An Empirical Study on Evaluation Model of Port Service Quality : Based upon SERVPERF

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DECLARATION

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Abstract

Due to increasing cargo traffic by sea transportation, shipping companies have focused on large container vessels and “Hub & Spoke” strategy for economy of scale. Thus, ports have struggled to concentrate on port development, port marketing, hinterland development, incentive policy, etc. However, it is necessary for ports to be aware of port service quality to take competitive advantage for port competition.

The purpose of this study is to suggest evaluation model of port service quality and find out causality of port service quality which affect customer satisfaction and customer loyalty. In this paper, we examined the impact of port service quality on customer satisfaction and customer loyalty based on suggested evaluation model. From 137 acceptable data from questionnaire survey responded by shipping companies calling to ports in Korea, we conduct factor analysis and Structural Equation Modeling (SEM) using SPSS 15.0 and AMOS 7.0.

We establish 8 hypotheses based on SERVPERF in order to test correlation of 5 dimensions of port service, port service quality, customer satisfaction, and customer loyalty. From the result of the hypothesis testing, we accept 6 hypotheses out of 8 with high Significance level and reject 2 hypotheses. Surprisingly, the result shows that customer satisfaction and port service quality do not affect customer loyalty in spite of

high effect of port service on customer satisfaction. Therefore, it is reasonable to suppose that other factors (port charge, port location, hinterland, etc.) instead of port service quality are highly considered when shipping companies choose ports.

On the other hand, the result of direct, indirect & total effects analysis shows that all five port service dimensions have high indirect effects on customer loyalty via port service quality and customer satisfaction.

For additional analysis, Importance-Performance Analysis (IPA) approach is used for strategy of port service. The result of IPA indicates that port's performance of a contract, port workers' skill, constant efforts for port development, etc., have high importance and low satisfaction. On the contrary, CIQ process, EDI performance, prompt cargo handling through check gate, notice about port situation, etc., have high satisfaction and low importance.

This research provides deep view of port service by analyzing effects of port service on port service quality, customer satisfaction, and customer loyalty. Besides, IPA shows gaps between perceived service satisfaction and importance in order to help ports or port authorities to establish reasonable strategies.

Key Words: Port service quality, Customer Satisfaction, Customer Loyalty, SERVPERF, Structural Equation Modeling (SEM), Importance-Performance Analysis (IPA)

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1. Introduction

1.1. Background and purpose of study

The effect of globalization has integrated world economy. Due to the world economic cooperation and development, international trade between nations or continents has been rapidly increased. In particular, each nation has attempted to have competitive advantage through regional economic integration such as ASEAN (Association of Southeast Asian Nations), APEC (Asia-Pacific Economic Cooperation), NAFTA (North American Free Trade Agreement), and EU (European Union). Furthermore, the issues of trade liberalization, economic cooperation, and deregulation are currently discussed through negotiation of FTA (Free Trade Agreement) and WTO (World Trade Organization).

Table 1.1. Top 10 container service operators

Rank	Carrier	2004		2005		2006	
		TEU(a)	Ship(b)	TEU	Ship	TEU	Ship
1	AP Moller Group	900,509	346	1,523,347	570	1,630,693	533
2	MSC	618,025	237	736,301	268	977,417	312
3	CMA CGM	373,191	178	424,494	188	624,709	253
4	Evergreen Group	437,618	151	470,234	155	542,898	166
5	Hapag-Lloyd	186,610	48	221,763	57	446,825	135
6	COSCO	253,007	125	308,223	123	389,738	126
7	CSCL	236,079	106	317,541	111	375,904	120
8	APL	295,321	91	326,291	106	347,395	108
9	Hanjin	284,710	75	291,207	75	334,444	81
10	NYK	265,192	96	292,304	110	313,629	115
Total		3,850,262	1,453	4,911,705	1,763	5,983,652	1,949

Source: Containerization International Year Book 2005-2007

(a) TEU in service

(b) Vessels in service

The regional economic cooperation as well as economic development, based on advance

in information accessibility, caused the significant increase of international trade volume by sea transportation. According to IMF (International Monetary Fund), the growth rate of world economy in 2006 was 5.0% after growth of 4.4% in 2005.

On the other hands, total cargo traffic on the world increased by 6.5% on average 2000 to 2006 (ISL, 2007), which is mostly handled by sea transportation. From the result of traffic increase, shipping companies have focused on not only M&A and strategic alliance but also technology development of vessel speed and size for economy of scale. In terms of economy of scale, large ship service in main routes is the appropriate way to reduce transport cost by decreasing frequency of port calling. That is why shipping companies need to allocate enough vessel capacity by M&A or global alliance. Table 1.1 summarizes that, in 2006, the 10 biggest shipping companies handled 5.98 million TEU (65.3%). In addition, the 20 biggest shipping companies handled 8.12 million TEU (87.3%).

Table 1.2. Total cargo traffic of the fastest growing ports (2005-2006)

Port	Country	Total traffic in mill t		% change over previous year
		2005	2006	
Saigon New Port	Vietnam	14.6	20.0	37.3
Paranagua	Brazil	24.9	32.6	31.0
Guangzhou	China	241.7	302.8	25.3
Qinhuangdao	China	167.5	204.9	22.4
Qingdao	China	184.3	224.2	21.6
Shanghai	China	443.0	537.0	21.2
Philadelphia	US	42.0	50.6	20.4
Bremen/Bremerhaven	Germany	54.2	64.6	19.1
Dubai Ports	UAE	92.5	110.0	18.9
Nhava Sheva	India	37.8	44.8	18.7

Source: 2007, Shipping Statistics and Market Review, In: Institute of Shipping Economics and Logistics, Vol. 51, No. 12, p. 3 (www.isl.org)

Particularly, due to global trade of Asia-Europe and Asia-America increased by China Effect, Chinese mainland ports (Shanghai, Shenzhen, Qingdao, Ningbo, Guangzhou, etc.), have been grown rapidly. Furthermore, since some ports developed recently with a

good advantage of vessel calling and great economic potential took part in a competition, the competition in certain regions has been more accelerated.

Above table 1.2 shows the fastest growing ports for 2005-2006. Due to “Hub & Spokes” strategy, shipping companies input very large container ships to main routes and uses feeder network to nearby ports. Thus port competition for a hub port appears to be stiff in a region. Accordingly, it is necessary for ports to be aware of the needs for port service and struggle for competitive advantage by focusing on port development, port marketing, hinterland development, incentive policy, etc.

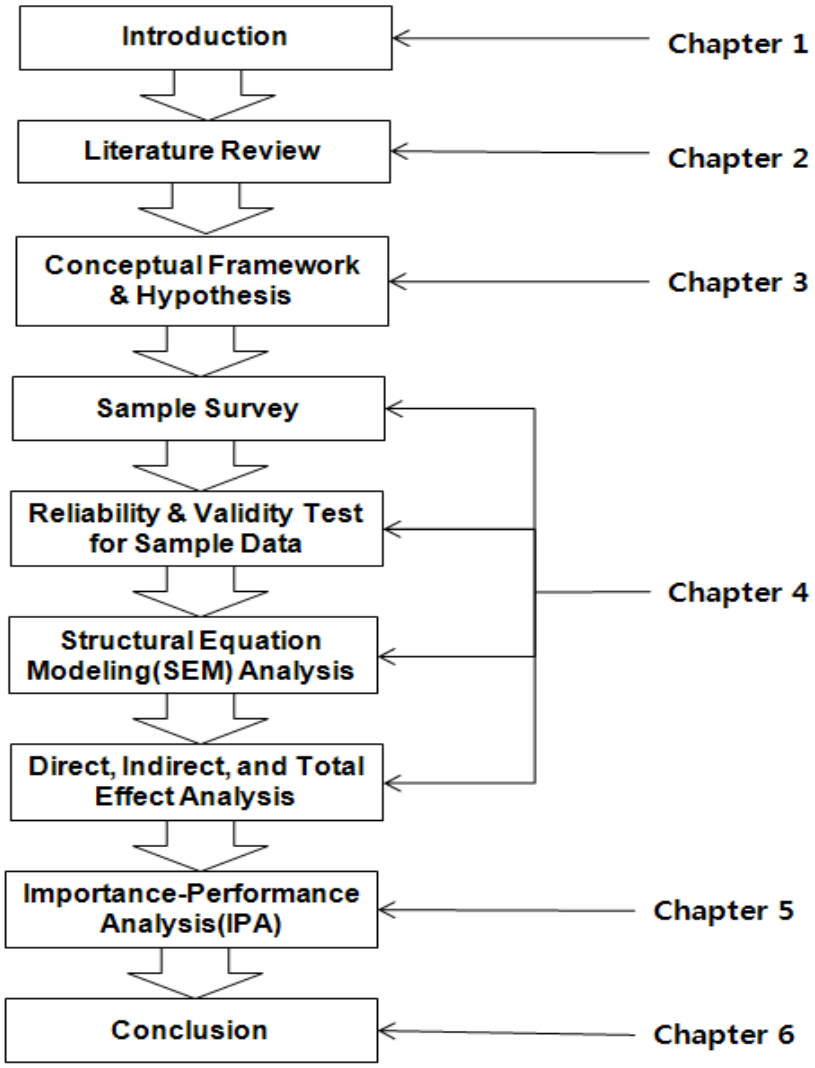
The purpose of this study is to suggest evaluation model of port service quality and find the impact of port service quality on customer satisfaction and customer loyalty. Many attempts based on SERVQUAL have been made in order to evaluate port service quality. On the other hand evaluation using Structural Equation Modeling (SEM) based on SERVPERF gives a good account of a structural model of shipping companies’ satisfaction and loyalty without the conceptual limitation of the expectation. In this paper, we are going to examine the proposed model and find port service items to meet customers’ demand. We perform questionnaire survey on shipping companies in order to approach current port service situation from the view of service users. For reliability and validity of the research model, we separate factors perceived by shipping companies, and examine the model with SEM.

1.2. Study structure

This study consists of 6 chapters. In chapter 1, we mention study background, the purpose of this study, summarized outline of contents, and introduction of methodology used for analysis. In chapter 2, through literature review, we define port service quality, customer satisfaction, customer loyalty. In chapter 3, operational definitions of variables are given and 8 hypotheses of the model are established with conceptual framework. In addition, we confirm the application possibility of the concepts from previous studies. Chapter 4 is the empirical study: sampling design, reliability and validity test, structural equation modeling, and hypothesis test. Besides, direct, indirect and total effect analysis

is examined for effects between factors. In order to estimate importance and satisfaction of each service attribute, additional analysis is conducted in chapter 5 using Importance-Performance Analysis (IPA). Finally, in chapter 6, we summarize the research results and mention the limitation of this study and suggestions for future research. Figure 1.1 shows the structure of this research.

Figure 1.1. The structure of research



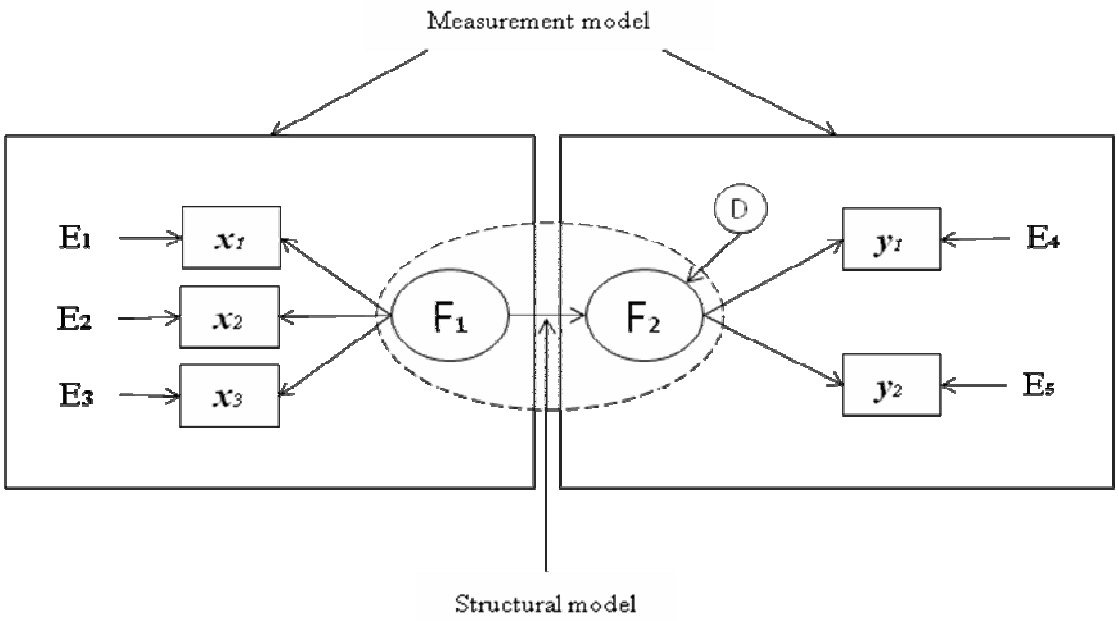
1.3. Methodology

In this study, analysis of Structural Equation Modeling (SEM) is basically used to test

hypotheses of the suggested model. For the research of social science and behavior science, this analysis has been widely used due to its advantage of analysis composed of factor analysis and regression analysis (Bae, B. R., 2007). Factor analysis is statistical method which makes new summated scale after extracting factors by common characteristics based on correlation between variables. Regression analysis is used to expect future throughput, experiment results, or association by calculating dependent variables by independent variables. Simple regression and multiple regressions are included in regression analysis. In general, SEM is also known as “analysis of covariance structure” or “causal modeling” (Arbuckle, 2006).

SEM is developed to analyze a model with holistic and systematic view (Kim, G. S., 2005). The SEM model consists of measurement model and structural model. Measurement model reflects characteristic of factor analysis. Structural model reflects characteristic of regression analysis or path analysis.

Figure 1.2. Structure of Structural Equation Modeling



Source: Kim, G. S., 2005, Analysis Structural Equation Modeling, SPSS Academy, p. 399

From figure 1.2, SEM has measurement models connected by structural model. Measurement model is designed by observed variables (x, y), latent variables (F), error

variables (E), and residual variable (D). Structural model connects the measurements (latent variables). Through factor analysis of input data (x, y), the latent variables and path coefficients are calculated.

