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Mr. GORE. Thank you very much.

We are going to hear from the rest of the panel before we ask questions of you, but I know there will be a lot because your testimony is very thoughtprovoking.

I might just mention in passing to our next witness that the people who run the program in Pittsburgh, that the President is visiting today will be testifying here tomorrow during the second day of these hearings.

Our second witness on this panel is Paul Strassmann, vice president of the Information Products Group at Xerox Corp., who has studied the impact of new technologies on the economy.

Mr. Strassmann, we are delighted to have you here. Please proceed.

**STATEMENT OF PAUL STRASSMANN, VICE PRESIDENT,
INFORMATION PRODUCTS GROUP, XEROX CORP., STAMFORD,
CONN.**

Mr. STRASSMANN. Thank you, Mr. Chairman.

I have spent my entire career installing information technology in the office, white-collar environment, and I would like to confine my remarks entirely to the white-collar relationship to information technology.

Also, to keep within the 10-minute limit, I would like to have your permission to use slides as a way of speeding up communication.

Mr. GORE. That will be fine.

Mr. STRASSMANN. The committee was asking for predictions, and I want to issue a disclaimer. We cannot predict; we can only say what can we do in order to create a society where there will be a potential labor shortage. I will highlight productivity in the same way as Mr. Skeen highlighted productivity as the key to employment. I will dwell on that point.

I will then try to present to this committee that the present way of looking at jobs in terms of service sector jobs versus goods producing sector jobs is not perhaps the most useful way of looking at the future. Next I will describe the new jobs.

Let me begin by the theme of productivity. We, in the United States are a society that has climbed the level of output in terms of national income per capita to about a \$10,000 income. The society is experiencing its maturity through declining jobs and through increasing automation. We are not able to provide new jobs.

What I will project to this committee is a new horizon, which could bring us perhaps to a level of at least \$50,000 of real income per capita. New factors of production, based on information, can create a completely new economic environment.

The point I want to make is that the current debate about productivity, as being synonymous with unemployment, is faulty. I totally reject the idea that a productive society must have an environment where there is unemployment. We know that full employment is possible both in a productive as well as in an unproductive society.

I would like to suggest to this committee that the key issue about jobs of the future is aggregate output in terms of high productivity performance of the work force.

I will admit that in the event we are just slicing the same pie, then automation will cause unemployment. The ease that I will present this morning is a case that if we want to create full employment, we have to radically reposition our labor resources so that we can more than double real income per capita.

In America and in our Western society we have seen again and again the ability of society to double and triple output in income, and that is really the key to the future.

Now in order to understand how we can double output, how we can realize enormous opportunities for our work force, I would like to suggest to you that the current way of looking at jobs may not be entirely correct. The current approach basically is to look at goods producing jobs, the blue line, on my exhibit. It shows about 30 million jobs projected to be fairly level or, if Mr. Cetron is right, actually declining. Adding to these 30 million jobs are about 70 million service jobs. That is how you get the 100 million jobs.

However, I would like to draw to your attention a different line, approximately 50 million jobs which I have identified as "information-producing" jobs. Let me suggest to you that the way I am going to present my argument today is to say that there are 50 million information workers in the U.S. economy, and there are 50 million goods producing workers. I will concentrate on the pivotal role of the 50 million information workers in determining the productivity of the United States of America over the next few decades.

Now just to make sure that we understand what we mean by information workers, here are the occupational categories showing people and the percentages. When you look where we are spending our manpower today and how we allocate efforts, about 80 percent of our white-collar work force is really operating ongoing administrative processes and only about 20 percent is devoted to investment in the future, which includes education.

I hope you bear with me with this rather complex diagram, but I want to point to this disaggregation of the U.S. economy between the production sector and the information sector. You see what goes to the consumers, which is 1.87 trillion. You find that, in fact, the information-handling sector gives only a very small fraction of its output to consumers. Most of the information sector, the overwhelming amount of it, is going really as overhead on top of the job of producing goods.

Let me repeat. The vast amount of white-collar labor in America is deployed as overhead. One of the reasons why there is a decline in productivity and why our income per capita is not growing is that we are an overhead-rich society. An overhead-rich society is not competitive. An overhead-rich society tends to create a displacement of labor. An overhead-rich society does not grow income. Therefore, it does not create jobs.

The key to the future of America is how we can take the highly skilled resources we have in information handling—our managers, professional technicians, our teachers, our artists—and really have them contribute to increasing the wealth of the society.

Where are those people? I want to point out that, by and large, \$525 billion of their cost is in social-related services—Government, education, health, and so forth, and, of course, corporate bureaucracies.

