technology. Because more than enough capacity exists to satisfy normal in-house needs, be they mathematical computation, data processing, simulation, or storage and retrieval, the idle or excess capacity is readily saleable to others. Banks and aircraft manufacturers have already made such time available to persons outside the enterprise. Economies of scale may well lead to larger and larger machines with consequent incentive for in-house computer owners to sell computer time to the general public. Efficient utilization of these computers implies organization of time-sharing systems. It likewise implies increased use of communication channels obtained for the most part from communications common carriers pursuant to tariffs filed with this Commission or state regulatory commissions, depending upon the intra-state or interstate nature of the channel.

5. Secondly, several of the major computer manufacturers maintain computer service bureaus. They sell computer time to customers and usually operate on a batch process basis. However, conversion to time-sharing is proceeding rapidly. The potential for providing the computer with general economic data to compliment specific company or industry data, has led to the establishment of data banks which can be used for such purposes as economic forecasting, product marketing analysis, and more specialized uses such as legal and medical reference library services. Multiple access to such data banks is again dependent on communications links obtained from common carriers under applicable tariffs.

6. Additionally, there are hundreds of non-manufacturing firms which offer a wide range of data processing and specialized information services. These services may be provided on either a batch processing or time-sharing basis. Many of these concerns are local in scope, but others are equipped with multiple access computers and are endeavoring to develop national time-sharing systems of which communication channels will be an integral part.

7. Finally, there are some very highly specialized computer services currently being offered. An example is the stock quotation service. For a number of years, brokers and financial institutions throughout the country have been supplied with up-to-the-minute prices and quotations on securities and commodities through central real-time computers. The service enables a broker to query the computer's store of market data and receive the information on a print-out or visual display device. It has been proposed that the computers be programmed to provide capability for storing and processing buy and sell orders between individual brokers. In both instances, private line circuits leased from common carriers under applicable tariffs supply the connecting link between the computer and the brokers.

8. Other specialized computer services combining data processing and communications include a hospital information service, a coordinated law enforcement service utilizing computers to tie together the law enforcement efforts of a number of local authorities, and various kinds of reservation services.

9. Most, if not all, of the major computer manufacturers offer for sale or lease computers which can be programmed for message and circuit switching in addition to their data processing functions. There are a number of operational computerized message switching systems owned by large corporations in diverse fields. Most of these systems replaced electro-mechanical switching units provided by the communications common carriers. Motivations of increased business efficiency and maximization of the capabilities of the computer are apparently leading toward the acquisition by large corporations of computer systems. These systems permit data processing and message switching to be effectively combined with communication channels linking remote locations to form a real-time data processing and communications system.

III. <u>Computers and the Common Carriers</u>

10. The communications common carriers are rapidly becoming equipped to enter into the "data processing" field. Common carriers, as part of the natural evolution of the developing communications art, are making increased use of computers for their conventional services to perform message and circuit switching functions. These computers can likewise be programmed to perform data processing functions. For example, Western Union is establishing computer centers, not only for its public message and Telex systems, but eventually to provide as well a variety of data processing, storage and retrieval services for the public. The first such computer centers, planned by the company as part of its "national information utility" program, was opened

March 16 of this year in New York City. This center, and others to be established in key cities, will be programmed to offer time-sharing, information processing and data-bank services. Western Union's planning looks to the establishment, through a national, regional and local network of computers, of a gigantic real-time computer utility service which would gather, store, process, program, retrieve and distribute information on a broad scale. This company will also arrange to design, procure and install all necessary hardware for fully integrated data processing and communications systems for individual customers, and provide the total management service for such systems.

11. The Bell System has not yet indicated any plan to provide a similar information service, or to offer local data processing services to the public. However, it is implementing a program to convert all central offices from electro-mechanical switching systems to electronic switching. Similar conversion programs are being undertaken by other carriers in the industry. Interface, terminal and outstation equipments are being developed by the industry to match computer systems with communication channels. It might be observed here, that the Touch-Tone telephone instrument has significant potential as a computer input device, utilizing the telephone switched network. After a connection to a multiple access computer is completed in the regular manner, the same buttons can be pressed to enter information into the computer or to query the computer and get back a voice answer. A number of systems of this type are now in service.

