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Innovation Resistance Model of Sustainable SCM: Mediating Effect on Dynamic Capability

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Abstract

Purpose – Although the importance and necessity of "sustainable supply chain management (SCM)" is emphasized, it is often not realized due to conflicting results, the long time required, and large-scale changes brought about by sustainability. This study used the innovation resistance model to confirm the influence of sustainable SCM innovation resistance factors and dynamic capabilities on adoption intentions. This approach made it possible to understand the factors that hinder adoption of sustainability practices and to identify the relationships among influencing factors. It should also help to establish effective policies or strategies.

Design/methodology – Through a literature review, the characteristics of sustainable SCM were classified into relative advantage, compatibility, perceived risk, and complexity. The effects of these innovation characteristics on innovation resistance in sustainable SCM and the effects of innovation resistance on adoption intentions were confirmed. In addition, the effects of SCM capabilities on innovation resistance and adoption intentions were analyzed, and the mediating effect of innovation resistance was analyzed.

Findings – Compatibility, perceived risk, and flexibility had significant effects on innovation resistance. In turn, innovation resistance had a significant effect on adoption intention, and flexibility had a significant effect on intention to adopt. A partial mediating effect of resistance to innovation was confirmed.

Originality/value – Although many previous studies have acknowledged trade-offs with sustainability, most sustainable SCM studies dealt with the correlations among positive drivers of adoption, practices, and performance. This study confirmed the process of accepting sustainable SCM innovation in a single model and is expected to serve as a cornerstone for future sustainable SCM adoption studies. In addition, our findings should help establish effective policies or strategies to activate SSCM adoption by identifying the factors that hinder the adoption of sustainable SCM.

Keywords: Innovation Resistance Model, Innovation Resistance, Innovation Adoption, Sustainable SCM, SCM Dynamic Capability
JEL Classifications: C83, M10, O31

1. Introduction

Demands for sustainable practices and social responsibility on companies are growing along with the importance of non-financial information related to sustainability. A reported 67% of 182 global banks have adopted sustainability-linked lending (SLL), a form of environmental, social, and governance (ESG)-oriented lending that considers a company's ESG record when reviewing loan applications and links the borrower's sustainability-related activities to interest rates (Hana Financial Research Institute, 2021). In 2020, approximately $7.4 billion of funds were borrowed through SLL, although most were from large companies

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with a high degree of ESG development (Hana Financial Research Institute, 2021).

Consumers and stakeholders are demanding sustainable practices and social responsibility from companies, and the concept of sustainability, as part of ESG policies, is growing in importance throughout companies and their operations and supply chain management (Matos et al., 2020). The impacts of war, pandemics, and climate change are not confined to one industry or country but affect global supply chains. Incorporating sustainability into supply chains is a recognized tool to improve society and protect the environment, given that supply chains are global and intertwined among multiple stakeholders.

However, actual progress on this front has been marginal. Many companies are aware of the benefits of sustainable supply chain management (SSCM) but are not prepared to implement it due to the technical complexity and long time frames involved (Stevens and Johnson, 2016). The aim to innovate is often abandoned or results in only partial implementation because large-scale changes are required (Van et al., 2010). A number of recent studies has recognized the trade-offs involved between various sustainability-related outcomes (Matos et al., 2020; Hahn et al., 2015; Ye, Yeung and Huo, 2020). Sustainability practices, while often implemented with good intentions, do not guarantee positive outcomes and can have negative impacts. Within a supply chain, sustainability and resilience can conflict, with relatively dominant firms benefiting at the expense of weaker firms (Traustrims et al., 2020). However, most studies of SSCM deal with the correlations between positive drivers for adoption and practice and with performance through practice; studies on the roadblocks to sustainable practices are lacking.

This study identifies factors that affect adoption of sustainable SCM using the innovation resistance model. The characteristics of the innovation resistance model were defined as characteristics of SSCM, which was classified according to four innovation characteristics through a literature review. The innovation resistance model classifies these characteristics into four categories: relative advantage, compatibility, perceived risk, and complexity. The impact of these characteristics on resistance to SSCM innovation and, in turn, the impact of innovation resistance on adoption intention are analyzed.