It is the concentration of these jobs in two areas—manufacturing overhead and socially related overhead—that then creates the drag on our ability to produce. The reason why this is a drag, if I may use that term, is because the bulk of our overhead costs are not subject to any market forces. We have created a society where we have taken the possessors of information and, by and large, we have segregated them into jobs where the accountability for their performance is not directly regulated by market forces.

What do I then see are some of the major trends that will shape the direction of jobs of the future? I will present to you three major trends which are, in my opinion, necessary to get our society going toward substantially higher levels of income.

First, jobs which today are in what I call information overhead categories have to become services subject to market. This means that rather than to own big corporate staffs or big consulting staffs in organizations, in Government, in universities, you should be able to purchase those services as management services from the market. The same applies to office services.

Information technology is the key enabler to this shift. Information services now provide the avenue for creating a marketplace for information labor on a transaction basis.

I believe that the solution to the problem of training, vocational education, is to take the funding for education, to as large extent as possible, out of social overhead and place it as a direct cost for achieving a given objective.

Information technology is uniquely attuned to achieving that objective.

Preventive medicine is clearly the kind of service that is subject to market. I see the movement on the part of insurance companies to start providing incentives so that you can get services which improve your well being rather than cure your disease. Of course, consumer information is necessary so that consumers can make intelligent market-oriented decisions.

The second major trend that will unlock our potential of productivity is that we will have to reallocate a much larger portion of our white collar resources from administration and custodial expenses to creation and investment in the future. Tax laws and incentives have to be created so that software development, education based on delivered performance, entertainment and art, health and public services, and research development consume a much larger proportion of our white-collar resources than is currently the case. Twenty percent of our white-collar resources devoted to investment is not enough.

Last, I see that productivity will come through conveying to our population a different image of what jobs are all about. The current vision of jobs is that you get trained. You go to school, you get a certificate, and then you become a specialist. Such a pattern does not lead to productive jobs.

The jobs which we have studied over a decade, which are productive, are jobs where people can do a variety of tasks; namely, the

forklift operator in the warehouse also makes decisions about pick lists, shipping, and loading the truck, rather than having to go through a clerk. The forklift truck operator is both an operator and an information worker.

This means that every day is training day. It is not the idea of going 3 months off to a retreat to study and then coming back re-treaded. That is not the image of the future. Every day is training day.

All production is customized. That is why we need generalists. Of course, we must then provide a much more flexible working environment.

In conclusion, then, Mr. Chairman, I am suggesting that if America is to become a productive society, we are going to have a job scarcity. We will not have enough people, and that is the scenario I think that we ought to establish as our agenda.

The key to our achieving a highly productive society is to take the information workers and make them productive. That means that we will have to shift to a market-oriented economy. Of course, new skills will be necessary and many new policies will be necessary. Within the confines of the charter today you wanted to have an outlook, a scenario of the future.

Thank you very much.

[The prepared statement of Paul A. Strassman follows:]

U. S. HOUSE OF REPRESENTATIVES

Committee on Science and Technology - Subcommittee on Investigation and
Oversight

IMPACT OF INFORMATION TECHNOLOGY ON EMPLOYMENT

Testimony by:

Paul A. Strassmann, Vice President

Information Products Group

April 6, 1983

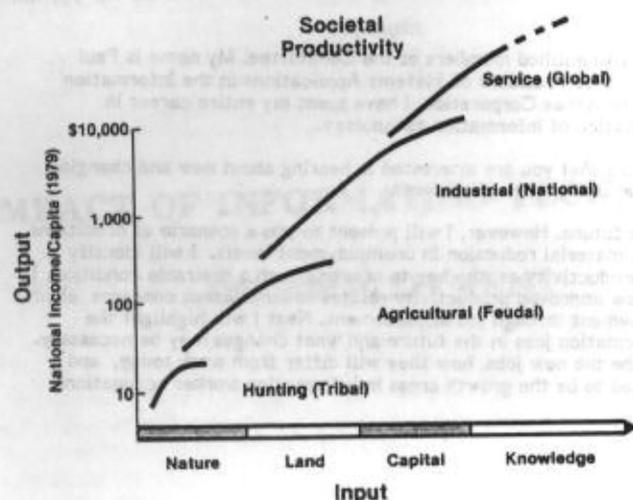
XEROX Corporation, Stamford, Ct.

Impact of Information Technology on Employment/Page 1

Mr. Chairman and distinguished members of the Committee. My name is Paul Strassmann and I am Vice President of Systems Applications in the Information Products Group of the Xerox Corporation. I have spent my entire career in managing the installation of information technology.

