

카노 모형을 이용한 화주의 컨테이너항만 선택 모형 분석

한국SCM학회 2019 춘계컨퍼런스,
2019.05.24, 09:00~18:00, 서울 대한상공회의소

박병인, 물류통상학부 , 전남대학교
고창성, 산업경영공학과, 경성대학교

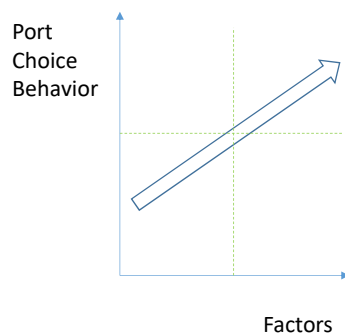
KSCM 2019 Spring Conference

2/41

PRESENTATION OUTLINE

• RESEARCH MOTIVATION	3
• RESEARCH GOALS & METHODOLOGY	5/6
• LITERATURE REVIEWS	7
• ASSUMPTIONS	9
• KANO MODEL	10
• EMPIRICAL TESTS	17
• FINDINGS of the KANO ANALYSIS	25
• STRATEGIES BUILDINGS by EFA, CFA, and IPMA	26
• IMPLICATIONS	35
• CONCLUSIONS AND FUTURE STUDY	39/40

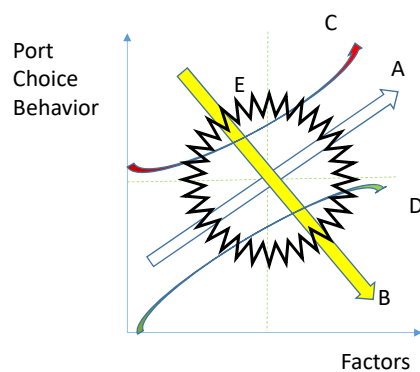
RESEARCH MOTIVATION



• Implicit assumptions of the factor characteristics

- Proportional relationship to port choice behavior
 - ❖ Linear relations between port selection factors and behavior (see left graph)
- Beliefs: **The larger, the better**
 - ❖ prefer a larger score on the Likert scale

RESEARCH MOTIVATION



• Possible forms of the port choice factors to behavior

- **Linear**
 - ❖ Proportional (A)
 - ❖ Reversal (B, wrong question) reverse calculation \Rightarrow Positive
- **Nonlinear** (Swan and Combs, 1976)
 - ❖ Expressive (C)
 - ❖ Instrumental (D)
- **Indifferent** (E)

RESEARCH GOALS

- To identify the factor **characteristic forms for the land-side decision makers** through the **Kano model**
 - Linear
 - Non-linear
- **To modify and develop the port choice model** for shippers and forwarders
 - With factor characteristics
 - To improve port choice behavioral analysis
- **To build the revised strategies** for a port
 - Via a new approach with an **IPMA(Importance-Performance Map Analysis)** approach

METHODOLOGIES

- Background theory
 - **The Kano Model**
 - **The Structural Equation Modeling**
- **Empirical study**
 - **Pooling and condensing a potential factor set** ← literature reviews and interviews
 - Analyzing **factor characteristics** ← a survey with **Kano questionnaires**
 - Applying an **IPMA** approach to the survey results ← **EFA & CFA**
 - Research **findings and implications**

KSCM 2019 Spring Conference 7/41

LITERATURE REVIEWS

Factors		①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	⑯	⑰	⑱
Port Location	Network Accessibility			●	●		●		●		●		●		●		●		●
	Inland transit time					●		●		●		●		●		●		●	
	Inland transit cost	●		●		●		●		●		●		●		●		●	
Port Efficiency	Geographical location	●			●				●	●		●		●		●		●	
	Speedy cargo handling				●		●		●	●		●		●		●		●	
	Reliable cargo handling				●		●		●	●		●		●		●		●	
Port Effectiveness	Congestion	●		●		●					●					●			
	Cargo damage		●						●	●		●		●				●	
	Quick response to customers needs		●						●	●		●		●				●	
	Service quality							●			●	●						●	
	Customs handling	●																●	
Port connectivity	Port safety and security	●							●					●				●	
	Port management		●						●									●	
	Frequency	●		●	●	●	●		●	●		●		●		●		●	
Charges	Intermodal links	●						●		●		●		●				●	
	No. of shipping services					●	●											●	
Port infrastructures	THC	●							●				●		●		●		●
	Freight rates		●	●												●		●	
	Port facilities	●	●	●		●		●	●	●	●	●	●	●	●	●	●	●	●
	Port size	●			●												●	●	●
	Port throughput volume		●	●	●	●								●		●	●	●	●

Source: Martinez and Feo(2016), and revised and recategorized by the authors.
 ①: ① Slack, 1985; ② Murphy et al., 1992; ③ Kim, 1993; ④ Cho, 2002; ⑤ Nir et al., 2003; ⑥ Tiwari et al., 2003; ⑦ Veldman & Bolkmann, 2003; ⑧ Yeo et al., 2004; ⑨ Ugbonna et al., 2006; ⑩ De langen, 2007; ⑪ Yeo et al., 2008, 2011; ⑫ Tongzon, 2009; ⑬ Onut et al., 2010; ⑭ Caillaux et al., 2011; ⑮ Steven & Corsi, 2012; ⑯ Yuen et al., 2012; ⑰ Castillo-Marzano et al., 2013; ⑱ Ng et al., 2013

