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Smart Factory Activation Plan through Analysis of Smart Factory Promotion Status and Introduction Plan Data

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Abstract

A smart factory is defined as a cutting-edge, intelligent factory that integrates all production processes from product planning to sales with information and communication technology. Through these factories, each company produces customized products with minimal cost and time. The smart factory promotion project in Korea has produced positive results even in difficult environments such as the COVID-19 situation. Through the transition to a smart manufacturing production system, the competitiveness of small and medium-sized businesses has been greatly strengthened, including increased productivity and reduced costs. This study was based on surveyed data conducted by organizations related to smart factory promotion in 2020. Significant contents and major characteristics that emerged from the surveyed data were inferred and described. Since the meaningful contents reflect the reality of the company, more efficient promotion of smart factories will be possible in the future.

Keywords: Smart factory, AI, ICT, Smart factory level, Smart factory promotion status.

1. Introduction

Due to the recent worsening of the global economic environment, our country's economic environment is experiencing difficulties. These economic difficulties appear to have a relatively large impact, especially on small and medium-sized businesses. To overcome this poor environment, many companies are participating in smart factory and promoting smart factory projects. The main purpose of the smart factory promotion project is to improve the management environment system, including production, using ICT technology [1, 3, 4]. The meaning of smart factories appears in various ways [1, 2]. The organization that supports the smart factory project nationally is the Smart Factory Promotion Team. The meaning of smart factory in the smart factory promotion team is an intelligent factory that integrates all production processes from product planning to sales with ICT (information and communication) technology [1]. In these smart factories, each company produces customized products with minimal cost and time [1, 3].

The smart factory promotion project in Korea has produced positive results even in difficult environments such as the COVID-19 situation. In particular, in the case of K-quarantine-related industries such as masks and diagnostic reagents, it was reported that the performance of smart factories was proven even during the COVID-19 crisis with productivity increasing by more than 50% in a short period of time [5]. According to the 2019 Smart Factory Research and Analysis Research Report by the Ministry of SMEs and Startups, small and medium-sized companies that introduced smart factories showed an average improvement of about 30% in terms of productivity, and an improvement of 43.5% in terms of quality improvement. In addition, it was found that 15.9% was reduced in cost [6]. However, despite these positive achievements, we found that the data from the survey results of companies that promoted the project implied what should be aimed at when promoting smart factories.

In this study, we discussed the meaning of data from various surveys conducted by smart factory promotion agencies targeting companies in 2020 [7]. We also looked at the meaningful content and meanings implied in the survey results. These meaningful survey results are expected to lead to a more efficient direction and increase the participation rate of companies when pursuing smart factory projects in the future. In addition, if the various special advantages revealed in the survey results are reflected in the project implementation process, it is expected that companies' satisfaction with the smart factory project will greatly improve.

As for the research content, Chapter 2 first deals with the investigation of the current status and analysis of smart factory promotion by company's sales size. Chapter 3 covers smart factory introduction plans and reasons for non-introduction. Finally, the conclusion is described.

2. Current status and analysis of smart factory promotion by sales volume

2.1 Smart factory progress status

First, this study covered the results of a survey on the status of smart factories by companies' sales volume. The survey results are shown in Table 1 below. There are 5 specific items regarding the smart factory promotion status used in Table 1. 5 specific items ((a) partially completed and in operation, (b) currently in progress, (c) planned for next year, mid to long term, (d) interested There is but no specific plan, (e) none) were used.

30,553 companies participated in the survey, and sales volume was divided into 7 areas. It can be seen that most of the participating companies are small and small businesses. Looking at the survey results in Table 1, it shows that most companies are not interested in or are not pursuing smart factories.

Table 1. Smart factory promotion status by sales volume: Smart factory promotion status

Sales volume (Unit: 100 million)	Number of companies	(a)	(b)	(c)	(d)	(e)
~ 5	13,240	0.9	0.4	1.4	2.7	94.5
5~10	4,632	1.3	0.4	2.1	4.4	91.8
10 ~ 50	7,771	6.9	3.8	1.7	5.0	82.5
50 ~ 100	2,008	13.7	4.6	1.5	7.2	73.0
100 ~ 300	1,871	25.8	5.8	2.7	11.5	54.2
300 ~ 1000	759	29.0	10.9	0.9	9.9	43.9
1000 ~	272	35.3	10.0	0.9	9.9	43.9

The meaningful (characteristics) contents that can be inferred from Table 1 are as follows. First, the survey results for items (a) (partially built and in operation) and (b) (currently in progress) show that as the volume of sales increases, the results of the items also increase. This means that as sales volume increases, smart factory promotion is also increasing. The fundamental cause of this is that as sales increase, the need to build a smart factory increases, the infrastructure such as financial status required to build a smart factory is in a sounder financial condition than that of a small company, or the system and human resources required to build a smart factory are in place. This can be said to be the main cause. Second, the results for item (d) (no interest and no specific plan) and item (e) (none) are high in the very small business group. This seems to be because there are difficulties in promoting smart factories, such as financial problems, lack of understanding, and composition of the promotion organization.