12. International carriers have recently proposed new computer message switching and data processing services. One such carrier offers a service to air lines under which it switches messages between and among the various leased circuits connected to its computer. In addition, it plans to employ the same computer to store and supply up-to-the-minute seat inventory information with respect to flights of those air lines subscribing to this additional service, through communication facilities connected to air line offices and agencies on an on-line real-time basis. Other carriers plan to introduce similar service offerings.

IV. Discussion of the Problems

13. The above review, although by no means exhaustive, is illustrative of the convergence and growing interdependence of the computer and communications. This convergence takes a variety of different forms and applications thereby making it difficult to sort them into simple discrete categories. It is impossible at this time to anticipate fully the nature of all of the policy and regulatory problems that future developments may generate. Nevertheless, it is desirable to focus on those problems that are presently definable within the existing state of this burgeoning industry.

14. Communication common carriers, whose rates and services are subject to governmental regulation, are employing computers as a circuit and message switching device in furtherance of their undertakings to provide communication channels and services to the general public. There is now evidence of a trend among several of the major domestic and international carriers to program their computers not only for switching services, but also for the storage, processing and retrieval of various types of business and management data of entities desiring to subscribe therefor in lieu of such industries providing this service to themselves on an in-house basis or contracting with computer firms for the service.

15. Accordingly, we find communication common carriers grafting on to their conventional undertaking of providing communication channels and services to the public various types of data processing and information services. One such carrier has, in fact, committed its future to using its combined resources of computers and communication channels to meet the information requirements of the business community and other professional and institutional segments of our society by the establishment of a national and regional centralized information system. As a consequence, common carriers, in offering these services, are, or will be, in many instances, competitive with services sold by computer manufacturers and service bureau firms. At the same time, such firms will be dependent upon common carriers for reasonably priced communication facilities and services.

16. As previously indicated, a large number of non-regulated entities are employing computers to provide various types of data processing and specialized information services. The excess capacity of the in-house computer is made available for a charge to others; in other instances computer service bureaus sell computer time to a number of subscribers on a shared-time basis; and in still other instances, highly specialized information and data bank services are provided. At an ever increasing rate, with the development of time-sharing techniques, remote input and output devices of the users are linked to the computer by communication channels obtained from common carriers. The users located at the remote terminals are served so rapidly that each is under the illusion that he alone has access to the central processor. The flexibility of the computer makes possible, in addition to data processing services, message switching between various locations of the same customer, or between several different customers. This allows the data processing industry to engage in what heretofore has been an activity limited to the communications common carrier.

17. Common carriers have thus far taken different approaches to the question of the applicability of the regulatory provisions of the Communications Act to their computer service offerings. Notwithstanding that various aspects of such offerings appear to involve activities, such as message switching, which historically have been regarded as common carrier activities subject to regulation, no consistent policy

is established and followed with respect to the filing of tariffs by carriers to cover those offerings. This is understandable considering the competitive activities of a similar nature by non-regulated entities as well as the apparent difficulties in classifying the various elements of a computer service into discrete communication and non-communication compartments.

18. From the common carriers' standpoint, regulation should extend to all entities offering like services or to none. It is urged that the ability to compete successfully depends on the flexibility required to meet the competition; and that the carriers would be deprived of this flexibility if they alone were restricted in their pricing practices and marketing efforts by the rigidities of a tariff schedule. Thus, we are confronted with determining under what circumstances data processing, computer information and message switching services, or any particular combination thereof -- whether engaged in by established common carriers or other entities -- are or should be subject to the provisions of the Communications Act. We expect this inquiry to be of assistance to the Commission in evaluating the policy and legal considerations involved in arriving at this determination.

V. Communication Tariffs and Practices

19. The interdependence between data processing and communication channels is bound to continue under the impetus of remote processing in combination with the growth of time-shared computer systems and services. In the past, the relationship between the relative cost of the two segments was of little concern. Data processing was expensive and in a relative sense higher than its communication counterpart. The trend toward lower EDP costs resulting from larger computer systems, has tended to shift the relative cost positions. Indeed, there is some indication that in the near future communication costs will dominate the EDP-communications circuit package. It is natural, then, that the computer industry finds its attention devoted increasingly to communication tariffs and regulations, in its search to optimize the communication segment of the package. In fact, fears are expressed that the cost of communications may prove to be the limiting factor in the future growth of the industry.

