

原本

A FACT FINDING STUDY ON
THE IMPACTS OF MICROCOMPUTERS
ON EMPLOYMENT

- SUMMARY -

prepared by
A Working Group, on behalf of
The Special Committee on the Impacts of
Microelectronics on Employment

November 10, 1979

JAPAN

FOREWORD

Science and technology is a two-edged sword. Extensive application of technological innovation is an indispensable factor for sound growth in economy and improvement of the quality of life. However, it may also cause the decline of international competence and an increase in unemployment, if a country relies largely upon labor-intensive and structurally-defective industries. Recently, some concern has been voiced about the adverse effect of technological innovation in technology-intensive countries upon the economic and labor situations in other developed nations. It cannot be overlooked that a sense of crisis is mounting in relation to, among other things, the application of microelectronics and computer technology, or more specifically, microcomputer technology. Reflecting this situation, studies on the influence of microelectronics upon employment are now in progress in a number of developed countries and the issue has been discussed at OECD meetings as well.

In Japan, up to now this has never been a major issue, due to the facts that the fast economic growth during the past 30 years has provided an expanding labor market and there has been sufficient opportunity for the labor force to be transferred from old jobs to newly created jobs mainly within individual enterprises. However, in view of slower economic growth and the inevitable changes in industrial structure that are foreseen in the 1980's, Japan will, sooner or later, face the problem of interaction between technological innovation and employment. In particular, if this country chooses to emphasize knowledge-intensive industries in the 1980's, it will not be able to avoid employment problems, arising from the extensive use of microelectronics.

The efforts of analyzing the employment problems that may arise from the extensive introduction of microelectronics

technology in various industrial and business sectors, and of finding policy alternatives for creating new jobs, for training and retraining of the labor force to diminish or alleviate unemployment, will be crucial factors in the nation's future industrial growth and social stability.

Such efforts will also provide useful information to the developed part of the world as a whole, where Japan will play an important role as a producer of microelectronics and associated products.

Based upon the above-mentioned motivation, a special committee has been organized under the sponsorship of the Ministry of International Trade and Industry, Japan, to explore the problems and to study possible measures. The present document, which is the English version of the summary of an interim report of the working group of this committee, is prepared as material for discussion on microelectronics and its implications for employment.

November 10, 1979

HIROSHI INOSE
Chairman

The Special Committee on
the Impacts of Microelectronics
on Employment

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I. INTRODUCTION

1. Purpose and Scope

The microcomputer has been widely recognized as the most important element of microelectronics influencing the nature of society during the 20th century. The major changes that the microcomputer and its application will bring to both suppliers and users have almost been transformed into reality. The impact is now beginning.

The purpose of this study is to explore (identify) the changes that are taking place, the reasons behind them, and the trends of the future, and as material for further discussion to provide a document of some estimations on the impact of microcomputers on employment and its implications.

In a broad sense, microelectronics embraces computer and computer-based technologies, as well as digital technology. And the most important aspect of microelectronic is the microcomputer. In this sense, the term "microelectronics" is often acknowledged as a synonym for "microcomputer technology". This being the case, this study takes up microcomputers and their impact on employment.

This fact finding study, performed by the working group at the Research Institute of the Japan Management Association, was commissioned by the Special Committee on the Impacts of Microelectronics on Employment, organized at the Japan Information Processing Development Center under the sponsorship of the Ministry of International Trade and Industry, Japan.

2. Approach

In undertaking this survey, we decided to analyze the effect of microcomputers on employees and to study the general trend for popular diffusion of microcomputers. Based on these studies, case studies were conducted through interviews with the corporate executives who are involved in the development of microcomputers and their associated products to identify the changes. Then we tried to estimate the number of employment situations changed by the application of microcomputers.

This report includes case studies on the following product areas:

- Industrial Products
- Office Machines
- Consumer Products

This is followed by a summary of our tentative estimations of the changes in employment based on our observations through interviews.

3. Major Findings

- (1) The equipment manufacturers are actively introducing the microcomputers and are developing new products with higher added values. At the same time, the diffusion of microcomputers has given birth to new types of small and medium enterprises with high technological capability, namely, systems houses, for systems integration and development of application programs.
- (2) Impacts of microcomputers and associated products on the employees of the suppliers are summarized as follows:

- In the development area, there has been an urgent need for software development personnel, particularly digital technology-based software engineers. Serious concern has been expressed about the shortage of personnel in this area in conjunction with a rapid increase in the demand for sophisticated and custom-made software.
 - In the manufacturing area, there has been no significant change in employment. However, productivity per capita has greatly increased owing to innovations in manufacturing processes. Owing also to the process innovations the necessity for skilled labor is decreasing.
 - In the marketing area, personnel has increased slightly.
 - In the maintenance area no change has been observed so far.
- (3) As for the impacts on the employees of the users caused by the use of microcomputers and associated products, it is generally forecast that substantial numbers of the existing labor force will lose their jobs because of the labor saving aspects of the equipment and that a substantial shortage will occur in systems and software personnel.

II. IMPACTS OF MICROCOMPUTER APPLICATION ON PEOPLE

- Case Studies -

1. Introduction

The product areas covered under the studies are the following three.

Industrial Products	{ Production Automating Equipment Analysis, Measuring and Inspection Equipment Process Control Equipment
Office Machines	{ Ordinary Office Machines Commercial Office Machines Automatic Station Equipment
Consumer Products	{ Watches Electronic Calculators Sewing Machines

The studies were implemented by individually visiting applied equipment manufacturers. The results of this survey are based on the deep understanding and sincerity of executives from 20 companies.

2. Industrial Products

(1) Introduction

Due to management needs such as increases in productivity, improvement in quality, and labor saving for production in industrial segments, the use of electronics of the computer system type has been general for all industrial equipment. The application of microcomputers has made this equipment

"intelligent" and has upgraded its capability by increasing performance, reliability and flexibility. Further, the application of microcomputers has made improvements in style, weight and operability, realizing lower sales prices by reducing the manufacturing cost of equipment.

The reduction in manufacturing cost is due to increased productivity of equipment by utilizing the characteristics of microcomputers (versatility, multifunction characteristics, low cost, style, etc.). The greatest factors in terms of cost are said to be the intensification of components and miniaturization of equipment.

The foregoing change has started to have considerable impact on industries related to industrial equipment, including equipment manufacturers, and human aspects (job categories and skill) of the users.

