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An Examination on the Effect of Information System and Organizational Participation Factors on the Intention of Continuous Use and System Introduction Performance: Focusing on the MES for SMEs

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Abstract

Background/Objectives: Manufacturing Execution System (MES) is a system that provides information that optimizes production activities throughout the manufacturing process. Many small and medium-sized manufacturing companies have recently introduced manufacturing execution systems to strengthen their competitiveness.However, many of them have not been getting the effect of introducing MES.To address this issue, this study aims to improve the efficiency of system application by analyzing the factors affecting the continuous use intention of MES and to help small and medium-sized enterprises that plan to adopt the system.

Methods/Statistical analysis:The main subject of this study came out from the survey through the management or executive officers of small and medium-sized manufacturers that introduced the MES.A questionnaire was produced for this purpose andthe survey was conducted either by direct interview or by e-mail. The questionnaire was composed of 30 questions, asking for information system factors, organizational participation factors, continued use, system introduction performances, and general status. Using IBM SPSS Statistics 22 as an analytical tool for the questionnaires, technical statistics, reliability analysis, and exploratory factor analysis were conducted. In addition, using AMOS 22.0, we conducted a confirmed factor analysis, structural model analysis, and mediation effecttest.

Findings: The results of the study are summarized as follows. First, it has been shown that information system factors have a significant effect on the continuing use intent. Second, it has been shown that the Organizational participation factors have a

significant effect on the continuing use intent. Third, continuous use has been shown to have a significant effect on the system introduction performance. Fourth, continuous use was shown to have a mediated effect between external and endogenous variables.

Improvements/Applications: If the questionnaire could be designed to identify the extent of system use by MES users, the more accurate results would be expected than it is now. In addition, if a questionnaire was organized to identify the level of application of MES-introduced companies' systems, the results of the study could be more meaningful.

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1. Introduction

According to the Korea Institute for Industrial Economics, MES is defined as a production management system that accurately identifies the situation at the manufacturing site from customer orders to finished products, provides optimal work instruction information in real time, and monitors quality status and production status. Many small and medium enterprises are recently introducing or improving their production information systems to enhance their competitiveness.The most frequently system adopted with government support is the MES.However, in many cases, the system is suspended due to the system failure or difficulty in applying the site.Related to this issue, some studies have been conducted to verify the impact of the quality of information systems and participation by members of the organization on the performance of management, but little studies have focused on the continued use. This study analyzes the impact of information system factors and organizational participation factors on the intention of continuous use of the system and examines whether they affect the performance of introduction.

2. Materials and Methods

2.1. *Information System Factor*

The higher the quality of the information systems introduced to the organization or the more suitable for the job, the better the performance [1].In the study on the relationship between ERP systems and internal performance by Lee Jong-ho and Joo Sang-ho (2004), information system factors included IT/IS infrastructure and the degree of integration between information technology [2according to research like this The factors of the information system can be divided into ease of use and system compatibility. Fethi & Ferah (2004) analyzed the performance of the system from the end user perspective. They said the perceived ease of use of the information system would affect perceived usefulness and eventually contribute to enhancing end user satisfaction[3].Finke's study (1998) argued that the more effectively the information system is connected to the reference system, the higher the performance of the introduction [4]. In the study by Kim Byung-gon and Oh Jae-in (2002), empirical analysis revealed that among the technical characteristics of the information system, technical compatibility is an important factor in the successful implementation of the information system [5].The successful model of information systems in DeLone and McLean (2003) argued that system quality and information quality affect the use of each information system and user satisfaction, and that the use of information systems affects user satisfaction. [6]. A summary of previous studies shows that information system factors affect the intended use and satisfaction of users and the performance of introduction.

2.2.*Organizational Participation Factors*

In general, there are many studies that argue that the organizational factors of companies that introduce information systems have characteristics that positively affect their performance [7]. The introduction of MES results in changes in the current work system and changes in the work system are accompanied by organizational changes.The study by Park Chang-ki, Shim Soo-jin, and Han Young-chun (2014) determined that changes in the organization pushed forward with the introduction of the ERP system will affect the level of resistance of the members and will eventually affect the performance of the ERP system [8]. Kettinger & Grover (1995) argued that companies should encourage the active participation of members of the organization to effectively manage change within the organization. [9].

Ang et al (1995) said participation by users currently working is essential to minimize initial resistance to organizational changes [10]. Combining the above prior research, the introduction of MES brings about a change in the system. And it can be seen that participation by members of the organization is an important factor in reducing resistance to change and introducing a successful system.