20. While the charges of the carriers are of prime importance, including the question of minimum periods of use, other tariff provisions and restrictions should also be scrutinized. Such tariff provisions as those relating to shared use and authorized use may well be in need of revision in light of the new advanced technology. Likewise, any restriction on the use of customer owned or provided equipment, including multiplexing equipment, must be reviewed for their effects on a burgeoning industry

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24. Both the developing industry and the Commission must be prepared to deal with the problems promptly so that they may be resolved in an effective manner before technological advances render solution more difficult. The Commission is interested not only in promoting the development of technology, but it is at the same time concerned that in the process technology does not erode fundamental values.

VII. Items of Inquiry

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B. Describe the basis for and structure of charges to the customers for the services listed in A above.

C. The circumstances, if any, under which any of the aforementioned services should be deemed subject to regulation pursuant to the provisions of Title II of the Communications Act.

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3. When furnished by entities other than established communication common carriers.

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I. The respects in which present-day transmission facilities of common carriers are inadequate to meet the requirements of computer technology, including those for accuracy and speed.

J. What measures are required by the computer industry and common carriers to protect the privacy and proprietary nature of data stored in computers and transmitted over communication facilities, including:

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26. Accordingly, there is hereby instituted, pursuant to the provisions of Sections 4(i) and 403 of the Communications Act of 1934, as amended, an inquiry into the foregoing matters.

27. In view of the scope and complexity of the matters involved, it appears desirable that interested persons be afforded an opportunity to suggest additions to and modifications or clarifications of the items of inquiry specified above. To this end, all interested persons are invited to submit appropriate recommendations in this regard on or before December 12, 1966. The Commission will thereupon issue such supplement to this Notice of Inquiry as may be warranted and will then specify a date by which written responses to said Notices shall be required.

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FEDERAL COMMUNICATIONS COMMISSION

Ben F. Waple
Secretary

Adopted: November 9, 1966

Released: November 10, 1966

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D. C. 20554

FCC 66-1004
90954

In the Matter of)
)
Regulatory and Policy Problems Presented)
by the Interdependence of Computer and)
Communication Services and Facilities)

DOCKET NO. 16979

NOTICE OF INQUIRY

By the Commission: Commissioner Wadsworth absent.

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1. The modern-day electronic computer is capable of being programmed to furnish a wide variety of services, including the processing of all kinds of data and the gathering, storage, forwarding, and retrieval of information -- technical, statistical, medical, cultural, among numerous other classes. With its huge capacity and versatility, the computer is capable of providing its services to a multiplicity of users at locations remote from the computer. Effective use of the computer is therefore becoming increasingly dependent upon communication common carrier facilities and services by which the computers and the user are given instantaneous access to each other.

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II. Emerging Computer Enterprises

3. A brief review of the more important types of computer enterprises now emerging will serve to illustrate the growing convergence and interdependence of communication and data processing technologies.

4. First of all, there is the so-called in-house use of computers. Banks, aircraft manufacturers, universities and other types of institutions frequencly own or lease computers primarily for their own use. In the past, the batch processing technique has generally been employed to satisfy the needs of the in-house users. Recently, however, time-sharing systems have been installed, particularly at universities and hospitals following the example of pilot Project MAC at the Massachusetts Institute of Technology. Because more than enough capacity exists to satisfy normal in-house needs, be they mathematical computation, data processing, simulation, or storage and retrieval, the idle or excess capacity is readily saleable to others. Banks and aircraft manufacturers have already made such time available to persons outside the enterprise. Economies of scale may well lead to larger and larger machines with consequent incentive for in-house computer owners to sell computer time to the general public. Efficient utilization of these computers implies organization of time-sharing systems. It likewise implies increased use of communication channels obtained for the most part from communications common carriers pursuant to tariffs filed with this Commission or state regulatory commissions, depending upon the intrastate or interstate nature of the channel.