KSCM 2019 Spring Conference 8/41

LITERATURE REVIEWS

- All the research is probably based on the **implicit assumption**
 - **proportional relationship** of factors to port choice behavior
 - **No existed researches** which dealt with **the characteristics form** of factors
- Collecting the potential port selection criterion through the literature reviews, and Min & Park(2019)
 - Port location-related criteria (Network Accessibility, **inland transit cost**)
 - Port efficiency-related criteria (Cargo handling speed, cargo handling reliability)
 - Port effectiveness-related criteria (Customs handling, **port operation skill**)
 - Port connectivity-related criteria (A variety of shipping routes)
 - Charges-related criteria (THC, **freight rates**)
 - Port infrastructures-related criteria (Port and terminal size)

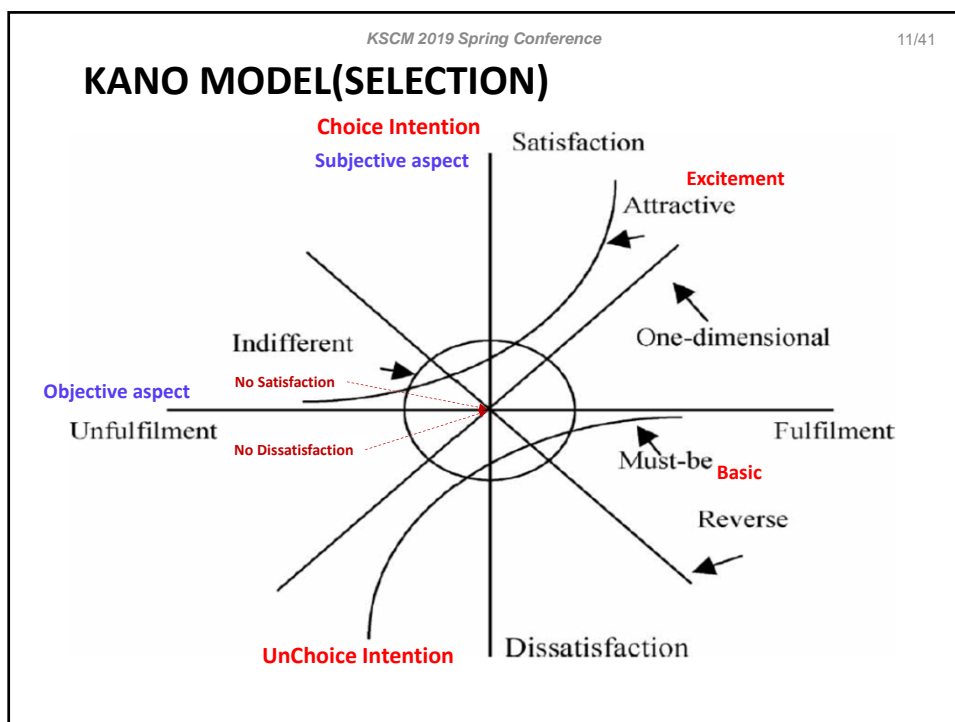
ASSUMPTIONS

- The port users select ports by the **preference recognitions or perceptions** to several related factors of their own
- Port choice factors would be a **multi-dimensional** form to choice behavior
 - Proportional form
 - Factors affecting selection behavior only above a certain level (Attractive or excitement)
 - Minimum requirements (Must-be)
 - Indifferent

⇒ We may construct a port choice behavior structure reflecting each factor characteristics via the Kano model.

The KANO MODEL

- Developed by **Kano, Noriaki et al. (1984)**
 - **Two-dimensional service-quality modeling**
 - ❖ Kano, N., Seraku, N., and Takahashi, F. (1984), "Attractive quality and must-be quality," *The Journal of the Japanese Society for Quality Control*, 14(2), 39-48. – Written by Japanese
 - Based on the idea of **Herzberg's Motivator-Hygiene Theory**
 - So-called **three-factor theory**
- Assumption
 - The existence of **nonlinear and asymmetric relationships**
 - Between the attribute-level performance of service factors and overall customer satisfaction (OCS)



KSCM 2019 Spring Conference 12/41

Factor Categories in Kano Model

Characteristics	Definition	Recommendations
Attractive (Satisfiers) -Excitement	An <i>Attractive</i> attribute leads to a better satisfaction , whereas its absence does not increase dissatisfaction	Include a good number of <i>Attractive</i> attributes
One-dimensional (Criticals)	A <i>One-dimensional</i> attribute fulfillment helps enhance the satisfaction and vice versa.	Include a good number of <i>One-dimensional</i>
Must-be (Dissatisfiers) -Basic	A <i>Must-be</i> attribute absence produces absolute dissatisfaction and its presence does not increase satisfaction	Continue <i>Must-be</i> attributes
Indifferent (Neutrals)	An <i>Indifferent</i> attribute, that result neither in satisfaction nor dissatisfaction, whether fulfilled or not.	Avoid <i>Indifferent</i> attributes as many as possible
Reverse	A <i>Reverse</i> attribute presence causes dissatisfaction and its absence causes satisfaction.	Avoid <i>Reverse</i> attributes

() : Cadotte, E. and Turgeon, N.(1988), "Dissatisfiers and Satisfiers : Suggestions from Consumer Complaints and Compliments," *Journal of Consumer Satisfaction, Dissatisfaction, and Complaining Behavior*, 1, 74-79.

