

II. Summary of the Results

1. Changes in Production and Employment

- In terms of both production and employment, electric and precision machinery showed the highest rate of growth. —
- 1 The over-all growth rate of shipment during the 5 years from 1976 to 1981 was 47%. By industry, electric and precision machinery recorded the highest rate of 83% increase, followed by general machinery with 64% increase, printing with 62% increase and transport machinery with 55%, while the lowest rate of 18% increase was registered in textile and garment.
 - 2 The number of employees showed an increase of 8.0% in electric and precision machinery. All other branches showed a decrease of varying rates. The average rate of decrease was 5.2% (see Table 1).
 - 3 Of the establishments studied, 10% had micro-electronics-related goods among their products. By enterprise scale, large ones (with 1,000 workers or more) showed a high rate of 19%. By industry, electric and precision machinery registered the highest rate of 39%, followed in order by general machinery 17%, metal products 10%, iron, steel and nonferrous metals 9% and printing 7%.
 - 4 A look at the changes in production and employment relative to the production or non-production of micro-electronics-related products, the establishments producing such goods showed a growth rate of 71% in shipment during the said 5 years, far surpassing an increase of 42% registered in the enterprises not producing such goods. In terms of employees, the former showed an increase of 2.9%, while the latter declined by 7.3%.

Table 1 Rates of Increase or Decrease in Shipment and Employees

(%)

	Shipment	Employees
Total	147.3	94.8
Food	126.1	94.2
Textile & garment	118.1	84.2
Wood, furniture	138.0	89.1
Pulp, paper	126.5	83.3
Printing	162.4	97.7
Chemistry, petroleum, rubber	145.6	90.5
Ceramics, quarrying	141.6	92.8
Iron & steel, nonferrous metals	137.9	89.6
Metal products	133.2	91.9
General machinery	164.1	95.6
Electric & precision machinery	183.1	108.0
Transport machinery	154.8	95.3

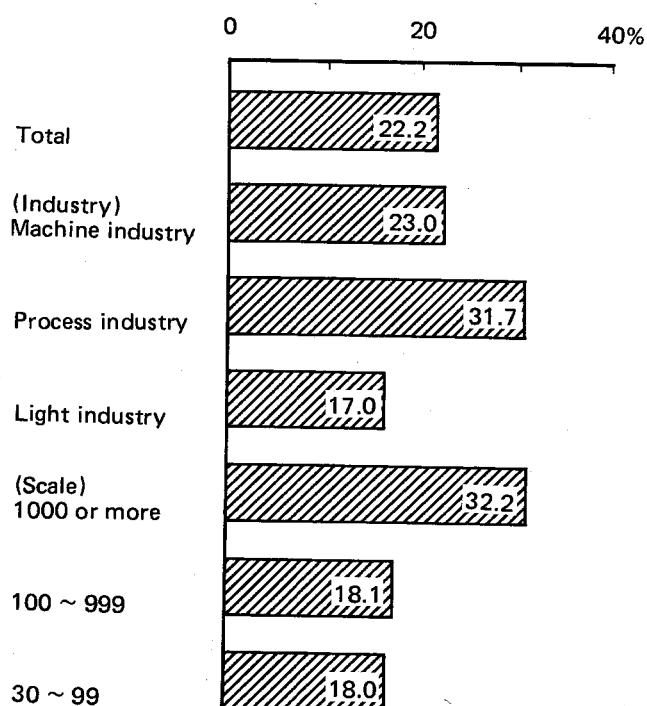
2. Introduction and Use of Automated Machinery

— Such machinery has already been introduced into 30% of the enterprises and used by 20% of the skilled workers; various hindrances may stand in the way of future introduction of such machinery on any active scale. —

- 1 The enterprises which introduced, during the past 5 ~ 6 years, automated machinery in which electronics-operated automatic control devices had been built in represented 32% of all manufacturing enterprises. Another 23% replied that they had not introduced but were studying the possibility of introducing such machinery. Thus, the proportion of the enterprises using such machinery is expected to reach 50% in the not too distant future.
- 2 The ratio of skilled workers who use automated machinery was 22% of all skilled workers.

When viewed by industry, equipment industry made up 32%, followed by machinery 23%, and light industry 17%. By enterprise scale, large enterprises employing 1,000 workers or more made up 32%, while medium & small enterprises with 999 employees or less showed a substantially low rate of 18% (see Chart 1).

Chart 1 Ratio of Skilled Workers using Automated Machinery by Industry and Enterprise Scale



- 3 When the ratio of skilled workers mentioned in 2 above is viewed by occupation, we find that chemical workers, package wrappers, rubber-plastic workers, metal material workers, mechanics (52 ~ 32%), etc. showed high rates.

The ratio of skilled workers using industrial robots was high among rubber-plastic workers (12%), followed by testing-analysis workers, painting workers, package wrappers and welders (7 ~ 4%) (see Table 2).

When the total of workers using industrial robots was taken as 100, the percentage composition by occupation was 25% for mechanics, 13% for electric appliances assemblers workers, 11% for welders and 8% for rubber-plastic workers.

NC machine tools were used by 20% of the mechanics.

Table 2 Occupations with High Rates of Workers using Automated Machinery

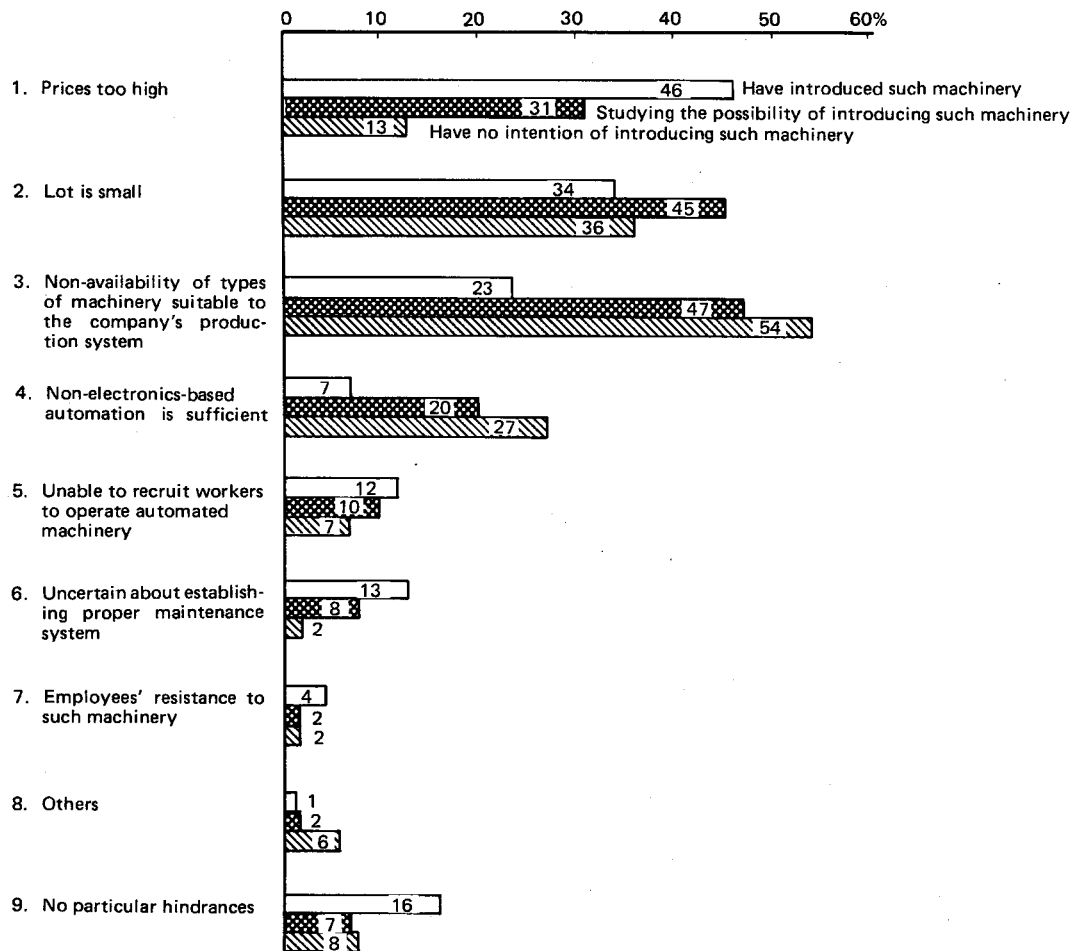
(%)

Order	Total No. of automated machinery		NC machine tools		Industrial robots		Other automated machinery	
1	Chemical	51.8	Programming	25.0	Rubber-plastic	12.2	Programming	30.0
2	Wrapping	39.2	Machining	19.3	Testing-analysis	6.6	Machining	29.3
3	Rubber-plastic	36.6	General machinery assembling & repair	7.7	Painting	5.8	Chemical	28.6
4	Metal materials	32.6	Welding-sheet metal	5.3	Wrapping	5.4	Rubber-plastic	23.0
5	Programming	31.9	Production management	3.8	Welding-sheet metal	4.4	Metal materials	19.4
6	Machining	31.6	Transport machinery assembling & repair	3.5	Programming	4.1	Ceramics	17.1
7	Printing-book-binding	28.4	Repair & maintenance	3.3	Repair & maintenance	3.9	Testing & analysis	13.4
8	Ceramics	25.9	Rubber-plastic	2.8	Ceramics	3.9	Welding-sheet metal	13.0
9	Operation of fixed engines	25.2	Draft smanshing & development	2.6	Machining	3.5	Operation of fixed engines	13.0
10	Electric appliance assembling & repair	22.7	Woodworking-furniture	2.4	Electric appliance assembling & repair	3.5	General machinery assembling & repair	11.8

- 4 To analyse the growth of production and employment in enterprises having introduced automated machinery and in those not yet introduced such machinery, as high as 56% growth in shipment was recorded in enterprises having introduced such machinery, 43% in those studying the possibility of introducing such machinery, and 21% in those not considering the introduction of such machinery. The growth rates of employment in these three categories of enterprises were -2.9%, -3.7% and -14.2% respectively.
- 5 As hindrances to the introduction of automated machinery in the future, many of the enterprises having introduced such machinery pointed out "prices too high" and "lot is small," while many of those not considering the introduction of such machinery mentioned "non-availability of types of machinery suitable to the company's production system" and "lot is small" (see Chart 2).