Another characteristic of SEM is error and residual variables. Particularly it overcomes disadvantage of regression analysis which ignores error of measurement variables. Therefore, SEM is now widely applied for social science and behavior science. For the analysis of SEM, LISREL, CALIS, EQS5, LISCOMP, SEPATH, M-plus, and AMOS are used (Bae, B. R., 2007). However, we use AMOS (Analysis of Moment Structure) developed by Arbuckle (1999)[1] due to the advantage of easy use.

For additional analysis, Importance-Performance Analysis (IPA) is performed in chapter 5. IPA is the method which helps to find strategies by evaluating attributes of importance and performance on scatter plot. From attributes plotted on a two dimensional matrix (importance and performance), researchers or managers are easily find strategies by analyzing the position of each attribute. In this study, we use IPA for additional analysis based on reliability and validity test performed chapter 4. Detailed information of IPA will be explained in chapter 5.

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2. Literature Review

The purpose of this chapter is to review previous studies on service quality, customer satisfaction, and customer loyalty. Besides, we also examine previous studies on port competition for port service and port service quality. Based on literature review, we will be able to establish hypotheses for the analysis of this study.

2.1. Service quality

2.1.1. Concepts of service quality and characteristics

In spite of a great deal of weight on importance of service in modern society, academic approaches to service have just started in the 1970's. Due to the late awareness and characteristics of service, academic achievements have been attempted and recognized in the 1980's by Grőnoroos, Parasurman, and Zeithaml, etc. Besides, due to the increasing attention to service quality for added value and benefit, companies and researchers have recently focused on importance of service quality in earnest. In addition, recent business researches show that competition of service among companies is more important than non-service components. Especially, service marketing in the field of marketing is getting popular in terms of differentiation of competition between service providers and product providers (Roh, H. S. and Lee, C. Y., 1996).

In contrast to production of goods, service is so intangible and invisible that it is difficult to be defined and measured. Parasuraman, Zeithaml, and Berry (1985) mentioned that it is more difficult for the consumer to measure service quality than product quality, and Roh, H. S. and Lee, C. Y. (1996) also demonstrated that service quality cannot be defined and estimated as easy as product quality.

Lewis and Booms (1983) mentioned that service quality is a measure of match between delivered service level and customer expectations (Parasurman, Zeithml & Berry, 1985). After that, Parasurman, Zeithml and Berry (1988) defined service quality as a consumer's judgment or attribute about the overall excellence of service provider's

performance. They also emphasized that perceived service quality is determined by a comparison between perceived service and expected service. Likewise, the conceptual approach was considered with not only the results of service but also process of service. Parasurman, Zeithml and Berry (1985) mentioned that importance of interaction between service providers and customers needs to be significantly considered for service evaluation.

Table 2.1. The summary of the former studies on service quality

Researcher	Content
Oliver (1980)	A model proposed to expresses expectation effect and disconfirmation effect for consequences of satisfaction decisions
Churchill & Suprenant (1982)	The efficiency of using only performance perceptions to measure service quality
Lewis & Booms (1983)	Focused on meeting customers' needs and requirements, and how well the service delivered meets customers' expectations
Grőnoroos (1982)	service quality is the result of evaluation between technical quality and functional quality
Grőnoroos (1984)	Perceived quality of service quality service is dependent on the comparison of expected service, and thus the outcome of a comparative process
Parasurman, Zeithml & Berry (1985, 1988)	Customers' perceptions of overall service quality depend on the difference between the actual performance and their expectations
Zeithaml (1988)	Service quality refers to a consumer's judgment or attribute about the overall excellence of service provider's performance
Bolton & Drew (1991) Woodruff, Cadotte & Jenkins (1983)	An additional support for performance-only measures of service quality
Bolton & Drew (1991a)	Performance ratings strongly affect the measure of service quality, while the effects of disconfirmation(SERVQUAL) are generally insignificant and transient

Source: modified based on former literature, and "LiLi, 2007, Measuring Service Quality in Hotel Restaurants - A Study of Restaurants' Patrons in China, for master degree, Chungwoon University, pp. 16"

According to Grőnoroos (1982), service quality is the results of evaluation between technical quality and functional quality. In service providing activity, functional quality

is more important than technical quality. Technical quality is the results of “What” which consumers can get, on the other hand, functional quality is the process of “How” which consumers can experience or access.

Oliver (1980, 1981) insisted that service quality is evaluated by comparison between expectation and performance. Performance supports satisfaction increase as the performance/expectation ratio increase. Likewise, consumers have expectation of something provided, and estimate service quality after performance which they are provided.

When numerous studies for service have been attempted, the characteristic of service is also studied by several researchers. Although options are divergent on characteristic of service, it can be generally categorized by objective quality and perceived quality. Several researchers (Swan & Combs, 1976, Holbrook & Corfman, 1985, Zeithml, 1987) emphasized the difference between perceived quality and objective quality. However, many studies preferred perceived quality rather than objective quality. Especially, Parasurman, Zeithml and Berry (1988) compared 5 dimensions (tangibles, reliability, assurance, empathy, responsiveness) as perceived quality. The classification by characteristic is as following table 2.2.

Table 2.2. Classification by characteristic of service

Researcher	Service Quality	
	Objective quality	Perceived quality
Swan & Combs (1976)	Instrumental performance	Expressive performance
Grőnoroos(1982)	Technical quality	Functional quality
Lethinen, U. & Lethinen, J. R. (1982)	Physical quality	Interactive quality
Holbrook & Corfman (1985)	Mechanistic quality	Humanistic quality
Parasurman, Zeithml & Berry (1985) Grőnoroos (1984)	Outcome quality	Process quality

According to Swan and Combs (1976), service quality in production performance has instrument performance and expressive performance. Instrument performance for

service quality is technical dimension as the technical results of service process. Expressive performance for service quality is psychological level resulted by contact between customers and companies. As mentioned, Grőnoroos (1982) divided service quality into technical quality and function quality. The technical quality is the concept of “What”. The functional quality is the concept of “How” to estimate service quality. Technical quality is what customers get, and functional is the delivery of how service providers perform service to customers (Grőnoroos, 1982). SERVQUAL and Gap model are based on the concept of service expectation and service performance which was suggested by Grőnoroos. Holbrook & Corfman (1985) suggested mechanistic quality as objective characteristic and humanistic quality as subjective reaction. Lethinen, U. and Lethinen, J. R. (1982) introduced physical quality, interactive quality, and corporate quality. Physical quality is about physical characteristics of service and corporate quality is about impression or profile of company. Interactive quality is about quality resulted by the relationship between consumers and employees. Parasurman, Zeithml and Berry (1985) focused on process quality, and separate process quality to 10 dimensions.

2.1.2. Measurement of service quality

For strategies for service differentiation, companies need to meet customers’ expected service level or provide better service (Roh, H. S. and Lee, C. Y., 1996). Thus, the necessity of measurement for service evaluation is stressed, and academic approaches for service quality have been made since 1970’s.

Especially, experimental service measurements for service quality called SERVQUAL and gap model was devised by Parasurman, Zeithml and Berry (1985). They proved that there are 10 measurement criteria of SERVQUAL which can be universally applied to service industries. The measurement consists of 10 dimensions as table 2.3.

SERVQUAL suggested by Parasurman, Zeithml & Berry (1985) give important meaning to service research based on measurement criteria. However, due to disputation

of criteria redundancy, SERVQUAL including 5 dimensional scales with 33 items was proposed after assurance and empathy was modified by item-to-total correlations analysis and factor analysis (Parasurman, Zeithml & Berry, 1988).

Table 2.3. 10 dimensions of SERVQUAL (1985)

Dimension	Definition
Tangibles	Appearance of physical facilities, equipment, personnel, and communication materials
Reliability	Ability to perform the promised service dependably and accurately
Responsiveness	Willingness to help customers and provide prompt service
Competence	Possession of the required skills and knowledge to perform the service
Courtesy	Politeness, respect, consideration and friendliness of contact personnel
Credibility	Trustworthiness, believability, honesty of the service provider
Security	Freedom from danger, risk or doubt
Access	Approachability and ease of contact
Communication	Keeping customers informed in language they can understand and listening to them
Understanding the customer	Making the effort to know customers and their needs

Source: Zeithaml, V. A., Parasuraman, A. and Berry, L. L., 1985, Problems and Strategies in Service Marketing, In: Journal of Marketing, Vol. 49, pp. 33-46

Table 2.4. 5 dimensions of SERVQUAL (1988)

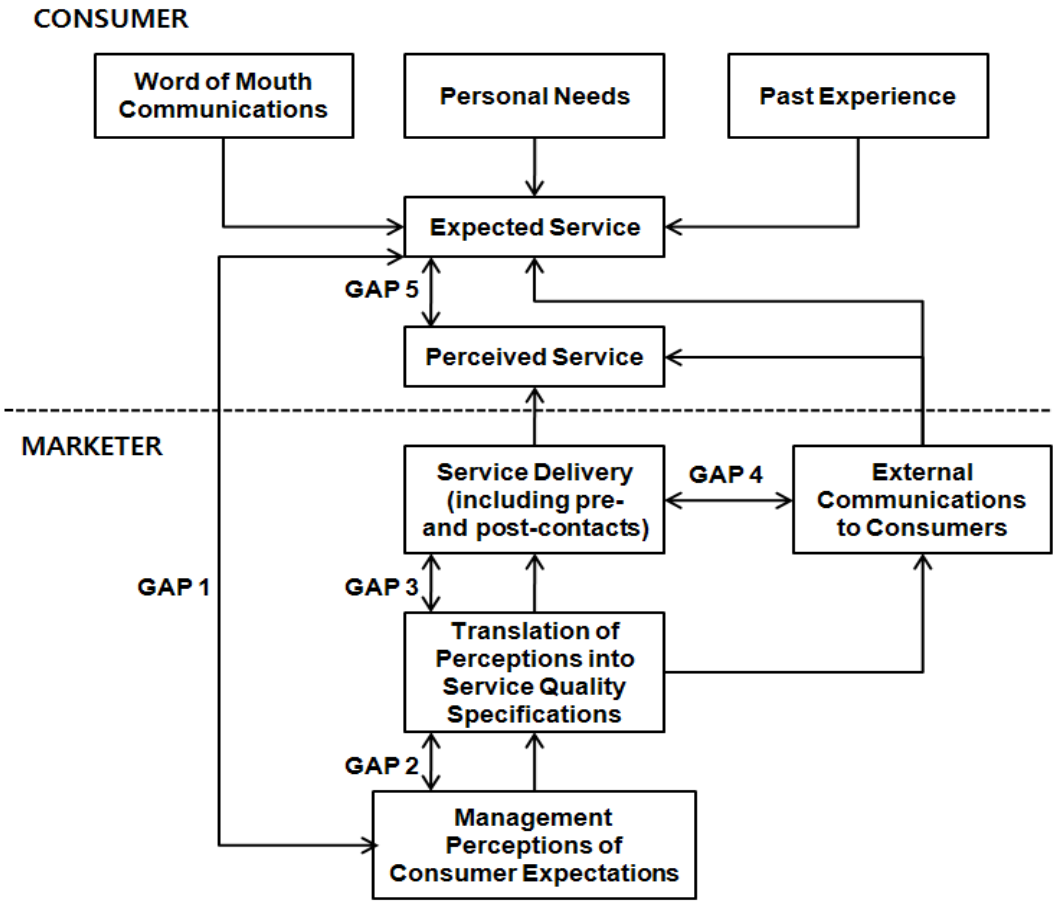
Dimension	Dimension	Definition
Tangibles	Tangibles	The appearance of physical facilities, equipment, personnel, and communication materials
Reliability	Reliability	The ability to perform the promised service dependably and accurately
Responsiveness	Responsiveness	The willingness of the employees to help customers and provide prompt service
Competence	Assurance	The knowledge and courtesy of employees and their abilityto convey trust and confidence
Courtesy		
Communication		
Credibility		
Security		
Access	Empathy	The provision of caring, individualized attention to customers
Understanding		

Source: Parasuraman, A., Zeithaml, V. A. and Berry, L. L., 1988, SERVQUAL: A Multiple-item Scale for Measuring Consumer Perceptions of Service Quality, In: Journal of Retailing, Vol. 64, No. 1, pp. 12-40

Based upon previous studies on service quality (Grőnoroos, 1982), Parasuraman, Zeithaml, and Berry (1985) introduced gap model for service quality measurement. The characteristic of the model is that it considers both side of marketer and consumer to

estimate service quality in detail. Service quality can be determined by gap between expected service and perceived (Gap 5). In addition, marketer need to improve service quality by analyzing the other gaps: expected service, perceived service, service delivery, service quality specifications, external communications to customers, and expected service and management perceptions of customer expectations (Gap 1), management perceptions of customer expectations and service quality specifications (Gap 2), service quality specifications and service delivery (Gap 3), service delivery and external communications to customers (Gap 4). Figure 2.1 shows the service quality Gap model describing gaps of each component.

Figure 2.1. Conceptual Gap model of service quality



Source: Parasuraman, A., Zeithaml, V. A. and Berry, L. L., 1985, A Conceptual Model of Service Quality and Its Implications for Future Research, In: Journal of Marketing, Vol. 49, p.44

However, Hopkins, etc al. (1993) found great disparity of five gaps of SERVQUAL

proposed by Parasuraman, A., Zeithaml, V. A. and Berry (1985), after testing the difference of perceptions from shippers and carriers in U.S. Carman (1990) also applied SERVQUAL to four service industries (business school placement center, tire store, dental school patient clinic, and acute care hospital), and found that all the results were not same although construct of SERVQUAL was stable and firm. In addition, focusing on ten service industries in Korea (hospital, hotel, department store, regional administration office, airlines, amusement park, beeper service company, fast-food restaurant, bank, and service company of education book delivery), attempts to measure and compare components were made by Yi, Y. J., Kim, J. Y. and Kim, J. I. (1996). The results of this study also show that each industry has difference of importance.