Your invitation stated that you are interested in hearing about new and changing jobs as well as in our ability to predict them.

I cannot predict the future. However, I will present to you a scenario of conditions that could lead to a material reduction in unemployment levels. I will identify improved societal productivity as the key to creating such a desirable condition. I will also address how improved productivity relates to our current concerns about generating unemployment through job displacement. Next I will highlight the critical role of information jobs in the future and what changes may be necessary. Lastly, I will describe the new jobs, how they will differ from work today, and what can be expected to be the growth areas in information worker occupations.



The scenario that may produce a severe labor shortage is based on the transformation of the US from an industrial society into a highly productive service society, with national income per capita in the \$15,000 to \$25,000 range within twenty to fifty years. The current income in 1979 terms, is less than \$10,000 per capita and has remained stagnant as we keep adding less productive service labor, without adequate capital, to an industrial base which does not employ capital efficiently.

Diminishing societal productivity is not something altogether new. A hunting society, based entirely on the exploitation of nature, reaches diminishing productivity at a very low level of about \$25 per capita. An agricultural society, based entirely on the exploitation of nature and land, reaches diminishing productivity at about \$250 per capita. It seems that industrial societies reach their diminishing productivity at about \$10,000 capita. If we can create a highly productive services economy, I see no limit on the wealth we can generate and on the amount of labor resources we can employ productively.

Technological Unemployment

- Full Employment Possible both in Productive or Unproductive Societies
- What Matters is Aggregate Output
- If Output does not Change Automation Causes Unemployment
- For Growth in Output/Capita Automation is Necessary

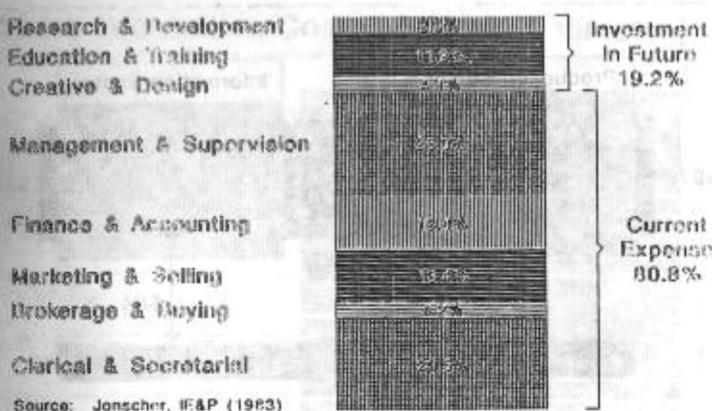
It is unfortunate that "productivity", which I have used as the necessity for future gains, has become identified with unemployment. I totally oppose tying in discussions about productivity gains as always resulting in increases in unemployment. Full employment is possible both in productive and in unproductive societies. What matters is aggregate output. Increases in aggregate output generate wealth and create new jobs. If you have a society where output does not grow then you will have unemployment if automation is introduced. In a productive society the objective is to increase the total wealth of citizens. If we can double wealth, as we have done many times in the past, then we will not have technological unemployment.

Growth Of Employment By Industry Sector



I will now highlight a different breakdown of employment trends as a way of dealing with the issues of changes that are needed in the workplace. The conventional employment growth curves show fairly stagnant employment in goods producing sectors and strong growth in the services producing sector. The two curves add up to total industrial employment of less than 100 million workers in 1980. I want to draw your attention to the third line, designated as information producing workers. In 1980 there were about 47 millions in this category. Most of them can be found in the services sector, even though a large portion of goods producing employees are also in information producing jobs. I consider the information workers the key to achieving productivity gains in the future.

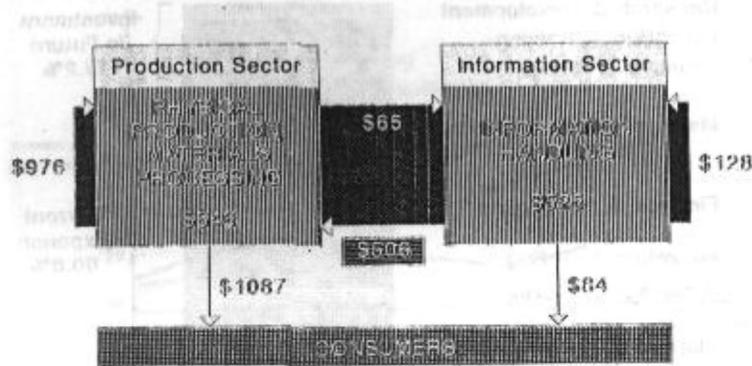
U.S. Information Workforce (1978)