- ° The application of microcomputers to NC machine tools started around 1975, realizing reduced costs of equipment, miniaturization, lightweight, multifunction, simplified operation method, low maintenance, etc. Advantages for machine tool manufacturers are: drastic reduction in the number of components, reduced manufacturing time, improved reliability, and lowered cost because of miniaturization.
- ° The introduction of microcomputers to industrial robots started around 1975, and the possibility for complete automation of manufacturing processes increased.
- ° Miniaturization, lightweight, and the possibility for multipurpose utilization are expected to permit industrial robots to be used not only in manufacturing industries, but also in other industrial areas in general.

- ° In continuous processing industries such as oil, chemical, cement, paper, and pulp, overall instrumentation systems, including minicomputers and control computers, have been in use based on process instrumentation by industrial meters. However, centralization of control means greater impact when operation stops and this has been a subject of discussion. Distribution of control by microcomputers in the process control area solves this problem. At the same time, it has increased operability and has made centralization of management easier. Labor saving is large with distributed synthetic instrumentation systems. However, these systems are for enterprises which already have minicomputer control systems, and the demand is for replacement.
- ° Equipment in the analytic, measuring, and inspection area is changing from analog equipment in the IC age to digital equipment in the microcomputer age. Microcomputers have been actively used in all product areas. The diffusion of microcomputers has permitted the debut of new types of products, such as LSI testers and logic analyzers, which did not exist before. Advantages which digital equipment offers to equipment users are: automation of analyzing, measuring, and inspection by microcomputer-intelligent equipment, high precision, reliability, flexibility, and simplification of work.

(2) Impacts on Producers

- Development and Design -

- ° Machine tool manufacturers are trying to manufacture NC machine tools in-house and are actively introducing the required technology. As a result, electronic personnel are increasing. However, machine tool bodies, excluding NC section, require a high degree of machining

technique, and no direct impact on mechanical engineers by in-house fabrication of NCs is expected.

- ° In the area of industrial robots, intelligent robots capable of demonstrating microcomputer functions are not expected to be used on a full scale until after 1980. Manufacturers are testing them for introduction to the market at present, and no personnel changes by manufacturers have taken place.
 - ° In the area of process control equipment, training and education of engineers has been actively carried out as software technology in particular is required parallel to beefing up of development personnel. Analog instrumentation engineers are retraining as digital engineers, and hardware engineers are retraining as software engineers.
 - ° In the analyzing and measuring equipment area, new products have been constantly developed since the introduction of microcomputers. Development competition in the same industry has been intense. Product development requires digital circuit engineers, software engineers, and other new personnel, and new employees are hired in large numbers. Analog circuit designers are changing their technology area by technical reeducation or self-education.
- Manufacturing -
- ° In the machine tool area, labor saving in the manufacturing department was attained by a drastic reduction in the number of parts used when machine tools started to use NCs. The introduction of microcomputers further shortens manufacturing processes.

- ° In the process control area, skilled machinists are no longer needed, and personnel have been reduced by shortened process time and the need for fewer parts. The situation is tackled by relocation. Production workers are retrained. In-house development and engineering staff are responsible for this job.
- ° Production workers in the analyzing and measuring equipment area receive technical reeducation to engage in manufacture of digital equipment. Therefore, no change in personnel has been caused by the introduction of microcomputers. Productivity per capita has increased considerably, coupled with an increase in demand.

- Marketing and Maintenance -

- ° Machine tools, industrial robots, and process control equipment are basically manufactured after orders are received. There is no change in marketing structure. Maintenance is simplified. However, to continue contact with the users, check cycles remain the same as before. (In many instances, subsidiary companies are responsible for maintenance.)
- ° Sales of products in new categories have increased in the area of analyzing and measuring equipment, and education in technical matters for marketing and maintenance personnel has been necessitated. Maintenance frequency per machine is drastically lowered even if sales volume is increased, and there will be no increase in maintenance personnel.

(3) Impacts on Related Suppliers

- ° In the machine tool area, impacts on subcontractors of mechanical parts are anticipated. However, the ratio

of machine tools with NC functions is still about 30%. Impacts on parts manufacturers by the use of micro-computers in NC sections will be a future problem.

- ° In process control equipment area, a drastic reduction in metal parts and frames (by miniaturization) has reduced business available to subcontractors. The subcontractors are required to introduce electronic technology.
- ° A large change in engineering is taking place with equipment for analyzing and measuring. The subcontractors are reeducating engineers, mostly under the guidance of equipment manufacturers. Increases in work are coped with by investment in new equipment, and no increase in labor force has been made.

(4) Impacts on Users

- ° The first objective for users in introducing automated manufacturing equipment is labor saving. Parallel with the trend of manufacturing divisions for knowledge intensification, automation and unattended operation have progressed rapidly. In the background of this trend is a shortage of skilled labor. Equipment containing microcomputers permits replacement of process workers by a few unskilled workers.
- ° Small and medium enterprises have been experiencing a chronic shortage of skilled labor. The installation of machine tools with high performance, low price, and high operability will solve the problem of labor shortage. Therefore, there will be almost no impacts on employment in the short term.
- ° Automation is a goal of users in the case of process control also. Replacement by equipment will be welcome

if workers can be freed from bad working environments and the quality of control is increased. However, reliability is considered more important than price, and field tests over a period of several years are required for installation of new models. Rapid introduction will be curbed. If substituted, process control will be possible with only about 1/5 the personnel force required before.

- ° In the analyzing and measuring equipment area, it is considered only a matter of time before the conventional equipment is replaced by digital equipment. Skilled workers for measurement, inspection and analysis are no longer necessary. Also, minicomputer control operators are not essential. Operation of a continuous work system requires a minimum of operators. However, these operators are not required to have specific skills or experience. Part-time or unskilled labor can operate the digital equipment and so lower the operating costs.

3. Office Machines

(1) Introduction

In these studies, copying machines and facsimile terminals, in which conventional mechanical technology was prevalent, were selected from the broad range of existing office machines. ECRs (Electronic Cash Registers) and POS (Point of Sales) terminals, which are store counter equipment, were selected as commercial machines, and automatic station equipment was taken up as special purpose equipment. Effects and impacts of equipment individually differ.

- ° The application of microcomputers to ordinary office machines has increased equipment performance, reliability, and operability, and a rapid expansion in demand has

ensued parallel with the realization of low prices. At present, the manufacturers are engaged in fierce competition for higher market shares, centering on stand-alone type equipment. The manufacturers are announcing new models of copying machines and facsimile terminals at a rate of 1.5 ~ 2 models a year per manufacturer.

