WILL ELECTRONIC PRINCIPLES MAKE POSSIBLE A BUSINESS REVOLUTION

W. W. McDowell
Director of Engineering
International Business Machines Corporation

I am very appreciative of the opportunity which your committee has afforded to me to speak to this great audience of scientists, engineers and business people attending the 1954 Western Computer Conference. You gentlemen have accomplished much in a relatively short time. You will accomplish even more in the future.

Your work is one with which I am obviously closely associated. It is one that is very dear to my heart. I am a firm believer in the fact - as Dr. Huntoon said last year, "You ain't seen nothing yet" in the field of automatic and semi-automatic machines for the control of factory and office.

Your committee deserves great commendation for the program which they have arranged for this conference - Automatic Control and Data Processing. To the lay person I suspect these are thought of as two distinct subjects, which for the most part must be dealt with separately. To most people, automatic control implies something that deals with engineering or manufacturing problems, while the other deals primarily with accounting and statistical information - the problems which are present in an office. To date, I suppose that in a very broad sense this is true, but I wonder if they are not much more closely allied than many of us might realize.

You are all, of course, well aware that an automatic control system may require a considerable amount of data processing ability. A number of papers which will be presented today on flight control systems will point out this need. On the other hand, so-called data processing systems often result in some form of automatic control. We will later hear a paper from Dr. Oliver Whitby, which will describe some of the devices which are required in order to make data processing systems more automatic from the standpoint of the control of a business.

We will hear more at this conference about automatic control of machine tools. In the developments which have been accomplished to date, with which I am familiar, the automatic control applies to the cutting element on the machine tool. An operator must change the tool when it becomes dull. I am in no sense belittling the development in this area, but merely pointing out that the automatic part of it extends only to a certain point.

Is this example of the machine tool so much different - from the standpoint of automation - than a data processing system, which is programmed to perform a complex production control problem? In this instance the machine automatically makes certain decisions based on many complicated factors, and it is fair
to state, I believe, that the machine has performed a very difficult automatic control problem.

In other words, I am thoroughly convinced that automatic control and data processing really go hand in hand, that you ordinarily do not have one without the other, that in developing an effective system they both play a very important and essential part. The two have now become so entwined that in the future it will be difficult to logically separate them.

It is for these reasons that I feel the agenda for this conference is so appropriate.

As I stated earlier, tremendous strides have been made in the application of computers and electronic equipment to industry and business. Time will not permit mentioning of all of the papers which will be given at this conference, but the fact that you are able to talk with authority about so many control and data processing systems as applied to business and industry is in itself proof of the strides which have been made. There will be much more done as time goes on. Each year business machines will become more and more complete and perform in a more efficient manner.

In general, and for probably obvious reasons, the machines which have been developed to date have proceeded on the basis of adapting electronic principles to form a new machine concept which tries to duplicate the results now being obtained. Thus, when a study is made to see what an electronic business machine may do in the way of providing improved efficiencies the only basis on which a study can be made, either on the part of management of the business, or on the part of an engineer, is on the data and concepts currently available and the procedures currently followed.

In most instances, business management is able to present a very clear cut and convincing picture of exactly what functions and results are required. Their Methods people, as a result of studying procedures for many years, are well acquainted, based on their concept of the needs of business, with exactly what a new machine should do. Many of the rules and procedures were evolved as a result of an extremely detailed and careful analysis of the basic problem, but many others were formed by tradition on what apparently had happened in the past, or on opinion as to the essentials for a particular business.

This situation is, I think, bound to be present in any large, well-established organization. I am not suggesting this in any critical manner, but as an inevitable product of growth in any business. I am certain that it exists in IBM.

This approach to the application of electronic principles to business problems has produced and will continue to produce astounding results. Unfortunately, however, there are many studies made which show that the projected savings are marginal or where a more or less "brute force" method must be used to justify the investment.
And yet, because of the versatility of electronics it is not obvious why such should be the case. Why are so many of the complex business problems apparently incapable of being effectively solved by the electronic business machine?