While it is certain that automated machinery would continue to make its way into industry, not a few sectors would find themselves unfit for the introduction of such machinery for reasons of the nature of trades or enterprise scale.

**Chart 2 Hindrances to the Introduction of Automated Machinery in the Future
(Percentage Composition of Enterprises) D.A.**



3. Progress of Technological Innovations and Changes in the Work Contents of Skilled Workers

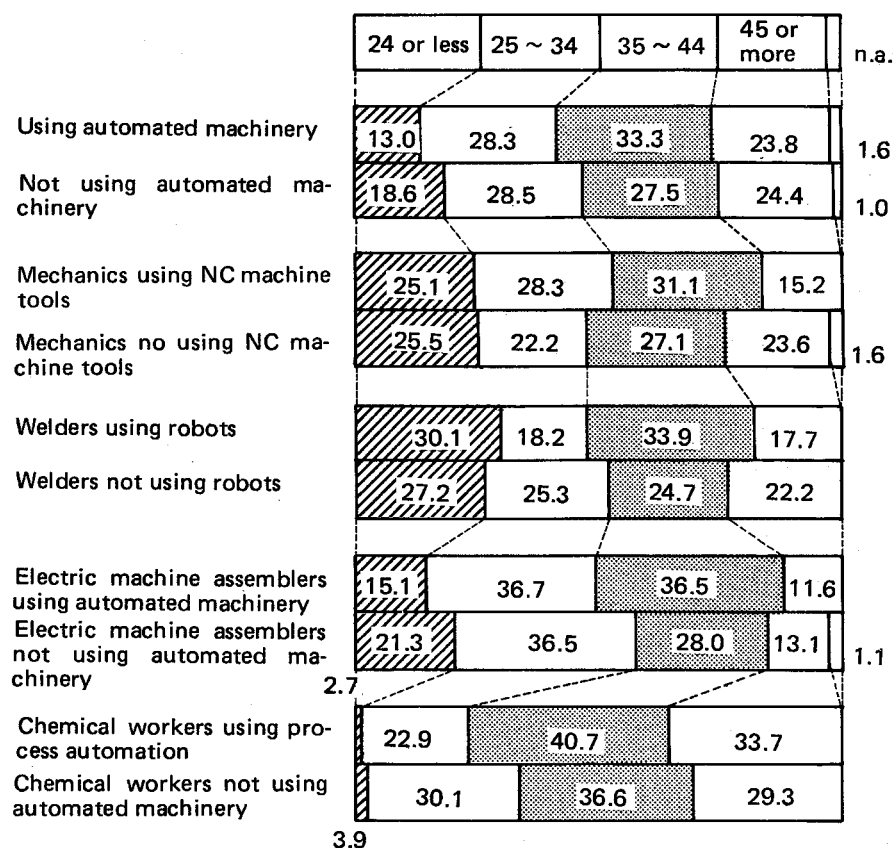
(1) Characteristics of personnel assigned to automated machinery

— Key skilled workers who have manual skills and brains are assigned to automated machinery. —

- 1 The age composition of the personnel assigned to automated machinery showed that those in the age group 25 ~ 44 made up about 62%, and those aged 45 or more occupied 24%. Such distribution of personnel by age was almost same as in the case of workers not using automated machinery.

However, when we compare mechanics using NC machine tools and welders using industrial robots with those engaged in the same occupations without using such machinery, we find that the proportion of workers aged 45 or more was low among those using such machinery. Apart from occupations such as chemical workers using process automation where automation has been introduced since about 1955, it appears that generally speaking key skilled workers were assigned to automated machinery on a priority basis (Chart 3).

Chart 3 Age Composition of Workers using Automated Machinery and Those not using such Machinery



- 2 An analysis of the abilities and characteristics possessed by the workers assigned to automated machinery shows that “those with ordinary level of skill ability to understand” such as inexperienced workers or female part-time workers was mentioned by no more than 20% of the enterprises studied, and “those with high levels of skill and the ability to understand” (34%) and “those with the ability to understand rather than high skill level” (23%) have been assigned to automated machinery in large numbers (see Chart 4).

Such characteristics coincide with those of the duties of automated machine operators.

(2) Qualitative changes of skills resulting from technological innovations

- Skills of operating automated machinery have generally become more and more sophisticated due to the combination of duties. Few people consider that the value of the skills possessed by skilled workers would become less due to technological innovations. –

**Chart 4 Skill Levels of Personnel Assigned to Automated Machinery
(Percentage Composition of Enterprises)**

	Those with high levels of skill	Those with the ability to understand rather than high skill levels	Those with high levels of skill and the ability to understand	Those with ordinary level of skills and ability to understand	N.A.
					(%)
Total	16.9	22.9	33.7	20.3	6.2
1,000 or more	19.7	18.8	41.0	17.9	2.5
100 ~ 999	14.2	23.7	35.1	21.3	5.6
30 ~ 99	18.2	23.5	30.8	19.0	7.7

Note: Of the personnel assigned to automated machinery, the ratio of responses given by enterprises as constituting the biggest percentage composition is indicated.

- 1 The range of skills exercised by a skilled worker using conventional machinery and equipment has been divided, as a result of automation, into such monotonous work as button-pressing operation and watching, and such intellectual work as planning, adjustment, foreseeing troubles, diagnosis, programming, etc.

When these two categories of work are performed by different persons, the simplification of the operator's skills makes further progress under the so-called process of polarization of skills to two extremes. However, when these two categories of work are compounded and assigned to one skilled worker, the operator's skill becomes sophisticated rather than simplified.

When we take a look at the division of duties in the establishments using NC machine tools, the general tendencies were towards sophistication. In many large enterprises in particular, skilled workers were requested to perform a wide range of duties. Compared with large enterprises, medium and small enterprises clearly tended towards assigning single-skill (Table 3, Chart 5).

The causes for such differences according to enterprise scale may partly be due to the kind of products made by the enterprise concerned, but basically be taken as a reflection of the differences, according to enterprise scale, in education and training designed to improve the quality of the employees.

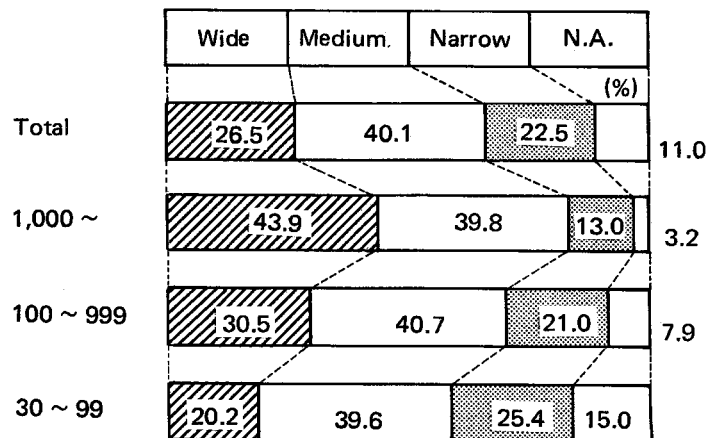
Table 3 Assignment of Duties Relating to NC Machine Tools by Occupation

(%)

	Starting, stopping, watching machinery	Measure- ment, inspection, recording	Program- ming	Prepara- tory arrange- ments, adjust- ment	Foreseeing troubles, diagnosing troubles	Simple repair	Major repair
All scales							
Skilled workers	87.7	63.4	43.4	72.3	26.5	34.5	2.6
Maintenance workers	2.4	4.8	2.0	4.4	16.2	21.0	6.8
Supervisors	7.5	14.4	18.8	18.6	24.9	17.7	2.9
Engineers	4.4	15.5	41.3	16.1	24.3	26.4	15.3
Farm out	0.3	1.2	4.2	1.0	18.7	15.7	72.3
1000 workers or more							
Skilled workers	96.2	83.2	56.4	84.2	42.8	49.0	3.8
Maintenance workers	5.4	10.0	6.2	14.2	47.7	49.7	36.9
Supervisors	14.7	18.7	9.8	16.4	19.5	18.8	7.4
Engineers	3.8	11.2	61.7	8.7	35.0	21.5	35.3
Farm out	1.8	1.1	4.0	1.7	14.7	7.0	63.7
100 ~ 999							
Skilled workers	91.2	68.8	44.3	76.1	31.4	36.8	3.5
Maintenance workers	1.5	3.7	1.7	4.7	14.4	24.7	6.9
Supervisors	9.5	11.2	18.6	19.5	22.0	16.5	2.2
Engineers	5.8	16.6	45.1	15.3	25.2	29.4	15.9
Farm out	0.2	1.8	5.2	0.9	15.5	15.9	75.8
30 ~ 99							
Skilled workers	83.2	55.2	40.1	67.2	19.5	29.5	1.5
Maintenance workers	2.4	4.3	1.4	2.1	10.5	12.0	—
Supervisors	4.5	15.7	20.7	18.2	28.1	18.3	2.3
Engineers	3.6	15.4	34.1	18.3	21.4	25.5	10.1
Farm out	—	0.9	3.5	0.9	21.9	17.5	71.8

Note: Ratio of responses to the number of enterprises having introduced N.C. machine tools.