In addition, when innovation resistance affects adoption intention, the influence of SSCM dynamic capacity on innovation resistance and adoption intentions and the role of innovation resistance are evaluated. With acceleration of change and the emergence of new competitors, it is difficult to secure a long-term sustainable competitive advantage with a single supply chain. Businesses must respond with flexible and agile strategies to changes in the business environment. SSCM dynamic capability is the ability to respond to uncertain situations and is essential for innovation and securing competitive advantages (Sambamurthy, Bharadwaj and Grover, 2003; Tapscott, Ticoll and Lowy, 2000; Thomas et al., 2018). Companies with strong dynamic capabilities are more likely to exert initiative in changing the business environment toward one that emphasizes sustainability.

The majority of companies has no desire to innovate, and only a minority is willing to change (Ram, 1987). Governments and communities often see sustainability as new and essential for future generations, but most companies will not accept it simply because it is innovative. We need to determine how companies are accepting SSCM and which innovation characteristics affect adoption intentions. Understanding the acceptance of innovation should lead to successful adoption of SSCM.

This study confirms the influence of SSCM innovation resistance factors and dynamic capabilities on adoption intentions. Because the innovation resistance model includes conflicting factors that can affect the adoption of SSCM, it is possible to confirm the relationship between complex factors that cause multicollinearity. In addition, by confirming the mediating role of innovation resistance when SSCM dynamic competency affects the intention to adopt it, the influence of dynamic competency on changes and the importance of managing innovation resistance can be confirmed. The results of this research should help establish effective policies or strategies to encourage the adoption of SSCM.

2. Empirical Framework and Hypothesis

2.1. Sustainable Supply Chain Management

In the early studies, supply chain management emerged as a concept that involved integration across functions, internal supply chain integration, and external integration encompassing suppliers and customers (Stevens, 1989). The main concerns were improving customer service and reducing inventory and operating costs, which were recognized as drivers of business performance (Johnson and Templar, 2011). The scope for supply chain management has since expanded (Rodríguez-González, Maldonado-Guzman and Madrid-Guijarro, 2022). In particular, the recent supply chain crisis has introduced the need for sustainability (Matos et al., 2020).

Sustainability encompasses economic, environmental, and social dimensions, according to a report by the United Nations, and has been defined as meeting the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987; Han Neung-Ho and Choi Doo-Won, 2022). In many studies since then, SSCM has been defined as a company's strategic efforts to achieve not only economic performance goals, but also environmental and social performance goals throughout the supply chain (Carter and Rogers, 2008; Han Neung-Ho and Choi Doo-Won, 2022; Rodríguez-González, Maldonado-Guzman and Madrid-Guijarro, 2022). To motivate companies toward sustainability, they must perceive a positive impact on those outcomes. However, positive intentions can lead to unexpected results or trade-offs between outcomes. In recent years, SSCM researchers have begun to acknowledge the trade-offs, and studies on unexpected outcomes and tension-causing factors have been conducted (Carter, Kaufmann and Ketchen, 2020; Matos et al., 2020; Hahn et al, 2015; Ye, Yeung and Huo, 2020).

However, positive and negative factors that could affect the adoption of SSCM have yet to be evaluated in a single study, as each factor was individually quantitatively evaluated. This study categorizes factors using an innovation resistance model and tries to identify those that affect adoption of SSCM by companies. This allowed us to identify key factors that have a significant impact on the SSCM adoption rate. Among these, positive factors should be emphasized, corporate interest should be encouraged, and negative factors should be addressed in future policy establishment.

2.2. A model of Innovation Resistance

Ram (1987) argued for the innovation resistance model, criticizing existing studies that focused on innovation adoption and diffusion as suffering from a pro-innovation bias. Innovation resistance and adoption coexist with innovation because they are not opposing platforms, although innovation is accepted only when innovation resistance is overcome. Resistance refers to all actions to maintain a current situation under pressure for change

(Zaltman and Wallendorf, 1983). Accordingly, innovation resistance arises from the changes caused by innovation. Rogers (2002), who advocated the diffusion of innovations theory, defined innovation as an idea, process, product, or service that an individual or organization perceives as new. Lundblad (2003) presented studies on process innovation in organizations and suggested that process innovation can also be applied to the resistance model.