2.3.*Intention of Continuous Use*

The intention of continuous use of a production information system may mean that the user who introduced and implemented the system intends to continue using it without interruption or switching to another system.Research on the acceptance intention of the information system is also important, but it is very important to identify the sustainable use intention in order to expand corporate profits [11].Domestic studies also found that long-term viability and practical success of information systems depended on continuous use rather than initial use [12].DeLone and Mclean (2003) found that user satisfaction with system quality for information systems plays an important role in the success of information systems [6].Oliver (1980) argued that user satisfaction has a direct and positive impact on potential future intentions of action, such as sustained intent to use [13]. To summarize these studies, the continued use of the user has an important impact on the successful introduction of the MES, and the quality of the information system has to do with the continued use intent.

2.4.*System Introduction Performance.*

Related to the performance of MES adoption, Delone & McLean (2003) combined individuality and organizational performance into a net profit and presented a revised success model [6]. Kaplan & Norton (1992) proposed a Balanced Scorecard (BSC) that provides managers with a strategic and comprehensive vision that complements existing financial valuation methods[14]. The Balanced Scorecard is designed to measure by dividing the financial perspective, internal work process perspective, organizational innovation and learning perspective, and customer perspective [14]. In terms of domestic research, Ha Ju-yeon (2002) proposed a model that presented user satisfaction, business performance and organizational performance as performance variables for the effects of ERP Introduction[15].Joo, Seok-Jung (2006) measured financial performance, customer satisfaction, and internal business processes among Kaplan & Norton's balanced performance indicators, and all the measurement results were found to have a significant effect [16].The study by Lee Mun-bong (2006) showed that information quality and service quality significantly affect user satisfaction, and user satisfaction affects students' learning performance [17].The results of the above study show that financial, organizational and personal performance are used as common measurement variables for the system introduction performance.

2.5. *Research Models and Hypothesis*

2.5.1. Research Models

According to the previous study, it was found that the information system factors and the degree of participation in the organization affect the performance of the introduction, and the continuous use intention affects the performance of the introduction.However, very little research has been conducted on how organizational involvement and information system factors

correlate with ongoing intentions.Therefore, the purpose of this study was to analyze the effect on the relationship between factors of information system factors / organization participation factors and system introduction performance by setting the sustained use intention of the system as a mediating effect.As Figure 1 shows, independent variables are information system elements and organizational participation factors, dependent variables are system introduction performance, and parameters are Intention of continuous use.

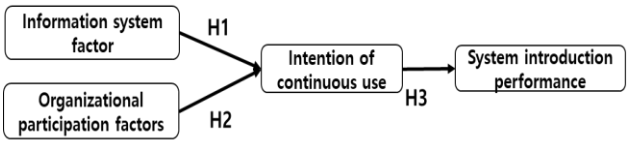

Figure 1. Research model

2.5.2. Research hypothesis

Hypothesis 1(H1): Information system factors will have a positive effect on intention of continuous use.
Hypothesis 2(H2): The Organizational participation factorshas a positive effect on intention of continuous use.
Hypothesis3(H3): Intention of continuous use have a positive effect on system introduction performance.
Hypothesis 4(H4): Intention of continuous use have a positive mediating effect between information system factors and system introduction performance.
Hypothesis 5(H5): Intention of continuous use have a positive mediating effect between Organizational participation factors and system introduction performance.

2.5.3 Operational definition of variables

The operational definition of each variable is summarized as [Table 1].

Table 1: Operational definition of variables

Measurement variable	Operational definition	A leading researcher
Information system factor	The degree to which it is not difficult to learn how to use the introduced MES and is organized to be easy to use.The degree to which the introduced MES is compatible with the software, hardware, and communication services commonly used in the enterprise.	[18,19,5]
Organizational participation factors	The degree of active involvement and influence in the construction of your system. Degree of effort to understand how to use. The degree of understanding and support for the system introduction, deployment goals.	[20]
Intention of continuous use	Satisfaction with the introduced MES and the level of continuous use. The degree of recommendation to others about the MES in use.	[11,12]
System introduction performance.	Increasing sales, improving work efficiency, and improving production capacity through the introduction of MES.	[6, 14]