Since SERVQUAL was devised, many modified models for service quality have been introduced and discussed. Cronin and Taylor (1992) agreed the 22 variables of 5 dimensions (Parasuraman, A., Zeithaml, V. A. and Berry, 1985), but raised the problem of the concept of expectation, and suggested SERVPERF. As they insisted that customer's expectation is included in performance, performance-only scale was used in the model. In order to demonstrate the superiority of SERVPERF, service quality was measured and compared by four different equations, and they showed the performance-based measure is more appropriate for service quality (Cronin and Taylor, 1992). The four equations used for the study are SERVPERF, SERVQUAL, weighted SERVPERF, and weighted SERVQUAL:

Service quality = Performance - Expectations (2-1)

Service quality = Importance* (Performance - Expectations) (2-2)

Service quality = Performance (2-3)

Service quality = Importance*Performance (2-4)

On the other hand, Teas (1993) suggested evaluated performance model (EP model) and normed quality model (NQ model) based on SERVQUAL. EP model is a perceived quality model including ideal point concept, and NQ model is proposed based on EP model and revised SERVQUAL model (Teas, 1993). In order to explain the conceptual

problems raised by Parasuraman, A., Zeithaml, V. A. and Berry (1994), Teas (1994) distinguished the NQ model from the SERVQUAL mixed model.

2.2. Port service quality

2.2.1. Port selection criteria

It is difficult to define port service and determine measurement variables. However, in regard to port service, measurement variables were used to be extracted from the former studies of port selection criteria and port competition. Most of the studies for port selection criteria were conducted mainly through the method of questionnaire or interview with shipping lines, forwarders, shippers, or transport companies. In order to find port selection criteria or to compare competition level of ports, analysis has been carried out with the collected data.

Table 2.5. Former studies on port selection criteria

	French	Willingale	Slack	Peters	Kim, H. S.
Year	1979	1982	1985	1990	1993
Criteria	-Terminal facilities -Tariffs -Connectivity -Service level -Port congestion -Port operators -Economy of hinterland -Trade policy -World economy trend -Economic status of the nation	-Location factor -Technical factor -Operational factor -Fiscal factor -Manpower factor	-Calling frequency -Port accessibility -Tariffs -Port congestion -Inter-linked transportation network	-Service level -Available facility capacity -Status of the facility -Port operation policy -International politics -Change of social environment -Trade market -Economic factors -Features of competitive ports -Functional changes of transportation -Materials handling	-Annual handling volume -Cost per cargo -Transport distance -cost for inland transport -Loading time -Average port time

First of all, French (1979) divided port selection criteria into internal factor and external

factor. Internal factor includes terminal facilities, tariffs, service level, port congestion, and connectivity. External factor is separated to economy of hinterland, trade policy, world economy, economic status of the country (French, 1979). Willingale (1982) investigated 20 shipping companies in Europe to extract port selection criteria. He identified the process of route plan and selection of port depending, and considered 5 factors (location factor, technical factor, fiscal factor, manpower factor, operational factor) as port selection criteria (Willingale, 1982). According to Slack (1985), important criteria for port selection is calling frequency, tariffs, port accessibility, port congestion, and inter-linked transport network. The selection criteria of Peters's research (1990) also were classified into internal factor and external factor such as the research of French (1979). It includes service level, status of the facility, operation policy, trade market, etc. In addition, Kim, H. S. (1993) shows the criteria in terms of import and export. In export group, transport distance, annual handling volume, loading time, average port time, cost per cargo tonnage, and cost for inland transport have high priority. On the other hand, the number of calling vessels, transport distance, cost for inland transport, etc., are shown in import group.

Besides, Murphy, et al. (1987) conducted ANOVA analysis and T-test to find priority of selection criteria. He expanded his research using 9 factors: large and/or odd-sized freight, low freight handling shipment, low frequency of loss and damage, available equipment, large volume shipment, convenient pick-up and delivery times, information concerning shipment, assistance in claims handling, and flexibility in meeting special handling requirement (Murphy, et al., 1992).

2.2.2. Measurement of port service quality

Due to the rising attention to service in maritime industries, several studies on evaluation of shipping service have been conducted in 1990's. However, since ports faced cutthroat competition for hub port, port service was realized as important part of port competition. Terminals and port authorities have focused on evaluation of port service. While generally shippers or forwarders evaluated quality of shipping service, port service is likely to be measured by port users: mainly shipping companies, inland

transport companies, shippers, etc. Measurement of service quality in port industries have been conducted mainly in terms of customer satisfaction. However, due to its subjective characteristics of evaluation, it is necessary to establish port service criteria and make evaluation model for decision making.

Kim, B. J. (2000) carried out ANOVA analysis in order to estimate the perception difference of importance, expectation, and performance of terminal service quality between users (shipping lines) and providers (container terminals). He used 6 factors (capacity of terminal facility, tariffs competitiveness, productivity, flexible operation, reliability, and additional support service) with collected 104 data from shipping lines (41) and container terminals (11). Especially, he shows that importance of each factor perceived by shipping lines is not that different depending on the characteristics (calling frequency, handling volume, the number of service vessel, etc.) of respondents. In contrary to importance, perceived satisfaction is significant different depending on terms of shipping lines

Su, S. W. and Bang, H. S. (2002) used analysis of Structural Equation Modeling (SEM) which has good advantage of factor analysis and regression analysis with error variables. He estimates the effect of perceived logistics service quality on repurchasing intention in port with 3 factors of functional quality, technical quality, and physical quality. The variables of functional quality are convenience, connection, security, growth, and accuracy, but, variables have 18 sub-variables. Technical quality consists of loading, CY, CFS, transport, and information and physical quality includes berth length, depth, crane, reefer plug. The results of their study supported that functional and physical quality is significant determinant of logistics service quality in port.

Song, C. H. and Song, S. Y. (2004) evaluated perceived port logistics service quality with a focus on the shipping lines calling Busan and Gwangyang port. He used moderated regression analysis for hypothesis testing with 50 acceptable responses from shipping companies. He also used the concepts of functional quality and technical quality. However, variables for functional quality are mostly related to employees' attitude such as kind attitude, faithful attitude, serious attitude, cooperative attitude, and

quick response to customers' claim. On the other hand, technical quality factor has facilities and equipment, working accuracy, working reliability, technical handling of equipment, and knowledge for work.

Table 2.6. Recent studies on evaluation of port service quality

	Kim, B. J.	Su, S. W. & Bang, H. S.	Song, C. H. & Song S. Y.	Kim, E. S. & Pak, M. S.	Kim, B. I. & Cho, C. H.
Year	2000	2002. 09	2004. 08	2006. 06	2007. 09
Evaluated for	Perception of the service quality at container terminal	Perceived service quality to container ports	Perception of port logistics service quality	Perception of the service quality at container terminal	Effect of Port Service Quality on the Customer Satisfaction and Post-Behaviors
Measured by	41 shipping lines 11 terminals	69 shipping lines 16 terminals	79 shipping lines	Shipping lines Shipping agencies	Shipping lines
Acceptable response	106(82.7%)	157(78.5%)	50	96	215
Scale	9 point Likert scale	7 point Likert scale	-	7 point Likert scale	-
Variable	-capacity of terminal facility -Tariffs competitiveness -productivity -flexible operation -reliability -support service	**Functional quality** -convenience -connection -security -growth -accuracy **Technical quality** -loading -CY -CFS -transport -information **Physical quality** -berth length -depth -crane -reefer plug	**Functional quality** -kind attitude -faithful attitude -quick response -serious attitude -cooperative attitude **Technical quality** -facilities & equipment -working accuracy -working reliability -technical handling of equipment -working knowledge	**Tangibles** **Reliability** **Responsiveness** **Assurance** **Empathy**	**External quality** -cargo volume -size of hinterland & FTZ -accessibility & distance **Internal quality** -port cost -berthing capacity -incentive policy -schedule reliability **Interactive quality** -kind attribute -performance skill -port total information -port sales -partnership with customers
Hypothesis testing	ANOVA analysis	Structural Equation Modeling(SEM)	Moderated regression analysis	Regression analysis	Structural Equation Modeling(SEM)

Kim, E. S. and Pak, M. S. (2006) used 5 dimensions of SERVQUAL model (tangibles, reliability, responsiveness, assurance, empathy) to evaluate the effects of perceived service quality of container terminal on customer satisfaction. He used regression analysis with acceptable 96 responses from shipping lines and shipping agencies in

Korea. Their research shows significant positive effects of terminal service on customer satisfaction and customer loyalty.

Kim, B. I. and Cho, C. H. (2007) developed measuring tool for service evaluation and estimated effects of port service quality on the customer satisfaction and post-behaviors focusing on Incheon and Shanghai port. He defined 3 factors (external quality, internal quality, and interactive quality) and used SEM analysis for evaluation of port service.

2.3. Customer satisfaction and loyalty

Customer satisfaction is so psychological that it is not easy to estimate the state with quantitative figures. However, through the efforts to meet customer satisfaction, service providers can get more benefit and added value. Thus, perceived satisfaction by customers makes it possible to improve purchase intention.

Table 2.7. Formal studies on customer satisfaction and loyalty

Researcher	Component	Result
Woodiside, et al. (1989)	Service quality Customer satisfaction Behavior intention	Effect of service quality on overall customer satisfaction and effect of overall customer satisfaction on behavior intention are acceptable
Cronin & Taylor (1992)	Service quality Customer satisfaction Purchase intention	Effect of service quality on customer satisfaction and effect of customer satisfaction on purchase intention are acceptable
Boulding, et al. (1993)	Service quality Overall service quality Behavior intention	Effect of service quality on overall service quality and Effect of overall service quality on behavior intention are acceptable
Taylor & Baker (1994)	Service quality Customer satisfaction Purchase intention	Both of service quality and customer satisfaction affect purchase intention

Soruce: Yoon, T. S. and Goo, J. D., 1999, A Study on the Relationship between Customer's Perception of Service Quality and Purchase Intention, In: Journal of Commodity Science & Technology, Vol. 21, pp. 238

Regarding customer satisfaction, the concept of customer satisfaction has difficulties in measurement due to the characteristic of redundancy with psychology or behavior

studies in social science. However, mainly in the marketing literature, response to evaluation of perceived and expected service has been widely used to define the concept. For instance, Oliver (1981) considered customer satisfaction as the discrepancy of perceived service and expected service.

Customer loyalty is the resource to sustain competitive advantage which service providers or service producers (Kim, S. Y., 2004). Thus, by improving customer loyalty, companies can get more benefits and added value. Parasuraman, Zeithaml, and Berry (1996) mentioned that customers' behavioral intentions are influenced by service quality. Cronin and Taylor (1992) evaluate relation between service quality, customer satisfaction, and purchase intention. And they proved that the effect of service quality on customer satisfaction and the effect of customer satisfaction on purchase intention. The former studies about causality of service quality on customer satisfaction and customer loyalty is as table 2.7.

3. Conceptual Framework and Research hypothesis

In this chapter, we extract items related to port service, and then operational definitions of variables are stated based on former literature and pilot test. Besides, we establish hypotheses for analysis and present conceptual framework of suggested model.

3.1. Development of measurement variables

3.1.1. Extraction of items

Port service items are extracted from former studies about port selection criteria, port competitiveness, port service quality which was discussed in chapter 2. Furthermore, we added more items from interviews, research papers, magazines, internet websites, class materials, and discussion with graduate students majoring in ports and logistics. We choose 62 items through pilot test, and after interview with specialist group (professors, researchers, and managers in container terminal and shipping lines), we fixed 45 items for this research.

Table 3.1. Extracted items for measurement of port service quality

No.	Item
1	Enough handling equipment
2	Enough port facilities and berths
3	Deep water draft
4	24hrs/holiday cargo handling service
5	Incentive policies for high frequency of vessel calling
6	Prompt process of CIQ (Custom Clearance, Immigration and Quarantine)
7	Quick response to customer claims
8	Prompt dangerous cargo handling
9	Immediate information about cargo location
10	High productivity of port equipment to minimize port time
11	Notice about current local marine condition
12	Safe port arrival through vessel passage
13	Communication between yard and control center
14	Flexible and prompt berth allocation
15	Notice about information of port situation
16	Report of local weather forecasts

Table 3.1. - continued

17	Efficient performance by EDI(Electronic Data Interface)
18	Free time of container freight station
19	Quick decision making process in terminal
20	Port's performance of a contract
21	Prompt cargo handling through check gate
22	Well-skilled port workers
23	Communication with port workers(language)
24	Port workers' supportive and cooperative attribute
25	Stable supply of workforce
26	Safety awareness training for port workers
27	Low possibility of cargo damage, missing, and pilferage
28	Low failure rates of handling equipment
29	Safety operation of port equipment
30	Efforts for security and safety in port
31	Well-equipped Navigation aids for safe vessel calling
32	Evacuation policy for emergency case
33	Clean port spaces and facilities
34	Periodic inspection for equipment and facilities
35	Restricted entrance
36	Quick ship repair services
37	Convenient arrangement for spare parts and ship's materials delivery
38	Convenience for bunker and water supply
39	Convenience facilities for crews
40	Emergency services for crews
41	Port authority' constant efforts for port development
42	Port authority' positive marketing activity
43	Try to listen to customer request
44	Efficient use in multi-modal transportation
45	Proximity of CY, CFS, and warehouses

3.1.2. Operational definition of variables

Parasuraman, A., Zeithaml, V. A. and Berry (1985) mentioned that criteria measured by consumers fit 10 dimensions, in addition, the dimensions and their descriptions are used as basic structure of service quality model (Parasuraman, A., Zeithaml, V. A. and Berry, 1985). Thus, after sufficient review based on literature about port selection criteria, port competition, and related resource, we designate 45 items as measurement variables. Besides, since 5 dimensions of SERVQUAL and has various potential as application method for service industries (Parasuraman, A., Zeithaml, V. A. and Berry, 1988), we give operational definitions of variables using 5 dimensions (tangibles, reliability, assurance, empathy, and responsiveness). However, instead of SERVQUAL, we use SERVPERF to focus on performance. That is because the concept of performance

includes customer expectation (Cronin and Taylor, 1992), and expectation will not be able to be measured consistently due to the subjective characteristic of service quality. In other words, consumers may not distinguish the level of expectation measurement, and it is possible for consumers to give good score for all the variables.

In our study, tangibles are defined as physical ability of port facilities and equipment, and assurance is reliable and believable attitude of port key players (port authority's attitude, workers' attitude or manner, or terminal's attitude, etc.). Reliability is defined as reliable and accurate ability to promise calling schedule of vessel, and empathy is other support activities to enhance customer satisfaction. In addition, the definition of responsiveness is given as immediate response to customer needs.