Application studies of the innovation resistance model related to operations include Park Chan-Kwon and Lee Yong-Gyu (2022)'s smart factory adoption resistance study, Oh Yong-Min and Boo Je-Man (2021)'s SCM system adoption resistance study, and Chu Jin-Young and Lee Dong-Heon (2018)'s smart factory energy management system resistance study. The functional elements of the innovation resistance model are largely divided into recognized innovation characteristics, consumer characteristics, and diffusion mechanism characteristics, and these studies focused on analyzing the influence using only recognized innovation characteristics.

This study also focused on the effects of perceived innovation characteristics on innovation resistance and willingness to adopt. Perceived innovation characteristics consist of relative advantage, compatibility, perceived risk, complexity, and effect of adoption on other innovations (Ram, 1987). However, because many studies excluded the "effect of adopting other innovations," and there are no innovations other than ESG, relative advantage, compatibility, perceived risk, and complexity were used as innovation characteristics in this study, along with innovation resistance and adoption intentions.

Rogers (1995) defined the relative advantages of innovation to include not only economic benefits but also value, social costs, and savings compared with inputs. The importance is not clarity of the relative advantage, but perception of that advantage (Rogers, 2002). Ram (1987) posited that innovation resistance occurs when there is a small relative advantage or a relative disadvantage.

The suitability of an innovation is the extent to which it matches existing values, past experience, and the needs of potential adopters (Rogers, 1995). Ram (1987) expanded Rogers' definition to include the extent to which it is consistent with traditional and cultural values and current lifestyles: the better is the fit, the faster it will be accepted over other innovations (Rogers, 2002).

Perceived risks associated with innovation can be classified into physical, performance, mental, and social varieties (Rogers, 1995). The degree of perceived risk can vary depending on the degree of innovation, and major innovations are perceived as high-level risks (Ram, 1987).

Innovation complexity is the degree to which a change is difficult to understand and use and is divided into idea complexity (hard to understand) and execution complexity (Rogers, 2002). The lower is the complexity, the faster the innovation will be accepted (Rogers, 2002).

Zaltman and Wallendorf (1983) defined resistance to innovation as any attempt to maintain the status quo in the face of pressure to change. Ram (1987) argued that resistance is a natural response to innovation because humans have an innate desire to maintain psychological equilibrium.

2.3. Dynamic Capability of SCM

Dynamic capability is how a company can embrace a new and innovative competitive advantage in a volatile environment (Teece, Pisano and Shuen, 1997). In a supply chain, material and information flow up and down rather than in a single direction. Research on dynamic capabilities is essential because it focuses on rapid market change, risk, and opportunity. Newer supply chains and products, particularly with the addition of sustainability criteria, tend to be much more dynamic compared with traditional markets due to immediate changes in customer behavior or stronger influences from non-governmental organizations (Beske, 2012). The dynamic capabilities of SCM have been studied with reference to a model developed by Teece, Pisano, and Shuen (1997), but there are differences in the terminology used according to the definition of the concept. Following definitions provided by Seo Young-Kyu, Song Do-Han-Song, and Huh Hoon (2021); Lee, S.M. et al (2013); and Lee Sang M. and Rha Jin-Sung (2016), this study considers agility and flexibility as dynamic capabilities of the supply chain. In particular, Lee Sang M. and Rha Jin-Sung (2016) structured visibility, agility, and flexibility as factors in the dynamic capabilities of a supply chain to examine their own impact on ambidexterity (the ability to challenge new opportunities using existing capabilities). However, because only agility and flexibility had a significant effect on ambidexterity, only they were configured as dynamic capability variables of the supply chain in this study.

To embrace the new, companies often require radical organizational re-engineering (Teece, Pisano and Shuen, 1997). Agility, one of the dynamic competencies, is the ability to respond quickly in a changing market environment and handle strategic decision-making processes in a timely manner (Lee Sang M. et al., 2013; Lee Sang M. and Rha Jin-Sung, 2016; Seo Young-Kyu, Song Do-Han-Song and Huh Hoon, 2021). In a broad sense, agility is defined as a company's ability to actively respond to changes in the market environment and create new opportunities through structural and organizational changes (Seo Young-Kyu, Song Do-Han-Song and Huh Hoon, 2021). Companies with high supply chain agility have low inventories, respond quickly and efficiently to market changes and consumer demands, and are able to integrate effectively with suppliers and partners (Mason et al., 2002).

