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Effects of Smart Factory Quality Characteristics and Dynamic Capabilities on Business Performance: Mediating Effect of Recognition Response

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Abstract

Purpose: The purpose of this study is to confirm the strategic direction of the firm regarding the capabilities of the organization and its employees in order to increase the utilization and business performance of employees by that introduce smart factories in the domestic manufacturing industry. **Research design, data, and methodology**: This study derived a structured research model to confirm the mediating effect of recognition responses between the quality characteristics of smart factories and dynamic capabilities. For the analysis, a total of 143 valid questionnaires were used for 200 companies that introduced smart factories from domestic SME's. **Results**: Quality Characteristics of Smart Factory and Dynamic Capabilities had a statistically significant effect on Usefulness. Recognition Response had a statistically mediating on the relationship between quality characteristics of smart factory and business performance. Recognition Response had a statistically significant effect on business performance. **Conclusions:** It suggests that firms introducing smart factory reflect them in their empowerment strategic because the recognition responses of its employees differ according to the quality characteristics and dynamic capabilities of smart factories. It also means that the information derived from the smart factory system is useful and effective to business performance and employees.

Keywords: Quality Characteristics of Smart Factory, Dynamic Capabilities, Recognition Response, Business Performance

JEL Classification Code: M11, M15, M19, M31

1. Introduction

Along with the global economic downturn, domestic small and medium-sized enterprises (SMEs) are experiencing low growth due to rising labor costs, raw materials, and incidental costs. SMEs need to secure a competitive advantage by introducing a new production system to increase productivity and producing products that meet customer requirements (Lim, Jo, Lee, Park & Park, 2017). However, domestic SMEs have entered an ultra-aging society and are experiencing difficulties due to a decrease in the labor force and an increase in labor costs caused by the diminished working population (Butner, 2010). In addition, in order to cope with the business environment of a firm whose product life cycle is shortened and rapidly changing due to changes in consumer demand, it is necessary to improve productivity efficiency and secure quality to maintain customer satisfaction (Lim et al., 2017). Many experts predict that The Fourth Industrial Revolution will change the business environment and firms.

The Fourth Industrial Revolution was first coined by Klaus Schwab, chairman of the Davos Forum, Switzerland, in June 2016. This is a change in the industry that is

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expected to build a virtual physical system capable of intelligently controlling objects by integrating real and virtual reality through robots or artificial intelligence. Compared to the previous industrial revolutions, the fourth industrial revolution, which has a wider range and a rapid impact, is characterized by hyperconnectivity and intelligent revolution. The Fourth Industrial Revolution has a wider range of effects that occur quickly. Due to these effects, the global market economy is becoming more uncertain, and global and large corporations are continuing to develop capital and technology. SMEs that lack technology and capital are also changing into smart factories in the era of The Fourth Industrial Revolution. Smart factory based on ICT (Information and Communication Technology) can find problems and make improvements and decisions using data generated by manufacturing facilities (Kim & Cho, 2015). It can acquire a competitive advantage by having a flexible production system due to customer needs and various other requirements. Firms that have introduced smart factories have seen reduced defect rates, improved productivity, and improved profitability; these improved performance results have increased the overall interest in smart factories by SMEs. However, despite the high interest from SMEs, specific studies on the recognition response of employees according to the quality characteristics of smart factories and the capabilities of firms are insufficient.

The purposes of this study are as follow. First, we examine the effect of quality characteristics of smart factory on recognition response. This is significant in that it attempts to show how the quality characteristics of the smart factory affect the employees' ease of use or usefulness. Second, we examine the effect of corporate dynamic capabilities on recognition response. This is meaningful in that it is integrative research on dynamic capabilities and employees' ease of use or usefulness. Third, we analyze the effect of recognition response on business performance. This is meaningful in that it examines the relationship between employees' recognition of the new system and performance. Although this study is limited in scope, it is still meaningful as an integrated study on the relationship between the quality characteristics and dynamic capabilities of smart factories and recognition responses, and how recognition responses affect business performance.

2. Research Background

2.1 Quality Characteristics of Smart Factory

Smart factory refers to a factory that produces products by integrating ICT technology into the entire process, from planning to sales of new products in manufacturing companies (Oh, 2018). Automation of the product production process, factory automation, product development, supply chain management and corporate resource management optimizes the time and cost to produce products, and controls each step by collecting and analyzing data between processes in real time. A smart factory is a management system in which the step-by-step components, according to a firm's product production, are represented through ICT technology in real time, and automation and digitalization are possible by integrating with IoT, artificial intelligence, and big data (Lasi, Fettke & Feld, 2015; Lee, 2015).