Source: Jonscher, IF&P (1983)

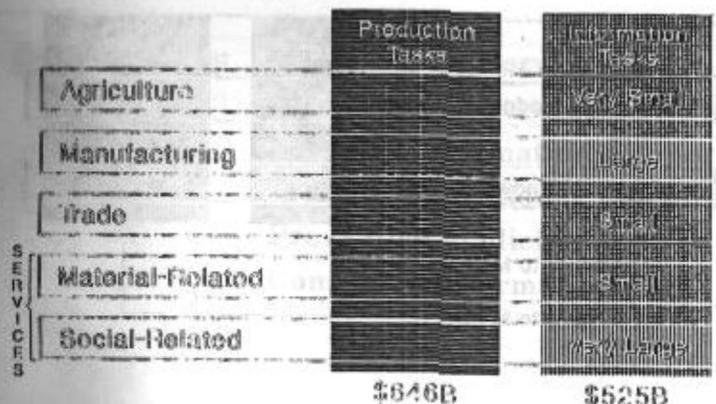
Since the information workforce is so important in what will follow I want to show a further breakdown of the categories included in this classification. It tabulates jobs we have come to recognize as "white collar" occupations. These are people who are dealing with information as their principal concern at work. It also groups people into a class that can be considered as an investment in future improvements in productivity and a class that administers ongoing operations.

National Economy - U.S.A. [1972, Billions]



Source: Jonscher, IE&P (1983)

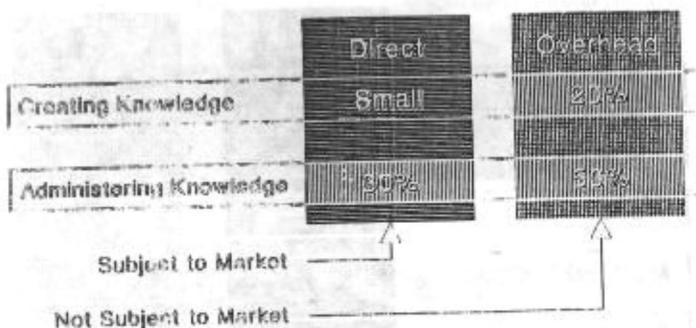
Where Information Costs Located [Estimates]



It is very useful to examine the contributions of the information sector. We do not have current numbers. The best work in this field are the analyses produced by professor Charles Jonscher of MIT, the most distinguished economist in the emerging field of information economics. The trends I will note have become magnified since 1972. What is noteworthy is the flow of costs between the Production and the Information Sectors. For every dollar of output to consumers the Production Sector has to use almost a dollar's worth of information labor. At present, the costs of information labor exceed the costs of physical production of goods and services.

Information costs are highly concentrated in the economy. We find them primarily associated with socially related services, such as in health, in education, in legal services. They are also found in manufacturing, in the form of administrative and managerial jobs.

Where Information Workforce Located [Estimates]



Another way of looking at the deployment of the information workforce, is to examine what portion of the total is employed in positions that are directly subject to the forces of the market economy and what part is occupying positions which are designated as organizational "overhead". In my estimate, over two thirds of all information worker costs are to be found in positions that are many layers away from the direct forces of the marketplace.

NEW JOBS:

Now: INFORMATION OVERHEAD

Future: SERVICES SUBJECT TO MARKET

Growth Areas: Management Services
Office Services
Network Information Support
Training, Vocational Education
Preventive Medicine
Consumer Information

I will now proceed to tell the Committee about the new jobs. Rather than give you numbers and occupational titles, my remarks will be set in the context of changes that will be necessary in order to improve societal productivity and in order to increase aggregate wealth available to our citizens.

We must make it possible to take information workers from jobs which are now carried as an overhead burden and place them in jobs which are structured so that they render services that are subject to the test of the marketplace. For example, I see major cost improvements in our goods producing sector to come from eliminating fixed overhead costs and acquiring much more efficient services at competitive rates. This will cause growth in many new areas and should also lead to increasing our advantage in exporting profitable services on a global scale.

NEW JOBS:

Now: ADMINISTRATION, CURRENT EXPENSE

Future: CREATION, INVESTMENT IN FUTURE

Growth Areas: Software Development
Performance Education
Entertainment, Arts
Health, Public Services
Research, Development

One of the principal reasons for the low levels of productivity of the information sector is its high labor intensity and low utilization of capital. Even though shipments of information technology products from the goods producing sector into the information sector are expanding faster than any other cross-industry variable, the limit on realizing future growth in productivity is not to be found in technology but in the way information workers are employed. I believe that we will have to redeploy large numbers of information workers from jobs where they are a current operating expense, into jobs in which they contribute to improved productivity by becoming a profitable investment. The growth areas will then be in jobs which involve the creation of new skills and new opportunities.

