the ground bus systems of complex dc analog computers. This approach to the grounding problem principally concerns ground currents as they affect low-frequency phenomena since, at higher frequency ranges, the effect of small coupling voltages is significant only as error and as a source of system instability.

The Need for Integration of Accounting Systems and the Design of Electronic Data-Processing Systems

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A SHORT TIME ago Henry Dreyfuss, the man who designed your telephone and many other commercial products, gave an address on the principles of good industrial design. Mr. Dreyfuss emphasized his fundamental point by quoting an old Greek philosopher, who said that “the measure of all things is man.”

No design can claim to be good unless it recognizes the needs, the abilities, the prejudices and even the hopes of the man who will use it. No matter how technically correct the design may be, if the man is not considered there will be friction wherever and whenever the man and the designed product come in contact.

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This touchstone seems especially suited for the designer of an accounting system, for the designer of electronic data-processing equipment, and for the business manager who must try to integrate both of these with his system of planning and control.

Probably few of you would dispute the statement that too often there is friction between the accounting system and the operating man. Late reports, inaccurate reports, misunderstandings as to the reason for variances, arguments over cost allocations, and so on, are all too prevalent.

I might go further, and ask each of you—please raise your hand if you have never had any friction with your budget . . .
The inadequacies and expense of present methods of handling accounting data have opened a golden door for electronic data-processing systems. Opened it so wide, in fact, that for a while it seemed as though all the electronics engineer had to do was to walk right in. Engineers and mathematicians had developed computers which made calculations at lightning speeds. The machines were versatile, too. Just how versatile many of the builders thought them to be is indicated by the experience of a business acquaintance of mine. He asked a manufacturer's representative what his new computer could do. The answer was, word for word, "It can do anything!"

Perhaps I should hasten to add that this happened in San Francisco. No one in Los Angeles would ever make a claim like that, I think.

Well, as we all know, there have been some obstacles. The early scientific computers undoubtedly were a good start. But many additional features were necessary before the machines began to appear suitable for accounting.

**Trend of Developments**

It is interesting and instructive to trace the trend of these developments, which were designed to decrease the friction between accountants and the electronic data-processing machines. For example, the first computers were entirely numeric. It is possible to code words to numbers; I might even pass out a code list, and give this talk entirely in numbers. But the friction, obviously, would be terrific. So general-purpose business machines have become alpha-numeric.

Another example is input-output. I know a number of accounting systems men, eager to find a machine suited to their needs, who, in their search for equipment, have visited many manufacturers. In a number of cases I have accompanied them and watched their faces as they walked through the door of a manufacturer's display room. As soon as the accountants saw that the machine demonstration was going to use an electric typewriter for input, and for output, for all practical purposes the demonstration was over.

We are fortunate this morning to have several talks by men whose organizations have recognized this problem and are doing something about it.

Still other examples of the way in which electronic designers are improving their equipment, to make the machines more suitable for accounting, are the introduction of such things as variable word lengths, sorting routines, buffers at input and output, increased high-speed random access storage, built-in checking devices, and an increasing variety of commands.

Meanwhile, there is also a trend to be observed among accountants. For one thing, they have made a real effort to become acquainted with the abilities of electronic machines. If any of you have had the experience of trying to interest someone in a new product, you will recognize how important and helpful such an effort can be.

Accountants in many companies are moving to make their systems more compatible with the abilities of electronic equipment. They have studied the possibility of standardizing their code systems, and their reporting procedures, and the forms they use. They have assisted in educating the operating and staff personnel as to the significance of electronics in their companies.

Perhaps the best known of such efforts is the "common language" project. While one might have some reservations as to whether this approach does not over-emphasize certain mechanical possibilities, it is evidence of real effort to come to grips with the problems.

**Pioneer Experience**

We have now reached a stage where it is possible to learn something from the experiences of the pioneers in the field of electronics in business. It is almost inevitable that a pioneer will do things differently than he would if he had more experience. No one is to blame for this; we are only to blame if we do not learn.

So, with no intent to be critical of the pioneers, but only to achieve better methods, let us examine some of these experiences.

Some companies have undertaken to install computers, but have insisted that the electronic system be used as a sort of service center. Operating managers are assured that nothing but the data processing will be changed. This we might call the "Safe But Sorry" approach.