Smart factory refers to a production system in which all stages, from supply to sales, are informationalized and linked in real time (Kim & Cho, 2015). A fully-realized smart factory is a data-based production system that collects and analyzes data in each step of the manufacturing process in order to identify the causes of problems in each process. Firms can grow by systematically managing, analyzing and utilizing product production information. It is possible to control and display all processes related to product production, such as controlling the production process at each stage, identifying the causes of failures and operating rates of production facilities, and identifying nonconforming products and their causes. Through these characteristics, products can be produced in a short time through improved productivity, reduced defect rates, and improved processes (Mario, Tobias & Boris, 2016). Advanced overseas firms are achieving results such as shortening delivery times, minimizing production downtime, reducing defect rates, and increasing energy savings through the introduction of smart factories (Kim, 2019). The characteristics of a smart factory can be found in the Information System Success Model (ISSM). DeLone and McLean (1992) Information System Success Model is evaluated in terms of information quality and system quality, and these characteristics effect use, or intention of use, and user satisfaction. Pitt and Kavan (1995) argued that service quality can be an important variable in the ISSM model of DeLone and Mclean (1992). DeLone and McLean (2003) measured the overall quality of the information system by adding service quality following system quality, and information quality, such as e-commerce, in an additional study. System quality is high when the system's information processing, hardware, software, etc. runs smoothly and without errors. Information quality refers to the value and utilization of information provided by the information system in a final calculation. If the information is efficiently utilized in the user's work, then the quality of information is high (Jo & Yang, 2011). Service quality means that the information system can effectively obtain the information expected by the user, and that it can be used continuously to

support the user (Song, 2012).

Therefore, in this study, using DeLone and McLean's (2003) ISSM, system quality, information quality, and service quality are the smart factory characteristics of interest.

2.2. Dynamic Capabilities

Resource-based theory is the competitive advantage of a firm's core competencies, irreplaceable resources and processes, that have value and scarcity for continuous growth and are difficult for rivals to imitate. It is said that you can have. It is said that core competencies that are the source of competitive advantage have heterogeneity and non-mobility (Barney, 2001).

In the rapidly changing business environment of the Fourth Industrial Era, SMEs respond quickly and flexibly to changes in the business environment, and for sustainable growth. Teece and Shuen (1997) argued that the existing resource-based theory is the core of a firm. In order to complement the limitations of capabilities, dynamic capabilities, a concept that can have a competitive advantage, is presented through the search, acquisition, and reorganization of information through internal or external resources. Teece and Shuen (1997), Eisenhardt and Martin (2000), Zollo and Winter (2002) build and integrate the internal and external capabilities of a firm in response to the rapidly changing external environment and rearrange them as necessary to meet the purpose of the firm. It is defined as the ability of an organization to modify, expand, or re-create accordingly(Zahra & Gravis, 2000). It is an active ability to build, integrate and redeploy internal and external resources owned by a firm to secure customer requirements and competitive advantages. Adamson and Shine (2003) argues that in order to build dynamic capabilities and show results, it is necessary for the ideas of employees, the knowledge acquired from inside and outside the firm, to be put into practice. Wang and Ahmed (2007) said that it is the ability to create, expand, and reorganize the resources and capabilities of an organization. Teece (2007) stated that it is the ability to detect risks and opportunities in a changing market environment, to capture new business opportunities, and to reorganize them to suit the business environment by utilizing the resources held by a firm. Morgan and Katsikeas (2004) stated that it is a market-based learning ability or the ability to rearrange corporate resources to secure resources and provide valuable products or services to the market. Kim and Ahn (2017) adjusts corporate resources according to the changing environment of firms through the ability to search, acquire, and reconstruct information. Ahn and Kang (2019) stated that it is the ability of firms to innovate in a form that can secure a competitive advantage by adjusting and reorganizing internal or external resources to respond to the rapidly changing business environment.

In this study, the factors of dynamic capabilities were called Opportunity Searching Competency, Resource Acquisition Competency, and Resource Reconfiguration Competency, proposed by Teece (2007). Opportunity Search Capability is an activity that detects opportunities and risks in a changing external market environment and includes search, monitoring, exploration, etc. Resource acquisition capabilities allow a firm to make quick decisions, as needed, when it detects opportunities and risks. Reorganization of resources refers to the ability to redistribute and rearrange the resources held by a firm for new business fields or new products for the firm's sustainable growth.