NEW JOBS:

Now: OCCUPATIONAL SPECIALISTS

Future: SERVICES GENERALISTS

Growth Areas: Operators also do Information Interactive Training
Customized Production
Distributed Management
Computer - aided Work
Part - time Work, at Home

Lastly, I see the emergence of new concepts organizing people in the workplace towards achievement of greater productivity. The last hundred years of the industrial civilization have been based on the concept of job specialization and task subdivision. The large expansion in the information workforce has been largely due to the employment of narrow specialists to handle matters of ever increasing complexity.

The future lies in jobs where individuals will have the opportunity to become generalists, that is, to do several tasks needed to get a job completed. "Blue collar" operators will also perform "white collar" tasks. Job enlargement will be possible because training will be continuous, on the job. Production and services will tend towards customized production rather than mass output by specialists. Employees will have to start assuming tasks which were previously reserved to management. The enabling technology to managing this increased complexity will be the personal computer, directly available to every person. The habits of the information worker will also change. Part-time work and work from the home will change attitudes about employee relations.

SUMMARY:

- * MANPOWER SCARCITY IN HIGHLY PRODUCTIVE SOCIETY.
- * KEY IS PRODUCTIVITY OF INFORMATION WORKERS.
- * AN EFFICIENT SERVICE ECONOMY HAS MARKET-BASED WORKFORCE.
- * NEW JOBS WILL REQUIRE NEW SKILLS.
- * NUMEROUS POLICY CHANGES NECESSARY BY GOVERNMENT AND BUSINESS.

I will now sum up. The scenario I presented today presumes that we will realize the enormous potential that is now available. To get there, we will need a workforce which not only has different jobs but also different working and behavioral patterns. For the purpose of these hearings I concentrated entirely on the changes necessary for more than one half of the workforce - the information workers. These changes will make it necessary to increase the influence of market forces on the allocation of resources. New occupational and managerial skills will have to be applied. I hope that the Congress will recognize that numerous policy changes will have to be introduced both by the government and by business before we will be able to aspire to doubling real income and to a labor shortage in a productive service economy.

Thank you.

Mr. GORE. Thank you very much.

We will also hold our questions for you until our panel has been completed.

Neither of the other two witnesses have slides, do you? We will turn the lights back on.

Harley Shaiken, our next witness, is a researcher in the program in science and technology in society at MIT at MIT's Laboratory for Manufacturing and Productivity.

We are delighted to have you here, Mr. Shaiken. Please proceed.

**STATEMENT OF HARLEY SHAIKEN, RESEARCH ASSOCIATE,
MASSACHUSETTS INSTITUTE OF TECHNOLOGY**

Mr. SHAIKEN. Mr. Chairman, I am delighted to be here.

I think the whole issue of technological change could be the most critical one we face in the coming decade as a society. I would like to get what I think are some strawmen out of the way at the beginning.

I do not really think the issue is the desirability of new technology or increased productivity. Both clearly present enormous positive social benefits to the society. The real issue, I think, is the social cost of the change and how that social cost is going to be paid. In this regard, I think we have given inadequate attention to the way these technologies are being implemented, how people are directly being affected, and the kind of transition that is going to be made.

What I would like to highlight today is why I feel these new forms of technology, automation based on microelectronics and computers, are fundamentally different than the kind of automation we have seen in the past.

In addition, I think the economic situation today in which these technologies are being introduced is also clearly different.

I would like to start, however, with a disclaimer. In any complex technological society employment depends on more than technology alone. It depends on other critical factors such as economic growth, demographics, and a range of other things. That notwithstanding, today we are looking at the introduction of a technology of unprecedented labor displacing potential. In that regard, I think we have to take very seriously the possibility that unemployment could be a short term, and possibly a long term, result of the kind of changes that we are seeing today.

However, I do not think we have to look toward the future. With 11 million people already unemployed, the key issue is not the possibility of displacement but how many people who are currently out of work, not as a result of technology but as a result of a market failure, as a result of poor competitiveness, how many people who are currently out of work never will return to meaningful employment. That makes the issue I think far more compelling and urgent than merely trying to predict displacement, let's say, in 1990 or the year 2000.

In a sense there is a false sense of security today because with an economic downturn comes a delay or a deferral in the introduction of new technologies in a wide range of industries. However, as the economy begins to recover, what we are liable to see is a pent-