- ° For commercial purposes, ECRs and weighing scales have been the main products. Development competition has become keener through the application of microcomputers, and their performance has been increasing and prices have been coming down.
- ° It seems that the diffusion of scales and ECRs in the market in Japan has reached the saturation level. The demand is expected to shift to POS terminals, which are regarded as the maincurrent products of commercial machines, by giving them many functions. POS systems permit automation of commercial business, and both terminals and scanning devices have increased the degree of perfection by the application of microcomputers. Full-scale diffusion is expected to bring significant innovations for users.
- ° The history of automatic station equipment started during 1965 ~ 1975 when automatic mechanical ticketing machines appeared on the market. The emergence of automatic gates has moved station work closer to automation. Microcomputers offer such advantages as improved work efficiency when railway fares are revised, improved durability, simplified system modification, and others. Improved printing systems for ticketing machines have also improved the quality of services for those who utilize them. Ticketing machines are mostly required for replacement.

(2) Impacts on Producers

- Development and Design -

- ° Active development work for new models has necessitated an increase in electronic and software engineers in the ordinary and commercial machine areas. There has been no change in the number of mechanical personnel.
- ° In the ordinary office machine area, short-term development competition occurs among the equipment manufacturers, and a large number of application systems engineers and programmers have been hired to beef up development. Copying machines and facsimile terminals depend much on optical, chemical, and mechanical technology, and there has been no reduction in the number of engineers for conventional technology. However, as it takes about two years to educate new employees in product engineering, reeducation of engineers for conventional technology has been actively undertaken to secure enough development personnel.
- ° A leading commercial machine manufacturer has reported that "Development and design personnel have doubled compared with five years ago. New employees have all been electronic engineers." Systems engineers and programmers have been particularly in demand. As long as development competition continues, employment of software engineers will continue. To meet personnel shortages, efforts have been made to retrain circuit design and assembly personnel into software engineers, and to provide technical education to workers inside enterprises and related suppliers by creating new system engineering departments.

- ° There has been no dramatic change in the area of automatic station equipment as the demand is stable and manufacturers and users are limited.

- Manufacturing -

- ° In ordinary office machines, the number of production workers has been slightly reduced, in spite of an increase in demand, by shortened processes and facility integration. Inspection processes have been simplified, but there has been no reduction in personnel. A flexible production system capable of meeting an increase in work volume has been instituted.
- ° Commercial machines are more electronic, and production lines are being automated parallel with drastic reduction in simple work. An unskilled labor force is replacing skilled production workers, and part-time workers are hired to do the work. Skilled workers are transferred to other production lines and get new jobs by relocation. Inspection processes have been simplified, but there has been no change in the number of personnel.
- ° Man-hours required for automatic station equipment have been reduced, but software engineers have been added, with the result that there has been no change in the number of personnel.

- Sales and Maintenance -

- ° Marketing competition is intensifying for ordinary office machines, necessitating strengthening of sales forces and improving their quality. Products are mostly distributed through sales agents belonging to equipment manufacturers, and education of agents is actively undertaken. The frequency of maintenance work has been greatly

reduced. The number of service units assigned per maintenance engineer has rapidly increased. Maintenance itself has been simplified. However, systematic education is considered necessary to prevent lowering the services level.

- ° Commercial machines are entering an era of new market development, and sales personnel have been increasing. Personnel with high technical capabilities are required when the sales method changes from selling single item commodities in small quantities to selling systems in large quantities.

(3) Impacts on Related Suppliers

- ° Ordinary office machines are experiencing an era of competition, and market entry and withdrawal by manufacturers in other industries are conspicuous. However, the situation is not serious enough to create a negative impact on existing enterprises.
- ° In the case of commercial machines, large manufacturers of scales and ECRs are enjoying sizeable portions of the market, and this trend is strengthening, reducing competitiveness of existing manufacturers producing conventional-type scales and of enterprises who have been behind in developing ECRs.
- ° Business of mechanical parts suppliers and of distribution stores dependent on repair revenue is decreasing, and the conventional scale industry is seriously affected.
- ° Engineering innovation is taking place among distribution agents of manufacturers of applied equipment. The increase in personnel has been parallel with the increase in demand. Engineering education in this area is financed by equipment manufacturers.

(4) Impacts on Users

- ° There is enough room for old-type office machines to be replaced by new models in terms of price, performance, and maintenance cost. However, the labor saving effect by new models in terms of the work force is not so high, even if target figures are taken into consideration.
- ° Working hours are expected to be shortened and skilled operators are expected to be dispensed with by utilizing new models in the case of ordinary office machines. However, division of work in ordinary offices is not so distinct, and productivity cannot be measured easily.
- ° With commercial machines, the productivity of cashiers in large mass-sales stores and department stores is said to have increased by about 20% by introducing POS terminals, compared with ECRs.
- ° No skilled operators are needed for ordinary and commercial office machines when they are introduced on a stand-alone basis.

4. Consumer Products

(1) Introduction

This section has taken up watches, which have often been called the starting point of mechatronics (mechanical electronics), card-thin electronic calculators, which are referred to as a product of microcomputer functions themselves, and sewing machines, in which microcomputers have begun to be utilized as functional parts. The impacts of microcomputer application has appeared most conspicuously and in different forms in them.

- ° The history of electronic (IC) watches can be traced to 1969 when an analog quartz watch made its debut. The price was still high, and diffusion of these watches progressed slowly. However, the speed of diffusion has rapidly accelerated since 1975 when low price, high performance digital quartz watches appeared on the market. Digital quartz watches using microcomputers have realized improved accuracy, simple operation, low price, and diverse functions. For watch manufacturers, man-hours have been reduced and facilities have been integrated as the number of parts used has drastically been reduced.

- ° Card-thin electronic calculators have shifted from business to consumer use and are now becoming daily necessities for personal use. The application of microcomputers started in 1977 and permitted larger capacities of memories, more diverse operational functions, additional control functions, and more functions at an increasingly lower price. In 1975, electronic circuit films were successfully developed to automate production lines. The use of microcomputer chips has permitted continuous automated production from design to production and inspection. The demand for electronic calculators has been nearly filled, and future demand is expected to move steadily.

- ° Sewing machines did not have electronic circuits up to 1975. Microcomputers application products were first introduced into the market in early 1979. Substitution of the cam drive mechanism by a microcomputer has realized reliability, durability, quietness, and diversification of pattern sewing. Prices have gone up slightly, and it is difficult to predict growth for the demand.