2.3. Recognition Response

The Technology Acceptance Model (TAM) explains the decision-making of individuals who accept new technologies in the information/technology field. Davis (1989) predicts the use and acceptance of information and technologies based on rational behavior theory. Davis (1989) studied rational behavior in the relationship between ease or usefulness as a factor that judges employees' will, attitude and execution, according to technology acceptance. TAM suggests that acceptance of new products, technologies, and services affects the user's beliefs about new products, technologies, and services, as well as intentions of use (Davis, 1989).

Ease of use refers to the degree to which users believe that new products, technologies, and services can be used without difficulty, are useful, and whether the user expects that efficiency and performance can be improved by utilizing new products, technologies, and services (Davis, 1989). In TAM, ease-of-use and usefulness ensure users can easily access new technologies, services, information systems, etc., and their intention to use increases as they believe that their work efficiency and performance will improve (Davise, 1989; Davise, Bagozz & Warshaw, 1989).

2.4 Business Performance

Firms try to evaluate and measure business performance with objective indicators. For managers, items that evaluate business performance are important. This is because, despite the performance of the same firm, the performance score of the firm may vary depending on the evaluation items for business performance. In addition, since employee performance can vary depending on the evaluation items, the employees try to perform work activities according to the evaluation items; if the evaluation items for business performance are selected well, the performance of the firm

can be improved. Business performance of a firm is analyzed as a profit calculation because it represents the maximum profit according to the purpose of profit. Business performance is represented by financial performance that can be analyzed numerically, and non-financial performance that cannot be measured. There are also financial results that appear in the short-term annually through innovation activities, and non-financial results in the mid- to long-term due to accumulation of innovation activities. Financial performance reflects past corporate activities and appears as corporate value and business performance. Financial statements refer to the financial performance centered on the statement of financial position and the income statement. Financial performance represents business performance in terms of financial figures such as operating profit, net profit, and return on investment (Kim, Yu & Lee, 2014). However, financial indicators in financial performance represent past corporate activities, and in many cases do not represent current corporate activities and value creation (Kim & Cho, 2015). Therefore, the market environment in which a firm is facing changes day by day, is diverse, and it is not enough to measure performance only in the financial statements in terms of planning and controlling management. There is a need for performance measures that can evaluate effective business processes within the organization and effective management activities that can achieve strategic goals and properly measure non-financial performance as well as financial performance (Kim & Ahn, 2017). Therefore, in this study, business performance can be regarded as the activity of a firm that shows short-term and mid- to long-term performance.

3. Research Design

3.1. Research Model & Hypothesis

This study aims to quickly adapt to the business environment in the rapidly changing Fourth Industrial Revolution Era to achieve sustainable growth by measuring the effect of the smart factory and the corresponding dynamic capabilities and core competencies of the enterprise and its business performance on recognition response. By checking whether there is a mediating effect between quality characteristics, business performance, dynamic capabilities, and business performance, small and medium-sized manufacturing companies are trying to find a link between ways of securing competitive advantages, capacity building, recognition response and business performance.

Figure 1 presents a research model including sub-substances

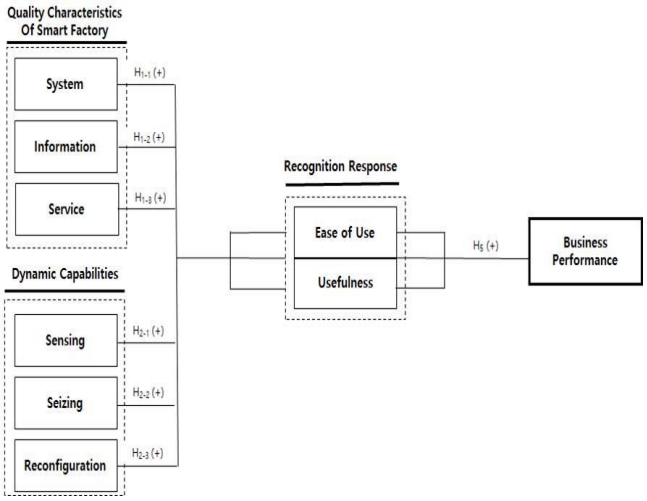

Figure 1: Presents a Research Model including Sub-substances.

Note) Mediation effect hypothesis (H3 ~ H4) was not presented.