Moreover, port service quality in this study represents level of overall port service quality, customer satisfaction is appointed as level of perceived satisfaction about facilities, information, development plan, and other support activities. Finally, customer loyalty is defined as customer behavior intentions through service satisfaction.

Table 3.2. Operational definition of variables

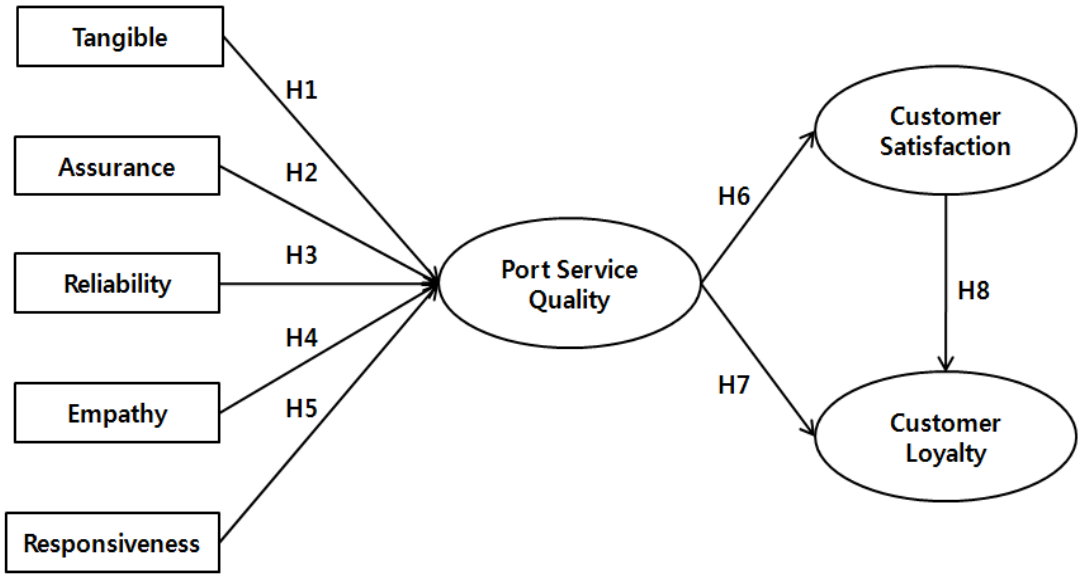
Dimension	Operational definition
Tangibles	Physical ability of port facilities and equipment
Assurance	Reliable and believable attitude of port key players
Reliability	Reliable and accurate ability to promise schedule
Empathy	Other activities to enhance customer satisfaction
Responsiveness	Immediate response to customer needs
Port service quality	Level of overall port service quality
Customer satisfaction	Level of perceived satisfaction about facilities, information, development plan and other support activities
Customer loyalty	Customer behavior intentions through service satisfaction

3.2. Conceptual framework and research hypothesis

Although many empirical studies have been attempted to determine relationship among service quality, customer satisfaction, and customer loyalty, the causality of their attributes are different depending on industries or market status. As mentioned in previous chapter, the purpose of this study is to develop evaluation model of port

service quality and find out service items which affect customer satisfaction and customer loyalty. Thus, in order to revile causality of port service quality, customer satisfaction, and customer loyalty, we propose the conceptual framework of this study with hypotheses established (See figure 3.1). The framework includes 5 dimensions (tangibles, assurance, reliability, empathy, and responsiveness), port service quality, customer satisfaction, and customer loyalty.

Figure 3.1. Conceptual framework



The 5 research hypotheses regarding paths to port service quality in the suggested model are identified as below;

H1. Tangible perceived by customer is positively related to Port Service Quality.
H2. Assurance perceived by customer is positively related to Port Service Quality.
H3. Reliability perceived by customer is positively related to Port Service Quality.
H4. Empathy perceived by customer is positively related to Port Service Quality.
H5. Responsiveness perceived by customer is positively related to Port Service Quality.

From the literature review about port service quality, customer satisfaction, and

customer, 3 hypotheses are added for analysis of structural model.

H6. Port Service Quality is positively related to Customer Satisfaction.

H7. Port Service Quality is positively related to Customer Loyalty.

H8. Customer Satisfaction is positively related to Customer Loyalty.

4. Empirical Study

4.1. Sampling design

For the accuracy and reliability in measurement variables of this study, literature review and specialist interview with researchers, professors, and managers are conducted. Questionnaire form is made with the final 45 items. The questionnaire form used for this study is in consideration of SERVERF Model suggested by Cronin and Taylor (1992), and also significantly takes into account the characteristics of port service. Although there are warehouses, transport companies, freight forwarders and other users using port service, we just focus on shipping companies for the purpose of this study.

4.1.1. Data collection and sample characteristics

For the data collection, the questionnaires for this study were distributed to shipping companies calling domestic ports in Korea. Face to face interview and e-mail survey were used, and completed forms were returned by fax, email, or collected by company visit. This survey conducted for total 6 weeks from the 14th of January to the 22nd of February.

Table 4.1. General characteristics of respondents

Status	Number of respondent (Percent %)	Working period	Number of respondent (Percent %)
Staff	32(23.4%)	Under 2 years	22(16.1%)
Assistant Manager	38(27.7%)	2 years – 4 years	25(18.2%)
Manager	34(24.8%)	5 years – 9 years	43(31.4%)
Deputy General Manager	16(11.7%)	10 years – 14 years	35(25.5%)
General Manager	15(10.9%)	15 years -19 years	7(5.1%)
Director	2(1.5%)	over 20 years	5(3.6%)
Total	137(100%)	Total	137(100%)

Due to subjective characteristics of this study, 4~5 questionnaires (total 185 questionnaires) were distributed to each company, and 141 (76%) questionnaires were returned. However, we practically analyzed our study with 137 (74%) forms except 4

inappropriate forms. The general characteristics of respondents are as following table 4.1. The number of acceptable respondents is 137 (from 100 to 200) so that we consider the data to be suitable for our analysis (Hair, et al., 1998).

4.1.2. Questionnaire design

The questionnaire form is totally 4 pages and consists of 4 parts; general information about respondent (4 questions), port service variables (45 questions), port service quality & customer satisfaction (5 questions), and customer loyalty (4 questions). The general information part includes company name, working department, job title, and working period. The part of port service variables is measured by 5 point likert scale, one of rating method, in order to find how much important the each questions are (1 = very unimportant, 3 = neutral, 5 = very important) and how satisfied the respondents are with the each questions (1 = very dissatisfied, 3 = neutral, 5 = very satisfied). The parts of port service quality & customer satisfaction and customer loyalty are also measured by five point likert scale (1 = Strongly Disagree, 3 = Neutral, 5 = Strongly Agree). The part of customer satisfaction includes the satisfaction level of port facilities, information service, other support activities, and development plan. The last part is about customer behavior intentions.

The questionnaire design of this research is for not only analysis of structural equation modeling but also IPA (Importance and Performance Analysis). Therefore, in the second part, participants are required to answer importance and satisfaction together. The questionnaire form for this study is included in Appendix B.

4.2. Reliability and Validity

Reliability is the possibility to get consistent results when measurement is conducted continuously by similar or same method. In other words, the concept of reliability may be described as stability, consistency, predictability, accuracy, and dependability (Chaiy, S. I., 2005:179). In order to measure reliability for research, Test-retest method, parallel-forms technique, split-half method, and internal consistency are normally used. However, internal consistency by Cronbach's α, a measure of reliability to find same

characteristic from different items, is widely used for recent researches.

Validity indicates how exactly the developed measurement model can explain the concept or attributes. If the result of validity is not applicable, the result of analysis may be consistent with the purpose of the study. The types of validity are content validity, criterion-related validity, and construct validity (Chaiy, S. I., 2005); content validity for representative of the measurement method, criterion-related validity for the prediction of certain standard, and construct validity for the concept of model design.

4.2.1. Internal consistency reliability

Generally data from over 200 respondents is suitable for analysis of Structural Equation Modeling (SEM). However, due to limited number of container shipping companies calling Korean ports and characteristic of maritime environment, we start the analysis based on the corrected data from 137 respondents using SPSS software ver. 15.0.

Prior reliability test, preliminary analysis is performed to remove items which are not really irrelevant to each factor. Item-to-Total-Correlation analysis suggested by Joshi in 1989 is used for the preliminary analysis. This is analysis method to extract acceptable items by analyzing the correlation of each item.

Table 4.2. The result of reliability analysis

Dimension	Number of Items			Cronbach α
	Initial stage	After preliminary analysis	After reliability analysis	
Tangibles	7	4	3	0.739
Assurance	7	6	6	0.775
Reliability	11	7	5	0.873
Empathy	15	8	6	0.838
Responsiveness	5	4	4	0.823
Customer Satisfaction	4	4	4	0.819
Customer Loyalty	4	4	4	0.829

If one of the items has low correlation Item-Total value ($\alpha<0.4$) in correlation analysis, we will remove the item one by one and keep analyzing until Corrected Item-Total

(CIT) value are all acceptable (α>0.4). Then we finally extract total 24 service items after exploratory factor analysis as reliability analysis. The result of exploratory factor analysis for reliability is as follow table 4.3. Although there are many research attempted to discuss the proper Cronbach α value, Cronbach α over 0.7 is generally acceptable.

In order to run exploratory factor analysis, we have to clarify extraction method first. There are several extraction methods for factor analysis; Principle Component Analysis (PCA), Common Factor Analysis (CFA), Maximum Likelihood (ML), and Generalized Least Square (GLS), etc. Principle Component Analysis is the most popular method with Common Factor Analysis, but the difference between Principle Component Analysis and Common Factor Analysis is depending on which variance it uses from the matrix results (Kim, G. S., 2005:197). That is, Principle Component Analysis uses total variance in comparison with Common Factor Analysis using common variance. In this research we use Principle Component Analysis to reduce factors by minimizing loss of information and retaining data.

The second thing we notice for factor analysis is choice of rotation method. The types of rotation are divided into basically orthogonal rotation and oblique rotation depending on independence and correlation of each item. In this study, we choose Varimax from orthogonal rotation which properly separates the characteristics of each factor. This Varimax rotation is also frequently used due to the advantage of clear explanation (Kim, G. S., 2005:199).

Table 4.3 summarizes the result of exploratory factor analysis based on 24 items. Eigen value, the size of variance explained by a factor, is calculated by the sum of square of all variables' factor loading by each factor. In factor analysis, when the Eigen value of factor exceeds 1.0, the number of factors is decided. As follow table 4.3 indicates, Eigen values of each factor are 1.325, 1.995, 2.387, 7.695, and 1.471. Thus, it shows that all the Eigen values about 5 factors are acceptable.

In order to determine collected data appropriate to factor analysis, Kaiser-Meyer-Olkin

(KMO) Measure of Sampling Adequacy and Bartlett's test of sphericity inappropriate are performed. Hair, et al. (1998) considered a KMO index of higher than 0.6 and Bartlett's P value of less than 0.5 as suitable for factor analysis. The result of this analysis shows that construct validity is significantly acceptable to this factor analysis (KMO index= 0.869, x^2 of Bartlett's test=1503.878, P value of Bartlett's test=.000). Besides, the five factors explain 61.803% of variance.

Table 4.3. The result of exploratory factor analysis

No.	Measurement variables	Factors				
		F1	F2	F3	F4	F5
1	Enough handling equipment	0.774				
2	Enough port facilities and berths	0.825				
3	Deep water draft	0.711				
4	Port's performance of a contract		0.485			
5	Well-skilled port workers		0.722			
6	Communication with port workers(language)		0.791			
7	Port workers' supportive and cooperative attribute		0.737			
8	Safety awareness training for port workers		0.649			
9	Port authority' constant efforts for port development		0.454			
10	24hrs/holiday cargo handling service			0.720		
11	Prompt dangerous cargo handling			0.716		
12	Prompt cargo handling through check gate			0.782		
13	Stable supply of workforce			0.701		
14	Low possibility of cargo damage, missing, and pilferage			0.747		
15	Incentive policies for high frequency of vessel calling				0.520	
16	Prompt process of CIQ (Custom Clearance, Immigration and Quarantine)				0.780	
17	Notice about information of port situation				0.677	
18	Quick ship repair services				0.510	
19	Convenient arrangement for spare parts and ship's materials delivery				0.817	
20	Convenience for bunker and water supply				0.845	
21	Quick response to customer claims					0.781
22	Immediate information about cargo location					0.774
23	Efficient performance by EDI (Electronic Data Interface)					0.594
24	Quick decision making process in terminal					0.737
Cronbach's α		0.739	0.775	0.873	0.838	0.823
Eigen value		1.325	1.995	2.387	7.695	1.471
% of Variance		5.522	8.144	9.947	32.062	6.128
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.869				
Bartlett's Test of Shphericity		Chi-Square = 1503.878 Sig. = 0.000				

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

From the result of exploratory factor analysis, 5 factors are determined as table 4.3. Each factor is regarded as 5 dimensions of service quality according to the operational definition: Tangibles (x01~x03), Assurance (x04~x09), Reliability (x10~x14), Empathy (x15~x20), and Responsiveness (x21~x24). It also shows Port service quality (y01), Customer Satisfaction (y02~y05), and Customer Loyalty (y06~y09) as latent variables. Table 4.4 shows all dimensions as latent variables and measurement variables as observed variables. The correlation matrix for these variables is attached in Appendix A.