**Chart 5 Range of N.C. Machine Tools Work performed by Skilled Workers
(Percentage Composition of Enterprises)**



- Note
- 1 Starting and stopping, watching machinery
 - 2 Measurement, inspection and recording
 - 3 Programming
 - 4 Preparatory arrangements, adjustment
 - 5 Foreseeing troubles, diagnosing troubles
 - 6 Minor repair
 - 7 Major repair

The term "wide" means the worker performs 5 or more of the above 7 items, the term "medium" covers 3 or 4 items and the term "narrow" covers 1 or 2 items.

- 2 An attempt was made to find out the distribution of skills used by skilled workers in the performance of jobs according to the 7 categories, which are (A) direct work where the quality of products and working speed are primarily controlled by machine, (B) direct work where the quality of products and working speed are determined by workers' skills, (C) work of watching, (D) information processing work, (E) repair and maintenance work, (F) work of instruction and supervision, (G) others.

According to the results obtained, the users of automated machinery had a low rate of (B) but high rates of (A), (C) and (D). For example, when a comparison is made between mechanics who are users of automated machinery and those who are non-users, (B) was 41% with the former and 63% with the latter, (A) was 53% against 46%, (C) was 14% against 2%, and (D) was 13% against 2% respectively. (Table 4)

Like this, the spread of automated machinery tends to increase the proportion of work of watching and information processing, although the subjective judgement of many of the skilled workers was "(B) Skill has the decisive role". This is a result of the fact that not a few operators of automated machinery are simultaneously operators of the conventional type of machinery, and that they consider, when making preparatory arrangements or foreseeing troubles or performing programming work, their skills acquired while operating the conventional type of machinery play a decisive role.

Table 4 Work Contents of Skilled Workers (Percentage Composition)

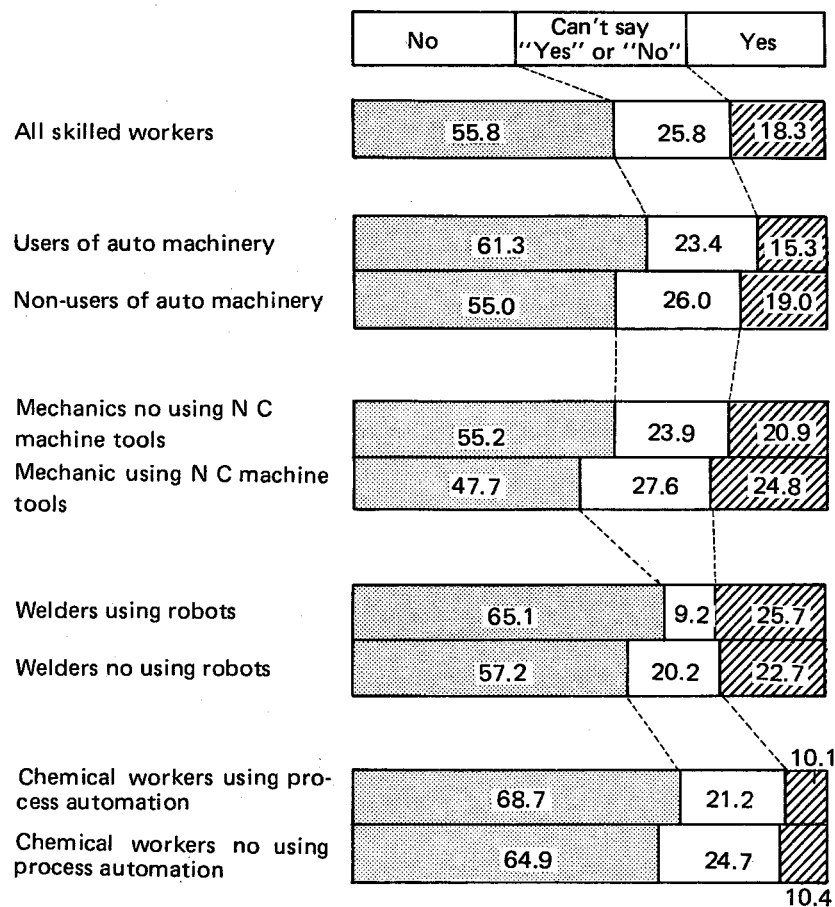
(%)

Item	Direct work		C Watching	D Information processing	E Repair and maintenance	F Instruction and supervision
	A Quality and speed are controlled by machine	B Quality and speed are determined by workers' skills				
Total	25.6	41.6	5.9	12.9	9.1	20.5
Mechanics using NC	52.8	40.9	14.4	13.3	5.3	26.0
Non-users	45.8	63.2	2.0	1.8	5.7	15.3
Welders using robots	28.6	45.5	6.3	8.1	2.4	39.3
Non-users	19.6	71.8	0.9	5.3	4.8	24.1
Electric machine assembler using auto-machine	26.6	28.5	8.9	15.1	12.8	49.4
Non-users	13.7	57.7	1.7	11.7	6.4	31.7
Chemical workers using process automation	31.5	13.5	53.3	25.9	5.6	22.2
Non-users	32.4	33.6	8.9	12.8	4.7	33.9

- 3 In response to the question "Do you think that the value of the skills possessed by skilled workers has gone down as a result of technological innovations?," 19% of the skilled workers said "Yes." A lower percentage of 15% was scored among the users of automated machinery (Chart 6).

The above result has been affected by such answers that, when the conventional skills become obsolete, "skilled workers can not perform work satisfactorily unless they learn new technologies positively" (69% of the skilled workers answered "Yes"), the conventional skills have a decisive role to play in making preparatory arrangements, maintenance and programming work, and an important role is played by the skills possessed by the skilled workers in improving the quality of products as will be mentioned later, and "the responsibility of skilled workers including one for the maintenance of machinery and equipment has become heavier" (64% of the users of automated machinery replied "Yes").

Chart 6 Reactions of Skilled Workers to the Question "Has Value of Skills Possessed by Skilled Workers Deteriorated?" Classified by Users of Non-users of Automated Machinery (Percentage Composition of Skilled Workers)



(3) Ability requirements which enterprises expect workers to possess and areas where skilled workers give full play to their skills

— Ability requirements which are now considered important are the knowledge of quality control, the ability to develop system-oriented thinking, the ME-related knowledge, hunch and knack. Skilled workers attach the greatest importance to quality improvement. —

- 1 Among the ability requirements which enterprises expect workers to possess and attach importance to during the past 10 years, "knowledge of quality control" ranked first. This was true regardless of the difference in enterprise scales and degree of automation introduced. In the background are the fact that the demand from the clients or parent companies for the technical precision of products has become more and more rigid, and small-group activities designed to realise quality improvement and greater efficiency have become strengthened.

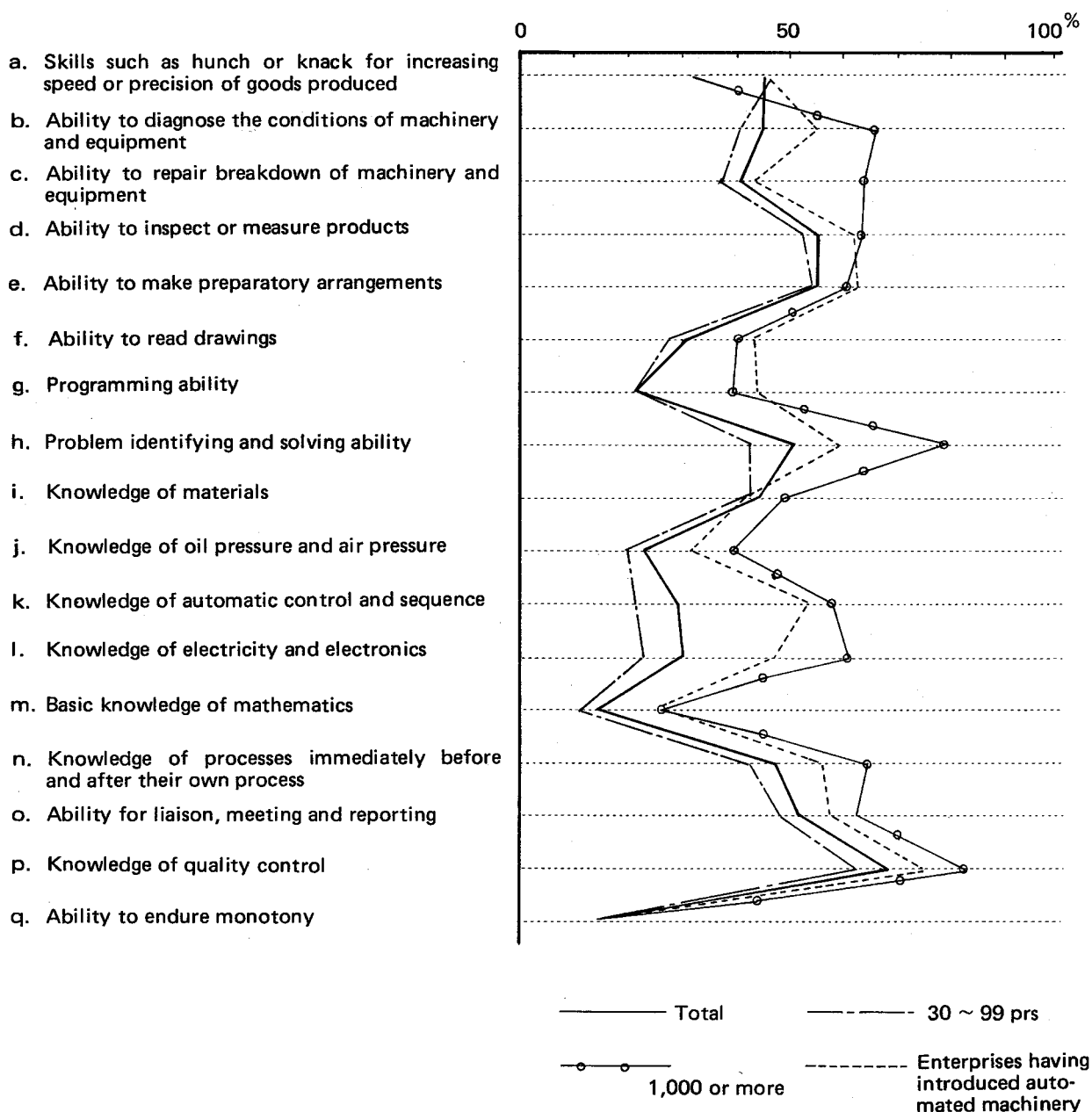
Other items referred to in large numbers in the replies were "problem-solving ability," "equipment diagnosing ability," "knowledge of pre- and post-processes." In other words, system-oriented thinking of detecting problems and finding solutions based on the full knowledge of whole equipment in use was required with a view to making the best use of the equipment installed.