Firms should seek the ability to effectively integrate existing resources and combine them into new combinations (Teece, Pisano and Shuen, 1997). Flexibility is the ability to reconfigure supply chain assets, strategies, and operations to respond to changes in products, customers, and suppliers while maintaining current performance (Candace, Ngai and Moon, 2011; Lee Sang M. et al., 2013; Lee Sang M. and Rha Jin-Sung, 2016). Supply chain flexibility has a positive impact on operational output and overall organizational performance (Lee Sang M. et al., 2013; Malhotra and Mackelprang, 2012). Flexibility also has a positive effect on learning, coordination, and integration (Lee Sang M. and Rha Jin-Sung, 2016).

Developing dynamic capabilities is a long-term investment and comes with significant costs, but it is unavoidable in order to respond to the ongoing and dynamic process of sustainability demands (Siems, Land and Seuring, 2021). Beske, Land, and Seuring (2014) demonstrated through empirical research that dynamic capabilities can enhance SSCM utilization and allow betterer adaptation to improvement and change. This is because companies pursuing sustainability strategies are innovative, as are companies with high dynamic capabilities. Therefore, it is predicted that companies with high dynamic capabilities are more likely to accept SSCM.

3. Empirical Method and Data

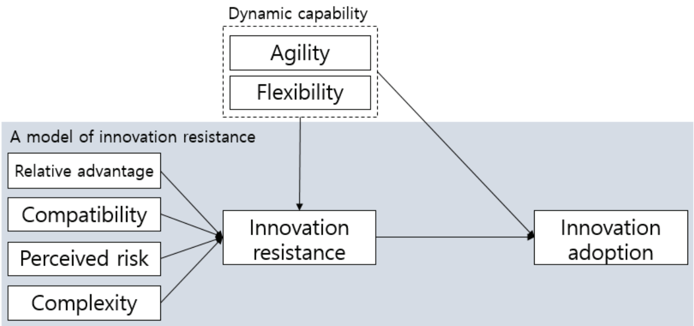
3.1. Research Hypothesis and Research Model

Park Chan-Kwon and Lee Yong-Gyu (2022), Oh Yong-Min and Boo Je-Man (2021), and

Chu Jin-Young and Lee Dong-Heon (2018) confirmed that the perceived innovation characteristics (relative advantage, compatibility, perceived risk, complexity) of the innovation resistance model had a significant effect on innovation resistance. Stevens and Johnson (2016) argued that, in order to adopt SSCM, thinking and practice must first be aligned, and the time scale and complexity of SSCM's radical change may be the reason for its slow adoption. Therefore, a hypothesis was established as follows:

H1: Relative advantage has a negative (-) effect on innovation resistance.
H2: Compatibility has a negative (-) effect on innovation resistance.
H3: Perceived risk has a positive (+) effect on innovation resistance.
H4: Complexity has a positive (+) effect on innovation resistance.
H5: Innovation resistance has a negative (-) effect on innovation adoption intention.

Fig. 1. Research Model



Lee Sang M. et al. (2013) and Seo Young-Kyu, Song Do-Han-Song, and Huh Hoon (2021) configured the dynamic capabilities of the supply chain into agility and flexibility to confirm their impact on performance. Agility is the ability to respond quickly to change, and flexibility has a positive effect on learning and adaptation (Lee Sang M. and Rha Jin-Sung, 2016). Sambamurthy, Bharadwaj, and Grover (2003) suggest that supply chain agility is essential for innovation. Gligor and Holcomb (2012) said that agility has a positive impact on operational capability. Therefore, the higher are the agility and flexibility, the lower is the resistance to innovation, and companies with high agility and flexibility are more likely to adopt innovation. It is predicted that innovation resistance will have a negative effect on the high adoption intention of companies with high dynamic capabilities. The following hypothesis was established:

H6: Agility has a negative (-) effect on innovation resistance.
H7: Agility has a positive (+) effect on innovation adoption intention.
H8: Flexibility has a negative (-) effect on innovation resistance.
H9: Flexibility has a positive (+) effect on innovation adoption intention.
H10: Innovation resistance will mediate the effect of agility on innovation adoption intention.
H11: Innovation resistance will mediate the effect of flexibility on innovation adoption intention.