DeLone and Mclean (2003) expressed that the success model of information systems uses system quality, information quality, and service quality as the preceding variables of organizational or personal influence. An information system is a system that receives a lot of data from an input system, processes it in a central processing unit, and finally outputs it in an output system. System quality, which is a quality characteristic of information systems, influences whether it is easy to use or useful (Szejka & Junior, 2017). In a study on Internet shopping experiences, found that the system quality had a significant effect on the perception of ease of use and usefulness, and the perception of ease of use and usefulness had a significant effect on the attitude of Internet shopping. An information system is realized to achieve a specific purpose by a firm, and the information system becomes easier to use overall, more useful, and easier to use continuously. It can be seen that this has a significant influence on whether the quality of information is easy to use or useful (Jo & Yang, 2011). Therefore, the following hypothesis was established.

H1: The quality characteristics of the smart factory will have a positive (+) effect on the recognition response.

Castaneda (2007) argues that employees of a firm are the assets of organizations and individuals when they encounter new information, products, and systems. According to experience, ease of use and usefulness of the recognition response were different. The group with fewer capabilities and less experience evaluates new products, technologies, and information by brand loyalty and beliefs; the group with more competence and experience focuses on

ease of use, performance and usability. Adamson and Shine (2003) showed that ease of use affects user satisfaction more than usefulness depending on the usage environment and the competence of employees. Schillewaert (2005) found that in a study on the adoption of information technology by employees, the perception of ease of use had a significant effect on whether or not it was useful, according to the individual capabilities of the employees and the organization. This can be judged as having an influence on whether the individual capabilities of the employees and the organization are acceptable and useful. Therefore, the following hypothesis was established.

H2: Type of dynamic capabilities will have a positive (+) effect on recognition response.

The purpose of a smart factory introduction firm is to automate facilities and improve business processes through systems and information. This is to increase business performance with improved productivity and flexibility (Balasingham, 2016; Butner, 2010; Wu, Yue, Jin & Yen, 2016). By introducing a smart factory, firms aim to increase productivity by automating each process, such as product production process management, defect rate management, quality management, production management, and inventory management. This is because facility automation based on robots and artificial intelligence improves productivity by data-based monitoring obtained from the manufacturing process, and rebuilding the production process of firms (Hopkins, Lavalle, Lesser, Shockley & Kruschwitz, 2011; Wang, Wan & Zhang, 2016; Wang, Ma & Zhang, 2018). Productivity improvement is achieved through the firm's internal capabilities, and it should be possible to easily and beneficially utilize the system, information, and services of the smart factory (Szejka & Junior, 2017). Therefore, the following hypothesis was established based on previous studies.

H3: The recognition response will mediate the relationship between the quality characteristics of the smart factory and business performance.

Research on dynamic capabilities and business performance is actively being conducted. A hypothesis was established by referring to the research results on the relationship between dynamic capabilities and organizational effectiveness. Heo and Lee (2012) stated that a firm's dynamic capabilities in overseas markets has a positive effect on its competitive advantage. As a result of analyzing the relationship between dynamic capabilities and organizational effectiveness, Kim, Yu and Lee (2014) confirmed that organizational effectiveness has an effect on creativity, job commitment, organizational citizenship behavior, and work performance. It was estimated that whether the relationship between dynamic capabilities and business performance is ease of use or usefulness will affect business performance by linking a firm's attempts at new things to organizational effectiveness. Porter (1996) argued that the role of leadership is for management to use the capabilities and perceptions of employees in order to properly carry out the management and innovation activities in their business strategies. Therefore, in this study, it was determined that recognition response could be a parameter in the relationship between dynamic capabilities and business performance. Therefore, the following hypothesis was established.

H4: Recognition response will mediate in the relationship between dynamic capabilities and business performance.

Seddon (1997) argued that recognition response, such as ease of use or usefulness, has a significant effect on individual performance and organizational performance while using specific technologies or systems. Davis (1989) stated that the perception of usefulness improves business performance due to the use of information systems, which in turn increases user satisfaction. DeLonr and Mclean (1992, 2003), Rai, Lang and Welker (2002) argued that high user satisfaction in information systems improves individual work performance and positively affects organizational performance. Kim and Lee (1986) stated that the higher the user's willingness to use the introduced information system, the higher the information quality, the higher the satisfaction, and the higher the work performance. Zmud, Boynton and Jacobs (1987) stated that the use of information systems improves business performance by reducing corporate costs, increasing management utility, and securing a competitive advantage. DeLone and McLean (1992) argued that information systems improve organizational decision-making capabilities and have a significant effect on business performance. Lee and Kim (2006) found that perception of usefulness and user satisfaction had a significant effect on individual performance, and that individual performance also affected organizational performance. Empirical studies have demonstrated the impact of perception of ease of use and usefulness. Therefore, the following hypothesis was established.