In the branches where automation has already made progress, "programming ability," "knowledge of sequence control," "knowledge of electricity and electronics," and other ME-related knowledge were mentioned in large numbers.

Very few replies mentioned that the skills of hunch and knack which have been built up through experience have lowered in importance in the days of advanced automation.

"Ability to endure monotony" associated with the simple work of pressing the button on the automated machinery was mentioned by a mere 15% of the enterprises (Chart 7).

Chart 7 Knowledge and Skills Which Enterprises Expect Key Skilled Workers of to Possess (Percentage Composition of Enterprises Replying "Importance has Increased")



- 2 The question was asked of skilled workers that in which areas they were expected to give full play to their abilities. "To improve the technical precision and quality" despite the degree of automation was mentioned in the largest number of replies. This meant that the mere progress of machines did not automatically produce technical precision and quality but required the skill and brain of skilled workers. This was followed by "work faster," "suitable action when inferior quality products were found," "consider proposals for improvement," etc. Among employees of intermediate age group, "consider proposals for improvement" was found in large number (Table 5).

Table 5 Abilities required of Skilled Workers on the Job, classified by Users or Non-Users of Automated Machinery (Percentage Composition of Skilled Workers)

(%)

	Total	Mechanics	Welders	Chemical workers
		Users of NC Non-users	Users of robots Non-users	Users of process automation Non-users
a. To improve technical precision and quality of products	76	93 92	86 89	82 77
b. To pick up speed	51	62 69	42 64	14 34
c. To take appropriate action when trouble occurs	24	19 17	32 7	66 28
d. To take appropriate action when inferior quality products are found	41	26 32	55 34	45 43
e. To make an efficient programme	22	37 12	16 28	16 23
f. To consider proposals for improvement	40	48 49	53 43	53 51
g. To endure monotonous	10	6 10	7 11	3 11
h. Others	4	1 2	0 2	3 6

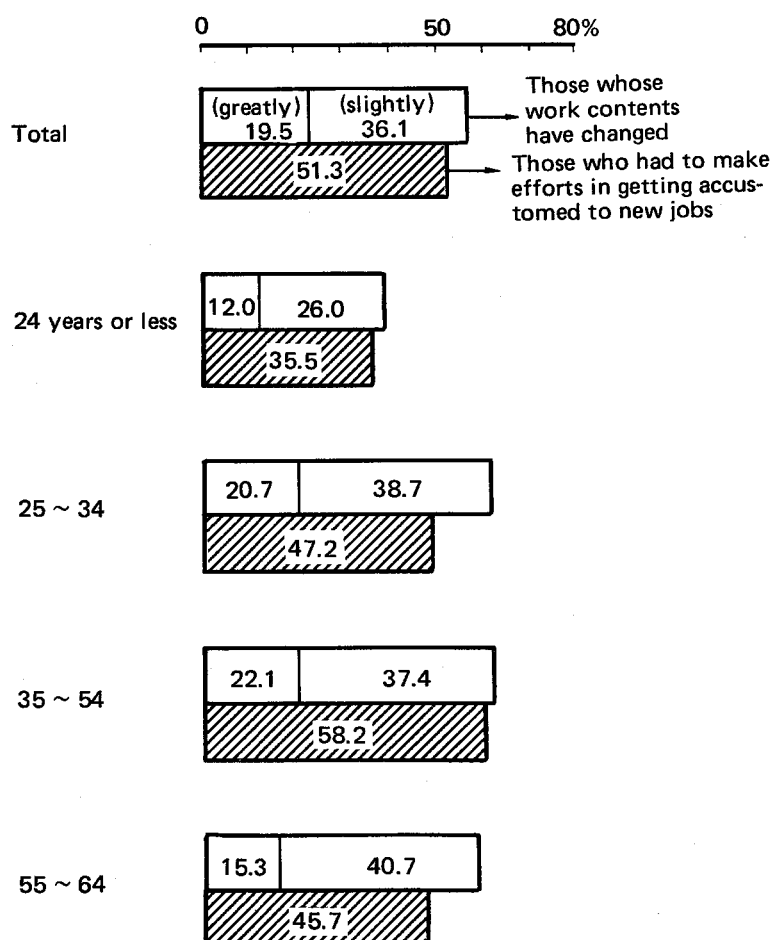
(4) Adaptability to changes

- Those skilled workers whose work contents have changed during the past 5 years occupied 56%, and many faced difficulties at the time of transfer to other jobs. Occupations in increasing demand are operators of automated machinery, programmers, maintenance and repair workers, etc. —

- Those whose work contents changed greatly during the past 5 years represented 20%, while those whose work contents changed slightly represented 36%. Main reasons for such changes were the need for adjusting personnel redundancy or shortage, the introduction of new equipment, changes in products or raw materials. Of those whose work contents changed, 51% mentioned that they had to make great efforts in getting accustomed to new jobs (Chart 8, Table 6).

Enterprises which saw the need for changing workers' jobs in the future made up 29%, while the figure was 40% in the case of large enterprises. Main jobs to which older persons may be transferred were, in the view of enterprises, "analogous jobs where their skills can be utilized" (28%, 41% in the case of large enterprises). In connection with such job transfer, it is expected that the demand for the adaptability to changes will become stronger in the future.

Chart 8 Skilled Workers Whose Work Contents have Changed During the Past 5 Years and had to Make Great Efforts in Getting Accustomed to New Jobs (Percentage Composition of Skilled Workers)



**Table 6 Principal Reasons which necessitated changes in Skilled Workers Work Contents
(Percentage Composition of Skilled Workers) M.A.**

(%)

	Introduc- tion of equip- ment	Changes in products and materials	Adjust- ment of personnel redundancy or shortage	Promotion	Education, job rotation	Transfer to other jobs
Total	24.8	14.8	25.5	8.7	8.4	9.7
(Ages)						
24 or less	12.4	8.1	19.6	2.4	10.9	10.4
25 ~ 34	25.3	16.3	26.4	9.8	8.4	12.3
35 ~ 54	28.5	16.6	26.2	10.7	8.1	8.1
55 ~ 64	29.2	11.5	31.5	2.5	4.6	6.8
(Scale)						
1,000 or more	34.3	18.8	25.9	13.1	12.9	6.3
100 ~ 999	22.0	13.2	29.2	8.5	7.2	8.8
30 ~ 99	18.8	12.9	19.6	4.5	4.6	15.1

- 2 15% of the enterprises replied that the percentage composition of skilled workers by occupations in their enterprises had changed during the past 5 ~ 6 years. Occupations whose ratio had increased were operators of automated machinery, programmers, maintenance and repair workers, all of which required a considerable period of learning on the part of skilled workers.
- 3 Education at the time of job transfer was mainly given in the form of on the job training after the transfer (28%), and few of medium and small-scale enterprises provided group training (Table 7).