3.2. Research Method

The survey targeted office workers in companies in the manufacturing industry who have not adopted SSCM and who manage supply chains. Responses to the survey were collected through online and face-to-face methods. A total of 114 questionnaires was collected, and analysis was conducted based on 113 copies, excluding one partially unanswered questionnaire.

Table 1 shows the sample frequency analysis based on a total of 113 valid samples. Machinery and equipment manufacturing had the largest number of responses, and the average annual sales for three years was 30 to 50 billion won. As for the number of employees, the highest response rate was between 10 and less than 100 people.

Table 1. Frequency Analysis of Samples (n=113)

Industry group	Freq.	%	Annual sales (billion won)	Freq.	%
Metal processing manufacturing	4	4	Less than 1	14	12.4
Rubber and plastics manufacturing	3	3	10~50	16	14.2
Manufacture of timber and wood products	6	5	50~100	22	19.5
Garment manufacturing	4	4	100~300	19	16.8
Food manufacturing	7	6	300~500	38	33.6
Medical drug manufacturing	11	10	over 50 billion won	4	3.5
Chemical manufacturing	8	7	**Number of employees**	**Freq.**	**%**
Automotive equipment manufacturing	3	3	less than 10	17	15.0
Electrical equipment manufacturing	13	12	10 to less than 100 people	45	39.8
Computer and communication equipment manufacturing	12	11	100 to less than 300 people	11	9.7
Other machinery and equipment manufacturing	15	13	300 to less than 1000	27	23.9
Other	27	24	1000+	13	11.5

The questionnaire items were rated on a 7-point scale. The operational definitions and measurement items established in this study are shown in Table 2.

Table 2. Detailed Measurement Items and References of Research Variables

Constructs	No	Detailed Measurement Items	Reference
Relative Advantage (RA)	1	Enhancing environmental performance	Darvish, Archetti and Coelho (2019), Eskandarpour, Dejax and Péton (2021), Saunders et al. (2020), Park Chan-
	2	Improvement of financial performance	
	3	Increase capital increase efficiency (investment and lending)	
	4	Benefits for overall management (time reduction, inventory management, demand forecasting, etc.)	
	5	Improving social performance (Business ethics, transparency, labor rights protection, food security issues, gender inequality, etc.)	
	6	Improve corporate image (social value)	

Constructs	No	Detailed Measurement Items	Reference
Compatibility (CP)	1	Align with existing processes	kwon and Lee Yong-gyu (2022), Gold and Heikkurinen (2018), Glover (2020), Galeazzo and Klassen (2015) Testa and Iraldo(2010) Gruchmann, et al. (2021), Ivanov (2018), Fahimnia, Jabbarzadeh and Sarkis (2018), Baumer-Cardoso et al. (2020) Golicic, Lenk and Hazen (2020)
	2	Required for the process	
	3	Align with organizational culture	
	4	Meet the needs of our employees	
Perceived Risk (PR)	1	Temporal risk due to late performance onset	
	2	Risk due to differences between proposed and actual benefits	
	3	Risk due to the difference between the proposed cost and the actual accepted cost	
	4	Causes of Conflicts with Stakeholders (Stakeholders: board of directors, shareholders, etc. who value financial performance)	
	5	Supply chain resilience (elasticity) decline	
Complexity (CX)	1	Difficult to learn, ambiguity	
	2	Requires a lot of effort (time, money, etc.) to learn	
	3	A lot of knowledge required	
	4	Difficult to apply	
	5	Requires a lot of effort (time, money, etc.) to apply	
Innovation resistance (IR)	1	Low preference for sustainable SCM	Lundblad (2003) Park Chan-kwon and Lee Yong-gyu (2022), Oh Yong-Min and Boo Je-Man (2021)
	2	Resistance to sustainable SCM	
	3	Absence of willingness to learn sustainable SCM	
	4	Absence of willingness to accept sustainable SCM	
	5	Adoption of sustainable SCM is cumbersome	
Innovation adoption intention (IA)	1	Intention to accept sustainable SCM	
	2	Actively considering adoption of sustainable SCM (degree of confidence in adoption)	
	3	Planning for future use of sustainable SCM	
	4	High interest in sustainable SCM	
	5	Use sustainable SCM in the future (plan to continue using it after adoption)	
Agility (AG)	1	Rapid decision-making in response to market changes	Shang, Shin and Lee (2018), Seo Young-Kyu and Song Do-Han and Huh Hoon (2021), Chae and Olson (2013)
	2	Rapid response to market changes	
	3	Agile response to customer needs	
	4	Execute Agile Decision Making	
Flexibility (FX)	1	Flexibility for special requirements	
	2	Flexibility to fluctuating demand	
	3	Flexibility to fluctuating delivery times	
	4	Flexibility to Competitive Supply Range	