Table 4.4. Measurement variables by dimensions

Dimensions	No.	Measurement variables
Tangibles	x01	Enough handling equipment
	x02	Enough port facilities and berths
	x03	Deep water draft
Assurance	x04	Port's performance of a contract
	x05	Well-skilled port workers
	x06	Communication with port workers(language)
	x07	Port workers' supportive and cooperative attribute
	x08	Safety awareness training for port workers
	x09	Port authority' constant efforts for port development
Reliability	x10	24hrs/holiday cargo handling service
	x11	Prompt dangerous cargo handling
	x12	Prompt cargo handling through check gate
	x13	Stable supply of workforce
	x14	Low possibility of cargo damage, missing, and pilferage
Empathy	x15	Incentive policies for high frequency of vessel calling
	x16	Prompt process of CIQ (Custom Clearance, Immigration and Quarantine)
	x17	Notice about information of port situation
	x18	Quick ship repair services
	x19	Convenient arrangement for spare parts and ship's materials delivery
	x20	Convenience for bunker and water supply
Responsiveness	x21	Quick response to customer claims
	x22	Immediate information about cargo location
	x23	Efficient performance by EDI (Electronic Data Interface)
	x24	Quick decision making process in terminal
Port Service Quality	y01	A port which I use has high level of overall service quality
Customer Satisfaction	y02	I'm satisfied with port equipment and facilities
	y03	I'm satisfied with provided port information
	y04	I'm satisfied with other support activities
	y05	I'm satisfied with port development plan
Customer Loyalty	y06	I'll recommend a port by word of mouth
	y07	When I need to change, I'll consider a port as priority
	y08	I'll maintain the number of vessel's calling or make it crease
	y09	I'll continuously use a port if there is no unavoidable reason

4.2.2. Confirmatory factor analysis

Validity is about how exactly the concepts or attributes can be explained, and it is considered as the essential phase for further analysis. Content validity is how the concept of measurement variables reflects the model concept. For content validity in this study, most of the measurement variables are based on previous studies, and then deeply discussed with specialist group (researchers, professors, and managers).

After exploratory factor analysis and reliability test, confirmatory factor analysis for each dimension is performed in order to estimate construct validity. Confirmatory factor analysis is useful for convergent validity and discriminant validity of construct validity. In terms of construct validity, convergent validity means that the correlation should be high when variables are measured by different method from same concept. For instance, service, price, and taste have high correlation under the concept of restaurant quality. On the other hand, discriminant validity means that rather different concepts have low correlation. For example, in the case when satisfaction of product and the number of employees have low correlation, it can be interpreted as high discriminate validity. Multi Trait-Multi Method matrix (MTMM) and factor analysis are the method for construct validity (Kim, G. S., 2005:150).

For the fitness evaluation of confirmatory factor analysis, we use GFI (Goodness of Fit Index; ≥ 0.8), AGFI (Adjusted Goodness of Fir Index; ≥ 0.8), P value (≥ 0.05), RMR (Root Mean Square Residual; ≤ 0.05), NFI (Normed Fit Index; ≥ 0.90). x^2, GFI, and RMR are included in absolute fit index, overall model fit index. On the other hand, incremental fit index including AGFI and NFI is fit index of proposed model when compared with default model. The details of the fit indexes will be explained in chapter 5.

Based on the above theories of validity, confirmatory factor analysis for 5 service dimensions (tangibles, assurance, reliability, empathy, responsiveness) is performed. This is basically for the validity of all exogenous measurement variables. Although

some fit indexes of this analysis are relatively low and unsatisfactory, they are acceptable due to sample size and attributes of variables.

Figure 4.1. 5 dimensions for confirmatory factor analysis

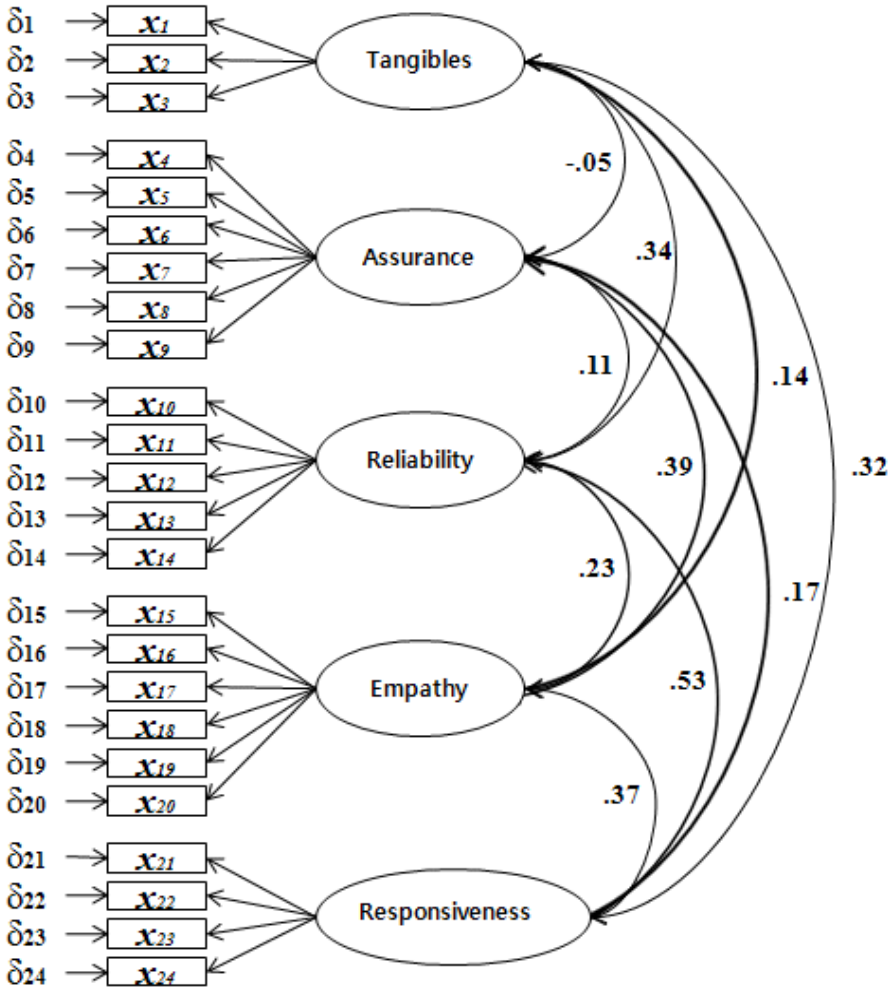


Table 4.5. The result of confirmatory factor analysis for total service dimensions

GFI	AGFI	RMR	NFI	χ^2	P	CFI
0.851	0.815	0.178	0.394	243.569	0.460	0.988

The 5 service dimensions for confirmatory factor analysis and the result of the analysis are as figure 4.1 and table 4.5. It shows that GFI and AGFI are higher than 0.8. The above model in figure 4.1 has δ in order to include error variables which measurement

variables cannot explain.

For the validity of further analysis, we also perform confirmatory factor analysis of each dimension. From the result of analysis presented in table 4.6, we confirm convergent validity for all the dimensions (GFI $\geq$ 0.8, AGFI $\geq$ 0.8, P value $\geq$ 0.05, RMR $\leq$ 0.05, NFI $\geq$ 0.90). Especially, GFI and AGFI indexes for all dimensions show higher than 0.90. However, when the number of variables is less than 4, model fit index is definitely perfect. Therefore, in case of tangibles, x^2, GFI, NFI, CFI values show 1.000.

Table 4.6. The result of confirmatory factor analysis for each dimension

Dimensions	No. of variables	x^2	P	GFI	AGFI	RMR	NFI	CFI
Tangibles	3	0.000		1.000		0.000	1.000	1.000
Assurance	6	14.675	0.100	0.964	0.916	0.049	0.760	0.877
Reliability	5	7.609	0.179	0.978	0.933	0.023	0.877	0.950
Empathy	6	13.268	0.151	0.967	0.924	0.035	0.805	0.919
Responsiveness	4	0.663	0.718	0.998	0.988	0.009	0.986	1.000
Customer Satisfaction	4	4.503	0.105	0.983	0.917	0.020	0.919	0.949
Customer Loyalty	4	2.777	0.249	0.990	0.949	0.012	0.945	0.983

4.3. Hypothesis Testing

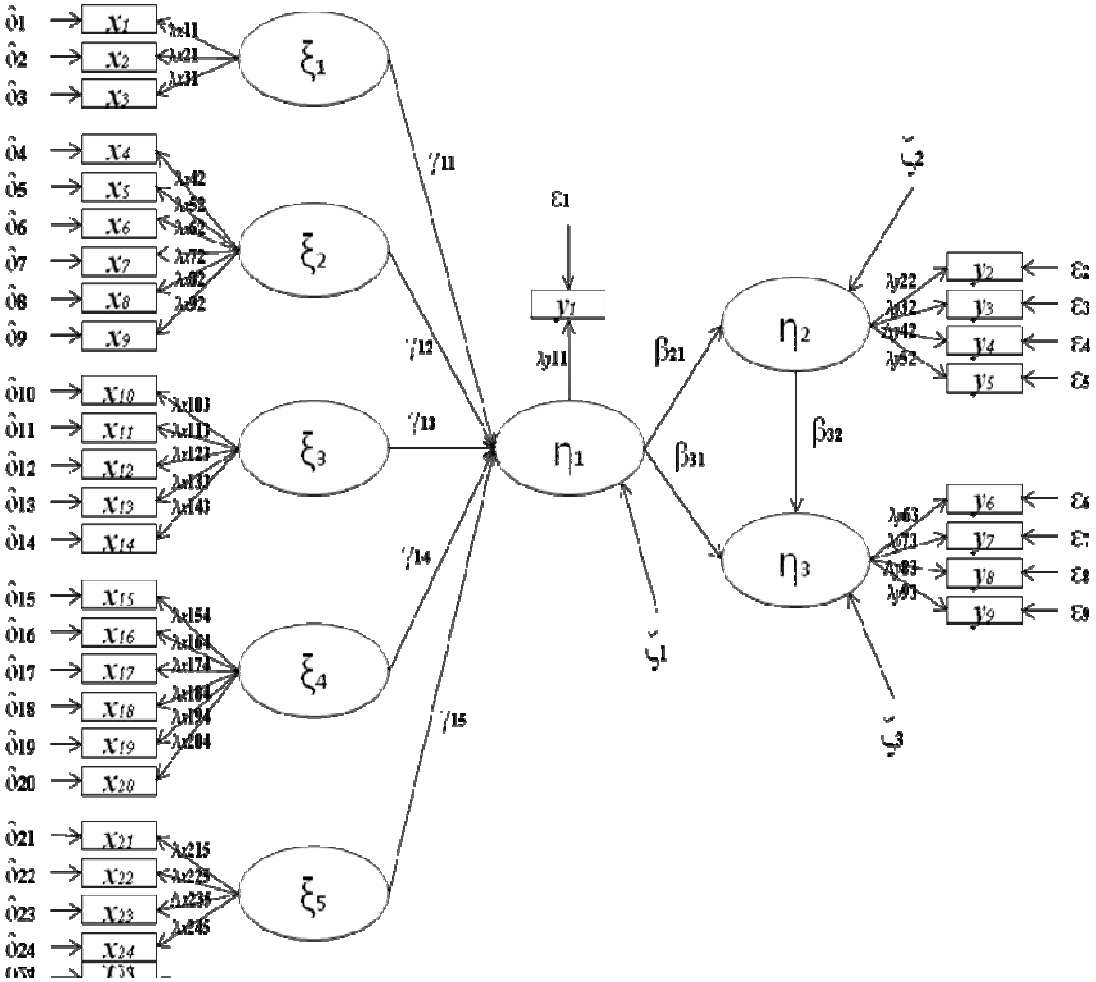
4.3.1. Model design

Based on previous reliability and validity test, measurement variables are determined, and research model using Structural Equation Modeling (SEM) is suggested as following figure 4.2. We will evaluate model fit and perform hypothesis test with this proposed model using AMOS 7.0 which is well known for easy-to-use statistic software.

SEM is designed by using exogenous observed variables (x) and exogenous latent variables (ξ), endogenous observed variable (y) and endogenous latent variables (η), error variables of x(δ), error variables of y(ε), residual variables of $\eta(\zeta)$ and path values of each link (γ, β, λ) (Cho, H. C., 1999). The 5 service dimensions (tangibles, assurance, reliability, empathy, responsiveness) extracted by exploratory factor analysis and

confirmatory factor analysis are used as exogenous latent variables (ξ1~ξ5), and endogenous latent variables indicate port service quality (η1), customer satisfaction (η2), customer loyalty (η3).

Figure 4.2. Path diagram of research model



ξ : exogenous latent variable (service dimensions)
η : endogenous latent variable (port service quality, customer satisfaction, customer loyalty)
x : exogenous observed variable
y : endogenous observed variable
δ : error variable of *x*
ε : error variable of *y*
ζ : residual variable of η
γ : causality between ξ and η
β : causality of η
λ*x* : causality between ξ and *x*
λ*y* : causality between η and *y*

Observed variables are divided to tangibles (*x*01~*x*03), assurance (*x*04~*x*09), reliability (*x*10~*x*14), empathy (*x*15~*x*20), responsiveness (*x*21~*x*24), port service quality (*y*01), customer satisfaction (*y*02~*y*05), and customer loyalty (*y*06~*y*09). The definitions of all variables are shown in table 4.7.

Table 4.7. Definitions of variables for research model

Sign	Name of variables	Sign	Name of variables
x01	Enough handling equipment	ξ1	Tangibles
x02	Enough port facilities and berths	ξ2	Assurance
x03	Deep water draft	ξ3	Reliability
x04	Port's performance of a contract	ξ4	Empathy
x05	Well-skilled port workers	ξ5	Responsiveness
x06	Communication with port workers (language)	η1	Port service quality
x07	Port workers' supportive and cooperative attribute	η2	Customer Satisfaction
x08	Safety awareness training for port workers	η3	Customer Loyalty
x09	Port authority' constant efforts for port development	y01	The level of service quality about a port I use is high
x10	24hrs/holiday cargo handling service	y02	I'm satisfied with port equipment and facilities
x11	Prompt dangerous cargo handling	y03	I'm satisfied with provided port information
x12	Prompt cargo handling through check gate	y04	I'm satisfied with other support activities
x13	Stable supply of workforce	y05	I'm satisfied with port development plan
x14	Low possibility of cargo damage, missing, and pilferage	y06	I'll recommend a port by word of mouth
x15	Incentive policies for high frequency of vessel calling	y07	When I need to change, I'll consider a port as priority
x16	Prompt process of CIQ (Custom Clearance, Immigration and Quarantine)	y08	I'll maintain the number of vessel's calling or make it crease
x17	Notice about information of port situation	y09	I'll continuously use a port if there is no unavoidable reason
x18	Quick ship repair services		
x19	Convenient arrangement for spare parts and ship's materials delivery		
x20	Convenience for bunker and water supply		
x21	Quick response to customer claims		
x22	Immediate information about cargo location		
x23	Efficient performance by EDI (Electronic Data Interface)		
x24	Quick decision making process in terminal		

SEM has structural model reflecting path analysis and multiple regression analysis,

based on measurement model including characteristics of factor analysis. By calculating the endogenous latent variables for structural model, causality equations of the proposed model are estimated as below;

$$\eta 1 = \gamma 11\xi 1 + \gamma 12\xi 2 + \gamma 13\xi 3 + \gamma 14\xi 4 + \gamma 15\xi 5 \quad (4\text{-}1)$$

$$\eta 2 = \beta 21\eta 1 + \zeta 2 \quad (4\text{-}2)$$

$$\eta 3 = \beta 31\eta 1 + \beta 32\eta 2 + \zeta 3 \quad (4\text{-}3)$$

4.3.2. Measures of model fit

Researchers need an assessment for model fit, a step for model validity test. Model fit means consistency of data used for analysis, in other words, evaluates the difference between the characteristics of sample date and the theoretical characteristics. Assessment of model fit for structural equation model is not that simple like general statistical methods, that's because error and residual need to be considered together for estimate. Therefore there is no only absolute measure for the analysis, but three fit measures are basically used for overall model fit measures; Absolute Fit Measures, Incremental Fit Measures, Parsimonious Fit Measures (Hair, et al., 1998). Absolute Fit Measures, indexes based on the information difference (distance) between a fit model and data, include x^2, GFI, AGFI, RMR, and RMSEA. Incremental Fit Measures, indexes comparing a baseline model and a fit model, include NFI, TLI, BFI, CFI, and RNI. Parsimonious Fit Measures, index reflecting a model complexity, include PNFI, PGFI, AIC, BIC, etc.