(2) Impacts on Producers

- Development and Design -

- ° In digitizing watches, mechanical and precision personnel have been reeducated, while the employment of information processing engineers has been increased. In-house manufacture of microcomputer components has increased the proportion of electronic and information processing engineers to 70% of the engineering personnel of one manufacturer. It has also been reported that "it is extremely difficult to convert analog-orientated personnel into digital-orientated personnel, and there is a limit to technical reeducation."
- ° With electronic calculators, automation is engulfing the design section as well, and there has been no numerical change in personnel. Engineers are tackling new product development.
- ° In the case of sewing machines, mechanical function parts are the main components, and new models are developed by development teams of mechanical and electronic engineers. Personnel have slightly increased. A considerable number of electronic engineers have been hired since 1970 in anticipation of the electronic age. About ten years have already passed, and education on digital technology was given to development engineers and managers when microcomputers were adopted.

- Manufacturing -

- ° The number of parts used in making watches has been reduced to 1/10 by digitization, and production line personnel have been reduced drastically. The manufacturers have relocated personnel by diversifying product lines and

are maintaining employment.

- ° Production lines of electronic calculators have been completely automated, and there is no human intervention, including the finished-product inspection process. Workers have been relocated to production lines for new equipment.
- ° Microcomputer applied sewing machines have not yet been mass produced and are produced in parallel with conventional electronic sewing machines.

- Sales and Maintenance -

- ° Watches have been regarded as high price commodities and have been sold in jewelry stores. However, digital watches have caused a major change in the distribution system. The entry of manufacturers of electrical equipment has intensified price competition, and the distribution method itself has been forced to improve. There has been no change in terms of personnel.
- ° Distribution of electronic calculators has also been changed to a mass-sales distribution method.
- ° There is no impact at present in the case of sewing machines.

(3) Impacts on Related Suppliers

- ° The demand for watches has increased, but the work volume of parts and tool suppliers has drastically decreased. Suppliers affiliated with watch manufacturers have been asked to cooperate in diversifying products to maintain cooperative relations.

- ° The low price trend of watches has lowered distribution margins, and the profit position of retail stores has declined. Digital watches require no repairs, and there is a possibility that stores specializing in watches will experience management deterioration.
- ° The intensified competition for low price of electronic calculators has made larger manufacturers even stronger. This has driven many manufacturers of electronic calculators out of the market.

5. Observations

Regarding the impacts of the application of microcomputers on employment, the following table can be obtained from the survey. The table shows the impacts on the manufacturers and users by increases or decreases in personnel. In this table increases are handled as positive and decreases as negative.

Manufacturers				Product Area	Users		
Development, Design	Mfg.	Sales, Maintenance	Parts Maker		Engineers	Skilled Workers	Unskilled Workers
o	*	o	Δ	Analytic, Measuring	-	Δ	-
*	Δ	*	Δ	Process Control	Δ	Δ	-
o	Δ	*	*	Manufacturing Automation	-	Δ	Δ
o	Δ	o	-	Ordinary Office Machines	-	x	x
o	Δ	o	Δ	Commercial Machines	o	Δ	x
*	Δ	*	*	Automatic Station Equipment	-	-	x
o	Δ	*	Δ	Watches	-	-	-
Δ	Δ	*	-	Calculators	-	-	-
o	x	x	x	Sewing Machines	-	-	-

(It is to be noted that a decrease in personnel does not necessarily mean a negative factor for the development of manufacturers, or users.)

o Positive
Δ Negative
* No Change
x Unknown
- Not Applicable

Manufacturers

- ° Impacts of the application of microcomputers are most conspicuous on equipment manufacturers at present. Insofar as case studies indicate, technology conversion and an increase in employment have taken place in the development and design departments. Manufacturing

departments have less personnel in general, while marketing departments have more personnel due to an increase in demand. Parts suppliers are beginning to have less work as the number of parts required is decreasing.

- ° The positive trend in the development department is supported by demand for new models. Internally, in all cases, the following trends can be observed:

- Reeducation of conventional engineers, or transfer to new technology by self study.
- New employment

Technology needed will be information processing technology (software technology), and application systems engineers and a large number of programmers will be required. In-house education, in most instances, is due to the fact that there are no appropriate organizations to train practical software engineers. Engineers in the development department often provide technical training to the manufacturing and marketing departments of their own companies, or to distributors.

- ° Engineers of conventional technology are theoretically not needed. However, engineers are eager to learn new technology, and technological conversion is relatively easy with them. Therefore, there has been essentially no reduction in employment for them.
- ° Relocation has been made actively in the manufacturing divisions. Production lines manufacturing microcomputer applied equipment are maintaining the same number of personnel due to an increase in demand. However, in the long term, a decrease is a foregone conclusion due to facility integration. Relocation is always made in

the work places. Workers are retrained, and sometimes their job categories inside enterprises are changed.

- ° Strengthening of marketing departments is supported by the necessity for development of new models and an increase in demand. Strategic factors of enterprises work strongly.
- ° Impact on parts manufacturers depends on the level of the electronic contents of equipment. In any event, impact in one form or another is unavoidable as a result of parts intensification by utilizing micro-computers. In most instances, they are required to copy by means of technology conversion and are receiving technical guidance by equipment manufacturers.

Users

- ° Impact on users in general is a reduction in personnel. There is a possibility that impact on limited areas, such as measurement, testing, analysis and instrumentation engineers, will be relatively conspicuous. However, efforts on the part of user enterprises will work to check an increase in personnel. It is forecast that the number of personnel will continue without a significant change.
- ° Impact on the users of business machines is unknown at present. However, the introduction of equipment is expected to curb an increase in personnel.

III. SOME ESTIMATIONS OF THE CHANGES OF EMPLOYMENT

- Introduction -

This is an attempt to forecast the impact of microcomputers on employment, based on information regarding improved functions of applied equipment, labor saving effect, etc. The trend of changes in terms of employment regarding individual enterprises, obtained in the course of surveys, has been utilized as a reference.

The forecast results cannot be used to synthetically view the impact on employment. However, the data will provide information when studying changes, which may take place in individual cases.

Regarding equipment which is judged not to cause changes in employment (fluctuation in concrete terms), their utilization has been analyzed and consideration has been made.

