

A Study of Factory Automation in the Korean Manufacturing Industry

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ABSTRACT

Uncompetitive companies can not survive in the domestic or international markets with the settlement of the Uruguay Round and the new world economic order bringing about cutthroat global economic competition.

Korean manufacturing companies have continuously invested lots of money for R & D and automation to overcome those difficulties in such a competitive domestic and international economic environment.

This article is to describe how and why Korean manufacturing companies have automated their factories, and what kind of problems are encountered in the process of automating, etc.

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INTRODUCTION

The term automation is familiar to us, but we find it difficult to know a commonly agreed upon definition of automation. Automation is viewed as a totally new set of concepts that relate to the automatic operation of a production process or as simply an evolutionary development in technology in which machinery performs some or all of the processcontrol function. Automation is a technology concerned with the application of mechanical, electronic, and computer - based systems to operate and control production. This technology includes :

- Machining centers
- Numerically controlled machines
- Computer aided design and manufacturing systems
- Flexible manufacturing systems
- Computer integrated manufacturing
- Automatic machine tools to process parts
- Automatic assembly machines
- Industrial robots
- Automatic material handling and storage systems
- Automatic inspection systems for quality control
- Feedback control and computer process control
- Computer systems for planning, data collection, and decision making to support manufacturing activities.

Companies implement automation for a variety of good reasons. Some of the important reasons for automating include the following :

1. Increased productivity. Automation of manufacturing operations holds the promise of increasing the productivity of labor.
2. High cost of labor. Because machines can produce at higher rates of output, the use of automation results in a lower cost per unit of product.
3. Labor shortages. In many advanced nations there has has been a general shortage of labor. Labor shortages also stimulate the development of automation as a substitute for labor.
4. Trend of labor toward the service sector. There has been a tendency for people

to view factory work as dangerous, difficult, and dirty. This view has caused them to seek employment in the service sector of the economy.

5. Safety. By automating the operation and transferring the operator from an active participation to a supervisory role, work is made safer.
6. High cost of raw materials. The high cost of raw materials in manufacturing results in the need for greater efficiency in using these materials. The reduction of scrap is one of the benefits of automation.
7. Improved product quality. Automated operations not only produce parts at faster rates than do their manual counterparts, but they produce parts with greater consistency and conformity to quality specifications.
8. Reduced manufacturing lead time. This gives the manufacturer a competitive advantage in promoting good customer service.
9. Reduction of in-process inventory. It is to the manufacturer's advantage to reduce work-in-process to a minimum. Automation tends to accomplish this goal by reducing the time a workpart spends in the factory.
10. High cost of not automating. A significant competitive advantage is gained by automating a manufacturing plant. The benefits of automation often show up in intangible and unexpected ways, such as improved quality, higher sales, better labor relations, and better company image. Companies that do not automate are likely to find themselves at a competitive disadvantage with their customers, their employees, and the general public.

There are some pros and cons of automation.

The arguments against automation are as follows :

1. Automation will result in the subjugation of the human being by a machine.
2. There will be a reduction in the labor force, with resulting unemployment.
3. Automation will reduce purchasing power.

The arguments for automation include the following :

1. Automation is the key to the shorter workweek.
2. Automation bring safer working conditions for the worker.
3. Automated production results in lower prices and better products.
4. The growth of the automation industry will itself provide employment oppertunities.
5. Automation is the only means of increasing our standard of living.

We assume that there are six stages for the implementation of automation.

- 1st stage : manual production method
- 2nd stage : mechanization of the manual production method
- 3rd stage : partly automation of the existing facility and single machine
- 4th stage : complete automation of single machine NC machine tool.
 - automated assembly machine
 - automated welding machine
 - automated packaging machine
- 5th stage : automation of production line
 - automation of processing line using NC (machining center)
 - FMC (Flexible Manufacturing Cell)
 - Automation of assembly line
 - Automation welding, assembling, and painting line using robot
 - Automated guided vehicle systems.
 - Automated Storage System
 - CAD/CAM System
- 6th stage : Automation of whole factory
 - FMS (Flexible Manufacturing System)
 - Automated Storage System (using computer)
 - Production system using computer

Research Methodology

We randomly selected about 2000 companies among 12,000 companies Korean Productivity Center's Data Base. Every company employed at least more than 50 persons. We sent the mail questionnaire to the 2000 companies, however 229 companies responded. In some cases, we visited the factories by ourselves.