2.2 Smart factory creation level and implementation method

This section presents the results of a survey on the level of smart factory creation and implementation methods for each company. The survey results are shown in Table 2 below. The level of smart factory creation was investigated by dividing it into three items, and the promotion method was subdivided into two items. First, the three items related to the level of smart factory creation consisted of (a) partial management system operation, (b) partial connection between management systems in each field, and (c) network-based connection of facilities, materials, and systems. The two items regarding the promotion method consisted of (a) government support and (b) self-promotion. 2,998 companies participated in this survey.

Table 2. Smart factory promotion status by sales volume: Smart factory creation level and promotion method

Sales volume (Unit: 100 million)	Number of companies	Smart factory creation level			Promotion method	
		(a)	(b)	(c)	(d)	(e)
~ 5	370	46.2	11.8	42.1	86.6	13.4
5~10	177	42.4	41.5	16.2	84.8	15.2
10 ~ 50	966	59.9	17.2	22.9	79.3	20.7
50 ~ 100	397	60.0	25.0	15.0	82.9	17.1
100 ~ 300	642	58.4	29.2	12.4	90.4	9.6
300 ~ 1000	320	55.4	34.0	10.6	83.1	16.9
1000 ~	126	46.4	34.4	19.2	79.2	20.8

The significant contents (features) inferred from Table 2 are as follows. First, the results of a survey on partial linkage items between management systems in each field showed that the partial linkage rate between management systems increased as sales volume increased, except for companies with less than KRW 500 million -1 billion. In addition, the contents of the partial management system operation items are unusual in that the ratio of companies with KRW 1 billion to KRW 30 billion is higher than that of companies with KRW 30 billion or more. On the other hand, the results of partial linkage between management systems in each field show that companies with more than KRW 30 billion show higher results than those with more than KRW 1 billion and less than KRW 30 billion, which can be seen as desirable in terms of the size of the company. No clear phenomenon was observed in the remaining smart composition level-related items for each group of companies.

Next, in terms of how to promote smart factories, it was found that more than 80% of companies promoted them with government support. These results can be interpreted in two ways. First, the government is taking

the lead in promoting smart factories. In particular, small-scale companies have limited finances, manpower, and necessary information. In this situation, without government support, most smart factories would have been impossible to build. Second, on a somewhat negative note, when small companies build smart factories with financial support from the government, they are not fully utilized due to the lack of manpower and lack of expertise to operate the construction system. The usability of the management system is weak except when purchasing and utilizing some automated devices.

2.3 Utilized software

The results of a survey on the software utilized by each company by sales volume regarding the current status of smart factory promotion are shown in Table 3 below. The software used for the survey was divided into five categories.

Table 3. Current status of smart factory promotion by sales volume: Utilized software

Sales volume(Unit: 100 million)	Number of companies	POP	MES	PLM	ERP	SCM	others
~ 5	370	11.8	55.4	2.5	43.8	2.5	-
5~10	177	0	49.5	0	60.9	0	-
10 ~ 50	966	6.4	49.8	5.7	52.8	0.4	-
50 ~ 100	397	15.2	59.7	1.9	41.5	2.1	-
100 ~ 300	642	8.3	61.8	1.3	49.4	0.4	-
300 ~ 1000	320	9.3	61.1	1.3	49.4	0.4	-
1000 ~	126	14.8	70.4	6.9	75.6	0.8	-

(Others: APS, FEMS, WMS, etc. have very low usage rates and are classified as 'other')

The significant content in Table 3 is that the software used by each company appears in that order: MES, ERP, POP, and PLM. In promoting smart factories, it can be seen that most companies are promoting smart factories with interest in MES systems for production and process management and ERP(enterprise-wide resource management) system. Therefore, future smart factory promotion projects also need to reflect the trends of these companies.

3. Smart factory introduction plan, intention, and reasons for non-introduction

3.1 Smart factory introduction plan, intention

In this section, companies' intentions to introduce smart factories and reasons for not adopting them were investigated. The results of the survey on plans and intentions to introduce smart factories are shown in Table 4 below, with a total of 4 items ((a) intention to introduce and no plan, (b) intention to introduce but no plan, (c) planning to introduce within 2 years, (d) introduced and being used). 2,005 companies participated in this survey.