Factor analysis and reliability and correlation analyses were conducted using SPSS 21.0 and AMOS 21.0. Hypothesis verification was analyzed by structural equation.

3.3. Factor Analysis

The KMO value was .760, higher than the standard value of .5. It is appropriate to conduct a factor analysis. As a result of exploratory factor analysis with Varimax rotation, complexity 1 was excluded because it was not grouped with complexity 2~5, as shown in Table 3. The lowest factor loading was .614, indicating high convergent validity for all survey questions, and most of the Cronbach's alpha coefficients were above or close to 0.8, indicating high reliability. As a result of confirmatory factor analysis, all standardized coefficients were significant at 0.5 or higher. The AVE value means the explanatory power, and an explanatory power of .5 or higher has an explanatory power of 50% or more. Although some factors fell short of the average variance extraction (AVE) standard of 0.5, all factors met the concept reliability (C.R) standard of 0.7 or higher, and most of the Cronbach's alpha coefficients were .8 or higher. Therefore, it is judged that the analyzed variables were properly measured through the items in this study.

Table 3. Factor Validity and Reliability Analysis

Variables		EFA				CFA	AVE	C.R.	Cronbach's Alpha
		1	2	3	4	Estimate			
Relative Advantage	4	.895	.128	.059	.160	.804	.463	.837	.872
	5	.772	.152	.071	.021	.668			
	1	.687	.299	.219	-.099	.734			
	6	.680	.158	.287	-.085	.652			
	2	.632	.463	.012	.033	.758			
	3	.624	.529	-.013	.026	.786			
Compatibility	1	.184	.852	-.169	.063	.849	.508	.804	.877
	3	.128	.843	-.024	-.054	.751			
	4	.294	.823	.021	-.081	.886			
	2	.295	.742	.165	.037	.713			
Perceived risk	3	.148	-.082	.813	.094	.796	.417	.778	.830
	2	.163	-.049	.802	.140	.819			
	4	.112	-.041	.800	-.041	.704			
	1	.208	.197	.736	.163	.737			
	5	-.080	.022	.614	.259	.529			
Complexity	2	.075	.046	-.010	.833	.611	.341	.673	.781
	3	.224	.149	.110	.832	.680			
	4	-.266	-.162	.280	.658	.684			
	5	-.079	-.143	.409	.653	.753			
KMO (Kaiser-Meyer-Olkin)									.762
Bartlett's Test of Sphericity								Chi-Square	1276.562
								df(p)	171(.000)

Notes: EFA=Exploratory Factor Analysis, CFA=Confirmatory Factor Analysis, AVE=Average Variance Extracted, CR=construct reliability, df=degree of freedom

The results of correlation analysis are shown in Table 4. Most correlations were significant at the $p<.05$ level. In order to verify the correlations between some factors that are not within the significance level, the square value of the correlation must be smaller than the AVE value. Based on this, all of the criteria were satisfied.

Table 4. Correlation Coefficient Analysis

	RA	CP	PR	CX	AVE
RA	1	0	0	0	0.463
CP	.656*** (0.430336)	1	0	0	0.508
PR	.297** (0.088209)	.015 (0.000225)	1	0	0.417
CX	.019 (0.000361)	.091 (0.008281)	.464*** (0.215296)	1	0.341

Notes: *p<0.1, **p<0.05, ***p<0.001.
( )=square of the correlation coefficient

4. Research Results

The model fit of the research model is presented in Table 5. The results of χ^2=1268.302, df=605, p=.000, χ^2/df=2.096, IFI= .825, TLI=.804, CFI= .822, RMSEA= .099, PCFI=.747 met or were close to the general standard values (χ2/df less than 3, IFI 0.9 or more, CFI 0.9 or more, RMSEA 0.1 or less, PCFI = 0~1 with higher values being better), confirming that the model fit indices were appropriate.