1. Software Engineers

(1) Premises for Forecast

a) The scope of software engineers will be defined as follows:

- ° Systems Engineers
- ° Systems Analysts
- ° Programmers

b) In this forecast, software engineers will be classified into two categories by use as follows:

- ° Application Software Engineers (ASE)
- ° Utilization Software Engineers (USE)

- c) A forecast for software engineers in connection with expanded usage of general-purpose computers, etc. is that between 1972 and 1985, they will show an annual growth rate of 12.0%. (The Industrial Structure Council, Information Industry Group, July, 1976)
- Personnel increases by expanded utilization of general-purpose computers, etc. (utilization software engineers) in this forecast are based on the foregoing indexes.

- Hypotheses: -

- Total number of software engineers
in all the industries: 80,310 (1975 census)
- The breakdown of software engineers
is as follows:

Software Engineers (80,310)	—	Application Software Engineers 40% (32,124)
		Utilization Software Engineers 60% (48,186)

- Annual average growth rates up to 1985 will be as
shown below:

° Application Software Engineers (ASE)

Case (1) — 15% (minimum)
Case (2) — 25% (medium)
Case (3) — 35% (maximum)

° Utilization Software Engineers (USE)

Case (1)	} — 12% (according to the forecast indexes by the Industrial Structure Council, mentioned above)
Case (2)	
Case (3)	

(2) Forecast Results

The transition of software enginners up to 1985 based on the foregoing hypotheses will be as follows:

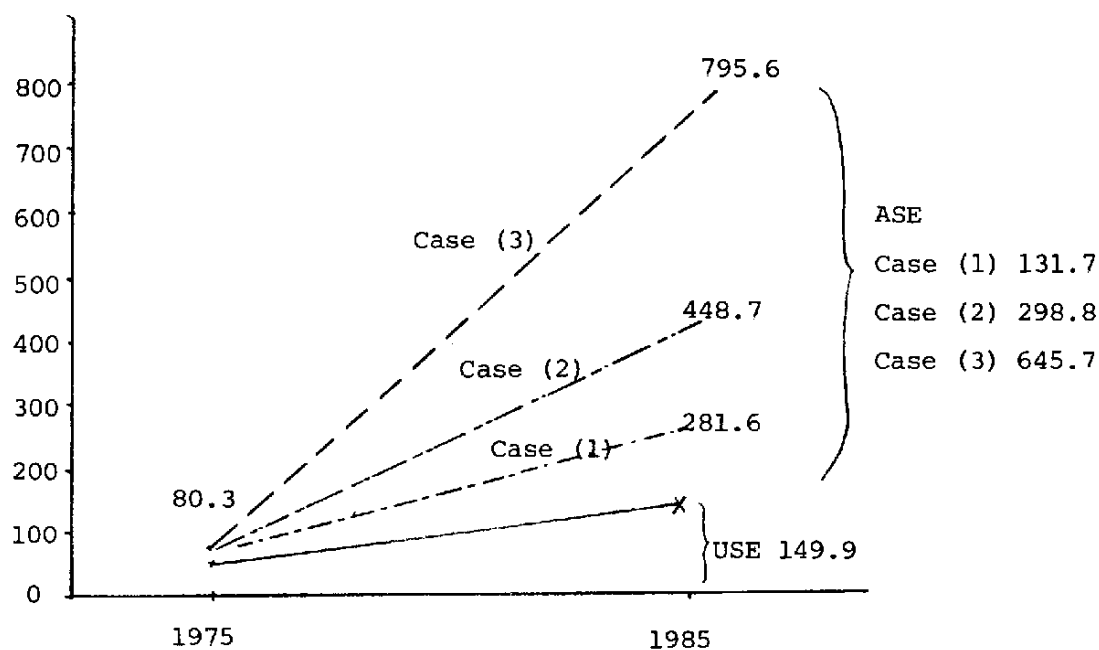
Transition of Software Engineers (Estimate)

(Unit: 1,000 persons)

	1975 Actual	1985 Forecast		
		Case (1)	Case (2)	Case (3)
Application Software Engineers	32.1	131.7	298.8	645.7
Utilization Software Engineers	48.2	149.9	149.9	149.9
Total	80.3	281.6	448.7	795.6

Transition of Software Engineers (Estimate)

Thousand Persons



Software Engineers, including ASE and USE, for all industries will total an estimated maximum 795,600 in 1985 (Case (3)). There will be an increase by 715,300 persons based on 1975. Even with a minimum increase, the total number of software engineers is estimated at 281,600 for 1985 (Case (1)). In this case, there will be an increase by 201,300 persons based on 1975.

2. Production Workers

(1) Premises for Forecast

- a) The scope of manufacturers of applied equipment where production workers are to be affected, will be defined as follows:
 - ° General machinery and equipment manufacturing
 - ° Electrical machinery and equipment manufacturing
 - ° Precision machinery and equipment manufacturing
- b) Production workers are to be affected under the following two conditions:
 - i) Expansion of microcomputer application (Called "process application ratio".)
 - ii) Increase in productivity by parts intensification of applied products (Called "Productivity increase ratio".)

- Hypotheses: -

- Total number of production workers in the three areas (1975 census) 1,884,150
- Demand for labor force in the three areas up to 1985 annual average (Industrial Structure Council) 2.6%

- Process application ratio in 1985:

Case (1)	30% (minimum)
Case (2)	50% (medium)
Case (3)	70% (maximum)

- Productivity increase in areas affected:

Production workers in manufacture of general machinery and equipment	20%
Production workers in manufacture of electrical machinery and equipment	30%
Production workers in manufacture of precision machinery and equipment	50%