3. Results and Discussion

3.1. *Empirical Result*

3.1.1. Demographic characteristics analysis

52% of the respondents were over 40 years old and 48% of them were under 40 years of age. The distribution of the respondents was 66% for men and 34% for women. The distribution of sales was 47.3% less than 3 billion, 23.1% between 3 ~ 5 billion, 18.8% between 5 ~ 10 billion, 7.5% between 10 ~ 30 billion, 3.2% between 30 ~ 50 billion, and the number of employees. The distribution was less than 20 persons 30.1%, less than 50 persons 35.5%, less than 100 persons 31.7%, more than 100 persons 2.7%. The industrial classification was 3.8% for other industries, 75.3% for machinery / metals, 7.5% for electricity / electronics, 6.5%

for information carriers, and 7.0% for chemicals and materials. The Business operation period was 16.1% under 3 years, 18.8% under 5 years, 29.0% under 10 years, 33.9% under 20 years, and 2.2% over 20 years.

3.1.2 Technical statistical analysis

Statistical analysis was performed to analyze the normality of measured variables. According to the criterion for descriptive statistics, individual measurement variables with a standard deviation of 3 or less, a maximum deviation of less than 3, and a maximum of less than 3 were found to have a normal distribution [21].

3.1.3 Exploratory factor analysis

In order to verify the validity, exploratory factor analysis was conducted. Principal component analysis was used to extract all the constructive factors and the orthogonal rotation method (Varimax) was used to simplify the factorial placement [22]. Generally, in the social science field, the selection criteria for factor items is considered to be a significant variable when the eigenvalue is above 1.0 and the factor load is above 0.4 [23].Therefore, this study applied factor selection criteria of general social science field. As a result of factor analysis, out of 12 items of information system factor, all 6 items, 6, 7, 8, 9, 10 and 11 items were excluded from the analysis item because 6 items were less than 0.4 factor loading.In addition, out of 4 items of factor of system introduction performance, item 4 showed less than 0.4 factor loading, which was excluded from analysis item. Six information system factors, four organizational participation factors, four continuous use intentions, three item system introduction performances, and a total of 17 items were used for analysis.

3.1.4 Measurement model analysis

3.1.4.1 Intensive validity and reliability analysis

Used CMIN / DF (<3.0), GFI · CFI · NFI · IFI (> 0.9), AGFI (> 0.8), RMSEA (<0.8), RMR (≤0.05) to test the fitness of the data [23]. Among all the measurement variables, questions 1 and 12 of the information system factor, in which the SMC value indicating the explanatory power of the measurement variables was 0.5 or less, were removed.The results of the reliability analysis were as follows. Cronbach's α values were distributed from 0.870 to 0.931 values (≥ 0.6) for all factors, thus ensuring the reliability of all factors. After analyzing the measurement model, the validity of the model was evaluated. The validity of the specific model was performed by dividing it into intensive validity and discriminant validity.The concept reliability (CR) value was used to evaluate the concentration validity.The mean variance extraction value (AVE) was used to evaluate the discriminant validity.As a result, conceptual reliability(CR) was lowest in the information system factor of 0.86 and all variables showed more than 0.85. Therefore, it can be judged that concentration validity is secured based on the concept reliability value. The results are shown in [Table 2] below.

Table 2: Confirmatory factor analysis result table

Latent variable	Observation variable	Non-standardization factor Enemy wit	standardization factor Enemy wit	S.E	t.	SMC	AVE	CR	Cronbach's α
Information system factor	ISF2	1.000	.718			.516	.613	.863	.870
	ISF3	1.099	.832	.104	10.575	.693			
	ISF4	1.002	.776	.101	9.916	.603			
	ISF5	1.107	.841	.10	10.66	.698			

				4	2				
Organizational participation factors	OF1	1.000	.836			.625	.708	.907	.886
	OF2	0.913	.791	.074	12.264	.696			
	OF3	1.043	.834	.079	13.204	.626			
	OF4	0.921	.791	.075	12.27	.711			
Intention of continuous use	CU1	1.000	.843			.735	.772	.931	.905
	CU2	1.012	.857	.070	14.382	.697			
	CU3	0.974	.835	.071	13.809	.676			
	CU4	0.978	.822	.073	13.477	.752			
System introduction performance.	IE1	1.000	.867			.910	.844	.942	.931
	IE2	1.129	.954	.059	19.263	.813			
	IE3	1.103	.902	.063	17.447	.516			
Measurement model Fitness	(initial model) $\chi 2$=131.972, df=113 p=0.107, CMIN/DF=1.168 RMR=.035, GFI=.924, AGFI=.898, RMSEA=.003 NFI=.943, CFI=.991, TLI=.990 (final model)$\chi 2$=90.429, df=84, p=0.296, CMIN/DF=1.007 RMR=.027, GFI=.940, AGFI=.915, RMSEA=.002 NFI=.957, CFI=.997, TLI=.996								