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VI. <u>The Problem of Information Privacy</u>

22. The modern application of computer technology has brought about a trend toward concentrating commercial and personal data at computer centers. This concentration, resulting in the ready availability in one place of detailed personal and business data, raises serious problems of how this information can be kept from unauthorized persons or unauthorized use.

23. Privacy, particularly in the area of communications, is a well established policy and objective of the Communications Act. Thus, any threatened or potential invasion of privacy is cause for concern by the Commission and the industry. In the past, the invasion of information privacy was rendered difficult by the scattered and random nature of individual data. Now the fragmentary nature of information is becoming a relic of the past. Data centers and common memory drums housing competitive sales, inventory and credit information and untold amounts of personal information, are becoming common. This personal and proprietary information must remain free from unauthorized invasion or disclosure, whether at the computer, the terminal station, or the interconnecting communication link.

24. Both the developing industry and the Commission must be prepared to deal with the problems promptly so that they may be resolved in an effective manner before technological advances render solution more difficult. The Commission is interested not only in promoting the development of technology, but it is at the same time concerned that in the process technology does not erode fundamental values.

VII. <u>Items of Inquiry</u>

25. In view of the foregoing, it is incumbent upon the Commission to obtain information, views and recommendations from interested members of the public in order to assist the Commission in resolving the regulatory and policy questions presented by this new technology. Accordingly, such information, views and recommendations are requested in response to the following items of inquiry:

A. Describe the uses that are being made currently and the uses that are anticipated in the next decade of computers and communication channels and facilities for:

1. Message or circuit switching (including the storage and forwarding of data);

2. Data processing;

3. General or special information services;

4. Any combination of the foregoing.

B. Describe the basis for and structure of charges to the customers for the services listed in A above.

C. The circumstances, if any, under which any of the aforementioned services should be deemed subject to regulation pursuant to the provisions of Title II of the Communications Act.

1. When involving the use of communication facilities and services;

2. When furnished by established communication common carriers;

3. When furnished by entities other than established communication common carriers.

D. Assuming that any or all of such services are subject to regulation under the Communications Act, whether the policies and objectives of the Communications Act will be served better by such regulation or by such services evolving in a free, competitive market, and if the latter, whether changes in existing provisions or law or regulations are needed.

E. Assuming that any and all of such services are not subject to regulation under the Communications Act, whether public policy dictates that legislation be enacted bringing such services under regulation by an appropriate governmental authority, and the nature of such legislation.

F. Whether existing rate-making, accounting and other regulatory procedures of the Commission are consistent with insuring fair and effective competition between communications common carriers and other entities (whether or not subject to regulation) in the sale of computer services involving the use of communications facilities; and, if not, what changes are required in those procedures.

G. Whether the rate structure, regulations and practices contained in the existing tariff schedules of communications common carriers are compatible with present and anticipated requirements of the computer industry and its customers. In this connection, specific reference may be made to those tariff provisions relating to:

1. Interconnection of customer-provided facilities (owned or leased) with common carrier facilities, including prohibitions against use of foreign attachments;

2. Time and distance as a basis for constructing charges for services;

3. Shared use of equipment and services offered by common carriers;

4. Restrictions on use of services offered, including prohibitions against resale thereof.

H. What new common carrier tariff offerings or services are or will be required to meet the present and anticipated needs of the computer industry and its customers.

I. The respects in which present-day transmission facilities of common carriers are inadequate to meet the requirements of computer technology, including those for accuracy and speed.

J. What measures are required by the computer industry and common carriers to protect the privacy and proprietary nature of data stored in computers and transmitted over communication facilities, including:

1. Descriptions of those measures which are now being taken and are under consideration; and

2. Recommendations as to legislative or other governmental action that should be taken.

26. Accordingly, there is hereby instituted, pursuant to the provisions of Sections 4(i) and 403 of the Communications Act of 1934, as amended, an inquiry into the foregoing matters.