(2) Forecast Results

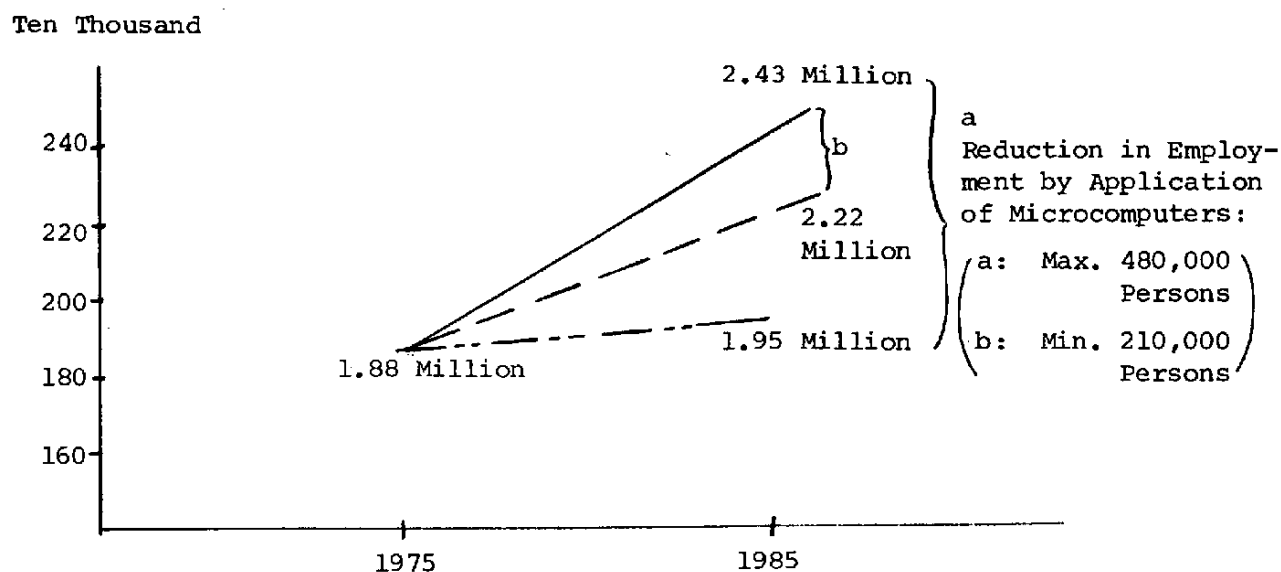
Based on the foregoing hypotheses, the number of process workers up to 1985 will be as follows:

Transition of Process Workers (Estimated)

(Unit: 1,000 Persons)

	Actual		1985 Forecast			
			Demand	Case	Case	Case
	1970	1975		(1)	(2)	(3)
Total Number of production workers	2,061	1,884	2,430	2,233	2,087	1,948
General Machinery Workers	796	739	953	896	859	820
Electrical Machinery Workers	1,056	929	1,198	1,096	1,018	946
Precision Machinery Workers	209	216	279	273	210	182

Forecast of Transition of Production Workers
(Estimated)



Production workers at manufacturers of applied equipment in 1985 will reach an estimated total of 2.43 million by natural increase through increase in demand for labor. However, expansion of microcomputer application is expected to reduce nominal employment by a maximum 480,000, or a minimum 210,000. The number of workers will be about 1.95 million in 1985 when the process application rate is maximum, representing a real increase of 70,000 persons (3.7%) relative to the number of workers in 1975. A real increase of 340,000 persons (18.1%) can be expected when the product application rate is minimum.

3. Salespeople

(1) Premises for Forecast

According to a physical distribution modernization program of the Ministry of International Trade and Industry,

POS (Point of Sales) terminals are expected to pass the diffusion stage and reach a development stage by 1985. Below, the impact is forecast assuming 1985 to be a development period and based on the following hypotheses:

- Hypotheses: -

- ° POS Diffusion Areas -- Department stores (including general supermarkets)
- ° Salespeople -- 260,000 (1975 Census)
- ° 1985 Diffusion Rate -- Maximum 50%, minimum 30%
- ° 1990 Diffusion Rate -- Maximum 100%, minimum 50%
- ° Demand for Labor Force -- Annual average 0.9%
(Industrial Structure Council)
- ° The breakdown of salespeople and Rate of Productivity Increase by POS Terminals

General clerks	25%
Accounting clerks	20%
Sales clerks	10%

(2) Forecast Results

Change in Number of Employees in Department Stores

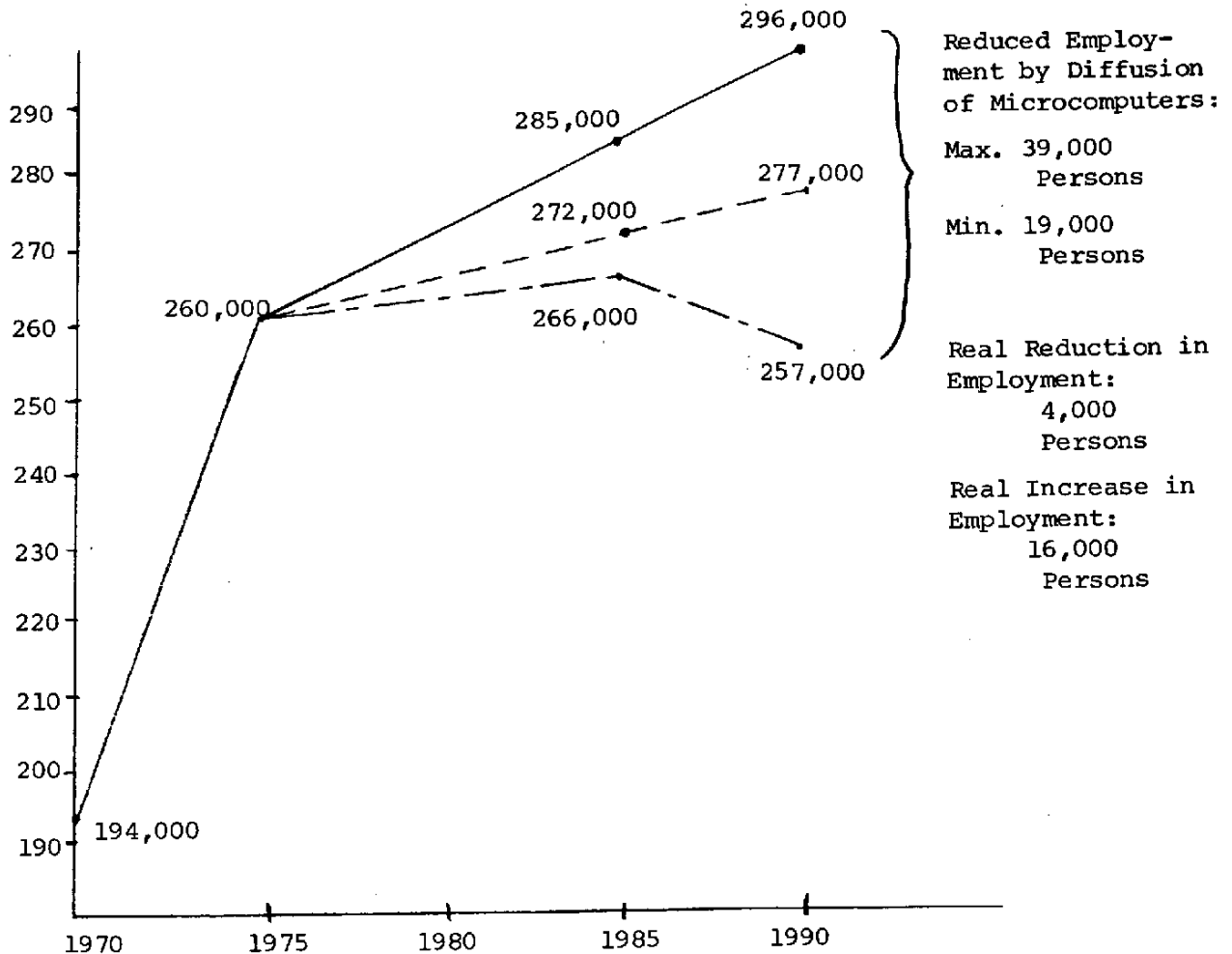
(Estimated)