Savings can be effected by using electronic equipment. However, in some cases where this approach has been used, the savings have not been as substantial as at first anticipated. More important, the great abilities of computers have been so restricted that their true potential is far from realized.

Too much caution is never going to eliminate the causes of friction which led businessmen to investigate the possibilities of electronics in the first place.

On the other hand, we have seen some groups who are going all-out. They have chosen their toughest problems to put on the computers. I call this approach "Let's Climb Mt. Everest."

Apparently this attitude has sometimes been adopted in the belief that it is necessary to prove the abilities of the machines, to make good the statement that a general-purpose computer can do everything. Or, in some cases, it may be the drive to achieve immense savings immediately.

Anyhow, this approach led one company to start with a routine which, according to reports, required the rather horrifying total of 240,000 program steps. Many exceptions existed. Since the high-speed memory of their machine could hold but a portion of such a program, many passes of the data would be required. As a result, the company has announced its decision not to use the computer on some of the exceptions.

We have often been assured that the ability to handle exceptions is one of the major advances that computers will bring over former procedures and equipments.
Here is a real source of friction. In the future, we can hope that companies will give more attention to the question whether plans calling for special computations are economically justified.

At the same time, it offers a challenge to the electronics engineer. Computers still are not flexible enough to handle anything and everything economically. I am not referring to some fantastic routine. I am speaking of a routine that was handled by other means before the computer was introduced, and again is being handled by these other means.

Then we have the companies who have ordered computers because it's fashionable. This approach might be called, "Look Ma, I'm Dancing!"

Several of these companies have found themselves in the embarrassing position of having to ask the manufacturers to postpone delivery of their machines. The companies had not made the necessary systems studies, prepared programs, and attended to all the other details that are necessary for a successful installation.

Still other companies have installed special-purpose computers and have operated them successfully on certain specific routines. But the companies have made little or no effort to extend the use of the equipment beyond these limited applications, or to explore the possibility of using different machines. I call this approach, "Jack, the Rabbit-Killer."

It seems a shame to see a big hundred-thousand-dollar system busy counting noses, when it could do this, and so much more, too. Gentlemen, there are giants among us. Let us not stop with killing rabbits, even though that is quite suitable as a way for a hungry man to start.

What conclusions can we draw from these varied experiences, and from the trends discussed earlier? Where do we go from here?

To answer these questions, it is necessary to reexamine the problems we still face.

**Management Needs**

In general, it seems apparent that the needs of management for information and for communication must be understood, measured, and analyzed much better than they ever have been before. We can hope that the increased interest in management science, in operations research, in mathematical programming, can help us here.

Part of the difficulty arises because accounting data must try to serve in so many ways. It must provide:

1. Data for decision purposes, to aid managers in choosing between alternative courses of action.
2. Data for attention getting, to help managers monitor operations on the exception principle.
3. Data for operating purposes, such as for payroll, billing, credit, cash receipts and disbursements, inventory, and so on.
4. Data for the historical record, such as reports to stockholders, the SEC, tax returns, state licensing, etc.

No program of electronic machine installation can be successful unless it recognizes these needs, and unless the system design integrates the many ramifications of each of these needs. Too often, in my opinion, electronic devices are being installed to gather the same old information, in much the same old way, to process the data in the same old patterns, to produce the same old report, so the same old management can go on filing it in the same old wastebasket—only just a little sooner.

**Integration**

Integration is not a simple concept.

You have to start down at the grass roots, with the business operations. A good reporting system, in the integrated sense, is not something that views the operations from afar. It is part of the operations. The operations would not be the same without it.

But this is only the beginning. We have to move up a level. Good systems design integrates not only within a function, but between functions. Our objective is to gear the sales to the production, and the production to the sales, and both to the financing, and all of these to the personnel, and so on, throughout the organization.

Still further, for those companies which have plants in different locations, we must have geographical integration. This puts the spotlight on quick, accurate, and not-too-expensive communication.

Still we cannot be satisfied. The whole operation is, or should be, guided and directed by top management, with their methods of planning and control. The systems design must meet their requirements, or there still will be friction and the design can be no more than a partial success.

Finally, and most important of all, we must not lose sight of the social implications. While exulting in the labor-saving that electronics can give, the improvements that it will offer, we must not forget that these changes affect people. Automation of the factory, and of the office, will have such an impact that some are speaking of it as a second industrial revolution.