Firstly, if x^2 value is so high, x^2 test, called test of independence or test of homogeneity, rejects null hypothesis of 'there is no difference'. However, x^2 criterion is sensitive depending on sample size (Schumacker and Lomax, 1996) so that it is necessary to show how x^2 value changes depending on increase (or decrease) of DF (Degree of Freedom). The value is represented as x^2/DF, but the options are divergent on acceptable level of x^2/DF. Wheaton, et al. (1997) suggested a ratio of approximately

five of less for reasonable model. Carmines and Mclver (1981) mentioned the ratios in the range of two to one or three to one. Marsh and Hocever (1985) recommended it as low as tow or as high as 5, and Byrne (1989) insisted that a ratio less than 2 is adequate.

Secondly, Jöreskog and Sörbom (1984) introduced Goodness of Fit Index (GFI) for parameter estimation of Maximum Likelihood (ML) and generalized least Squares (GLS), and it was expanded to other parameter estimation by Tanaka and Hunda (1985). It is the rate of sample covariance matrix (or correlation matrix) explained by proposed model, which indicates how proposed model explains all the data (Cho, H.C., 1999). The GFI value of 1.00 indicates perfect fit, and the range of value is 1.00 to 0.00.

Another fit index generally used for SEM is Adjusted Goodness of Fit Index (AGFI). It takes into account the Degree of Freedom (DF) available for testing model (Arbuckle, 2006). This index uses the information of DF for evaluation of model fit based on GFI, which has also the same range of value as GFI (1.00 to 0.00).

Root Mean Square Residual (RMR) represents the size of variance/covariance which cannot be explained by the model from sample data. RMR, called residual average, explains the difference of average between variables (Bae, B. R., 2007:189-190). The lower the RMR value, the better the model is. Besides, RMR of 0.00 indicates perfect fit. In regards to Root Mean Square Error of Approximation (RMSEA), as it is not affected by sample size, the model will be able to have consistency by considering model complexity. Thus, that is the excepted index from population (Bae, B. R., 2007). Steiger (1990) suggested the RMS, and Browne and Cudeck (1993) mentioned that RMSEA value less than 0.05 is close fit, less than 0.08 is reasonable error of approximation, and higher than 0.1 is inadequate.

James, Mulaik, and Brett (1982) introduced Parsimony Goodness of Fit Index (PGFI) adjusted from GFI. In comparison with AGFI estimated with degree of freedom, PGFI is estimated by considering parsimony of model. The range of PGFI is 1.00 to 0.00, the value close to 1.00 is recommended. Another index for model fit is Normed Fit Index (NFI). This index shows how the proposed model is improved compared with null

model, and it has the range of 1.00 to 0.00.

Table 4.8. Measures of model fit

Index	Description	Related literature
x^2 (Chi-square) & x^2 /DF	Measure which tests homogeneity of sample data and model	Wheaton, et al.(1997) Carmines and Mclver(1981) Marsh & Hocever(1985) Byrne(1989)
GFI (Goodness of Fit Index)	The rate which proposed model explains sample covariance matrix, generally used as overall model fit index	Bollen(1989) Jöreskog and Sörbom (1984) Tanaka and Hunda(1985)
AGFI (Adjusted GFI)	Modification of GFI that takes into account the degrees of freedom available	
PGFI (Parsimony GFI)	Modification of GFI that takes into account parsimony of model	James, Mulaik, and Brett(1982)
NFI (Normed Fit Index)	Index which indicates how proposed model is improved compared with null model	Benttler & Bonett(1980) Bollen(1989)
RMR (Root Mean Square Residual)	The rate which proposed model cannot explain covariance In contrast to GFI	
RMSEA (Root Mean Square Error of Approximation)	Index developed to overcome the limitation of sample size considering model complexity	Steiger(1990) Browne and Cudeck(1993)

Source: summarized and modified by author based on previous literatures and Amos 7.0 User's guide written by Arbuckle, J. L., 2006

4.3.3. Assessment of model fit

As parameter estimation method, Maximum Likehood (ML), Generalized Least Squares (GLS), Unweighted Least Squares (ULS), Scale-free Least Squares (SLS), and Asymptotically Distribution-free (ADF) are suggested in AMOS 7.0. Although ML is

widely used for Structural Equation Modeling, we adopt GLS to minimize the distance of data from the model.

After the initial analysis, we improve model fit value by using Modification Indices (MI) which represents the improvement possibility of model fit values. The model fit indexes and the result of assessment of model fit is as following table 4.9.

Table 4.9. The result of model fit index

Index	Acceptable level	Recommended level	Analysis result
x^2 (Chi-sqaure)		Low and close to DF	431.363
DF(Degree of Freedom)		The higher, the better	486
x^2/DF	≤ 5	Close to 1.000	0.888
GFI(Goodness of Fit Index)	0 ~ 1	≥ 0.8	0.808
AGFI(Adjusted GFI)	0 ~ 1	≥ 0.8	0.778
PGFI(Parsimony GFI)	0 ~ 1	Close to 1.000	0.700
NFI(Normed Fit Index)	0 ~ 1	≥ 0.9	0.332
RMR(Root Mean Square Residual)		< 0.05	0.192
RMSEA(Root Mean Square Error of Approximation)		< 0.05	0.000

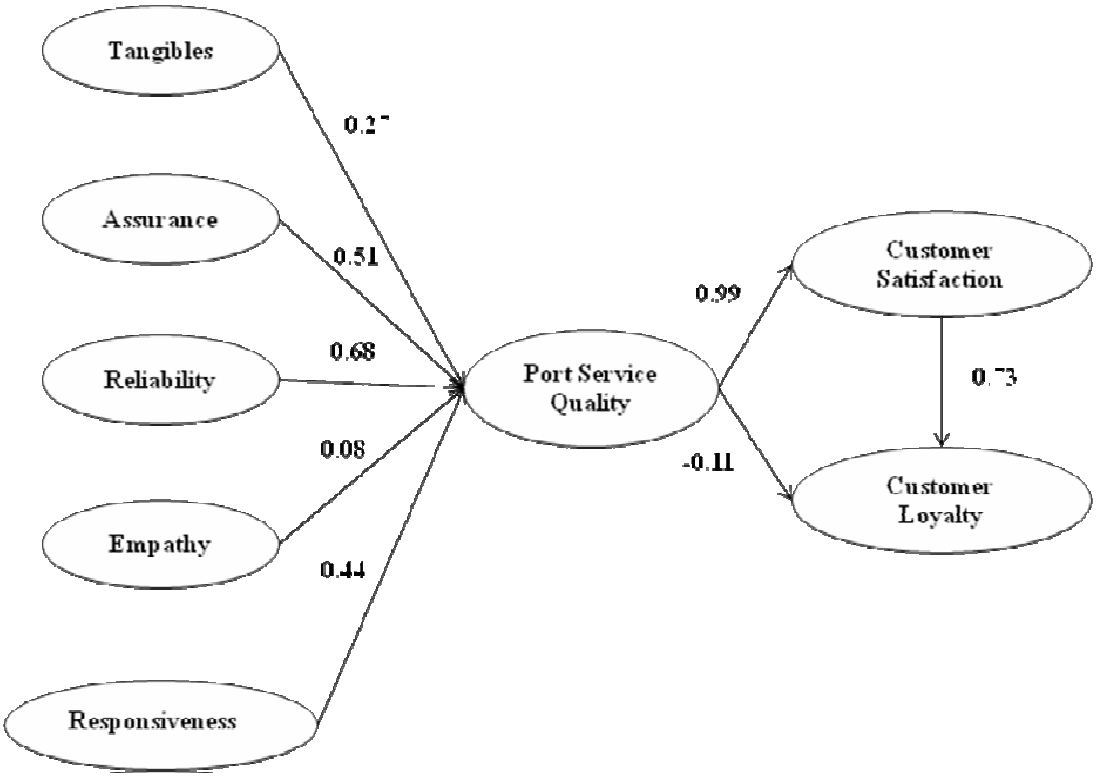
Source: modified based on 'Schumacker, R. E. and Lomax, R. G., 1996, A Beginner's Guide to Structural Equation Modeling, Lawrence Erlbaum', 'Cho, H. C., 1999, Structural Equation Modeling with Lisrel, Suk Jung, p. 111', 'Kim, G. S., 2005, Analysis Structural Equation Modeling, SPSS Academy', 'Bae, B. R., 2007, Structural Equation Modeling with AMOS 7 – Principles and Practice, Chung Ram, p 252', and 'AMOS Reference Guide, SPSS 7.0 software'

From the result, the values of x^2/DF (0.888), GFI (0.808), PGFI (0.700), RMSEA (0.000) are appropriate, and the values of AGFI (0.778) are rather close to 0.8. On the other hand, NFI (0.332) and RMR (0.192) is not acceptable for the term of less than 0.05, in other words, the value of NFI (0.332) represents that the suggest model is improved only 33% compared with the null model. Although it shows that several indexes are not acceptable, this model is considered as suitable from the view of multi-criteria evaluation.

4.3.4. The result of Hypothesis Test

From below figure 4.3, the estimated structural model shows path coefficients, relative effect relation, for hypothesis testing. Concretely, assurance (0.51), reliability (0.68), and responsiveness (0.44) have high path coefficients to port service quality. Besides, it shows port service quality (0.99) to customer satisfaction, and customer satisfaction (0.73) to customer loyalty.

Figure 4.3. The result of SEM analysis (standardized)



Although there are low coefficients of port service quality to customer loyalty (-0.22), port service quality affected by several service factors, customer satisfaction affected by port service quality, and customer loyalty affected by customer satisfaction represents structural relation. All the coefficients in the path diagram are calculated by standardized estimates.

The following table 4.10 summarizes the test results of hypotheses established in the

previous chapter. In regard to the path from tangibles to port service quality, the estimated path coefficient of 0.266 (t=2.310, p=0.021) shows significant difference so that the hypothesis 1 (H1), which tangibles perceived by customer is positively related to port service quality, is accepted. Hypothesis 2 (H2), which assurance perceived by customer is positively related to port service quality, is also accepted with significant difference at the level of $p<0.05$ (t=3.124, p=0.002). From the results of hypothesis 3 (H3), reliability perceived by customer to port service quality shows statistically significant difference at the level of $p<0.001$ (t=3.925). In addition, hypothesis 5 (H5), which responsiveness perceived by customer is positively related to port service quality, is also accepted (t=2.888, p=0.004).

Table 4.10. The result of hypothesis paths

Hypothesis	Hypothesis path	Estimate(a)	S.E.(b)	t	P	Result
H1	Tangibles → Port Service Quality	0.266	0.092	2.310	0.021	Accepted
H2	Assurance → Port Service Quality	0.515	0.236	3.124	0.002	Accepted
H3	Reliability → Port Service Quality	0.684	0.180	3.925	***	Accepted
H4	Empathy → Port Service Quality	0.076	0.081	0.731	0.465	Rejected
H5	Responsiveness → Port Service Quality	0.437	0.166	2.888	0.004	Accepted
H6	Port Service Quality → Customer Satisfaction	0.988	0.139	8.053	***	Accepted
H7	Customer Satisfaction → Customer Loyalty	0.727	2.873	0.222	0.824	Rejected
H8	Port Service Quality → Customer Loyalty	-0.108	3.278	-0.033	0.974	Rejected

(a) Path coefficient
(b) Standard error
**** Significance level p<0.001*

On the contrary, hypothesis 4 (H4), which empathy perceived by customer is positively related to port service quality, is rejected (t=8.053, p=0.465) with low estimate value (0.676). Empathy defined as additional activities to enhance customer satisfaction includes incentive policy, CIQ process, ship repair service, bunker and water supply, etc. However, it seems that empathy as port service is currently not related to port service quality in comparison with the other service factors.

Hypothesis 6 (H6), which port service quality is positively related to customer satisfaction, is accepted with significant difference at the level of $p<0.001$ ($t=8.053$). On the other hand, hypothesis 7 (H7) and hypothesis 8 (H8) are rejected since significance level of H7 ($t=0.222$, $p=0.824$) and H8 ($t=-0.033$, $p=0.974$) do not meet the level of $p<0.001$ or $p<0.05$. Thus, it is inferred from this result that customer satisfaction and port service quality are not related to customer loyalty in terms of port service. It shows that shipping companies do not make a decision or strategy only due to satisfaction of port service, in other words, they consider additional factors such as port rate, location, hinterland size, etc. Even though hypothesis 7 (H7) and hypothesis 8 (H8) are rejected, the reason may be evaluated by several perspective of analysis depending on sample group, extraction of variables, or model design. In addition, it's necessary to estimate detailed path coefficients for correlation.