Structure of Kano Questionnaires

Positive questions

How do you feel if a variety of service routes is high?

- ⑤ I like it that way
- ④ I expect it to be that way
- ③ I am neutral
- ② I can live with it that way
- ① I dislike it that way

Negative questions

How do you feel if a variety of service routes is low?

- ⑤ I like it that way
- ④ I expect it to be that way
- ③ I am neutral
- ② I can live with it that way
- ① I dislike it that way

Kano Evaluation

Customer requirements ↓	Dysfunctional (negative) question →				
	1. like	2. must be	3. neutral	4. live with	5. dislike
1. like	Q	A	A	A	O
2. must-be	R	I	I	I	M
3. neutral	R	I	I	I	M
4. live with	R	I	I	I	M
5. dislike	R	R	R	R	Q

Customer requirement is ...

A: Attractive
M: Must-be
R: Reverse

O: One-dimensional
Q: Questionable
I: Indifferent

Model Weaknesses

Code	(Original) Kano Model						evaluation
	A	O	M	I	R	S	
F01	4	16	5	9	0	1	One-dim.
F02	3	16	7	9	0	0	One-dim.
F03	3	13	7	11	0	1	One-dim.
F04	2	19	5	8	0	1	One-dim.
F05	4	12	6	11	0	2	One-dim.
F06	4	10	9	12	0	0	Indiff.

- The Kano model categorizes the quality attributes
 - by the frequency analysis
 - with a two-dimensional evaluation table

Customer Satisfaction Coefficient (CS-Coefficient: Berger et al., 1993)

- Indicative of **how strongly a product feature may influence satisfaction** or, in case of its "non-fulfillment" customer dissatisfaction
 - Extent of **satisfaction**: $(A+O)/(A+O+M+I)$
 - Extent of **dissatisfaction**: $(O+M)/(A+O+M+I) \times (-1)$
 - ❖ A minus sign is put in front of the CS-coefficient of customer dissatisfaction to emphasize its **negative influence on customer satisfaction** if this quality is not fulfilled

Berger, C. et al. (1993), "Kano's methods for understanding customer-defined quality," Center for Quality of Management Journal, 2(4), 2-36.

EMPRRITICAL TESTS

- A Kano Approach
 - Survey
 - Analysis
- An IPMA(Importance-Performance Map Analysis) Approach
 - Exploratory Factor Analysis
 - Confirmatory Factory Analysis
 - IPMA

A Kano Approach : Survey

Survey (2017.09.01~30)

Distributed	Collected	Valid
100	40	35

the Surveyed Factor-set

code	Selection factors	code	Selection factors
F01	Speedy cargo handling	F07	Quality of staff
F02	Reliable cargo handling	F08	A variety of service routes
F03	Cost for terminal handling	F09	Inland Network Accessibility
F04*	Abundance of container boxes	F10	Size of the port and terminal
F05*	Maintenance of empty containers	F11	Cost for inland transportation
F06	Customs handling	F12	Freight rates