**Table 7 Contents of Re-education provided to Older Skilled Workers
at the time of Job Transfer
(Percentage Composition of Enterprises) M.A.**

(%)

	Total	1,000 or more	100 ~ 999	30 ~ 99
Pre-transfer group training	25.5	41.2	26.0	22.1
Post-transfer group training	26.4	43.5	28.1	21.5
In the course of day-to-day work after the transfer	75.8	83.6	83.2	69.9
Transfer to job not requiring re-education	18.3	8.5	15.4	22.3
Others	10.0	3.4	11.8	10.1

4. Japanese System of Human Resources Development and Utilization

(1) Recruitment and training of prospective key skilled workers

- Enterprises prefer to recruit prospective key skilled workers from graduates of the industrial course of the upper secondary schools. The contents of training intended for key skilled workers vary greatly according to enterprise scale. —

- 1 As prospective key skilled workers who are to play a key role at the production site, the enterprises look most earnestly to graduates of the industrial course of the upper secondary schools. “Graduates of the industrial course of upper secondary schools” was mentioned by 48% of the enterprises (63% in the case of large enterprises), which far exceeded the percentage figures of 5 ~ 7% recorded with respect to graduates of the general course of the upper secondary schools, vocational courses of upper secondary schools other than the technical course and graduates of lower secondary schools. An analysis of skilled workers at work by educational background showed that as enterprise scale became larger the ratio of graduates of the industrial course also became larger (24% in the case of enterprises with 1,000 workers or more, 10% in the case of those with 30 ~ 99 workers).

The enterprises, which placed “graduates of the industrial course of the upper secondary schools” first, stated as the reasons “Time for teaching after recruitment can be saved as they have already received technical education” (59%), “They are suitable as blue-collar workers” (53%), and “prefer recruiting workers who have potentials as skilled workers” (47%). In the case of enterprises with 1,000 workers or more, “They are suitable as blue-collar workers” (59%), “The management prefer recruiting workers who have potentials as skilled workers” (55%), and “Those having received technical education” (49%). This meant that the enterprises paid attention to the aptitude or the potentiality or adaptability of new recruits rather than their immediate availability as skilled workers (Chart 9).

Meriting attention was the fact that graduates of the industrial course of the upper secondary school were engaged in such key jobs in the area of mechatronics as information-processing and repair-maintenance in larger numbers than graduates of other courses.

- 2 On the job training which took the form that leaders look after new recruits in the day-to-day work with a view to fostering them into cohort of key skilled workers was given in almost all enterprises. Enterprises which have clearly defined the training objectives including the knowledge and skills to be imparted represented 81% of those with 1,000 workers or more, 36% of those with 30 ~ 99 workers, while enterprises which provided basic training of a certain definite duration made up 75% and 28% respectively. Thus, the quality of training varied considerably according to enterprise scale (Chart 10).

Chart 9 Reasons for Recruiting Graduates of the Industrial Course of Upper Secondary School (Percentage Composition of Enterprises)

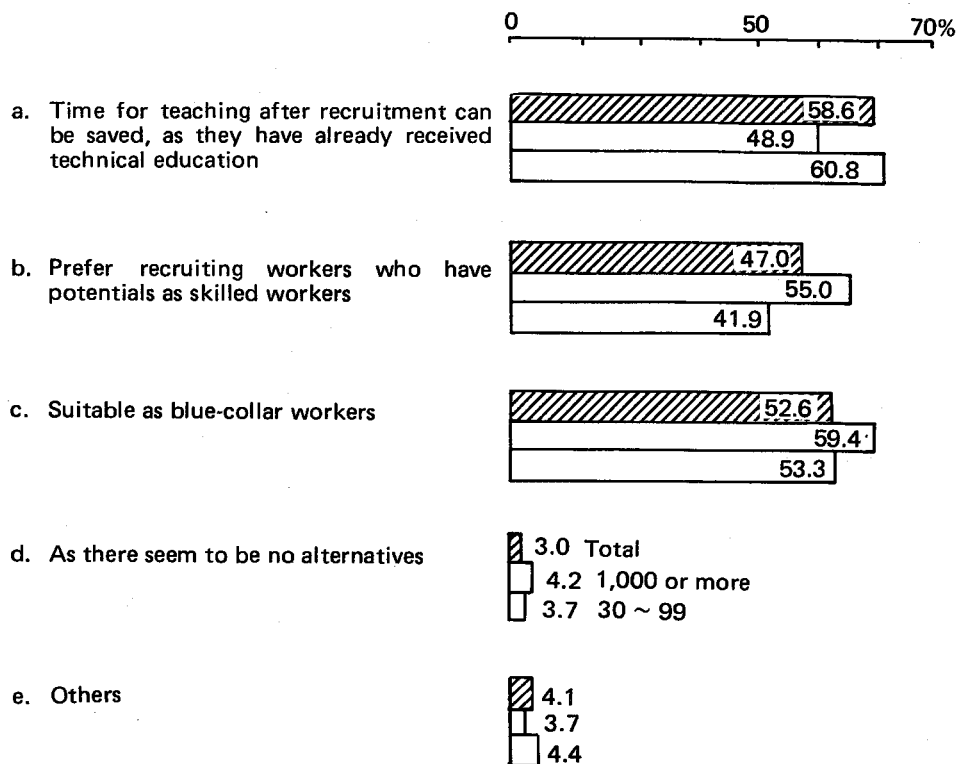
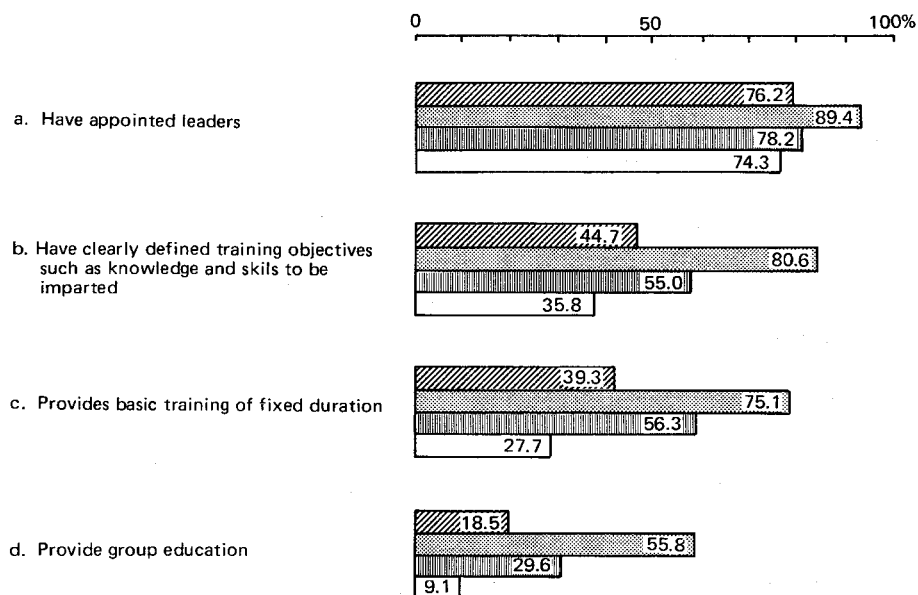


Chart 10 Methods of Education and Training New Recruits into Whort of Key Skilled Workers (Percentage Composition of Enterprises)



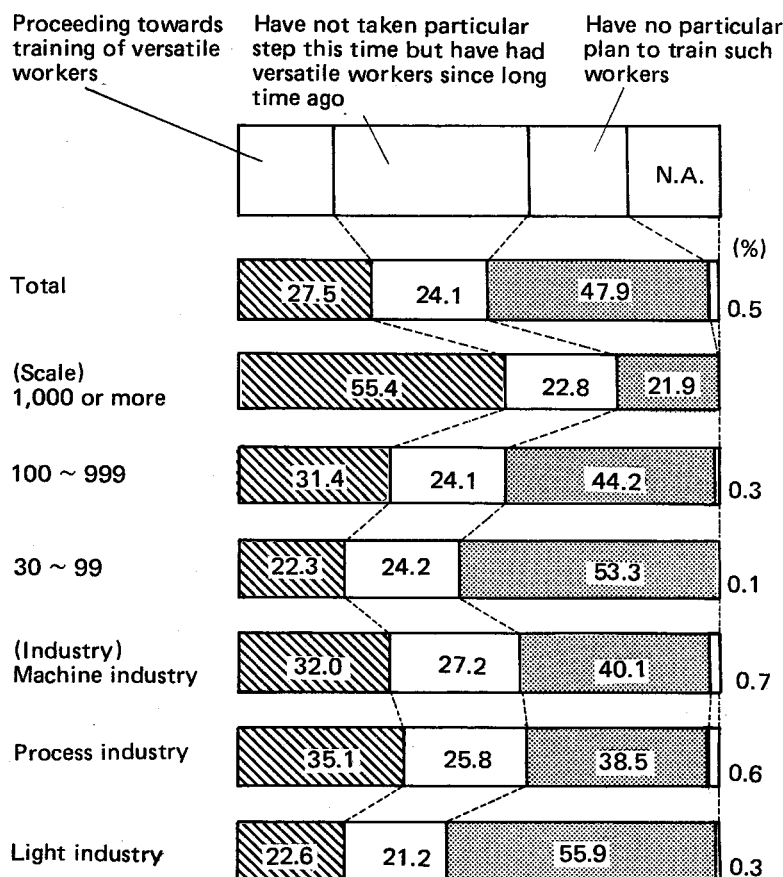
(2) Training of versatile workers

- The training of versatile workers has been more actively promoted by large enterprises. Many skilled workers also prefer to be trained as versatile workers. –

- 1 Enterprises which are “proceeding towards” combination or diversification of jobs to be shouldered by employees in the interest of fostering employees, rationalization, etc. occupied 28%, those “which have not taken particular step this time but have had versatile workers since long time ago” 24%, and those “which have no particular plan to train such workers” 48%. Enterprises which are “proceeding towards” combination or diversification of jobs represented 55% of those with 1,000 employees or more, 31% of those with 100 ~ 999 employees, and 22% of those with 30 ~ 99 employees (Chart 11).