For more detailed paths estimation, effect analysis (indirect, direct and total effect) is conducted. From the result of effect analysis summarized in table 4.11, it shows that tangibles give indirect effect (0.263) to customer satisfaction and indirect effect (0.162) to customer loyalty. Assurance has direct effect (0.515) to port service quality, indirect effect (0.509) to customer satisfaction, indirect effect (0.314) to customer loyalty. Meanwhile, indirect effects from tangibles, assurance, reliability, empathy, and responsiveness to customer satisfaction have approximate values of the direct effects to port service quality. Thus, it shows that 5 service dimensions are highly related to customer satisfaction as same as port service quality.

The most noteworthy point is the indirect effect of port service quality to customer loyalty. Even though the estimate value from port service quality to customer loyalty is estimated as -0.108, the indirect effect of the path is 0.719 via customer satisfaction. In other words, we may say that port service quality also significantly affect customer loyalty although hypothesis H8 (port service quality to customer loyalty) is rejected. In addition, reliability (0.417), assurance (0.314), responsiveness (0.267), tangibles (0.162), and empathy (0.047) show, in sequence, high indirect effects to customer loyalty.

Table 4.11. Effects analysis (Standardized)

		Port service quality	Customer satisfaction	Customer Loyalty
Tangibles	Direct effects	0.266	-	-
	Indirect effects	-	0.263	0.162
	Total effects	0.266	0.263	0.162
Assurance	Direct effects	0.515	-	-
	Indirect effects	-	0.509	0.314
	Total effects	0.515	0.509	0.314
Reliability	Direct effects	0.684	-	-
	Indirect effects	-	0.676	0.417
	Total effects	0.684	0.676	0.417
Empathy	Direct effects	0.076	-	-
	Indirect effects	-	0.075	0.047
	Total effects	0.076	0.075	0.047
Responsiveness	Direct effects	0.437	-	-
	Indirect effects	-	0.432	0.267
	Total effects	0.437	0.432	0.267
Port service quality	Direct effects	-	0.988	-0.108
	Indirect effects	-	-	0.719
	Total effects	-	0.988	0.610
Customer satisfaction	Direct effects	-	-	0.727
	Indirect effects		-	-
	Total effects	-	-	0.727

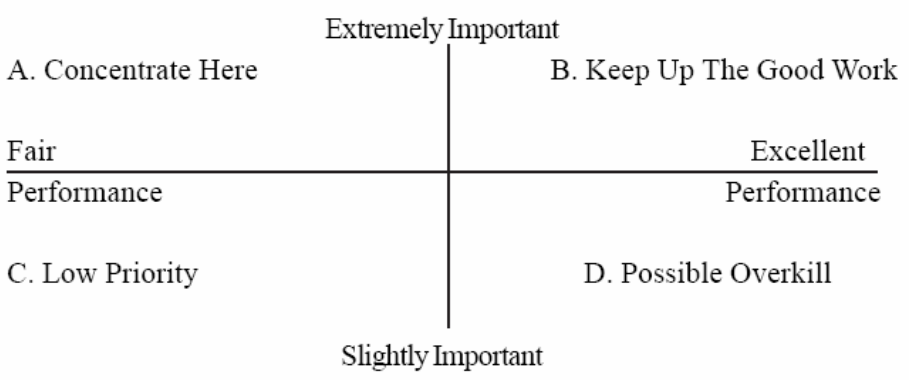
5. Importance-satisfaction assessment

5.1. Importance-Performance Analysis

Apart from SEM used for hypothesis testing, Importance-Performance Analysis (IPA) is used to conduct additional analysis in this chapter. IPA is the method to estimate the important attributes which are contained in goods and service. This process, in the first place, investigates which attributes are concerned more important for customers, then let them evaluate the performance again in order to compare and analyze each attributes of the importance and performance simultaneously (Kong, 2006:288).

Since Martilla & James (1977) used this method to estimate business strategy in automobile sales industry, it has been used in various fields; travel and tourism, leisure and recreation, education, healthcare marketing, etc. (Oh, 2001:617). With the advantage of easy and fast calculation, it has been well known for useful method of satisfaction or performance evaluation.

Figure 5.1. The original IPA framework



Source: Martilla, J. A. and James, J. C., 1977, Importance-Performance Analysis, In: Journal of Marketing, Vol. 41, No. 1, pp. 77-79.

Importance-Performance Analysis shows research results plotted on a two-dimensional matrix. As shown in figure 5.1, the original IPA framework is a graph designed by x-

axis for performance and y-axis for importance. The labels of the quadrants A, B, C, and D refer to marketing effort. A (Concentrate here), B (Keep up the good work), C (Low priority), and D (Possible overkill) (Martilla and James, 1977:77-79). Each attributes about importance and performance are marked in one of these 4 quadrants.

Table 5.1. 4 quadrants of IPA grid

Quadrant	Description
A	Importance of attributes is highly recognized to customers, but performance level is very low. Attributes positioning in this quadrant need more concentrated efforts for improvement.
B	Customers consider attributes very important, at the same time, organizations have high level of fulfillment.
C	This quadrant has low importance and low performance. Although performance is low, manager should not concentrate on the attributes due to low importance. Limited resources need to be used for this part.
D	This quadrant has low importance and high performance. Customers are satisfied with performance of organizations, however, organizations need to maintain current efforts.

Source: Byun, W. H. and Roh, C. C., 2002, A Countermeasure Strategy of Tourism Marketing for Activation of Backje Cultural Tourism : Application to IPA Model, Journal of Tourism and Leisure Research, Vol. 16, No. 4, pp. 30-31

In quadrant A, attributes are highly recognized to customers, but satisfaction level is very low. Hence, organizations are especially required to concentrate on the attributes in this quadrant. As quadrant B has high importance and high performance both, it's important for organizations to maintain current service level and strategy plan. On the other hand, quadrant C shows low importance and low performance, so lower priority should be given. Finally, quadrant D is recognized as low importance to customers, but it shows high satisfaction. However, organizations need to maintain service level.

In order to separate 4 quadrants, decision for the middle axis in IPA grid is a very important step for further analysis. Although median of data scale, standard deviation,

mean from minimum and maximum, etc. are used; mean from minimum and maximum is generally used in previous literatures. We also consider mean as middle axis in this study.

5.2. Difference analysis for satisfaction and importance of port service

We analyze IPA with 24 measurement variables resulted from factor analysis in chapter 4. To estimate service importance through questionnaire, we also use 5 point likert scale like service satisfaction.

T-test is a method of hypothesis testing, which selects ‘means of the two groups are equal’ (null hypothesis) or ‘means of the two groups are not equal’ (alternative hypothesis) by calculating p-value. If p-value is less than significance level (0.01 or 0.05), null hypothesis will be rejected and alternative will be accepted. T-test includes one-sample t-test, independent-samples t-test, and paired-samples t-test. In this study, as satisfaction and importance need to be compared in pairs, we use paired-sample t-test to calculate mean, standard deviation, t-value, p-value, and mean difference.

The results of paired-samples t-test for satisfaction and importance is as following table 5.2. From the results, most of attributes show statistically significant differences between satisfaction and importance ($p<0.01$), and prompt cargo handling through check gate (x12), convenient arrangement for spare parts and ship’s materials delivery (x19) also show significant differences ($p<0.05$). On the other hand, low possibility of cargo damage, missing and pilferage (x14), prompt process of CIQ (x16), efficient performance by EDI (x23) have no significant difference.

As a results of satisfaction mean, 24hr/holiday cargo handling service (mean=3.72), efficient performance by EDI (mean=3.70), convenience for bunk and water supply (mean=3.69), prompt process of CIQ (mean=3.65), convenient arrangement for spare parts and ship’s materials delivery (mean=3.55), enough handling equipment (mean=3.53), quick decision making process in terminal (mean=3.46) show high sample

mean in sequence. In terms of importance, stable supply of work force (mean=4.36), enough port facilities and berths (mean=4.32), enough handling equipment (mean=4.31), deep water draft (mean=4.18), 24hrs/holiday cargo handling service (mean=4.18), port authority' constant efforts for port development (mean=4.17), well-skilled port workers (mean=4.12) have high sample mean in sequence.

Table 5.2. Comparison of satisfaction and importance (Paired-samples t-test)

	Satisfaction			Importance			Mean Difference	t	P
	Mean	Std. Deviation	Rank	Mean	Std. Deviation	Rank			
x01	3.53	0.858	6	4.31	0.872	3	0.78	8.443	0.000**
x02	3.44	0.726	8	4.32	0.822	2	0.88	10.568	0.000**
x03	3.33	0.814	17	4.18	0.868	4	0.85	8.663	0.000**
x04	3.07	0.921	21	4.09	0.836	8	1.01	10.323	0.000**
x05	3.20	1.028	20	4.12	0.799	7	0.93	9.843	0.000**
x06	2.71	0.941	24	3.40	0.919	23	0.69	7.411	0.000**
x07	2.81	0.904	23	3.26	0.965	24	0.45	4.555	0.000**
x08	2.88	0.883	22	3.87	1.035	14	0.99	8.948	0.000**
x09	3.31	0.845	19	4.17	0.836	6	0.86	9.463	0.000**
x10	3.72	0.882	1	4.18	0.830	5	0.46	5.463	0.000**
x11	3.39	0.877	11	3.69	0.983	19	0.29	3.272	0.001**
x12	3.42	0.872	9	3.66	0.996	20	0.23	2.118	0.036*
x13	3.39	0.926	11	4.36	0.820	1	0.96	11.005	0.000**
x14	3.34	0.918	16	3.47	0.892	22	0.13	1.309	0.193
x15	3.39	0.958	11	3.97	0.757	9	0.58	6.313	0.000**
x16	3.65	0.879	4	3.79	0.870	15	0.14	1.450	0.149
x17	3.39	0.918	11	3.73	0.920	17	0.34	3.286	0.001**
x18	3.32	0.915	18	3.95	0.894	12	0.63	6.691	0.000**
x19	3.55	0.890	5	3.73	0.791	17	0.18	2.303	0.023*
x20	3.69	0.896	3	3.96	0.732	10	0.27	3.438	0.001**
x21	3.35	0.871	15	3.96	0.817	10	0.61	7.112	0.000**
x22	3.42	0.953	9	3.77	0.957	16	0.34	3.355	0.001**
x23	3.70	0.926	2	3.53	0.948	21	-0.17	-1.722	0.087
x24	3.46	0.899	7	3.90	0.760	13	0.44	5.057	0.000**

*Significance levels : *p<0.05, **p<0.01*

The high mean differences of importance and satisfaction are shown from port's performance of a contract (mean=1.01), safety awareness training for port workers (mean=0.99), stable supply of workforce (mean=0.96). That is, there are the differences of perception between ports and customers and customers are not really satisfied with those service provided by ports. In contrast, it shows that satisfaction of efficient

performance by EDI (x23) is higher than importance.

5.3. The result of importance-performance analysis of port service

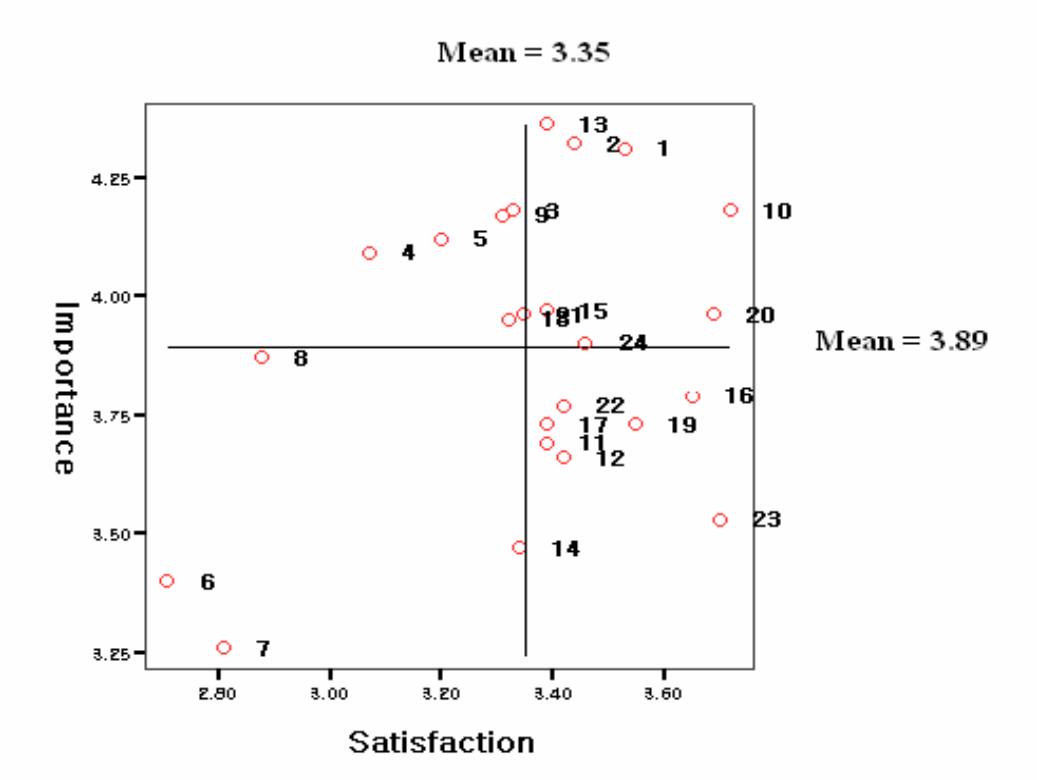
As the figure 5.2 below, sample mean of importance and satisfaction for port service are each 3.89 and 3.35, which are used for middle axis of importance (vertical axis) and satisfaction (horizontal axis) in IPA grid.

Attributes belong to quadrant A are deep water draft (x03), port's performance of a contract (x04), well-skilled port workers (x05), port authority' constant efforts for port development (x09). Hence, there is a room to be improved significantly due to high importance and low satisfaction. Terminals need to concentrate on the attributes in this quadrant in advance to meet customers' satisfaction.

Many attributes which ports consider important are positioning in quadrant B, which include enough handling equipment (x01), enough port facilities and berths (x02), 24hrs/holiday cargo handling service (x10), stable supply of workforce (x13), incentive policies for high frequency of vessel calling (x15), quick ship repair service (x18), convenience for bunker and water supply (x20), quick response to customer to customer claims (x21), quick decision making process in terminal (x24). As this quadrant shows high importance and high satisfaction, it's important to maintain or improve current service level and strategy plan.