* Added to the set from field interviews

Survey

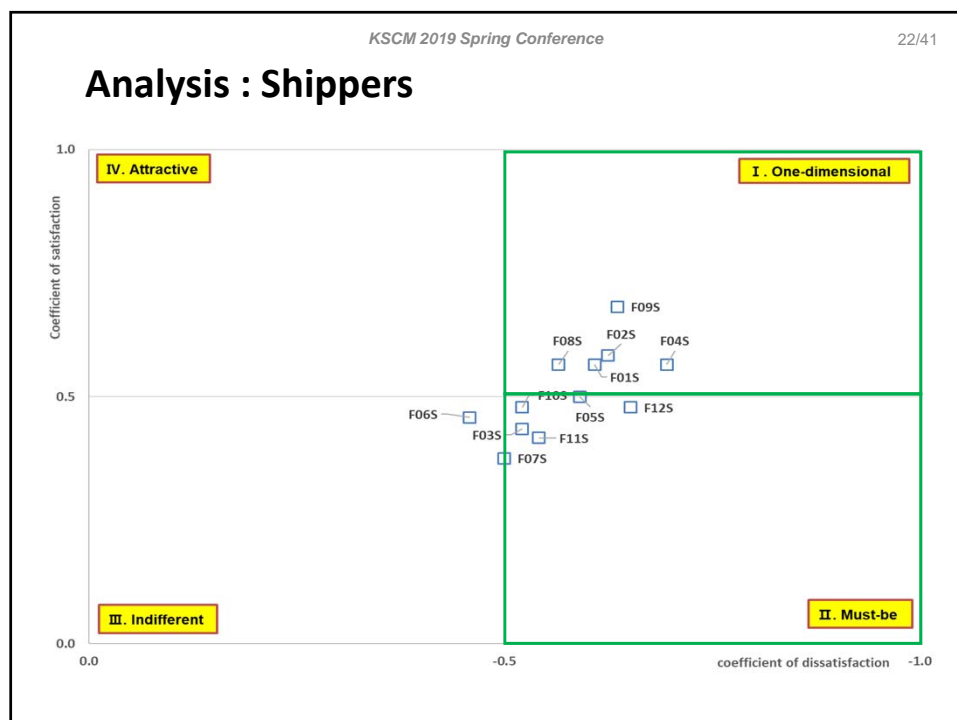
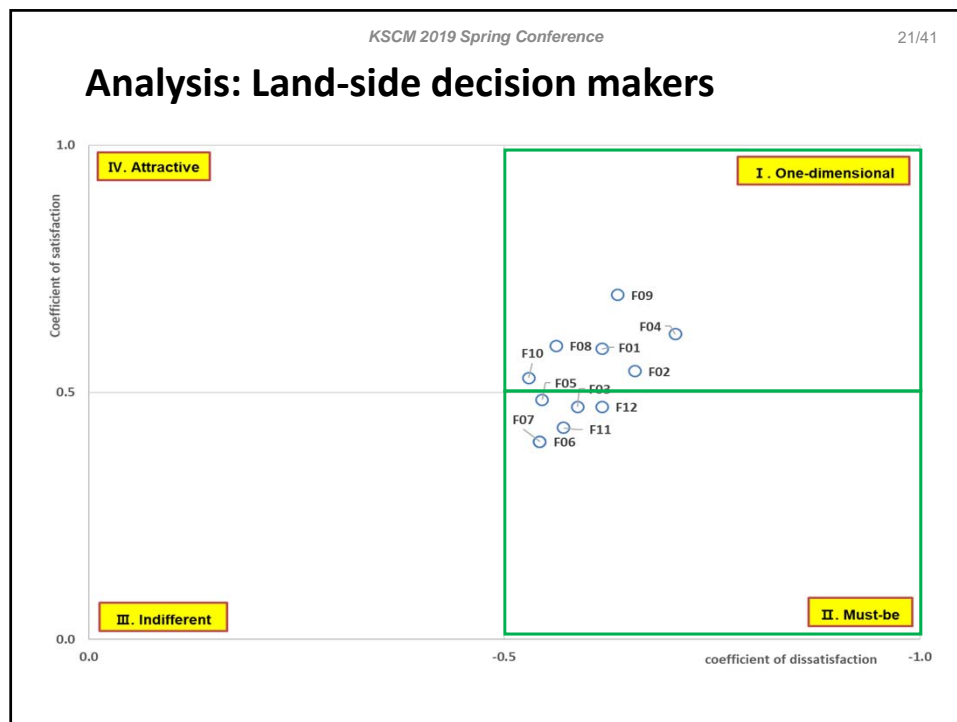
Demographical Statistics

Decision makers		Main usage port		Respondents			
Type	No.(%)	Port	No.(%)	Rank	No.	Seniority	No.
Shipper	24(68.6)	Gwangyang	22(62.9)	Ass. Manager	7	1~3yr	5
				Manager	11	3~5yr	7
Forwarder	11(31.4)	Busan	11(11.0)	Deputy General Manager	5	5~10yr	10
				General Manager	4	10yr ~	13
				Director	8		
Total	35(100.0)	Incheon	2(2.0)	Total	35	Total	35
		Total	35(100.0)				

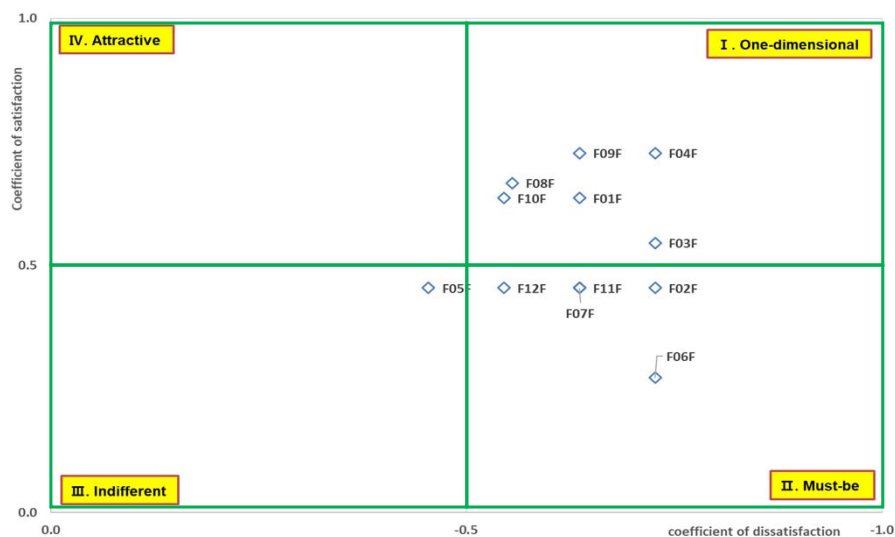
- ✓ Survey period: 01/09/2017-30/09/2017
- ✓ Questionnaire collection: email and in-depth interview