H5: Recognition response will have a positive (+) effect on business performance.

3.2. Data Collection

The survey in this study was targeted to small and medium-sized manufacturing companies from February to May, 2020. For the method of collecting questionnaire, a

total of 250 copies were distributed by e-mail, in person, or telephone, and a total of 143 copies of the collected questionnaires excluding unfaithful responses were used for analysis.

3.3. Scale of Variable

For this study, the quality characteristics of the smart factory were based on the research of DeLone and McLean (1992, 2003). It consists of five items, including the service item of the supplier, which is service quality. Based on the research of Teece (2007) and Kim and Ahn (2017), the dynamic capabilities type is the ability to detect the business environment in the uncertainty of the corporate environment, and to search for and explore external information and knowledge. Resource acquisition capability, which is the ability to utilize strategic alliances with external organizations or business partners to acquire resources, and resource restructuring capability, which is the ability to integrate or reorganize the firm's resources, capabilities, and structures, both offer new opportunities to the business field. Resource acquisition capability and resource restructuring capability are measured with six questions. Recognition response, based on the study of Davis (1989), is whether it is easy for anyone to learn and conveniently use anywhere, and is measured by three questions about usefulness. Business performance, which represents the business indicators of a firm, is measured on a 5-point Like art scale with nine items, based on a study by Jang and Kim (2010).

4. Research Methods

4.1. Analysis Method

The collected survey data were analyzed using SPSS 24.0 and Amos 24.0 statistical programs. Frequency analysis was performed to identify the demographic characteristics and technical statistical analysis to identify the characteristics of the variables. For the convergence feasibility analysis, a positive factor analysis was performed, and reliability was confirmed by calculating the Cronbach's α value to verify internal consistency. Correlational analysis between each variable was performed, and simple regression, multiple regression, and three-step mediated regression analyses were performed to verify the hypothesis.

4.2. Demographic Character Analysis

The demographic characteristics of respondents to the survey are as shown in Table 4-1.

Table 4-1: Demographic Characteristics

Demographic Factors		Frequency	%
Gender	Male	85	59.4
	Female	58	40.6
Position	Team Leader	68	47.6
	Executive	51	35.7
	CEO	24	16.8
Department	Sales/Marketing	38	26.6
	Manufacturing /Production	62	43.4
	Personnel /Management	25	17.5
	R&D	18	12.6
History	Under 1 year	18	12.6
	1 ~ 5 years	32	22.4
	5 ~ 10 years	31	21.7
	More than 10 years	62	43.4
Industry	Mechanical Engineering / Metal	43	30.1
	Electronics	46	32.2
	Rubber/Plastic	32	22.4
	Chemistry	17	11.9
	Nonmetalic minerals	5	3.5
Sales (figures)	Under 5 billion	62	43.4
	5 ~ 20 billion	53	37.1
	20 ~ 100 billion	19	13.3
	More than 100 billion	9	6.3
Employees	1 ~ 50	55	38.5
	51 ~ 100	49	34.3
	101 ~ 300	25	17.5
	More than 301	14	9.8
Production Structure	MTS	74	51.7
	MTO	69	48.3
Organizational Characteristics	Officialization	67	46.9
	Centralization	76	53.1

4.3. Validity and Reliability Analysis

A confirmatory factor analysis was conducted to confirm the validity of the variables in each question, and the results of reliability analysis through the Cronbach's α coefficient for internal consistency were presented in Table 4-2.