I think that one of the principal reasons may be that we are trying to ask a scientific machine to solve a non-scientific problem. We are trying to ask the machine to operate under a set of rules which, in many instances, are not consistent with its logical nature. We are saying that these are the rules of business, now you make the machine - adhere to them.

In contrast to this, one cannot help but wonder, however, how much more might be accomplished were it possible to find some means of scientifically studying and analyzing business needs on the same scientific basis as the machines and the components within the machines have been studied and developed. It is obviously a very complex subject, particularly since all businesses deal with customers of one type or another, and customers cannot be patterned as can machine tools. On the other hand, there is just beginning to be a feeling within industry that business procedures can be dealt with in a far more scientific manner than has been done in the past.

You are all familiar with the developments which have taken place, for instance, in oil refining, or in automotive production. Both of these operations evolved around a new scientific concept for getting results. They were far reaching and play an important part in our economy today.

Very little of this sort of thing has been done on the office side of business, probably because management has been unable to visualize a plan which would justify the investment costs. Also, business problems are undoubtedly far more involved than those of the automotive production line.

Yet, as businesses grow larger, the problem of handling office routines and management controls is becoming more and more difficult. More and more clerical people are added each year, and as they increase in numbers, the problems of communication, organization and control increase geometrically. The more people who are added, the more complex must be the controls to control them.

I wonder if the time has not come when it is essential that some means be found to incorporate into a business the same type of radical and bold new approach which was demonstrated in the automobile production line, or in the oil refinery. I have a very strong feeling that something of this sort can be done, and further, that when a plan is evolved, the electronic principles which you have or know about will make it possible to develop the machines which will really fit the plan. I do not feel, however, that this can be done by the development engineers and scientists alone.

In order to achieve this objective there must be a willingness on the part
of business to look at its problems and way of doing business in the same scientific manner as that used by the men developing the machines.

What I am really trying to suggest is that a new kind of partnership is needed -- a partnership between the development engineer and the business engineer. Perhaps the latter should be thought of as a business research engineer, a man who has the ability to analyze in a scientific manner the procedures and inter-relationships which are essential in order to conduct a successful business.

This thought is not new, but I wonder if we are giving it the proper emphasis. It is certainly somewhat akin to "operations research" which we are beginning to hear about. I think it is also akin to the thought which Dr. Hobson presented to this conference last year when he said, and I quote:

"It is a curious fact that, while tremendous advances have been made within industry to increase the efficiency of operations in the major functional areas - production, research, marketing, etc., - equivalent advances have not been made in the techniques for handling the routine facts of business operations. The volume of factual data mounts - the need for factual analysis grows greater - the demand for precisions continues unabated. But, by and large, management had had to meet the problem with the same mechanical aids used by a growing army of administrative and clerical employees. The 'clerical problem' is becoming a matter of great concern in industry. This situation gives a sense of urgency to the widening applications of high-speed electronic equipment on industry's data handling problems and their information processing systems. The possibilities appear to be tremendous - the result far-reaching. If the rate of progress continues for some time in the future as it has since World War II, it is conceivable that future business historians will know this period as the beginning of the 'administrative revolution.' If the trend continues, a new factor in the management equation will most certainly have been created."

Perhaps, also the theory of games has a place in this thing I am talking about. Again I do not know enough about it to chart any clear course. I do know, however, that when we have been faced with what appears to be an insurmountable problem that we have always found the means of chopping our way through it.

Is there any reason to feel that with sufficient study, and with the right kind of people, that startling new concepts of business might not be evolved which would cut at the heart of this problem?
Let me give you an example of the sort of thing I am talking about—oversimplified, but none the less illustrative.

We have in IBM what might be considered a rather complex production control problem. As would naturally be expected, we are using our punch card equipment to provide as nearly as possible an automatic solution to this problem. Because of the numbers of parts which we must control and the changes which inevitably occur during the course of a production cycle, we must use what we consider rather clumsy methods in performing our day-by-day planning operation. When we developed the 701 Electronic Calculator, which, as many of you know, is quite a powerful and fast machine, we went to work to try to program our production control problem on it.