Table 5. Research Model Fit

χ^2	df	P	χ^2/df	IFI	TLI	CFI	RMSEA	PCFI
1268.302	605	.000	2.096	.825	.804	.822	.099	.747

Notes: IFI=Incremental Fit Index, TLI=Turker-Lewis Index, CFI=Comparative Fit Index, RMSEA=Root Mean Square Error of Approximation, PCFI= Parsimony Comparative Fit Index

The hypotheses verification results of H1~9 are presented in Table 6. H1 to 4 are the effects of innovation characteristics on innovation resistance. Relative advantage (H1) and complexity (H4) did not have significant effects on innovation resistance. However, a simple regression analysis with two factors as independent variables was analyzed and is presented in Table 8. The simple regression result of relative advantage on innovation resistance was significant at .078, but R^2 was low at .028. This seems to indicate rejection because the explanatory power of the relative advantage is small in the overall model. In addition, since the simple regression analysis on the effect of relative advantage on the intention to adopt is significant, studies can be conducted with relative advantage as a parameter. A simple regression analysis on complexity was also conducted, but neither innovation resistance nor adoption intention had a significant effect.

Compatibility (H2) and perceived risk (H3) had a significant effect on innovation resistance. Compatibility was shown to have a negative effect on innovation resistance, which can be interpreted as a decrease in innovation resistance when innovation suitability is high. Compatibility means matching the company's process and organizational culture, suggesting that a match in direction of SSCM and the company's current process will reduce resistance to innovation. In order to decrease resistance to SSCM, it should be explained how the SSCM is not significantly different from the existing process. On the other hand, perceived risk appears to have a positive effect, indicating that innovation resistance increases when perceived risk is high. Perceived risk includes time and money consumption and conflict with stakeholders. Therefore, know-how and government support from companies that have successfully adopted SSCM will be needed to minimize these risks. In particular, the combination of fit and risk can be thought of as switching costs. The cost incurred in switching to SSCM is defined as the additional cost incurred when changing from an existing provider to another, according to Porter's (1980) definition. Such switching costs include not only financial losses, but also relational and procedural switching costs. Therefore, in order to switch to SSCM, there are large hurdles from the standpoint of companies, and resistance to innovation will be reduced only when the size of the hurdles and conversion costs are reduced.

Next, H5 is the effect of innovation resistance on adoption intention. Since the coefficient is negative, when innovation resistance is high, the intention to adopt is low. Therefore, if resistance to innovation is reduced by adjusting compatibility and perceived risk, the number of companies accepting SSCM will increase.

Agility, H6, did not have a significant effect on innovation resistance and did not affect adoption intention, H7. Therefore, when agility affects adoption intention, verification of the mediating effect of innovation resistance fails. On the other hand, in H8 and H9, flexibility had significant effect on innovation resistance and adoption intention, respectively. Accordingly, when flexibility affects the intention to adopt, verification of the mediating effect of innovation resistance proceeded to the next step.

The verification results of H10 and H11 are presented in Table 7, and direct effects, indirect effects, and total effects are indicated. The mediating effect was verified using the Sobel test value. H10 was rejected because H7 and H8 were not significant, and the Sobel test value was not significant. On the other hand, H11 had a significant Sobel test value of -2.6354. Therefore, innovation resistance shows a mediating effect when flexibility affects adoption intention. Companies with high flexibility in SCM have a high intention to adopt SSCM, but innovation resistance decreases intention to adopt. These results suggest that, since innovation resistance reduces the intention to adopt SSCM, it is possible to increase the intention of companies with high supply chain flexibility to adopt SSCM by reducing the degree of innovation resistance by adjusting the suitability and perceived risk, which are antecedents of innovation resistance.