Skilled workers who believe that they are versatile (or capable of operating several machines of different kind or performing a few different jobs) made up 44% of those employed by large enterprises, but less than 30% of those employed by medium and small enterprises.

Chart 11 Proportion of Enterprises Proceeding Towards Training of Versatile Workers



- 2 Principal types of skilled workers aimed at are those “capable of performing processes immediately before and after their own process” (40%), and those “capable of operating several machines of different kind” (36%). 16% was made up of those “who will be assigned to different jobs when young, with a view to assigning them to a most suitable one when they become older” (Table 8).

Table 8 Range of Work performed by Versatile Workers (Percentage Composition of Enterprises)

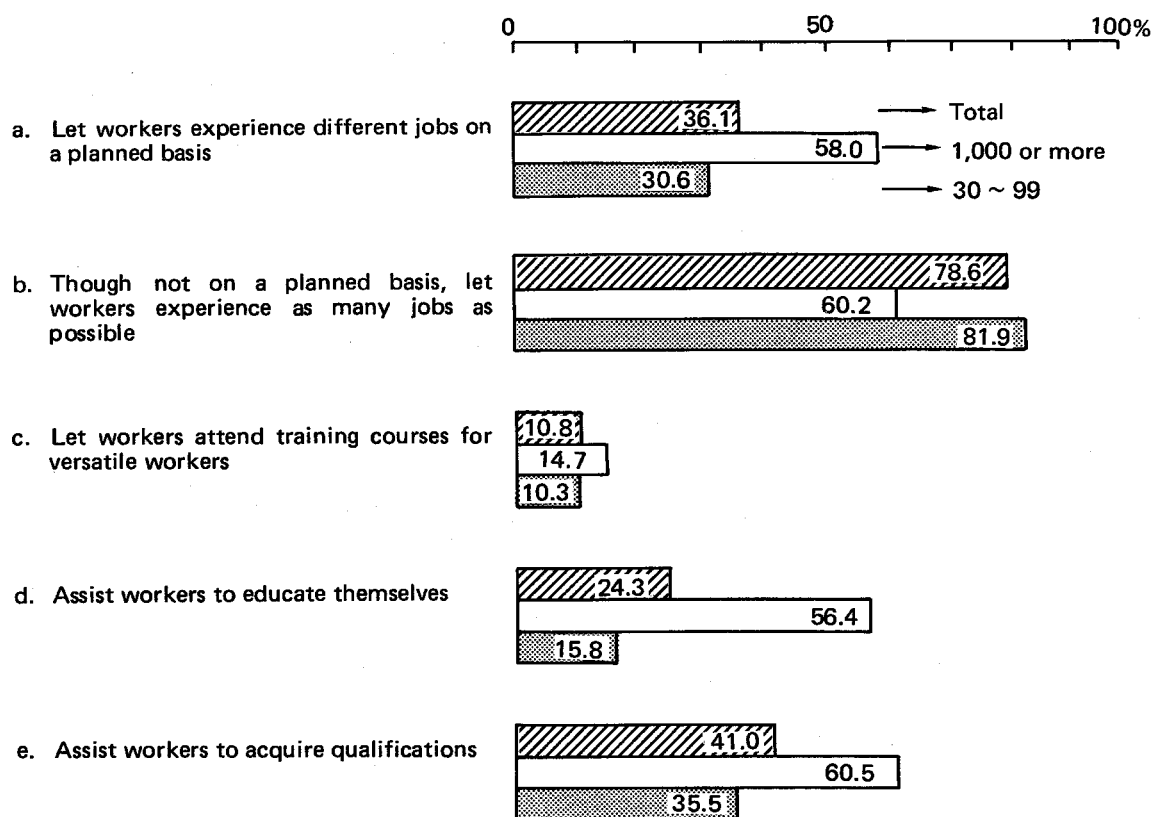
(%)

	Total	Scale			Industry		
		1,000 or more	100 ~ 999	30 ~ 99	Machine industry	Process industry	Light industry
a. One worker performs several processes	40.2	67.1	44.3	35.3	45.1	48.3	34.9
b. Machinery and electrical or electronics alternately	7.8	20.8	9.5	5.4	10.7	11.0	5.0
c. Operator performs part of repair and maintenance	14.7	39.3	19.4	9.6	14.8	25.7	12.7
d. One worker operates several machines of different kinds	35.6	53.6	41.1	31.5	42.2	39.3	29.7
e. Skills necessary for repair, installation at places visited on mission	6.6	8.6	7.9	5.9	13.2	2.9	2.0
f. When young, performs various jobs as measure for older ages	16.3	20.4	15.4	16.4	20.1	13.8	13.7
g. Others	0.3	0.9	0.5	0.2	0.3	1.6	0.1

- 3 The main objectives of the attempt at training versatile workers were “productivity improvement and a few but quality workforce” (89%), “fostering talented people” (58%), “increasing job satisfaction” (56%), and “increasing workers” adaptability to technological innovations” (54%).

The principal methods used were “though not on a planned basis, let workers experience as many jobs as possible” or transfer to similar jobs or job rotation were mentioned in large numbers. In the case of large enterprises, 58% replied “they let workers experience different jobs on a planned basis.” Equally important were “assist workers to acquire qualifications,” “assist workers to educate themselves” (Chart 12).

Chart 12 Principal Methods used for Training of Versatile Workers



- 4 The attitudes of skilled workers towards “training of versatile workers” included “positive action should be taken” (40%), “rather advisable to take action to this end” (29%); namely about 70% were in favour of such approach.

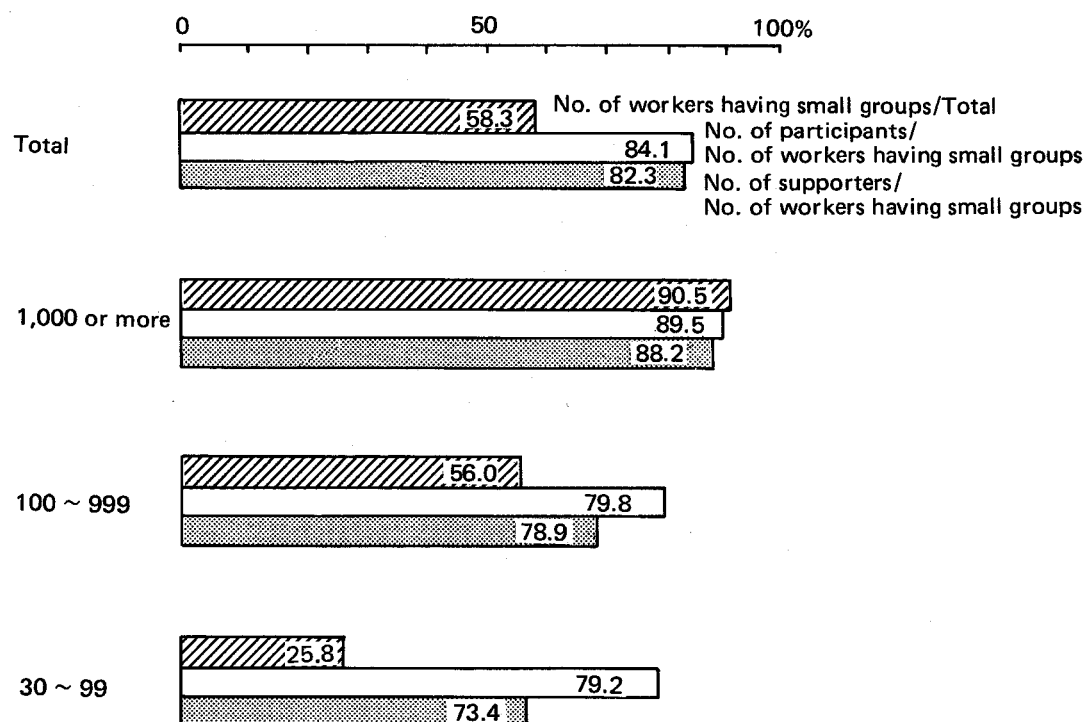
The reasons given by them were “increasing workers’ own capacities” (65%) and “increasing job satisfaction” (51%).

(3) Small group activities

- Small group activities became popular in large enterprises. Majority of skilled workers support such activities because such activities are conducive to ability development, self-realization and self-control. A few, however, are opposed to formalism. —

- 1 “There are voluntary small groups called QC circles or ZD circles at the workplaces” was the reply given by 91% of skilled workers of large enterprises, 56% of those of medium enterprises and 26% of those of small enterprises (Chart 13).