Analysis : Lind-side Decision Makers

Code	(Original) Kano Model						Satisfaction coefficients			
	A	O	M	I	R	S	Evaluation	Satisfaction	Dissatisfaction	Evaluation
F01	4	16	5	9	0	1	One-dim.	0.5882	-0.6176	One-dim.
F02	3	16	7	9	0	0	One-dim.	0.5429	-0.6571	One-dim.
F03	3	13	7	11	0	1	One-dim.	0.4706	-0.5882	Must-be
F04	2	19	5	8	0	1	One-dim.	0.6176	-0.7059	One-dim.
F05	4	12	6	11	0	2	One-dim.	0.4848	-0.5455	Must-be
F06	4	10	9	12	0	0	Indiff.	0.4000	-0.5429	Must-be
F07	4	10	9	12	0	0	Indiff.	0.4000	-0.5429	Must-be
F08	5	14	4	9	2	1	One-dim.	0.5938	-0.5625	One-dim.
F09	4	19	2	8	0	2	One-dim.	0.6970	-0.6364	One-dim.
F10	3	15	3	13	0	1	One-dim.	0.5294	-0.5294	One-dim.
F11	3	12	8	12	0	0	One-D./Indiff.	0.4286	-0.5714	Must-be
F12	3	13	8	10	1	0	One-dim.	0.4706	-0.6176	Must-be



Analysis : Forwarders



RESULTS OF THE KANO ANALYSIS

Characteristics	Landside Decision-makers		Shippers		Freight forwarders	
	code	factor	code	factor	code	factor
Attractive						
One-dimem.	F01	Speedy cargo handling			F01F	Speedy cargo handling
	F02	Reliable cargo handling	F01S	Speedy cargo handling	F03F	Cost for terminal handling
	F04	Abundance of container boxes	F02S	Reliable cargo handling	F04F	Abundance of container boxes
	F08	A variety of service routes	F04S	Abundance of container boxes	F08F	A variety of service routes
	F09	Inland Network Accessibility	F08S	A variety of service routes	F09F	Inland Network Accessibility
	F10	Size of the port and terminal	F09S	Inland Network Accessibility	F10F	Size of the port and terminal
			F05S	Maintenance of empty containers		
Must-be	F03	Cost for terminal handling	F03S	Cost for terminal handling	F02F	Reliable cargo handling
	F05	Maintenance of empty containers	F10S	Size of the port and terminal	F06F	Customs handling
	F06	Customs handling	F11S	Cost for inland transportation	F07F	Quality of staff
	F07	Quality of staff	F12S	Freight rates	F11F	Cost for inland transportation
	F11	Cost for inland transportation			F12F	Freight rates
	F12	Freight rates				
Indifference			F07S	Quality of staff		
			F06S	Customs handling	F05F	Maintenance of empty containers

FINDINGS of the KANO ANALYSIS

- There may be some factors which **contradict the implicit assumption** that port selection factors are proportional to port choice behavior
- The characteristics of the port selection attributes are **different from each stakeholder**
 - Characteristics of port selection attributes differ between shippers and forwarders
 - ❖ Factors that have only the same characteristics between each land-side users
 - Must-be(F11, F12), and One-dimensional (F01, F04, F08, F09)
 - ❖ **Possible problems** that mismatch characteristics between each land-side users
 - Possibility of the **unnecessary effort of a service provider** that does not reflect user characteristics
 - The conflict in the factor characteristics between the service providers of port facilities (PAs, TOCs, Government) and the land-side users may evoke some problems
 - ❖ **The Inefficiency of implementing port policies**
 - ❖ **The inefficiency of port management**

STRATEGIES BUILDING

- Exploratory Factor Analysis

Communalities

	Initial	Extraction
F01	1.000	.741
F02	1.000	.793
F03	1.000	.682
F04	1.000	.793
F05	1.000	.768
F06	1.000	.883
F07	1.000	.760
F08	1.000	.609
F09	1.000	.612
F10	1.000	.802
F11	1.000	.577
F12	1.000	.516

Extraction Method: Principal Component Analysis.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.741
Bartlett's Test of Sphericity	Approx. Chi-Square	361.360
	df	66
	Sig.	.000

Rotated Component Matrix^a

	Component	
	FAC1	FAC2
F06	.915	.215
F04	.886	.087
F05	.867	.123
F07	.782	.385
F12	.691	.196
F08	.664	.409
F02	.292	.841
F01	.271	.817
F09	.079	.778
F10	.444	.778
F03	.301	.769
F11	.046	.758

Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaiser Normalization.
 a. Rotation converged in 3 iterations.