Whatever part you have to play in this coming change, in the application of electronic computers to business, you cannot evade your responsibility to society. You must consider the people who will use it. You must consider the people who will be affected by it. For example, how can people be retrained so that they can continue to work in this brave new world? What should students do to prepare themselves? How can changes be introduced in an orderly fashion, so they will not upset whole communities?

In the last analysis, the measure of these machines is man. You may design remarkable equipment, and you may install the machines where they can make remarkable cost savings. But unless you have considered your responsibilities, some day your fellow men, your very own children, will look back upon your work and they will not thank you for what you have done.
Automatic Translation of Printed Code to Impulses Acceptable to Computing Equipment

J. T. DAVIDSON AND R. L. FORTUNE†

MR. CHAIRMAN... Ladies and Gentlemen:

It is a pleasure for Mr. Fortune and me to be allowed to make this presentation on "Automatic Translation of Printed Code to Impulses Acceptable to Computing Equipment."

It is probable that the best way to cover this subject is to describe a machine system known as the Stanomatic. This name Stanomatic is derived from the words Symbol Translator Automatically Energizing Office Machinery. We at The Standard Register Company saw no reason to depart from convention, but we will have to admit that we had a little difficulty finding the words to create a name. It was an effort, but we managed. Accidentally, of course, the name does have some significance when you consider that the Engineering and Research Division of The Standard Register Company developed this device.

Many of you may be wondering why The Standard Register company, with its more than 40 years of manufacturing business forms and feeding devices, has entered into this particular field. A short explanation is in order at this time, without violating the spirit of this conference and its scientific aspect.

We are manufacturers of continuous business forms and feeding devices for application to any type of business machine, such as typewriters, tabulators, etc. Our feeding devices are based on the principle of the pinwheel or sprocket feed. Our forms all carry holes down the sides, which we call Kant-Slip holes, and when these forms are fed into any type of business machine, the holes down the sides of the paper and the pinwheels or sprockets in the machine feed, align, and register these forms automatically and accurately.

We manufacture and carry as stock items some 750 types of pinwheel feed devices, each of them designed to fit the architecture of the machine on which they are installed. We manufacture special auxiliary equipment such as carbon separators, bursters, imprinters, etc. We send out of our plant two to three special devices a day, either adaptations of the standard pinfeed mechanisms or entirely new devices which, up until that time, have not been in existence. We manufacture thousands of autographic registers, the kind of machine you see on the hardware counter, in the jewelry store, florist shops, etc. We do not manufacture tabulators, typewriters, adding machines, bookkeeping machines, or similar types of equipment.

We have for years expounded on the subject of paperwork simplification, and, at times, in trying to carry the gospel of paperwork simplification to business people, we have felt that we were carrying the lone torch in a mass of darkness. Only recently have the businessmen of America begun to realize the intolerable burden of paper handling, and you people making up this conference have attempted to answer this need. Shuffling of papers, the recording and re-recording of information, have become such a burden that (as I believe you all know) there are more people employed in offices today than there are on farms.

We have always liked to feel that we are in a position similar to that of the Process Engineer in the manufacturing plant, except that we confine our efforts to process engineering in the office, attempting to streamline production, so that the end product has been completed as accurately and as quickly as possible with a minimum amount of manual effort. Our nationwide Sales Analysts and Service Departments have made thousands of recommendations for improvement of paper handling, elimination of repeated record making, and, of course, continuous forms and feeding devices for all types of business machines have eliminated the paper handling problem at the machine. Leaving the development, manufacture, and sale of computers and other office equipment in the very capable hands of those persons who are now working on such developments, The Standard Register Company will continue in the field of being the process engineers to American business, attempting to provide the auxiliary equipment and supplies for the input and output of these machines where conventional documents are still going to be necessary.

To those of us who have been associated with office procedures for years and to those who have only recently entered the field, it is a self-evident fact that one of the major problems involved in machine bookkeeping, whether it be mechanical or electrical, is the problem of getting the recording of the original transaction, whether it be retail or another type of transaction, into such shape or form that machines can recognize the recording and use it for the purpose of computation and accounting. The time-honored method of a human being using the eyes and brain to recognize printed material and transferring this information by means of fingers to keys in bookkeeping machines, typewriters, or key punches, will continue to be used, particularly where the volume is not too large. If the preparation of the original document of a transaction automatically created an auxiliary recording in addition to the conventional

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