3.1.4.2Discriminatory Feasibility Analysis

In order to test discriminant validity, the method proposed by Fornell and Larcker (1981) was used [23]. As a result of the discriminant validity test, the square of the correlation coefficient between all the variables did not exceed the AVE value. Therefore, it can be judged that the discriminant validity is secured. The results are shown in [Table 3] below.

Table 3: Measurement model discrimination feasibility evaluation result

Variable name	Information system factor	Organizational participation factors	Intention of continuous use	System introduction performance.
Information system factor	0.783			
Organizational participation factors	0.633	0.842		
Intention of continuous use	0.65	0.691	0.879	
System introduction performance.	0.59	0.654	0.743	0.919

3.1.5Test of hypothesis

To verify this hypothesis, structural model analysis was performed using AMOS 22.0.Table 4 below shows the estimation results of the structural equation model. The proposed model showed acceptable model suitability.

Table 4: Hypothesis test result table

hypothesis	Pass	Standardization factor	C.R.	P value	Result
Hypothesis 1 (H1)	Information system factor → Intention of continuous use innovation	0.359	4.135	***	Adopted
Hypothesis 2 (H2)	Organizational participation factors → Intention of continuous use innovation	0.486	5.584	***	Adopted
Hypothesis 3 (H3)	Intention of continuous use innovation → System introduction performance.	0.764	10.472	***	Adopted
Measurement model Fitness		CMIN=101.928, df=86, p=.116, CMIN/DF=1.185, RMR=.041, AGFI= .906 TLI=.990, CFI=.992, RMSEA=.032			

Hypothesis 1 (H1): The information system factor has a positive effect on the intention of continuous use. As a result of structural model analysis, the standardization coefficient was .359, C.R. was 4.135, and P value was .000.

Hypothesis 2 (H2): Organizational participation factors has a positive effect on the intention of continuous use. As a result of structural model analysis, the standardization coefficient was .486, C.R. was 5.584, and P value was .000.

Hypothesis 3 (H3): The intention of continuous use has a positive effect on the effect of introduction. As a result of structural model analysis, the standardization coefficient was .764, C.R. was10.472, and P value was .000.

3.1.6. Mediating effect analysis

We examined whether there was a mediating effect of the parameters (intention of continuous use) between exogenous variables (information system factors, organizational participation factors) and endogenous variables (system introduction performance).In order to verify the mediating effect, structural model analysis was performed using AMOS 22.0 Bootstrap. As a result of analyzing whether theintention of continuous usehas a mediating effect between exogenous variables (information system factors, organizational participation factors) and endogenous variables (system introduction performance), it was verified that the mediating effects of continuous use intention were all significant.The mediated effect verification results are shown in [Table 5].

Table 5: Table of mediation effect analysis table

hypothesis	Pass	Indirect effect		Result
		Standardization factor	P-value	
Hypothesis 4 (H4)	Information system factor → Intention of continuous use→ System introduction performance.	.239	.001	Adopted
Hypothesis 5 (H5)	Organizational participation factors → Intention of continuous use→ System introduction performance.	.182	.001	Adopted

4.Conclusion

As a result of this study, it was found that the information system factors and organizational participation factors influenced the intention ofcontinuous use and further, the intention of continuous use influenced the system introduction performance when introducing the manufacturing execution system to SMEs.In addition, the intention of continuous use was found to have a mediating effect between the information system factors and the system introduction performance, and it was also found to have a mediating effect between the organizational participation factors and the system introduction performance. Considering these results, it is believed that if the MES implementation system is discussed internally and the system implementation goals are shared, the organization will be more involved in the introduction of the system, which will increase the effectiveness of the introduction.Information systems should be designed so that users can learn quickly and easily, and production in the user manual to assist them can be considered one of the major factorsHowever, in this study, the distinction between survey respondents was insufficient.If the questionnaire had been designed to distinguish the extent of respondents' MES use, it would have produced more accurate results than the current study.It also failed to consider the level of MES adoption for the company. If the study had been carried out by subdividing the application level from the basic level to the middle level, the results of the study could have been better than the current one.

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