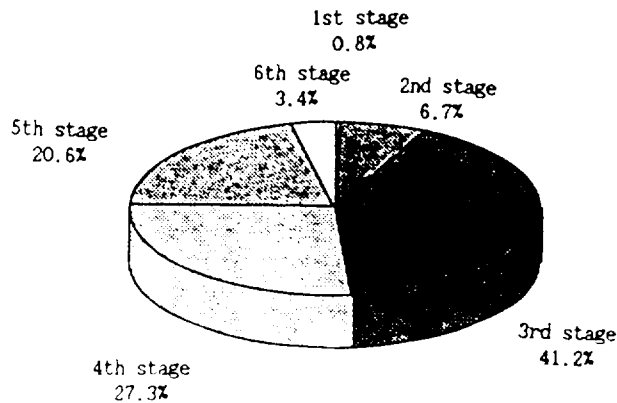
We classified the company whose employees are more than 50 and less than 300 as a small and medium size company, and more than 300 as a large company.

Results of Research

The present stages for the implementation of automation.

As we can see in the Figure 1, 7.5% of all the respondents belong to the 1st. and 2nd stage (manual production method and mechanization of the manual production method). Most of the responded companies still belong to the 3rd stage (partly automation of the existing equipment) and 4th stage (complete automation of a single equipment). 20.6% of the respondents belong to the 5th stage (automation of production line) and 3.4% of the respondents belong to 6th stage (automation of whole factory like CIM).

<Figure 1> Stages of automation of domestic manufacturing Companies



Automation stages by industry is shown in Table 1.

<Table 1> Scores for the automation stage by industry

Industry	Light industry	Chemical industry	Heavy industry	Electronical industry
Score	3.89	3.35	3.25	3.51

1. Sig = 0.0131

2. Scores for the automation stage : the average of 1~6 scores

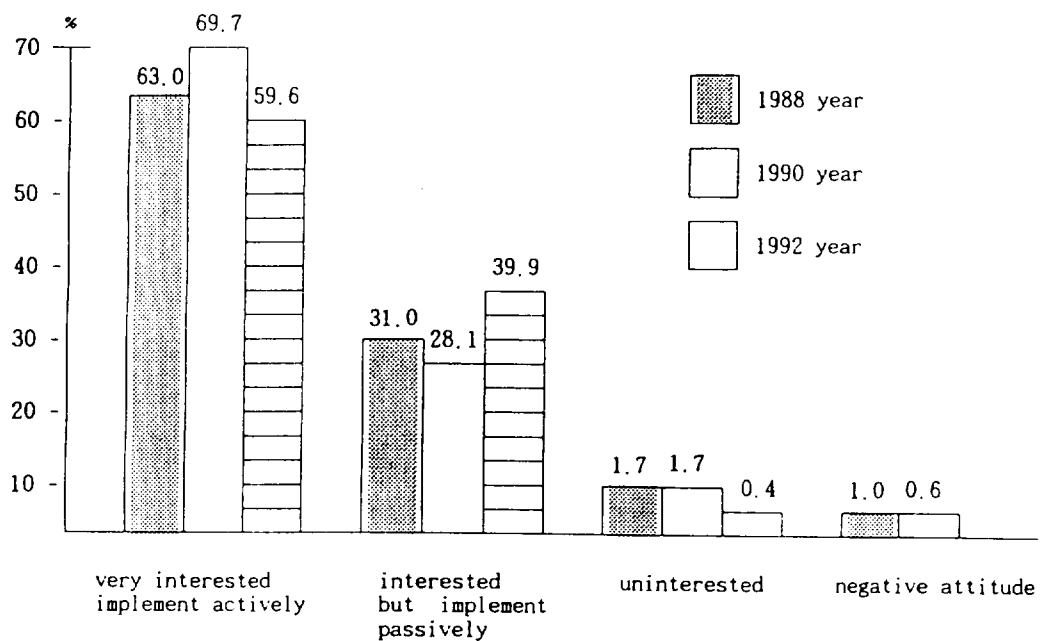
As shown in the table 1, the level of automation of the light industry like food, textile, shoes, paper mill and the like is relatively the highest. And the lowest level is the electrical industry.

Top management's attitude toward automation.

There is risk for the automation because high investment is needed. Therefore, top management should be much interested in the automation in order to implement the automation successfully. Small and medium size company's top management understanding is especially more important than the large size company, because they do not have enough money and qualified manpower for the implementation of automation.

59.6% of the responded companies are 'very interested and actively' implement, 39.9% were 'interested but implement passively' and 0.4% were 'uninterested'.