Table 4-2: Results of Validity & Reliability

Variable	Sub-Variables	Item	Construct Reliability	AVE	Cronbach's α
Quality Characteristics of Smart Factory	System	4	0.899	0.690	0.853
	Information	5	0.926	0.716	0.898
	Service	4	0.912	0.723	0.883
Innovation Activities	Management Innovation	10	0.953	0.773	0.963
	Technological Innovation	9	0.946	0.748	0.958
Utilization of Smart Factory	Facility Automation	5	0.913	0.679	0.945
	Process Improvement	3	0.907	0.766	0.903
	Production Material Construction	5	0.905	0.761	0.877
Management Performance		9	0.946	0.663	0.928

4.4. Correlation Analysis

Correlation analysis was conducted to confirm the strength and direction of the relationships between variables, discriminant validity, and the possibility of causal analysis. As a result of the analysis, the correlation coefficient of each variable was found to have a positive (+) relationship, and the coefficients ranged from 0.499 to 0.703. As a result of comparing the coefficient of determination, which is the square of the correlation coefficient, and the mean variance extraction index (AVE), each variable met the requirements for discriminant validity.

Table 4-3: Results of Correlation Analysis (n=143)

item	1	2	3	4	5	6	7	8	9
1.System	(.690)								
2.Informatin	.559**	(.716)							
3. Service	.643**	.697**	(.723)						
4. Sensing	.380**	.442**	.281**	(.773)					
5. Seizing	.335**	.448**	.330**	.486**	(.748)				
6. Recon figuration	.194**	.438**	.249**	.599**	.490**	(.679)			
7. Ease of Use	.477**	.503**	.589**	.231**	.164**	.324**	(.766)		
8. Usefulness	.560**	.592**	.579**	.357**	.351**	.210**	.480**	(.761)	
9. Business Performance	.627**	.620**	.685**	.266**	.230**	.227**	.601**	.650**	(.663)
Mean	3.307	3.442	3.330	3.405	3.560	3.171	3.240	3.663	3.528
S.D	0.777	0.738	0.794	1.002	0.942	0.899	0.861	0.722	0.667

Note: ** p<.01, PI: Innovation Activities, AVE marked in ( ).

4.5. Hypothesis Verification Result

To test the direct effect hypothesis, a simple regression analysis was conducted with gender, position, job, history, industry type, sales amount, and number of employees as control variables. Analysis results to verify <Hypothesis 1> regarding System quality (β=.506, p<.001), information quality (β=.529, p<.001), service quality (β=.646, p<.001) was found to have a statistically significant positive (+) effect on ease of use. In addition, system quality (β=.567, p<.001), information quality (β=.550, p<.001), and service quality (β=.535, p<.001) are statistically significant, respectively. Therefore, <Hypothesis 1-1>, <Hypothesis 1-2>, <Hypothesis 1-3>, <Hypothesis 1-4>, <Hypothesis 1-5>, and <Hypothesis 1-6> were all adopted. On the other hand, the result of the multiple regression analysis to

determine which of the quality characteristics of the smart factory has more influence on the perception of ease during recognition response shows that only service quality (β=.388, p<.001) has a statistically significant positive (+) effect. It was found that information quality (β=.310, p<.001) and system quality (β=.265, p<.002) had a statistically significant positive (+) effect on usefulness perception.

In order to verify <Hypothesis 2>, demographic characteristics were input as control variables and a simple regression analysis was performed. As a result, opportunity search capability (β=.201, p<.05), and resource restructuring capability (β=.293, p<.01) had a statistically significant positive (+) effect on whether it was easy or not. In terms of usefulness recognition, the ability to search for opportunities (β=.337, p<.001), capacity to acquire resources (β=.316, p<.001), and resource restructuring capabilities (β=.180, p<.05) were statistically significant, respectively. It was confirmed that there was a significant positive (+) effect.

Table 4-4: Intermediate Perception of Easy of Use in The Relationship between Smart Factory Quality Characteristics, Dynamic Capabilities and Business Performance

MediationVariable	Independent Variables (IV)	Step	Result	r^2	F
Ease Of Use	System	1(β1)	.477***	.509	72.074***
		2(β2)	.627***		
		3(β3 IV)	.441***		
		3(β3 MV)	.388***		
	Information	1(β1)	.503***	.496	68.908***
		2(β2)	.620***		
		3(β3 IV)	.425***		
		3(β3 MV)	.387***		
	Service	1(β1)	.589***	.529	78.500***
		2(β2)	.685***		
		3(β3 IV)	.506***		
		3(β3 MV)	.303***		
	Sensing	1(β1)	.231**	.378	42.615***
		2(β2)	.266**		
		3(β3 IV)	.134		
		3(β3 MV)	.570***		
	Seizing	1(β1)	.164*	.379	42.724***
		2(β2)	.230**		
		3(β3 IV)	.135*		
		3(β3 MV)	.579***		
	Reconfiguration	1(β1)	.324***	.362	39.802***
		2(β2)	.227**		
		3(β3 IV)	.036		
		3(β3 MV)	.589***		