**Chart 13 Workers who have QC or ZD-oriented Small Groups at their Workplaces,
Numbers of Participants and Supporters**



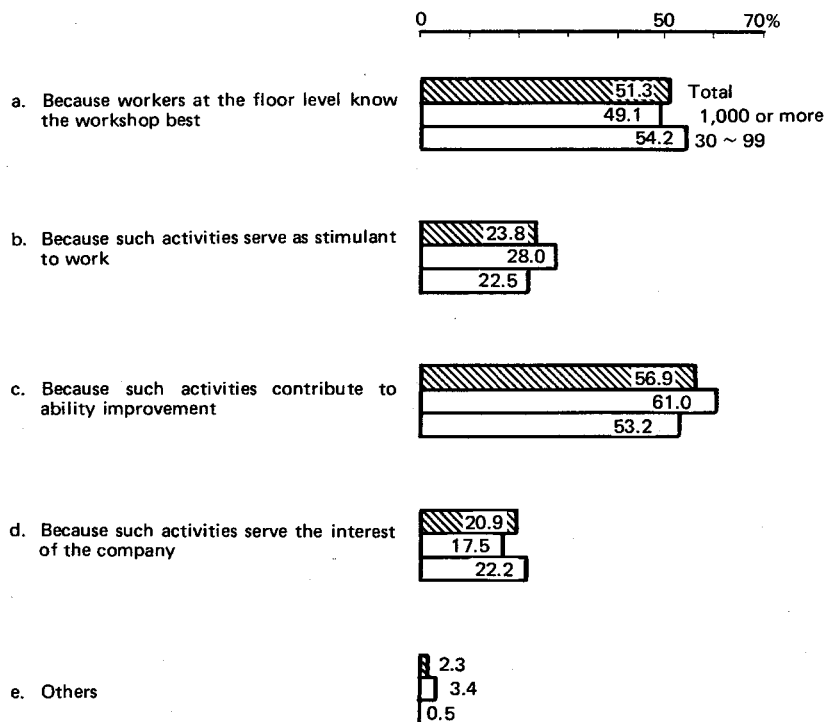
- 2 84% of those skilled workers who replied that there were small groups joined those small groups; and 82% of them (69% of all skilled workers) expressed their support to the activities of the these small groups.

The reasons given included "they contribute to ability improvement" and "because workers at the floor level know the workshop best" (Chart 14).

Small group activities mean those activities in which all members of a small group takes up, as its theme, "how to eliminate the causes for inferior quality goods" when such goods have been found, and discuss problems involved and consider proposals for improvement. Through such activities, skilled workers learn "how to solve problems," polish the ability to express their views through discussion, actually feel that their potentials are developing, increase job satisfaction by solving by themselves problems arising at their own workshop, the degree of their participation in small groups is reflected upon the company's formal appraisal of their performance; these are the factors that support small group activities.

- 3 Principal reasons given by those who take a negative stance towards small group activities were "shorter free time," and "such activities are the responsibility of managerial staff and engineers." Other views voluntarily given were "company's reaction to employees' suggestions for improvement is too slow and dull" or "autonomy is lacking in such activities."

Chart 14 Reasons of Supporting Small Group Activities
(Percentage Composition of Skilled Workers) D.A.



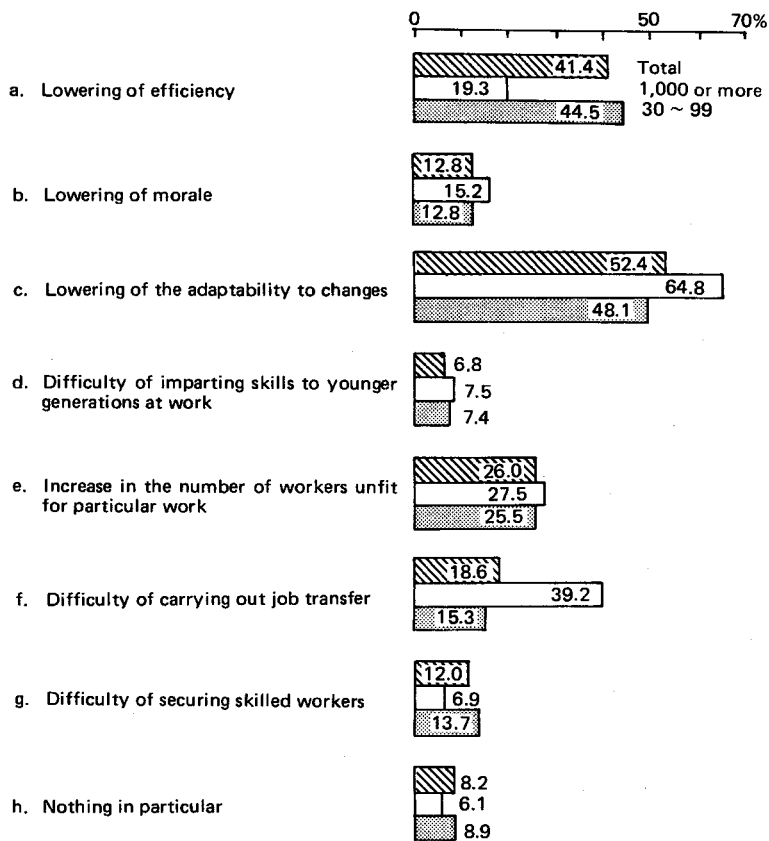
(4) Utilization of older workers

— As the workforce ages, many enterprises fear a lowering of the adaptability of workers at the production sites. Among older skilled workers, an increasing number have the fear that they might be left behind new technologies. Thus, the importance of education and training to cope with such situation is growing. —

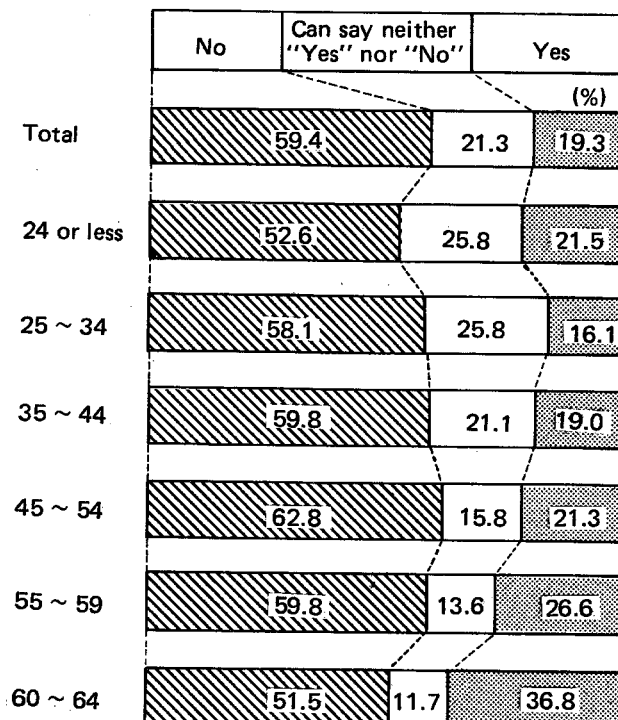
- 1 As a problem which is likely to occur at the production sites as the workforce ages and which is in the center of their concern is “lowering of the adaptability to changes (learning new technologies for example)” was mentioned in the largest number, followed by “lowering of efficiency” and “increase in the number of workers unfit for particular works.” (Chart 15)
- 2 Among skilled workers, only 19% thought that “important portion of the process has become handled by young workers, and older persons have been transferred to the subsidiary branches,” and the majority took the opposite stance. The percentage of skilled workers in the former category rose to 27% in the 55 ~ 59 age-bracket, and 37% in the 60 ~ 64 age-bracket (Chart 16).

Moreover, in response to the question “Do you think an increasing number of older workers have the fear that they may be left behind new technologies?,” one every three persons aged 35 or more said “Yes.”

**Chart 15 Problems Arising at the Production Sites as Skilled Workers Grow Older
(Percentage Composition of Enterprises) M.A.**



**Chart 16 Reaction of Skilled Workers to the Question "Important Portion of the Process has become handled by Young Workers, and Older Persons have been Transferred to Subsidiary Branches?" Classified by Age
(Percentage Composition of Skilled Workers)**

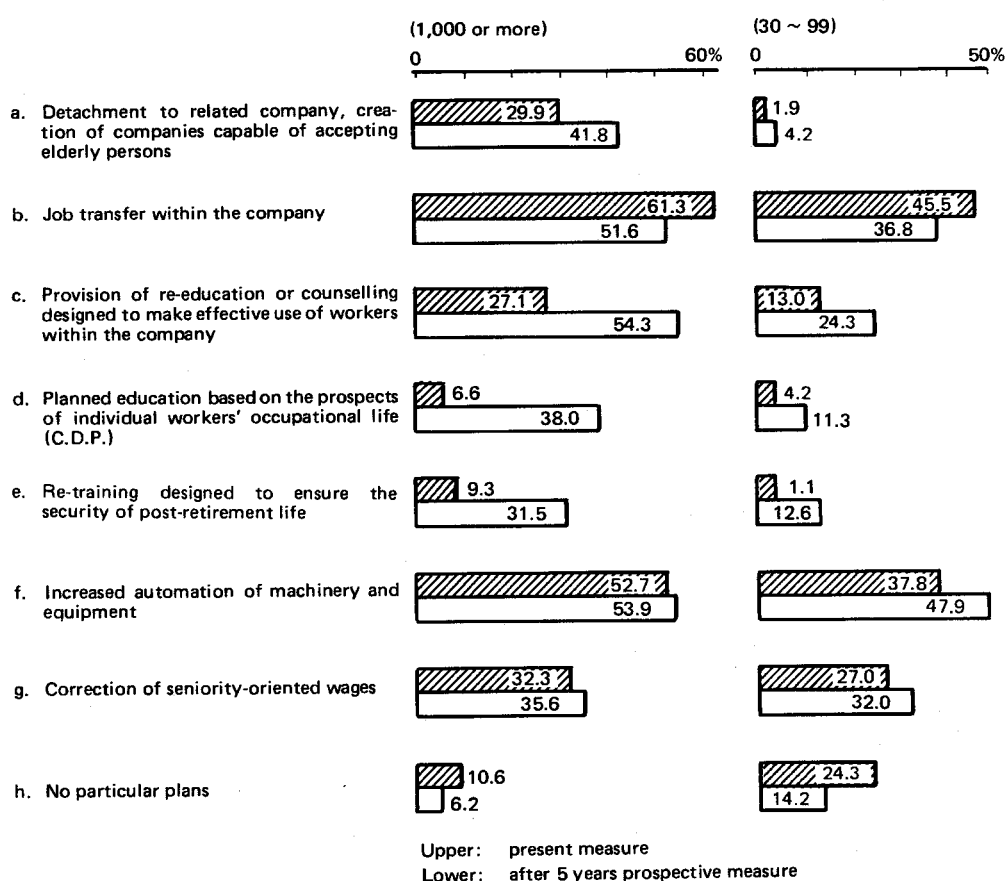


- 3 Major actions currently taken to overcome such difficulties included "job transfer within the company," "introduction of automated machinery," "correction of seniority-oriented wages," "detachment or creation of companies capable of accepting elderly persons," etc. in large enterprises. In small enterprises also, "job transfer within the company" and "introduction of automated machinery" were mentioned in large numbers (Chart 17).