STRATEGIES BUILDING

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.500	54.163	54.163	6.500	54.163	54.163	4.361	36.342	36.342
2	2.035	16.961	71.124	2.035	16.961	71.124	4.174	34.782	71.124
3	.978	8.152	79.276						
4	.688	5.735	85.011						
5	.619	5.162	90.172						
6	.327	2.728	92.900						
7	.234	1.948	94.848						
8	.219	1.824	96.672						
9	.204	1.697	98.369						
10	.101	.839	99.208						
11	.055	.462	99.670						
12	.040	.330	100.000						

Extraction Method: Principal Component Analysis.

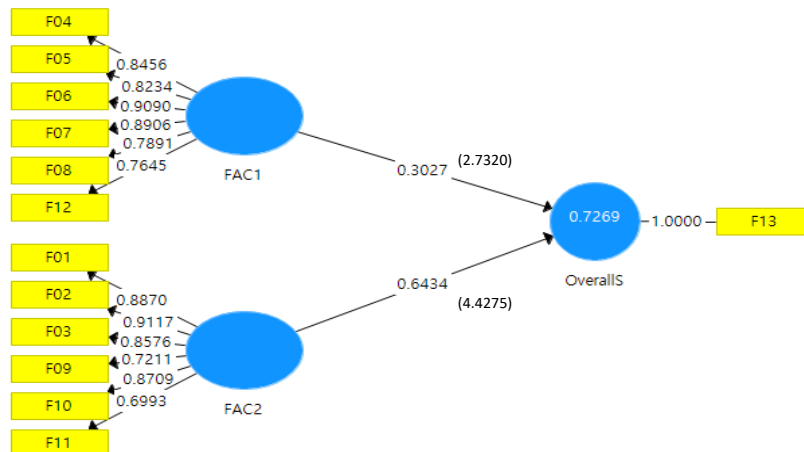
STRATEGIES BUILDING

• PLS-SEM : Results summary for the measurement models

Const ruct	Indicat ors	Factors	Convergent validity			Internal Consistency Reliability		Discriminant Validity
			Loadings	T-value	AVE	Composite Reliability	Cronbach α	
			>0.70	>1.96	>0.50	0.60-0.95	0.60-0.95	Not include 1 ?
	F04	Abundance of container boxes	0.8456	7.6024				
	F05	Maintenance of empty containers	0.8234	7.6603				
FAC1	F06	Customs handling	0.9090	11.947	0.7033	0.9341	0.9153	Yes
	F07	Quality of staff	0.8906	18.7921				
	F08	A variety of service routes	0.7891	9.9398				
	F12	Freight rates	0.7645	6.3046				
	F01	Speedy cargo handling	0.8870	15.5744				
	F02	Reliable cargo handling	0.9117	28.2443				
FAC2	F03	Cost for terminal handling	0.8576	13.7432	0.6868	0.9287	0.9080	Yes
	F09	Inland Network Accessibility	0.7211	6.3096				
	F10	Size of the port and terminal	0.8709	25.6742				
	F11	Cost for inland transportation	0.6993	4.1763				

STRATEGIES BUILDING

Path coefficients with t-values and outer loadings



STRATEGIES BUILDING

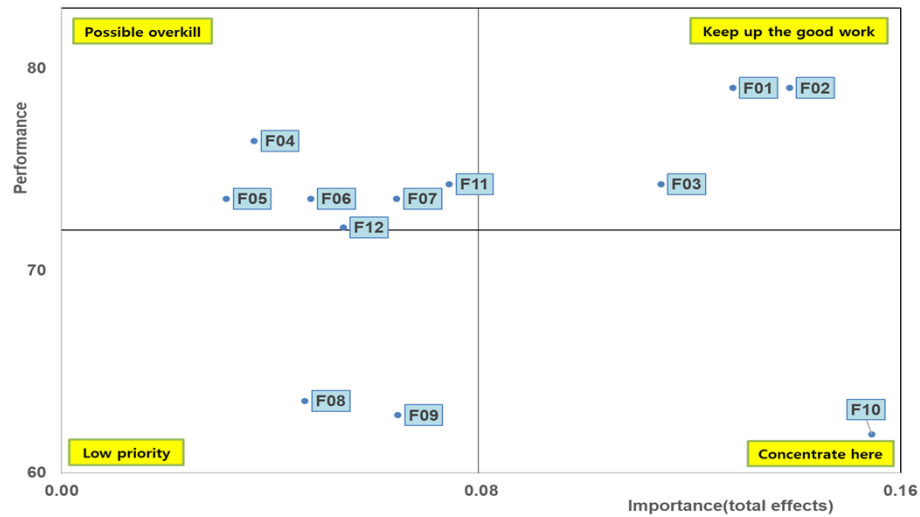
Decision makers' importance and choice intentions by the IPMA module