Note: *p<.05, **p<.01, ***p<.001, n.s: non-significant, R2& F-value presents results of three-step

Therefore, <Hypothesis 2-1>, <Hypothesis 2-3>, <Hypothesis 2-4>, <Hypothesis 2-5>, and <Hypothesis 2-6> were adopted, and <Hypothesis 2-2> was rejected. On the other hand, the results of the multiple regression analysis were found to have a statistically significant influence on the positive (+) effect of ease of perception on resource restructuring capacity (β=.293, p<.05). In addition, it was confirmed that there was a statistically significant

positive (+) effect on the recognition of usefulness by the order of opportunity search capability (β=.285, p<.05) and resource acquisition capability (β=.255, p<.05).

In order to verify <Hypothesis 3> and <Hypothesis 4>, a 3-step mediated regression analysis suggested by Baron and Kenny (1986) was conducted. In the relationship between smart factory quality characteristics and business performance, it was confirmed that the recognition response, whether it is ease or usefulness, is partially mediated. Therefore, <Hypothesis 3-1>, <Hypothesis 3-2>, <Hypothesis 3-3>, <Hypothesis 3-4>, <Hypothesis 3-5>, and <Hypothesis 3-6> were all adopted. Regarding the relationship between dynamic capability and business performance, it was confirmed that resource acquisition capability was partially mediated; opportunity acquisition capability, and resource restructuring capability were completely mediated. It was confirmed that the usefulness recognition was completely mediated by opportunity search capability, resource acquisition capability, and resource restructuring capability. Therefore, hypothesis <Hypothesis 4-1>, <Hypothesis 4-2>, <Hypothesis 4-3>, <Hypothesis 4-4>, <Hypothesis 4-5> and <Hypothesis 4-6> were all adopted.

Table 4-5: Mediation of Usefulness Perception in The Relationship between Smart Factory Quality Characteristics, Dynamic Capabilities and Business Performance.

MediationVariable	Independent Variables (IV)	Step	Result	R^2	F
Usefulness	System	1(β_1)	.560***	.521	75.666***
		2(β2)	.627***		
		3(β3 IV)	.384***		
		3(β3 MV)	.433***		
	Information	1(β1)	.592***	.354	38.349***
		2(β2)	.620***		
		3(β3 IV)	.362***		
		3(β3 MV)	.436***		
	Service	1(β1)	.579***	.566	91.112***
		2(β2)	.685***		
		3(β3 IV)	.464***		
		3(β3 MV)	.382***		
	Sensing	1(β1)	.357**	.424	51.483***
		2(β2)	.266**		
		3(β3 IV)	.038		
		3(β3 MV)	.636***		
	Seizing	1(β1)	.351***	.423	51.213***
		2(β2)	.230**		
		3(β3 IV)	.002		
		3(β3 MV)	.649***		
	Reconfiguration	1(β1)	.210*	.431	53.048***
		2(β2)	.227**		
		3(β3 IV)	.095		
		3(β3 MV)	.630***		

Note: *p<.05, **p<.01, ***p<.001, n.s: non-significant, R2& F-value presents results of three-step.

On the other hand, the analysis to verify <Hypothesis 5>, whether the recognition response was easy (β=.601, p<.001) and useful (β=.650, p<.001), were statistically significant in business performance, respectively. It was

confirmed to have a positive (+) effect. The results of multiple regression analysis to determine which factors affect business performance more among the perceptions of ease and availability were usefulness (β=.470, p<.001) and ease of use (β=.376, p<. 001) both of which had a statistically significant positive effect.

5. Conclusions and Implications

In this study, in the era of convergence and innovative change due to the development of information and communication technology, the quality characteristics of smart factories introduced by small and medium-sized manufacturing companies for sustainable growth and the dynamic capabilities that firms must possess are business performance. We present the mediating effect of usefulness perception on employees' recognition response.