<Figure 2> Top management's attitude toward automation



Top management's eagerness which belonged to the higher automation stage is greater than the top management's eagerness belonging to the lower automation stages. (Table 2)

<Table 2> Top management's attitude toward automation by automation stage

	3rd stage	4rd stage	5rd stage	6rd stage
very interested and implement actively	51.0%	54.2%	78.3%	87.5%
interested but implement passively	48.1%	44.2%	21.7%	12.5%
uninterested	1.0%	-	-	-
Total	100.0%	100.0%	100.0%	100.0%

Understanding of factory automation

Top management and middle management know relatively better than shop floor worker about factory automation (Table 3). Therefore, shop floor worker should be educated intensively about factory automation.

<Table 3> Level of understanding of the factory automation

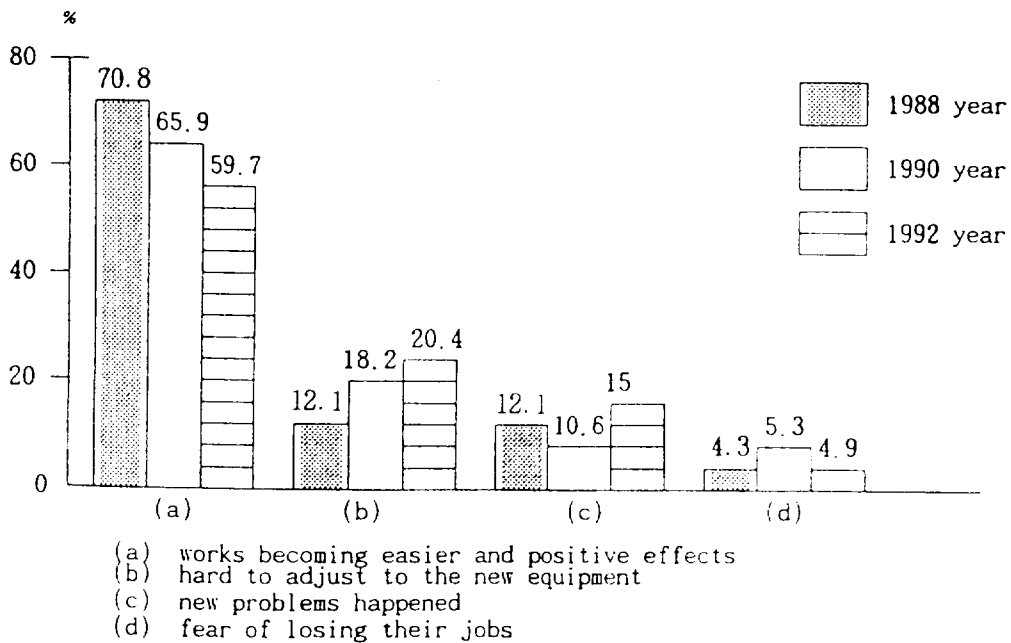
	know very well	know more or less	know uncorrectly	almost do not know
Top management	22.4%	9.9%	0.1%	-
middle "	18.9%	14.0%	0.4%	0.1%
shop floor worker	4.0%	21.6%	4.6%	3.1%
total	45.3%	46.4%	5.1%	3.2%

Employee's reaction to the automation

Figure 3 shows the employee's reaction to the introduction of automation equipment. 57.5% of the responded companies answered that their works were done easier and that they had a positive effect after the introduction of the automated equipment. 20.40% answered that they found it difficult to adjust to the new equipment and 15.0% answered that they encountered new problems.

The employees of large companies felt fear of losing their jobs much more than the employees of the small and medium size companies because of the introduction of the new automated equipment.

<Figure 3> Employee's reaction to the introduction of automation equipment



Motivation for factory automation

Why were Korean manufacturing companies eager to automate their factories? 90% of the respondents regarded capacity enlargement as the most important factor, 79.5% quality improvement, 79.3% work force reduction, 76.9% work environment improvement (Table 4).

<Table 4> Motivation for factory automation

	very unimportant	unimportant	so so	important	very important
Overcoming the lack of manpower	4.7	5.3	24.9	37.3	27.8
Work force reduction	0.6	4.1	16.0	45.6	33.7
Quality improvement	0.6	1.2	18.8	42.4	37.1
Capacity enlargement	-	0.6	9.4	42.9	47.1
Work environment improvement	0.6	1.2	21.3	41.4	35.5
Labour hour reduction	1.8	12.6	40.1	31.7	13.8
Image improvement	0.6	6.0	28.0	40.5	25.0

The degree of importance of factors required for the promotion of automation.

In order to implement automation effectively in the future, most important factor is 'Supplying sufficient capital'(important or very important: 65.9%) and next ones are 'Cultivating specialized work force'(63.4%) and 'establishing many supporting institutions' (58.2%).