Table 4. Plans and intentions for new/additional introduction of smart factories

Sales volume (Unit: 100 million)	Number of companies	(a)	(b)	(c)	(d)
5 ~ 20	324	77.2	17.9	3.1	1.9
20 ~ 50	329	75.4	12.2	4.3	8.2
50 ~ 80	219	72.1	11.9	7.3	8.7
80 ~ 120	196	70.9	13.8	5.1	10.2

120 ~ 200	235	68.1	10.6	3.4	17.9
200 ~ 500	412	71.1	8.7	5.8	14.3
500 ~ 1500	290	67.2	5.9	6.9	20.0

A significant result in this content is that the lower the sales, the higher the survey results regarding the intention to introduce smart factories and the lack of plans. In addition, the results of the survey regarding intention to introduce but no plan show that the lower the sales, the higher it is. This can still be seen as a combination of introduction infrastructure and financial problems. On the other hand, the results of the survey on introduction and utilization were confirmed to be higher as sales increased.

3.2 Reasons for non-introduction of smart factories

Next, the results of the survey on the reasons for not introducing smart factories are shown in Table 5, with a total of 10 survey items ((a) lack of understanding of smart factory introduction, (b) smart factory introduction and consultants Absence, (c) Difficulty in calculating an accurate input budget, (d) Securing initial investment funds, (e) Uncertainty of effect compared to investment, (f) Problems securing promotion/operation manpower, (g) Difficulty in building a system customized to corporate manufacturing characteristics, (h) Upgrade and maintenance costs, (i) Lack of interest in active use of the introduced system, (j) Other. 1,774 companies participated in this survey.

Table 5. Reasons for non-introduction of smart factory

SV	5-20	20-50	50-80	80-120	120-200	200-500	500-1500	average
NC	318	302	200	176	193	353	232	
(a)	13.5	11.6	7.0	9.7	8.8	8.2	6.0	9.25
(b)	6.9	6.6	5.0	6.3	7.8	5.4	3.0	5.85
(c)	10.7	11.9	14.5	12.5	13.5	15.0	12.9	13.0
(d)	23.0	21.9	27.0	21.0	20.7	16.7	14.7	20.7
(e)	17.9	18.2	18.5	21.6	23.8	26.1	26.7	21.8
(f)	8.8	12.6	11.0	7.4	9.8	7.1	6.5	9.02
(g)	5.0	9.3	4.5	8.5	2.6	4.0	9.1	6.14
(h)	5.0	2.6	3.5	5.7	8.8	11.0	13.8	7.2
(i)	8.2	5.3	9.0	7.4	4.1	5.7	6.5	6.6
(j)	0.3	0	0	0	0	0.6	0.9	0.25

(SV: Sales Volume, NC: Number of Company)

The significant contents of this survey are as follows. First, when looking at the entire group of companies, the reasons for not introducing smart factories were in the following order: uncertainty of investment effectiveness, difficulty in raising initial investment funds and calculating input budget. This appears to be a result related to the finances required to promote business, and it can be seen that investment resources are still a major concern for companies. Next, the most common reason for not introducing smart factories for companies with sales of less than KRW 8 billion was the difficulty in securing initial investment funds. This also shows that financial support is needed to promote smart factories. In addition, it can be seen that the results of lack of understanding of smart factory introduction are higher than those of companies with relatively high sales scale. This can be said to be an area where publicity is needed regarding the need for accurate promotion of small businesses. In addition, the problem of securing promotion/operation manpower was also found to be high among small companies.

A characteristic of companies with relatively high sales volume is that uncertainty about the effectiveness of investment is relatively higher than that of small companies. Looking at the contents of this item, it was found to be the area of greatest concern across all business groups. Additionally, the results regarding upgrade and maintenance costs show that the relatively higher the sales volume, the higher the related costs. This shows that after building some smart factory systems, efforts are made to build additional functions or improve performance. You can also see that maintenance costs also follow. This can be said to be a natural result of building and operating the system.

4. Conclusion

Smart factories are being implemented in various forms around the world with the purpose of increasing the efficiency and productivity of companies. Even in Korea, companies are facing negative environments such as high inflation, high exchange rates, and high energy after COVID-19. The government is implementing various policies to support these companies. Among them, the smart factory introduction support project has been providing small and medium-sized businesses with opportunities to improve management, increase productivity, and reduce costs. And its effects are also shown to be very positive based on press releases from related organizations.

This study was based on data from various surveys conducted on companies by organizations related to smart factory promotion projects. The significant contents that emerged from the survey results data were described. In addition, meaningful features and advantages revealed in the data were described. Such data may result from reflecting the reality of companies in promoting smart factories in the future. Therefore, it is expected to increase the participation rate of companies participating in the smart factory project. In addition, by reflecting the reality of companies in the entire process of promoting smart factories, companies' satisfaction with smart factories will increase.

Acknowledgement

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