The analysis results are as follows. First, it was confirmed that the quality characteristics of the smart factory, such as system quality, information quality, and service quality, all had a significant effect on recognition response. In addition, among the quality characteristics of the smart factory, only service quality was found to have an effect on ease. Information quality and service quality had a significant effect on the recognition of usefulness, meaning it is easy to use and easily recognized by the employees of the small and medium-sized manufacturing companies that have built smart factories. It can be said that it is necessary in the enterprise, suitable for the purpose of use, can be easily understood by employees, and recognizes the need for safety and speed of the operating system. Therefore, a smart factory firm should be able to select a supplier by analyzing the supplier more accurately so that the employees can use it easily and usefully. Second, it was confirmed that among the dynamic capabilities, the ability to search for opportunities and the ability to reconstruct resources had a significant effect on the perception of ease. Resource restructuring capabilities had more influence on ease of use than opportunity search capabilities. Opportunity search capability, resource acquisition capability, and resource restructuring capability all had a significant effect on the perception of usefulness, in the order of opportunity search capability and resource acquisition capability. This means that the smart factory establishment firm can easily understand the smart factory only when it integrates and coordinates the organization for environmental changes and develops the ability to reallocate resources or change processes by reflecting new environmental conditions. In addition, the smart factory can be used easily only when the employees have the ability to respond to and understand changing external situations, the ability to collect information, and the ability to perform benchmarking. Recognizing that the information collected by the smart factory can increase work efficiency and improve work performance is an organizational advantage in understanding and responding to changing systems and in acquiring external knowledge. Therefore, a smart factory building firm must first increase the firm's capabilities and build a smart factory so that employees can use it easily and usefully. Third, it was found that system quality, information quality, and service quality, which are the quality characteristics of the smart factory, are perceived in relation to business performance, in terms of ease or usefulness. This means that in the introduction and use of the smart factory, the fact that the employees easily recognize that they obtain the necessary information using the smart factory system has a great impact on business performance. In the case of firms that have adopted the smart factory system for sustainable growth, it has been found that employees can easily think about the use of the new system and adapt to it, which has a positive effect on business performance. This implies that it is necessary to pursue a strategy to increase the learning competencies of employees. In addition, it means that smart factories allow employees to utilize the information provided by the smart factory to increase the firm's growth. Therefore, it implies that the employees should pursue a strategy that can be used efficiently in business by analyzing necessary information from the smart factory. Fourth, in the relationship between dynamic capability and business performance, it was confirmed that resource acquisition capability was partially mediated while opportunity search capability and resource restructuring capability were completely mediated. Recognition of usefulness was mediated by opportunity search capability, resource acquisition capability, and resource restructuring capability. Although the ability of employees to acquire information and resources collected from the smart factory affects business performance, it means that business performance can be further improved if the employees recognize that they can use the smart factory easily and conveniently. Therefore, it is implied that smart factory companies should use education to increase their capabilities so that the main employees recognize that the smart factory can be used easily. Fifth, it was found that recognition response had an effect on business performance. This means that the ability of employees to search for external information, the ability to acquire the necessary resources for the firm from such information, and the ability to reconstruct the internal resources of the firm affects business performance. However, it is also necessary at times for SME employees to learn how to use it easily and comfortably. In addition, external information for sustainable growth, such as the firm's product market status, new product development, and new business model, is searched and analyzed; new

business strategies are constructed by using information tailored to the firm, and the firm's capabilities are reorganized. In addition, it is important for employees to recognize that such external information is useful for their work and can help them efficiently perform their job. Fifth, it was found that recognition response had an effect on business performance. High recognition means that innovative systems, such as Smart Factory, can be easily learned and utilized by employees. It also means that the information derived from the smart factory system is useful to employees.

On the academic side, this study empirically analyzed the effects of smart factory quality characteristics and dynamic capabilities on business performance by firms that introduced the smart factory system; the organizations introduced a new system and assessed the relationship between business performance and dynamic capabilities. An empirical analysis conducted on the role of recognition response in this relationship is of academic significance. On the practical side, since the quality characteristics and dynamic capabilities of the smart factory affect the recognition response, the smart factory company can identify and use them easily and conveniently for members of the organization. This implies that education/training plans should be established so that they can be the most useful.

This study has several limitations in analyzing the results, which future research needs to supplement. First, it is necessary to verify whether similar results are produced in different industries. By analyzing the quality characteristics, dynamic capabilities, ease of use, usefulness, and business performance of each business type, a suitable management strategy can be developed for the purpose of establishing the smart factory and the dynamic capabilities of the members of the organization. Second, it is necessary to study broader contexts, such as how organizational culture affects the relationship between the smart factory system and dynamic capabilities. This would allow the smart factory system establishment company to develop a utilization strategy according to the characteristics of each business type and organizational culture. Third, as an additional analysis method according to the establishment of the smart factory system, various realistic and meaningful analyzes are required.

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