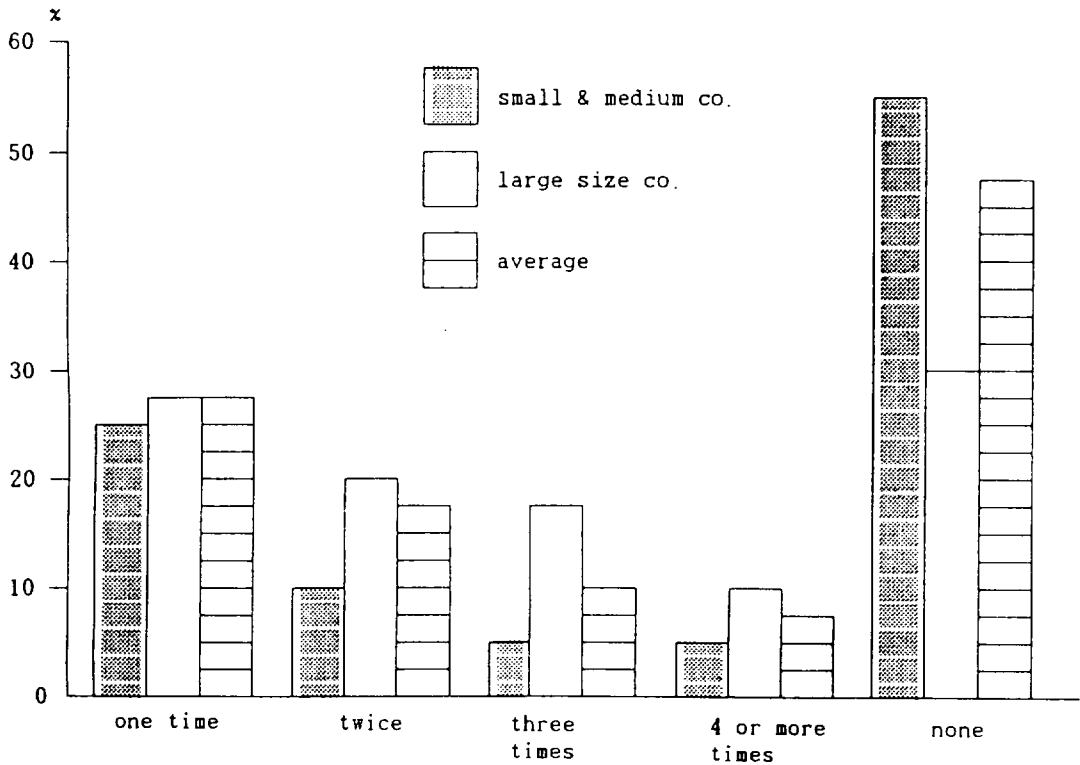
<Table 5> The degree of importance of factors required for the promotion of automation

	very unimportant	unimportant	so so	important	very important
Cultivating specialized work force	7.0	14.5	15.1	28.5	34.9
Establishing standard automated factory	4.7	21.2	38.8	22.4	12.9
Establishing many supporting institution	4.1	18.0	19.8	32.0	26.2
Supplying sufficient capita	7.6	12.4	14.1	25.3	40.6
Employee's good understanding	2.4	14.7	27.6	40.6	14.7

Failure in the operation of automation

42.7% of the respondents did not fail at all in the operation of the newly introduced automation equipment. 26.1% failed one time, 14.2% failed twice, 9.0% failed three times, and 8.1% failed 4 or more times (Figure 4).

<Figure 4 > Distribution of companies' failure in the operation of automation equipment



The effects by automation

The heavy and chemical industry's improvement rate of productivity is relatively higher than the other industries. However, the improvement rate of productivity of small and medium size companies is greater than the large size companies. On the other hand, there is little differences in the reduction rate of the defectives by industries and sales scale, but the reduction rate of the defectives of small and medium size industries is relatively higher than the large size industries (Table 6)

<Table 6> Automation's effects by industry, sizes of industry and sales

		improvement rate of pr- oductivity	reduction rate of defectives	reduction rate of manufactur- ing lead time
I n d u s t r y	light	41.8%	23.7%	40.0%
	chemical	76.8%	19.1%	30.9%
	heavy	64.1%	27.5%	36.5%
	electrical			
	electronical	42.0%	29.8%	36.8%
S i z e	small and medium	59.7%	50.6%	37.2%
	large	44.4%	19.1%	34.1%
S a l e s	less than \$12.5M	69.0%	33.6%	41.1%
	\$12.5M~125M	38.7%	22.0%	27.3%
S c a l e	more than \$125M	55.0%	19.7%	42.5%

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