Table 6. Results of H1~7

Hypothesis				Estimate	S.E.	C.R.	P	S.Estimate	Result
H1	RA	→	IR	-.129	.179	-.722	.470	-.076	Rejected
H2	CP	→	IR	-.491	.137	-3.586	.000 ***	-.364	Accepted
H3	PR	→	IR	.283	.152	1.855	.064 *	.170	Accepted
H4	CX	→	IR	.081	.135	.598	.550	.052	Rejected
H5	IR	→	IA	-.479	.067	-7.169	.000 ***	-.577	Accepted
H6	AG	→	IR	-.126	.106	-1.187	.235	-.096	Rejected
H7	AG	→	IA	-.007	.085	-.082	.935	-.006	Rejected
H8	FX	→	IR	.275	.097	2.838	.005 ***	.230	Accepted
H9	FX	→	IA	.194	.080	2.441	.015 **	.196	Accepted

*p<0.1, **p<0.05, ***p<0.001.

Table 7. Results of H10~11

Hypothesis		Direct effect	Indirect effect	Total effect	Sobel test(Zp)	Result
H10	AG→IR→IA	-.006	0.055392	0.049392	1.1725	Rejected
H11	FX→IR→IA	.196	-0.13271	0.06329	-2.6354	Accepted

Table 8. Additional Regression Results

	Estimate	S.E.	S.Estimate	t	p	R^2
RA→IR	-.269	.152	-.166	-1.777	.078*	.028
RA→IA	.389	.131	.271	2.967	.004**	.074
CX→IR	.143	.139	.097	1.031	.305	.009
CX→IA	.121	.123	.093	.985	.327	.009
FX→IA	.220	.093	.218	2.359	.020**	.048
FX →IA	.191	.078	.189	2.437	.000***	.582
IR →IA	-.478	.069	-.540	-6.691		

*p<0.1, **p<0.05, ***p<0.001.

5. Conclusion

This study used the innovation resistance model to confirm the influence of sustainability SCM innovation resistance factors and SCM dynamic capabilities on adoption intentions. The influence of relative advantage, compatibility, perceived risk, and complexity, which are characteristics of the innovation resistance model, on resistance to sustainable SCM innovation was confirmed. Again, we confirm the effect of innovation resistance on adoption intention. In addition, the effects of SCM dynamic competency on innovation resistance and adoption intention and the role of innovation resistance were confirmed.

The analysis results are as follows. First, only compatibility and perceived risk had a significant effect on innovation resistance. Second, innovation resistance had a significant effect on adoption intention. Third, only flexibility among dynamic competencies had a significant effect on innovation resistance and adoption intention. Finally, when flexibility affects adoption intentions, there was a mediating effect of innovation resistance to decrease the influence of flexibility.

The significance of the study results is as follows. While the evaluation and results of sustainability are divided into positive and negative, the factors that can affect adoption of sustainable SCM are in a conflicting relationship with each other. This study classified the previously reported complex relationships between factors using the innovation resistance model and confirmed the influence relationship between them in one model. As a result, relative advantage has a significant effect in individual situations such as a simple regression analysis but does not have a significant effect overall. Innovation resistance and adoption intention differed depending on the dynamic capabilities of the company, and the mediating effect of innovation resistance was confirmed. Therefore, innovation resistance must be reduced when establishing policies to encourage enterprises to adopt SSCM. In order to reduce innovation resistance, a company must increase the suitability and flexibility of their processes and support the recognized risk (disadvantages). Compatibility and risk can be considered as costs incurred in switching to SSCM. Since the performance of sustainability includes non-financial performance (environmental and social effects), the relational and procedural switching costs should be reduced so the company can afford to reduce resistance to innovation and increase the intention to adopt it. Next, the company's capabilities should be increased to allow high compatibility and flexibility of SSCM. These goals should include not only a company, but all stakeholders throughout the entire supply chain and the government's infrastructure. To this end, it is necessary to encourage companies to recognize and accept SSCMs, which are important for the health of humans and the planet.

The limitation of this study is the small number of samples and the wide distribution of industrial groups. Future research should focus on a single industry with a larger number of companies. In addition, since the significant independent variable of perceived risk can have various sub-factors, a study that subdivides the types of perceived risk will be helpful. It is expected that the present study will contribute to adoption of SSCM in more companies.

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