(Unit: 1,000 Persons, %)

	Actual (Census)		1985 Forecast			1990 Forecast		
	1970	1975	Demand	Diffusion Rate 30%	Diffusion Rate 50%	Demand	Diffusion Rate 50%	Diffusion Rate 100%
A. Total Department Store Employees	244	315	343	332	326	359	340	320
B. Total Sales Business Employees	194	260	283	272	266	296	277	257
General Clerks	28	36	39	36	35	41	36	31
Accounting Clerks	19	30	33	31	30	34	31	27
Sales Clerks	147	194	211	205	201	221	210	199
Ratio of Employees in Sales Business B/A (%)	79.5	82.5	82.5	81.9	81.6	82.5	81.7	80.6

Forecast of Change in Employees in Department Stores
(Estimated)

Thousand Persons



Employment of sales personnel in department stores as a result of the diffusion of POS terminals will be affected by a maximum 39,000 person reduction (labor saving effect) and a minimum 19,000 persons in 1990, when future personnel requirements are taken into consideration. The real reduction when compared with 1975 will be 4,000 persons (1.5% less) if the diffusion rate is estimated at 100%. For an estimated diffusion rate of 50%, an increase of about 16,000 persons (6%) can be anticipated. Forecasts for 1985 are 6,000 persons more (about 2.3%) with a 50%

diffusion rate, and 12,000 persons more (4.6%) with a 30% diffusion rate.

Provided the diffusion rate reaches 100% in 1985, the number of persons engaged in sales will be 245,000, which represents a real reduction in employment of 15,000 persons (5.7% less) compared with 1975.

4. Office Workers

(1) Objects of Consideration

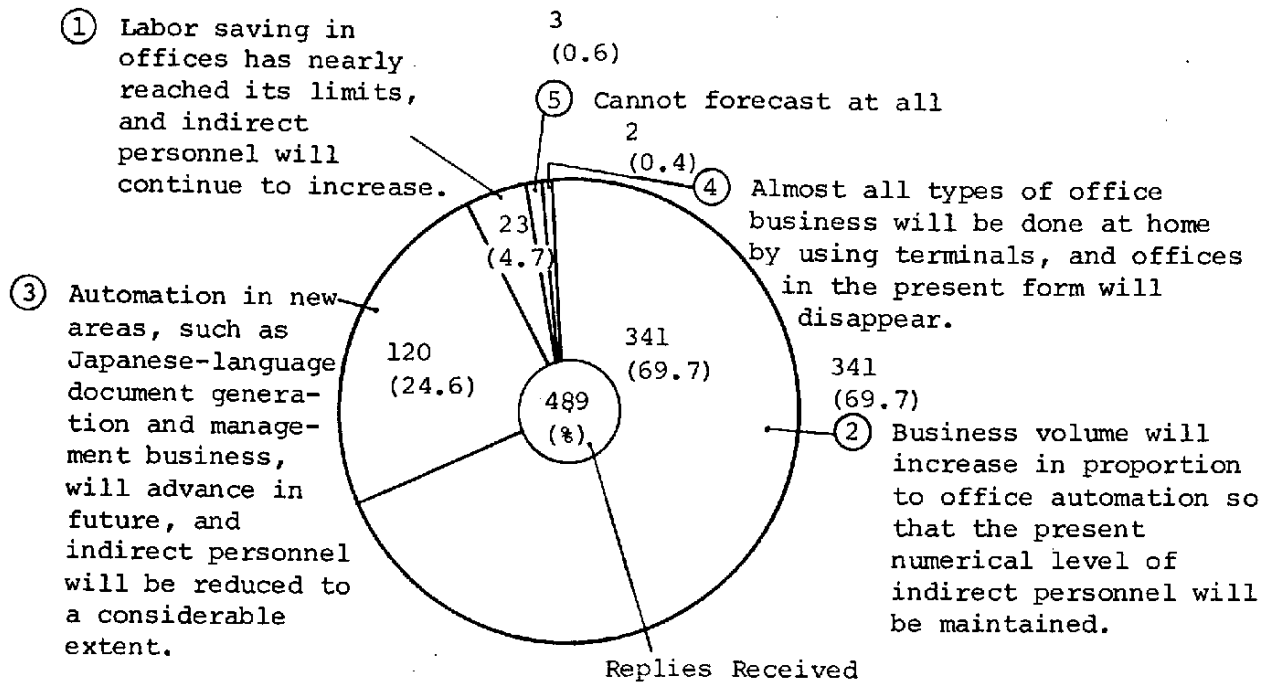
This Section will consider the impact on employment by microelectronics via office machines.

- ° Diffusion is near saturation -- Copying machines,
microfilms
- ° Diffusion is taking place -- Facsimile terminals,
office computers
- ° Diffusion is expected in future -- Word processors

(2) Utilization Trends of Business Machines

Users in Japan view office automation in 1985 as shown in the diagram below:

Change in Future Offices



(Source: JIPDEC "Survey of Trend for Information Processing")

According to this result, one fourth of the people who answered our questionnaire believe that office automation would affect the number of clerical personnel. The remaining three-quarters feel that the present state will be continued.

It is to be noted that "automation of new areas" would work to reduce personnel. That is, the diffusion of existing commodities will not generate employment.