Selection factors	Land-side decision-makers			shippers			forwarders		
	code	importance	performance	code	importance	performance	code	importance	performance
Speedy cargo handling	F01	0.1280	79.0476	F01S	0.1167	80.5556	F01F	0.1874	75.7576
Reliable cargo handling	F02	0.1388	79.0476	F02S	0.1293	81.9444	F02F	0.1919	72.7273
Cost for terminal handling	F03	0.1143	74.2857	F03S	0.1267	79.1667	F03F	0.0997	63.6364
Abundance of container boxes	F04	0.0367	76.4286	F04S	0.0426	72.9167	F04F	0.0061	84.0909
Maintenance of empty containers	F05	0.0314	73.5714	F05S	0.0356	71.8750	F05F	0.0040	77.2727
Customs handling	F06	0.0475	73.5714	F06S	0.0444	73.9583	F06F	0.0114	72.7273
Quality of staff	F07	0.0639	73.5714	F07S	0.0642	73.9583	F07F	0.0119	72.7273
A variety of service routes	F08	0.0464	63.5714	F08S	0.0493	68.7500	F08F	0.0073	52.2727
Inland Network Accessibility	F09	0.0641	62.8571	F09S	0.0604	69.4444	F09F	0.0836	48.4848
Size of the port and terminal	F10	0.1545	61.9048	F10S	0.1549	68.0556	F10F	0.2250	48.4848
Cost for inland transportation	F11	0.0739	74.2857	F11S	0.0553	77.0833	F11F	0.1762	68.1818
Freight rates	F12	0.0537	72.1429	F12S	0.0510	72.9167	F12F	0.0109	70.4545
Overall Satisfaction	F13		78.0952	F13S		80.5556	F13F		72.7273

KSCM 2019 Spring Conference

31/41

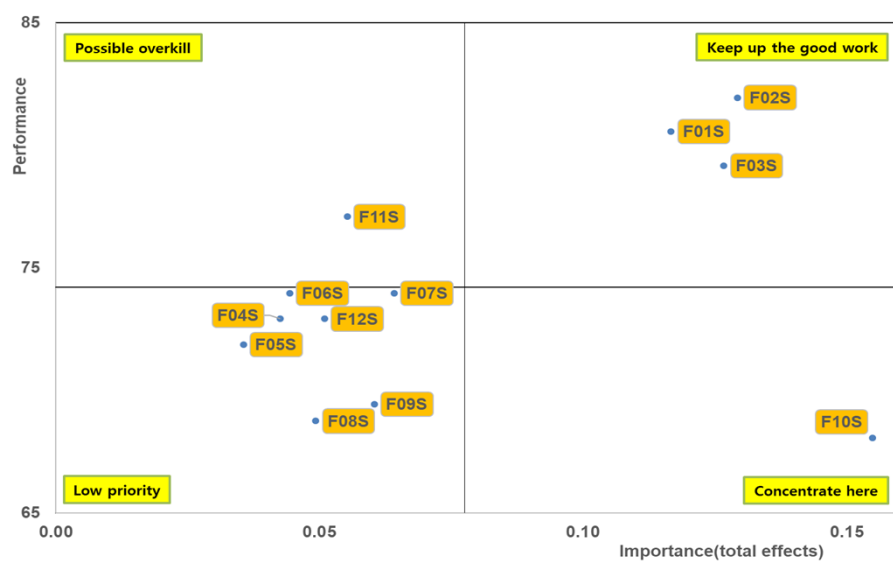
IPMA(land-side decision-makers)



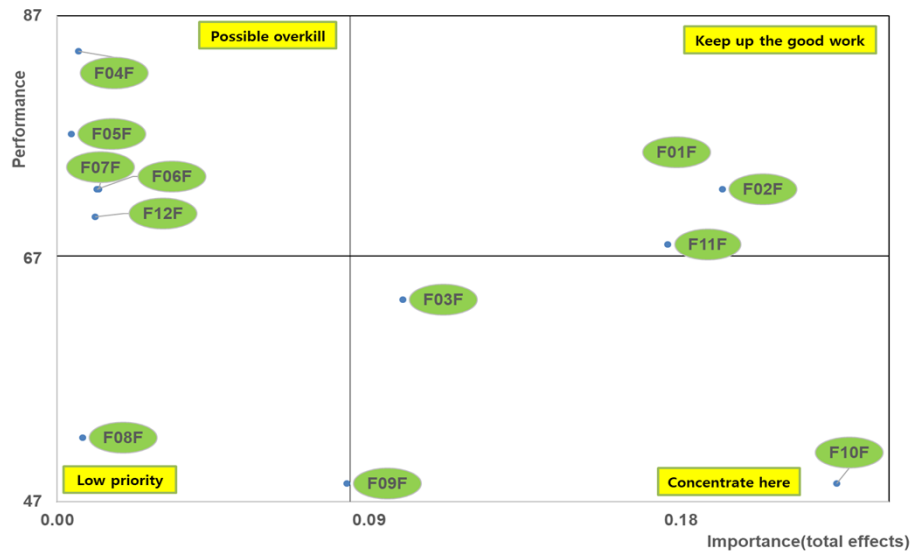
KSCM 2019 Spring Conference

32/41

IPMA(Shippers)