27. In view of the scope and complexity of the matters involved, it appears desirable that interested persons be afforded an opportunity to suggest additions to and modifications or clarifications of the items of inquiry specified above. To this end, all interested persons are invited to submit appropriate recommendations in this regard on or before December 12, 1966. The Commission will thereupon issue such supplement to this Notice of Inquiry as may be warranted and will then specify a date by which written responses to said Notices shall be required.

28. All filings in this proceeding should be submitted in accordance with the provisions of Sections 1.49 and 1.419 of the Commission's Rules (47 CFR 1.49, 1.419).

FEDERAL COMMUNICATIONS COMMISSION

Ben F. Waple
Secretary

Adopted: November 9, 1966

Released: November 10, 1966

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D. C. 20554

FCC 66-1004
90954

In the Matter of)
)
Regulatory and Policy Problems Presented) DOCKET NO. 16979
by the Interdependence of Computer and)
Communication Services and Facilities)

NOTICE OF INQUIRY

By the Commission: Commissioner Wadsworth absent.

I. Preliminary Statement

1. The modern-day electronic computer is capable of being programmed to furnish a wide variety of services, including the processing of all kinds of data and the gathering, storage, forwarding, and retrieval of information -- technical, statistical, medical, cultural, among numerous other classes. With its huge capacity and versatility, the computer is capable of providing its services to a multiplicity of users at locations remote from the computer. Effective use of the computer is therefore becoming increasingly dependent upon communication common carrier facilities and services by which the computers and the user are given instantaneous access to each other.

2. It is the statutory purpose and responsibility of the Commission to properly regulate interstate and foreign commerce in communications so as to make available to all the people of the United States a rapid, efficient, nationwide and worldwide communications service with adequate facilities at reasonable charges (See Section 1 of the Communications Act of 1934, as amended). Thus, the Commission must keep fully informed of developments and improvements in, and applications of, the technology of communications and of related fields. (See Section 218). Moreover, the growing convergence of computers and communications has given rise to a number of regulatory and policy questions within the purview of the Communications Act. These questions require timely and informed resolution by the Commission in order to facilitate the orderly development of the computer industry and promote the application of its technologies in such fashion as to serve the needs of the public effectively, efficiently and economically. To this end, the Commission is undertaking this inquiry as a means of obtaining information, views and recommendations from the computer industry, the common carriers, present and potential users, as well as members of the interested public. The Commission will then be in a position to evaluate the adequacy and efficacy of existing relevant policies and the need, if any, for revisions in such policies, including such legislative measures that may be required. It will also enable the Commission to ascertain whether the services and facilities offered by common carriers are compatible with the present and anticipated communications requirements of computer users. The Commission will then be in a position to determine what action, if any, may be required in order to insure that the tariff terms and conditions of such offerings are just and reasonable and otherwise lawful under the Communications Act. (See Section 201(b) and Section 202(a).)

II. Emerging Computer Enterprises

3. A brief review of the more important types of computer enterprises now emerging will serve to illustrate the growing convergence and interdependence of communication and data processing technologies.

4. First of all, there is the so-called in-house use of computers. Banks, aircraft manufacturers, universities and other types of institutions frequencly own or lease computers primarily for their own use. In the past, the batch processing technique has generally been employed to satisfy the needs of the in-house users. Recently, however, time-sharing systems have been installed, particularly at universities and hospitals following the example of pilot Project MAC at the Massachusetts Institute of Technology. Because more than enough capacity exists to satisfy normal in-house needs, be they mathematical computation, data processing, simulation, or storage and retrieval, the idle or excess capacity is readily saleable to others. Banks and aircraft manufacturers have already made such time available to persons outside the enterprise. Economies of scale may well lead to larger and larger machines with consequent incentive for in-house computer owners to sell computer time to the general public. Efficient utilization of these computers implies organization of time-sharing systems. It likewise implies increased use of communication channels obtained for the most part from communications common carriers pursuant to tariffs filed with this Commission or state regulatory commissions, depending upon the intrastate or interstate nature of the channel.

5. Secondly, several of the major computer manufacturers maintain computer service bureaus. They sell computer time to customers and usually operate on a batch process basis. However, conversion to time-sharing is proceeding rapidly. The potential for providing the computer with general economic data to compliment specific company or industry data, has led to the establishment of data banks which can be used for such purposes as economic forecasting, product marketing analysis, and more specialized uses such as legal and medical reference library services. Multiple access to such data banks is again dependent on communications links obtained from common carriers under applicable tariffs.