To our amazement, we found that we were unable to evolve a satisfactory set of formulas which would permit us to obtain an overall machine solution. There is no question in any of our minds that if we secure the right type of people and continue to work on this problem, a procedure can be found, but it is very probable that the solution will affect much more than just this particular job. It may well result in changes in our method of handling orders, our basic planning operation, the numbers of machine tools which are available, inventory policies, etc. Furthermore, when we get through we may find that the 701 is not properly balanced for this data processing application.

The same type of analysis can be made on costs, budgeting, order control, purchasing, planning and many others. In most instances, each application cannot be considered by itself. Its relationships and effect on related activities must also be carefully thought out. The solutions from the point of view about which I speak are tough, but I am thoroughly convinced solutions can be found.

The same might be said with respect to customer relations. Because we are dealing with personalities it cannot be as positive or scientific. There is every reason to believe, however, that with proper study and scientific analysis an improved relationship with customers can be found—one that would be more efficient and would readily fit machine solutions. An example of a new concept of customer relations is the "super market." I am not suggesting that all groceries should be super markets, but that there are ways to make significant advances in efficiencies and, at the same time, be susceptible to better machine solutions.

It was not so many years ago that airplane design was carried out without much reliance on scientific computation. Not too much was known about the factors which would lead to the safest and most efficient airplane. I suspect that even if a giant calculator had been available twenty years ago, it would have remained idle because no one knew enough about the behaviour of aircraft to intelligently apply problems to the machine. But today calculators aren't big or fast enough for them—all because the scientists and engineers in the aircraft industry have learned how to deal with the factors which affect
airplane design.

Can't this same sort of thing - with enough thought and study - exist in the concept of a business?

For the most part businesses do not have people who are scientifically trained to take this approach. Methods people within industry are doing a marvelous job and their services are indispensable but, unfortunately, most of them are not trained to deal with problems of this sort.

To do this work, a new type of scientist is required. Probably a basic engineering education is desirable, and in addition an excellent grasp of mathematics. He must be research minded. Large numbers are necessary. Such men are not available today and, therefore, must be trained. A number of universities have recognized this need, and I understand are in the process of developing courses which will assist in the training of people who can intelligently deal with this problem.

This program will cost a lot of money, but if business management can be convinced that an approach of this sort may result in real savings, the money will be found. Business management does not question the spending of many millions of dollars in research and development of new devices and products. Only a few years ago, however, this concept was not so widely held. Here, as with product research, the benefits must be shown.

I appreciate that the value of this type of research is hard to pinpoint. It is extremely difficult to understand. At the present time, the results which can be expected may be nebulous. It is a long range affair. Everything else, however, that we in this country, at least, have approached in a scientific manner has paid off handsomely. Again, is there any reason to believe that this type of research problem cannot also pay off handsomely?

The reason why I particularly wanted to speak to this group on this subject is that you can play a major role in explaining the need for this kind of research. You are, in one way or another, constantly in contact with business throughout the country. If you believe at all in this concept and its importance, you are in an excellent position to tell the story. You can show management how vital this step is. If you can sell the idea it will have a double-barreled effect on the work in which you scientists and engineers are primarily interested. First, it will help to make more businesses aware of the possibilities of more efficient solutions to their problems. Second, and the more important - and the one which will pay off the biggest dividends - through this scientific analysis will evolve methods which will be more compatible with the techniques which you have for the building of business machines.

This possibility is well illustrated in the current trend towards the "systems concept" for the development of weapons. A plan of this sort - a
scientific balance between all phases of the problem will inevitably lead to the most efficient results.

Is it not far more likely that this same overall scientific approach will also in the case of business machines, provide the most efficient and significant solution?

This whole concept may be considered by many to be in the class of the wildest of dreams. For my own part, however, I believe that the same systematic scientific analysis of business problems will yield the same beneficial results that have been achieved in industry, science, medicine and many other fields.

Those of you who do feel, with me, that there is something here, can do, I believe, a tremendous amount of good by talking about it to your associates in the scientific and business world and find a way together to tackle this problem head on. Its bigness and the lack of trained men should not be discouraging. Once we are convinced of its merit, the means will be found to accomplish it.

May I thank you again for making it possible for me to be present here with you today.