IPMA(Forwarders)



STRATEGIES for the Service Providers

Port selection factors	Land-side decision makers			Shippers			Freight forwarders		
	code	Kano	IPMA	code	Kano	IPMA	code	Kano	IPMA
Speedy cargo handling	F01	One D.	KU	F01S	One D.	KU	F01S	One D.	KU
Reliable cargo handling	F02	One D.	KU	F02S	One D.	KU	F02S	MB	KU
Cost for terminal handling	F03	MB	KU	F03S	MB	KU	F03S	One D.	CH
Abundance of container boxes	F04	One D.	PO	F04S	One D.	LP	F04S	One D.	PO
Maintenance of empty containers	F05	MB	PO	F05S	One D./MB	LP	F05S	Indiff.	PO
Customs handling	F06	MB	PO	F06S	Indiff.	LP	F06S	MB	PO
Quality of staff	F07	MB	PO	F07S	MB/Indiff.	LP	F07S	MB	PO
A variety of service routes	F08	One D.	LP	F08S	One D.	LP	F08S	One D.	LP
Inland Network Accessibility	F09	One D.	LP	F09S	One D.	LP	F09S	One D.	LP
Size of the port and terminal	F10	One D.	CH	F10S	MB	CH	F10S	One D.	CH
Cost for inland transportation	F11	MB	PO	F11S	MB	PO	F11S	MB	KU
Freight rates	F12	MB	PO	F12S	MB	LP	F12S	MB	PO

Note: 1) Att., Attractive; One D., One Dimensional; MB, Must-Be; Indiff., Indifference

2) CH, Concentrate Here; KU, Keep Up the Good Work; PO, Possible Overkill; LP, Low Priority

IMPLICATIONS

- The preferences of ship owners and forwarders are similar, but ports need to develop a separate response strategy for each decision maker as much as possible.
 - Especially, it is necessary to focus on the factors that are wrongly matched between the KANO model and the IPMA technique.
 - A port that the factors of the MB area in the Kano model are evaluated as the KU or CH areas, not the PO or LP areas in the IPMA technique might be recognized as a port which does not satisfy the essential requirement for port users.

IMPLICATIONS

- For shippers
 - The factor of cost for terminal handling(F03S) is located in MB area in the Kano model, but in the KU area in the IPMA approach.
 - ❖ The weight of the factor itself is as high as 0.1267, so it needs to be improved. By improving the performance of this factor by one unit, the overall performance can be improved by 0.16% from 80.5556 to 80.6823.
 - The size of the port and terminal (F10S) is also the MB area in the Kano model. The factor in the IPMA approach has a very high weight of 0.1549, but the performance is deficient as 68.0556, which belongs to the 'concentrated here' area.
 - ❖ Therefore, port service providers need to concentrate their efforts on this factor with the highest priority.
 - ❖ If the performance of size of the port and terminal(F10S) is increased by one unit, the overall satisfaction level of the port selection can be improved from 84.0580 to 84.2037.

IMPLICATIONS

• For freight forwarders

- The attributes of Cost for terminal handling(F03F) and Size of the port and terminal(F10F) are evaluated as the one-dimensional characteristics in the Kano model and the concentrated here area of the IPMA technique.
 - ❖ Port service providers could improve the overall selection behavior and satisfaction by concentrating their efforts on the one-dimensional factors in the Kano model as well as the concentrated here factors on the IPMA technique.
- If we improve the performance of Cost for terminal handling(F03F) by one unit, the overall performance (overall satisfaction) can be improved by 0.14% from 72.7273 to 72.8270.
- If the performance of Size of the port and terminal(F10F) is increased by one unit, the overall performance can be improved by about 0.31% from 72.7273 to 72.9523.

IMPLICATIONS

• For Freight forwarders

- The attributes of Reliable cargo handling (F02F) and Cost for inland transportation(F11F) are evaluated as the must-be characteristics in the Kano model and the keep up the good work area of the IPMA technique.
 - ❖ So it needs to improve urgently.
- If we improve the Reliable cargo handling(F02F) by one-unit further, the overall performance (overall satisfaction) can be improved by 0.26% from 72.7273 to 72.9192.
- If the Cost for inland transportation(F11F) factor is also improved by one-unit, the overall performance can be improved by 0.24% from 72.7273 to 72.9035.

CONCLUSIONS

- The construction of the port selection model should be **revised**
 - **Linear and nonlinear** factors are reflected separately
 - Factors of **minimum requirement and excitement**, also
- **Service strategies of service providers** (PAs, TOCs, Government) also need to be modified
 - The service providers reduced the gaps in the importance and characteristics of port selection factors to service users
 - Port operation and management strategy based on user needs is required
 - Important to establish policies for the operational efficiency of port management and satisfaction for port users

FUTURE STUDY

- Just an exploratory study
- **Generalization (Reliability and validity test** by in-depth studies)
 - Domestic
 - Global
 - A longer period