(3) Consideration in Detail

A study will be made regarding the commodities shown at the beginning of this Section.

a) Copying Machines

The present use of copying machines does not performance of the machines improves, the time saved by office personnel through machine performance will be transferred to other work.

b) Microfilm Equipment

Microfilm equipment has increased physical efficiency (space factor), but it has not contributed to human efficiency (photographing and retrieval). It will be difficult to implement technical improvements to remove this deficiency.

c) Facsimile Terminals

In many cases, facsimiles are used for the following purposes:

- i) Substitutes for telephone and mail
- ii) Substitutes for telex and teletype

The information that can be sent by telex and teletype is:

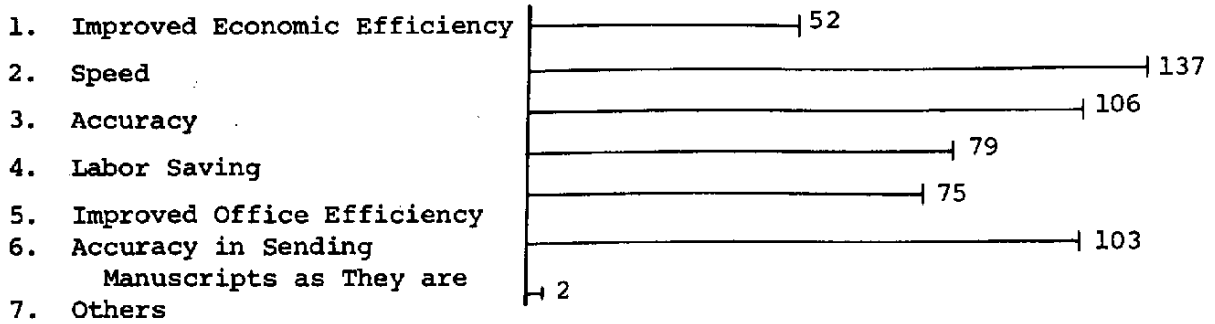
- i) General communication texts
- ii) Slips

However, the possibility of the effect of labor saving surfacing in case these forms of information are changed to facsimiles is low. It is because:

- i) There is a possibility for labor saving, but its volume is small.
- ii) Offers no possibility for labor saving.

Slips and other similar documents are ultimately input into computers. Granted that terminal sides have the benefit of labor saving, the burden from this benefit merely moves to the centers. A survey by the Electronic Association also shows that no one is expecting a reduction, as shown below.

The Effect of Installing a Facsimile Terminal



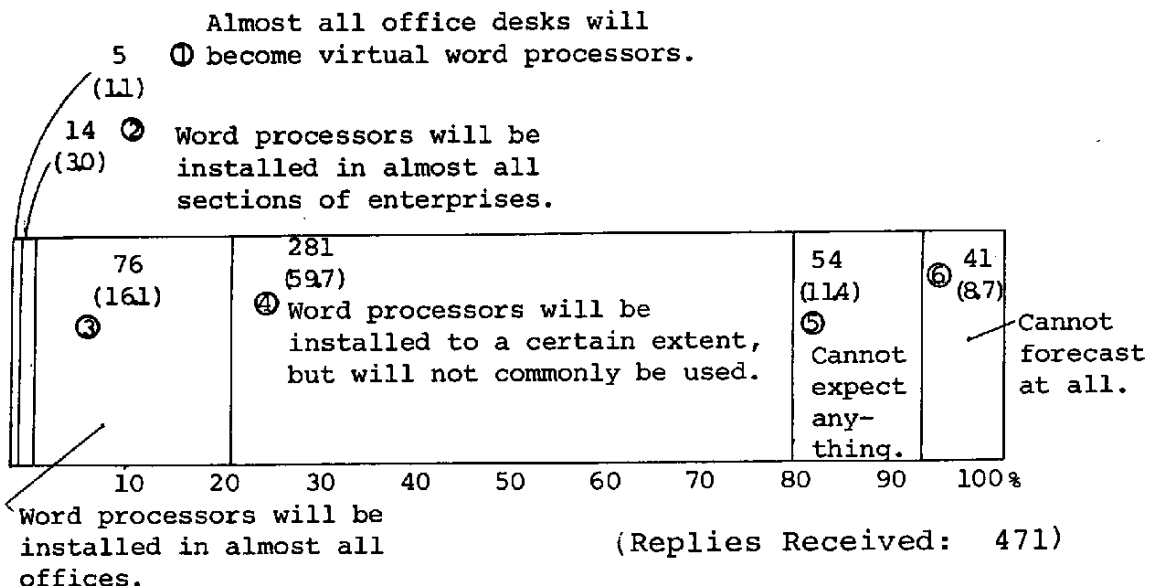
d) Office Computers

Enterprises installing office computers are small in scale and the jobs of their employees are not segmented as is the case with large enterprises. Therefore, the introduction of office computers does not necessarily result in personnel reduction.

e) Word Processors

Word processors are the equipment of a new area. It is difficult to forecast the demand for word processors as there are no past records. The only available information is data obtained by JIPDEC by sending a questionnaire to users regarding 1985. The data is shown in the diagram below.

Diffusion Degree of Japanese-Language Word Processors



THE HISTORY OF THE UNITED STATES

The history of the United States is a story of growth and change. From the first settlers to the present day, the nation has evolved through various stages of development. The early years were marked by exploration and settlement, followed by a period of rapid expansion and industrialization. The American Revolution and the Civil War were pivotal moments in the nation's history, shaping its identity and values. The 20th century brought significant social and political changes, including the rise of the American Dream and the challenges of the Cold War. Today, the United States continues to be a dynamic and influential global power.

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According to this data, only 20% of the replies forecast that word processors will be commonly installed. This survey will honor the opinions of the majority of the replies and will note that word processors will not be commonly installed.

(4) Conclusion

* Copying Machines

- ° Diffusion is saturated at present.
- ° The future demand will be for replacement.
- ° Therefore, no impact on clerical personnel is anticipated.

* Microfilm Equipment

- ° The degree of diffusion is and will be low.
(An increase in diffusion rate cannot be expected even if technical improvements are made.)
- ° Additional personnel are needed to install and utilize it effectively. However, the equipment is not likely to increase personnel.
- ° There is no possibility for reduced personnel by installing the equipment.

* Facsimile Terminals

- ° Rapid growth can be expected.
- ° Part of the increase will be from telex and teletype terminals.
- ° However, even if telex and teletype personnel can be reduced, there are only a few special operators so that the matter of reduced personnel will not arise.

* Office Computers

- ° Rapid growth can be expected.

- ° Enterprises that install office computers are small enterprises, and there will be no functional fragmentation of office personnel. In such an environment, no labor saving can be expected.

* Word Processors

- ° They will not be commonly used.
- ° Therefore, no labor saving effect will arise.

In other words, no significant increase or decrease in personnel can be expected on the utilization side.