6. Additionally, there are hundreds of non-manufacturing firms which offer a wide range of data processing and specialized information services. These services may be provided on either a batch processing or time-sharing basis. Many of these concerns are local in scope, but others are equipped with multiple access computers and are endeavoring to develop national time-sharing systems of which communication channels will be an integral part.

7. Finally, there are some very highly specialized computer services currently being offered. An example is the stock quotation service. For a number of years, brokers and financial institutions throughout the country have been supplied with up-to-the-minute prices and quotations on securities and commodities through central real-time computers. The service enables a broker to query the computer's store of market data and receive the information on a print-out or visual display device. It has been proposed that the computers be programmed to provide capability for storing and processing buy and sell orders between individual brokers. In both instances, private line circuits leased from common carriers under applicable tariffs supply the connecting link between the computer and the brokers.

8. Other specialized computer services combining data processing and communications include a hospital information service, a coordinated law enforcement service utilizing computers to tie together the law enforcement efforts of a number of local authorities, and various kinds of reservation services.

9. Most, if not all, of the major computer manufacturers offer for sale or lease computers which can be programmed for message and circuit switching in addition to their data processing functions. There are a number of operational computerized message switching systems owned by large corporations in diverse fields. Most of these systems replaced electro-mechanical switching units provided by the communications common carriers. Motivations of increased business efficiency and maximization of the capabilities of the computer are apparently leading toward the acquisition by large corporations of computer systems. These systems permit data processing and message switching to be effectively combined with communication channels linking remote locations to form a real-time data processing and communications system.

III. Computers and the Common Carriers

10. The communications common carriers are rapidly becoming equipped to enter into the "data processing" field. Common carriers, as part of the natural evolution of the developing communications art, are making increased use of computers for their conventional services to perform message and circuit switching functions. These computers can likewise be programmed to perform data processing functions. For example, Western Union is establishing computer centers, not only for its public message and Telex systems, but eventually to provide as well a variety of data processing, storage and retrieval services for the public. The first such computer centers, planned by the company as part of its "national information utility" program, was opened

March 16 of this year in New York City. This center, and others to be established in key cities, will be programmed to offer time-sharing, information processing and data-bank services. Western Union's planning looks to the establishment, through a national, regional and local network of computers, of a gigantic real-time computer utility service which would gather, store, process, program, retrieve and distribute information on a broad scale. This company will also arrange to design, procure and install all necessary hardware for fully integrated data processing and communications systems for individual customers, and provide the total management service for such systems.

11. The Bell System has not yet indicated any plan to provide a similar information service, or to offer local data processing services to the public. However, it is implementing a program to convert all central offices from electro-mechanical switching systems to electronic switching. Similar conversion programs are being undertaken by other carriers in the industry. Interface, terminal and outstation equipments are being developed by the industry to match computer systems with communication channels. It might be observed here, that the Touch-Tone telephone instrument has significant potential as a computer input device, utilizing the telephone switched network. After a connection to a multiple access computer is completed in the regular manner, the same buttons can be pressed to enter information into the computer or to query the computer and get back a voice answer. A number of systems of this type are now in service.

12. International carriers have recently proposed new computer message switching and data processing services. One such carrier offers a service to air lines under which it switches messages between and among the various leased circuits connected to its computer. In addition, it plans to employ the same computer to store and supply up-to-the-minute seat inventory information with respect to flights of those air lines subscribing to this additional service, through communication facilities connected to air line offices and agencies on an on-line real-time basis. Other carriers plan to introduce similar service offerings.

IV. Discussion of the Problems

13. The above review, although by no means exhaustive, is illustrative of the convergence and growing interdependence of the computer and communications. This convergence takes a variety of different forms and applications thereby making it difficult to sort them into simple discrete categories. It is impossible at this time to anticipate fully the nature of all of the policy and regulatory problems that future developments may generate. Nevertheless, it is desirable to focus on those problems that are presently definable within the existing state of this burgeoning industry.

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