Measures currently taken were "transfer workers to workshops which are capable of accepting older persons" or "correction of seniority-oriented wages", which were rather backward-looking ones based on the assumption that the ability of older persons would deteriorate.

As future measures, an increasing number of enterprises mentioned "re-education and counselling designed to make effective use of such persons within the company," "planned education based on the prospects of their occupational life," "re-education designed to ensure the security of post-retirement life."

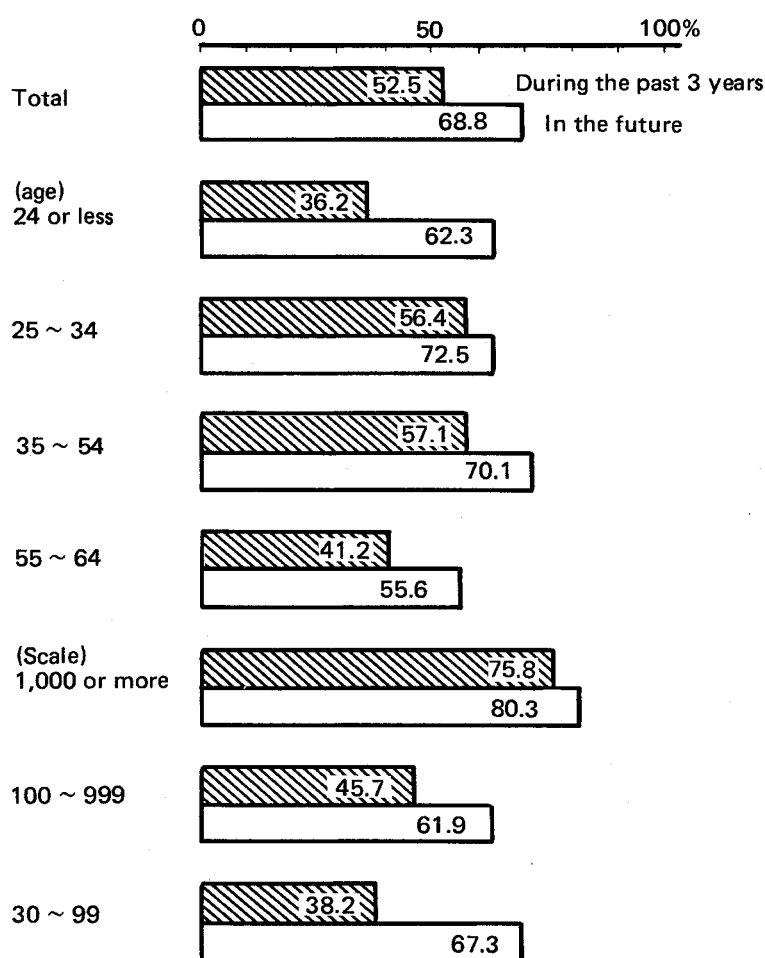
Chart 17 Measures to Cope with Ageing Skilled Workers
(Percentage Composition of Enterprises) M.A.



- 4 Skilled workers who received education or training or underwent self-instruction during the past 3 years in order to improve their occupational abilities represented 53%; and a high percentage was recorded among older persons. In large enterprises, the corresponding figure was 76%, while it was as low as around 40% in small enterprises.

Those who wanted to pursue studies in the future amounted to 60 ~ 80%, regardless of enterprise scales; 70% of skilled workers aged under mid-fifties wanted to study in the future (Chart 18).

**Chart 18 Proportion of Workers who received Education or Studied by themselves during the Past 3 Years or want to Pursue Studies in the Future in Order to Improve their Occupational Abilities
(Percentage Composition of Skilled Workers)**



5. Implications of the Study Results

(1) High adaptability at the production sites and supporting factors

- Versatile-skill-oriented training of skilled workers is the fountainhead for the high adaptability. Supporting factor is the expectation for skill improvement through work based on the premise of life-time employment. —
- 1 In the course of the progress of technological innovations centered on micro-electronics, it seems that large enterprises are marching on the road to skill combination or sophistication rather than simplification. As factors involved, it may be said that technological innovation itself requires greater sophistication of skills, and that the policy for job formation of the Japanese enterprises is to enlarge as much as possible the range of jobs to be done by one skilled worker. This is supported by the below-mentioned findings of this study.
 - (i) When an automated machinery is introduced, such works as making preparatory arrangements, programming and trouble foreseeing will increase. Then, the operator is to be required to perform such information processing works in parallel with the press-the-button work. Mechanics and assemblers will study electronics as necessary and build up the ability to operate effectively new equipment.
 - (ii) As is mentioned in the section entitled "Training of versatile workers," a skilled worker in a Japanese enterprise performs work on his own process as well as those on the processes immediately before and after his own process, or handle several machines of different kind. During the past 5 ~ 6 years, nearly 60% of the skilled workers have had their work contents changed. Many skilled workers are taking pains in getting accustomed to new jobs, but this helps to enlarge the range of their skills.
 - (iii) As was seen in the section entitled "Small Group Activities," skilled workers not only perform work according to work instruction sheets but also actively take part in small group activities for quality and efficiency improvement as a place for developing their abilities.
- 2 The fact that skilled workers in Japanese enterprises perform a wide range of jobs and show surprisingly high adaptability to changes may be due to the fact that skilled workers' potentials have been developed and they are well-motivated. The underlying factors include (i) the existence of many employees who have the sense of belonging to the community bound together by common fate, and indentify their own interest with that of their company in the Japanese society where the life-time employment is the rule, (ii) the maintenance of competitiveness among employees at a high level in the community of equality and uniformity, (iii) the ensuring of the improvement of a wide range of skills and the growth as a human being through work.

In other words, by performing more difficult jobs or a wider range of jobs, skilled workers may realise their own growth as human beings, while the enterprise may enjoy the fruits of productivity improvement resulting therefrom.

At the background of the successful functioning of the method of fostering skilled workers that aims at realising skill maturity through work are such favourable environmental factors as the availability for workers of ample opportunities for promotion under the favourable conditions of fast economic growth, and the high proportion of young workers with high adaptability.

- 3 However, it is not easily predictable whether or not this Japanese system of human resources development continue to function in the future as well, because it seems that, in the midst of aging workforce and progressing technological innovations, factors tending to weaken the high adaptability at the workshop are looming. The following three factors have been identified by the present study. It may be necessary to continue undertaking a study of the impact of such factors and action to alleviate such impact.

(2) Limits of the adaptability

- If technological innovations lead to the polarization of skills, mal-adaptation of older persons, and difficulty of securing potential key skilled workers, it might also bring about a lowering of the adaptability at the workshop. —
- 1 Large enterprises take action to train skilled workers from a long range viewpoint on the premise of lifetime employment, and increase the adaptability to changes, while medium and small enterprises are with little or no room for giving education and training to their employees and trend to rely on low-cost labour. Thus, there exists a large gap between these two groups. This is supported by the existence of a wide gap between the two groups of enterprises in the ratio of versatile workers to the total skilled workforce. The progress of automation might widen this gap by increasing the dependency of medium and small enterprises on simple labour. If the polarization of skills to two extremes makes progress in medium and small enterprises, it is considered that their adaptability to changes may deteriorate.
 - 2 Under conditions of advancing technological innovations and aging workforce, an increasing number of older persons feel “when reaching older ages, they are transferred to subsidiary branches.” One every three older workers replied, “an increasing number of older workers feel uneasy because some of them might be left behind new technologies.”

At this point in time, the proportion of skilled workers who feel, "they play an important role in the interest of their company" and "they are giving full play to their skills while at work" become larger in parallel with advancing ages. It seems therefore that skilled workers expectations for seniority-oriented role sharing have a significant role to play in motivating workers towards work. If, however, the above-mentioned uneasiness felt by older workers comes true and an increasing number of older workers are left behind technological innovations, the result would be more than just giving adverse effect upon motivation towards work and a lowering of morale in the older age bracket.

- 3 The core workforce which takes the lead in maintaining a high adaptability at the production sites in the face of rapid progress of technological innovations is made up of excellent graduates of lower and upper secondary schools who were employed by industry at a time when the rate of enrolment in upper secondary schools was not so high. The present study has found that many enterprises highly valued workers who were graduates of the industrial course of the upper secondary school.

If in the society, where the educational career is highly valued, the tendency towards general education which is linked to higher education becomes stronger and the status of vocational education continues to decline in the future, the task of securing potential skilled workers of high quality who are needed for carrying forward the high adaptability at the production sites to the up-coming generations may become very difficult.