In quadrant C, there are port workers' language communication (x06), port workers' supportive and cooperative attribute (x07), safety awareness training for port workers (x08), and low possibility of cargo damage, missing, and pilferage (x14). Even though it has low satisfaction, low priority should be given and limited resources need to be used for the attributes due to low performance.

Figure 5.2. Mean data plotting of the satisfaction and importance



x1. *Enough handling equipment*
x2. *Enough port facilities and berths*
x3. *Deep water draft*
x4. *Port's performance of a contract*
x5. *Well-skilled port workers*
x6. *Communication with port workers (language)*
x7. *Port workers' supportive and cooperative attribute*
x8. *Safety awareness training for port workers*
x9. *Port authority' constant efforts for port development*
x10. *24hrs/holiday cargo handling service*
x11. *Prompt dangerous cargo handling*
x12. *Prompt cargo handling through check gate*
x13. *Stable supply of workforce*
x14. *Low possibility of cargo damage, missing, and pilferage*
x15. *Incentive policies for high frequency of vessel calling*
x16. *Prompt process of CIQ (Custom Clearance, Immigration and Quarantine)*
x17. *Notice about information of port situation*
x18. *Quick ship repair services*
x19. *Convenient arrangement for spare parts and ship's materials delivery*
x20. *Convenience for bunker and water supply*
x21. *Quick response to customer claims*
x22. *Immediate information about cargo location*
x23. *Efficient performance by EDI (Electronic Data Interface)*
x24. *Quick decision making process in terminal*

It is inferred from figure 5.2 that Quadrant D is competitive advantage due to its high satisfaction compared with low importance. However, It seems that the service attributes here are over invested (Bang and Roh, 2006:118) Therefore, ports need to distinguish the service from others and to maintain current satisfaction. Prompt dangerous cargo handling (x11), prompt cargo handling through check gate (x12), prompt process of CIQ (x16), notice about information of port situation (x17), convenient arrangement for spare parts and ship's materials delivery (x19), immediate information about cargo location (x22), efficient performance by EDI (x23) are included in this quadrant.

6. Conclusion

6.1. Summary of study

The purpose of this study is to suggest evaluation model of port service quality and find out causality of port service quality which affect customer satisfaction and loyalty. In this paper, we examined the impact of port service quality on customer satisfaction and customer loyalty based upon suggested evaluation model. From 137 acceptable data from questionnaire survey responded by shipping companies calling to ports in Korea, we carry out factor analysis and Structural Equation Modeling using SPSS 15.0 and AMOS 7.0.

We establish 8 hypotheses based on SERVPERF in order to test correlation of 5 dimensions of port service, port service quality, customer satisfaction, and customer loyalty. From the result of the hypothesis testing, we accept 6 hypotheses out of 8 with high Significance level and reject 2 hypotheses. Surprisingly, the result shows that customer satisfaction and port service quality do not affect customer loyalty in spite of high effect of port service on customer satisfaction. Therefore, it is reasonable to suppose that other factors (port charge, port location, hinterland, etc.) instead of port service quality are highly considered when shipping companies choose ports.

On the other hand, the result of direct, indirect & total effects analysis shows that all five port service dimensions have high indirect effects on customer loyalty via port service quality and customer satisfaction.

For additional analysis, Importance-Performance Analysis(IPA) approach is used for strategy of port service. The result of IPA indicates that port's performance of a contract, port workers' skill, constant efforts for port development, etc., have high importance and low satisfaction. On the contrary, CIQ process, EDI performance, prompt cargo handling through check gate, notice about port situation, etc., have high satisfaction and

low importance.

This research provides critical view of port service by analyzing effects of port service on port service quality, customer satisfaction, and customer loyalty. Besides, IPA shows gaps between perceived service satisfaction and importance in order to help ports or port authorities to establish reasonable strategies.

6.2. Limitation of the study and suggestions for future research

The limitation of this study and suggestions for future research are as below;

First of all, the concepts of port service and port service quality are not clearly defined in spite of many attempts. In addition, question about validity of 5 dimensions which are applied to port industries still remains under the unidentified concept of port service. Therefore, future research about service quality, dimensions, and measurement variables for port industries are required basically.

In this study, we use SERVPERF (performance-based method) instead of SERVQUAL in order to focus on performance (perceived customer satisfaction) only. That is because expectation will not be able to be measured consistently due to the subjective characteristic of service quality (Cronin and Taylor, 1992). In other words, consumers may not distinguish the level of expectation measurement, and it is possible for consumers to give the good score for all the variables. However, as SERVPERF simply uses performance indicator, the limitation of structural causality may be occurred in the result of analysis.

In the former business or marketing researches, there are some cases that SERVQUAL and SERVPERF are used together. On the other hand, in the port industry, even though SERVQUAL is sometimes used for service measurement, I would like to suggest to measure port service with SERVQUAL and SERVPERF together in order to find adequate method for evaluation model of port service quality.

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Appendix A. Correlation matrix

	x01	x02	x03	x04	x05	x06	x07	x08	x09	x10	x11	x12	x13	x14	x15	x16	x17	x18	x19	x20	x21	x22	x23	x24
x01	1.000	0.602	0.453	0.137	0.055	0.067	0.027	0.199	0.213	0.231	0.364	0.315	0.270	0.266	0.226	0.113	0.161	0.202	0.120	0.157	0.211	0.334	0.258	0.338
x02	0.602	1.000	0.414	0.161	0.081	-0.016	0.027	0.241	0.060	0.242	0.258	0.309	0.266	0.296	0.353	0.092	0.180	0.130	0.110	0.038	0.197	0.251	0.284	0.185
x03	0.453	0.414	1.000	-0.003	0.019	-0.018	0.005	0.135	0.027	0.152	0.198	0.175	0.168	0.176	0.097	0.131	0.150	0.134	0.071	0.058	0.116	0.199	0.131	0.174
x04	0.137	0.161	-0.003	1.000	0.280	0.246	0.308	0.390	0.300	0.189	0.210	0.309	0.251	0.328	0.126	0.195	0.192	0.216	0.192	0.179	0.252	0.283	0.198	0.234
x05	0.055	0.081	0.019	0.280	1.000	0.478	0.381	0.293	0.327	0.160	0.093	0.161	0.188	0.187	-0.042	0.012	0.050	0.190	0.129	0.066	0.103	0.139	0.093	0.243
x06	0.067	-0.016	-0.018	0.246	0.478	1.000	0.609	0.472	0.321	0.023	0.158	0.188	0.268	0.191	0.178	0.151	0.304	0.366	0.309	0.321	0.198	0.205	0.059	0.247
x07	0.027	0.027	0.005	0.308	0.381	0.609	1.000	0.506	0.294	0.153	0.178	0.299	0.345	0.317	0.147	0.230	0.339	0.323	0.433	0.327	0.281	0.248	0.055	0.262
x08	0.199	0.241	0.135	0.390	0.293	0.472	0.506	1.000	0.271	0.193	0.287	0.332	0.443	0.430	0.194	0.174	0.320	0.383	0.261	0.177	0.369	0.356	0.227	0.355
x09	0.213	0.060	0.027	0.300	0.327	0.321	0.294	0.271	1.000	0.232	0.293	0.313	0.352	0.312	0.116	0.190	0.252	0.404	0.274	0.314	0.204	0.296	0.180	0.347
x10	0.231	0.242	0.152	0.189	0.160	0.023	0.153	0.193	0.232	1.000	0.469	0.578	0.462	0.437	0.195	0.202	0.103	0.305	0.221	0.242	0.265	0.276	0.381	0.333
x11	0.364	0.258	0.198	0.210	0.093	0.158	0.178	0.287	0.293	0.469	1.000	0.674	0.640	0.592	0.146	0.257	0.335	0.455	0.254	0.211	0.434	0.494	0.463	0.411
x12	0.315	0.309	0.175	0.309	0.161	0.188	0.299	0.332	0.313	0.578	0.674	1.000	0.629	0.648	0.248	0.233	0.341	0.372	0.330	0.309	0.374	0.367	0.422	0.444
x13	0.270	0.266	0.168	0.251	0.188	0.268	0.345	0.443	0.352	0.462	0.640	0.629	1.000	0.656	0.321	0.360	0.473	0.465	0.348	0.324	0.383	0.351	0.413	0.416
x14	0.266	0.296	0.176	0.328	0.187	0.191	0.317	0.430	0.312	0.437	0.592	0.648	0.656	1.000	0.250	0.256	0.374	0.440	0.310	0.198	0.339	0.307	0.335	0.337
x15	0.226	0.353	0.097	0.126	-0.042	0.178	0.147	0.194	0.116	0.195	0.146	0.248	0.321	0.250	1.000	0.331	0.374	0.232	0.363	0.330	0.010	0.114	0.167	0.147
x16	0.113	0.092	0.131	0.195	0.012	0.151	0.230	0.174	0.190	0.202	0.257	0.233	0.360	0.256	0.331	1.000	0.445	0.388	0.569	0.665	0.133	0.222	0.231	0.112
x17	0.161	0.180	0.150	0.192	0.050	0.304	0.339	0.320	0.252	0.103	0.335	0.341	0.473	0.374	0.374	0.445	1.000	0.461	0.594	0.505	0.286	0.304	0.338	0.358
x18	0.202	0.130	0.134	0.216	0.190	0.366	0.323	0.383	0.404	0.305	0.455	0.372	0.465	0.440	0.232	0.388	0.461	1.000	0.547	0.480	0.356	0.366	0.279	0.364
x19	0.120	0.110	0.071	0.192	0.129	0.309	0.433	0.261	0.274	0.221	0.254	0.330	0.348	0.310	0.363	0.569	0.594	0.547	1.000	0.731	0.297	0.258	0.256	0.313
x20	0.157	0.038	0.058	0.179	0.066	0.321	0.327	0.177	0.314	0.242	0.211	0.309	0.324	0.198	0.330	0.665	0.505	0.480	0.731	1.000	0.205	0.239	0.278	0.268
x21	0.211	0.197	0.116	0.252	0.103	0.198	0.281	0.369	0.204	0.265	0.434	0.374	0.383	0.339	0.010	0.133	0.286	0.356	0.297	0.205	1.000	0.609	0.441	0.591
x22	0.334	0.251	0.199	0.283	0.139	0.205	0.248	0.356	0.296	0.276	0.494	0.367	0.351	0.307	0.114	0.222	0.304	0.366	0.258	0.239	0.609	1.000	0.478	0.612
x23	0.258	0.284	0.131	0.198	0.093	0.059	0.055	0.227	0.180	0.381	0.463	0.422	0.413	0.335	0.167	0.231	0.338	0.279	0.256	0.278	0.441	0.478	1.000	0.502
x24	0.338	0.185	0.174	0.234	0.243	0.247	0.262	0.355	0.347	0.333	0.411	0.444	0.416	0.337	0.147	0.112	0.358	0.364	0.313	0.268	0.591	0.612	0.502	1.000

Appendix B. Questionnaire form

Questionnaire for port service quality

Dear Sir/Madam,

Thank you for participating in this questionnaire. This survey form is designed for development of port service quality measurement and for analysis of importance-performance correlation. It consists of 4 parts(58 questions), and It will probably take you 20 minutes to complete this form.

In this questionnaire you are asked importance & satisfaction about port service and all your answers will highly affect the result of this analysis. So please answer the questions carefully in your view. I promise that all your detail will be confidential and it will never be used for any other purpose.

If you have any other questions about this survey or questionnaire, please feel free to call me at +82.(0)51.410.4911. After you complete this form, please fax this form back to +82.(0)51.405.8822, or email me at Legin3@gmail.com.

I appreciate you taking the time to fill out this questionnaire, and I wish you good luck for all your future.

Sincerely yours,
Chang Jae Gon

1. This part is about general information about respondent. Please read each of the following questions, and fill or answer the questions.

1-1. What is the name of your company?
( )

1-2. What department are you belong to? Or what are you responsible for?
( )

1-3. What is your job title in your company?
o Staff o Assistant manager o Manager
o Deputy general manager o General manager o Director or higher position

1-4. How long have you worked for your company?
o under 2 years o 2 years – 4 years o 5 years – 9 years
o 10 years – 14 years o 15 years -19 years o over 20 years

2. This part is about service importance and satisfaction of a port you use. Read each of the following questions that most appropriately represents your opinion.

No.	Questions	Importance					Satisfaction				
		Very Unimportant				Very Important	Very Dissatisfied				Very Satisfied
1	Enough handling equipment	○	○	○	○	○	○	○	○	○	○
2	Enough port facilities and berths	○	○	○	○	○	○	○	○	○	○
3	Deep water draft	○	○	○	○	○	○	○	○	○	○
4	24hrs/holiday cargo handling service	○	○	○	○	○	○	○	○	○	○
5	Incentive policies for high frequency of vessel calling	○	○	○	○	○	○	○	○	○	○
6	Prompt process of CIQ (Custom Clearance, Immigration and Quarantine)	○	○	○	○	○	○	○	○	○	○
7	Quick response to customer claims	○	○	○	○	○	○	○	○	○	○
8	Prompt dangerous cargo handling	○	○	○	○	○	○	○	○	○	○
9	Immediate information about cargo location	○	○	○	○	○	○	○	○	○	○
10	High productivity of port equipment to minimize port time	○	○	○	○	○	○	○	○	○	○
11	Notice about current local marine condition	○	○	○	○	○	○	○	○	○	○
12	Safe port arrival through vessel passage	○	○	○	○	○	○	○	○	○	○
13	Communication between yard and control center	○	○	○	○	○	○	○	○	○	○
14	Flexible and prompt berth allocation	○	○	○	○	○	○	○	○	○	○
15	Notice about information of port situation	○	○	○	○	○	○	○	○	○	○
16	Report of local weather forecasts	○	○	○	○	○	○	○	○	○	○
17	Efficient performance by EDI(Electronic Data Interface)	○	○	○	○	○	○	○	○	○	○
18	Free time of container freight station	○	○	○	○	○	○	○	○	○	○
19	Quick decision making process in terminal	○	○	○	○	○	○	○	○	○	○
20	Port's performance of a contract	○	○	○	○	○	○	○	○	○	○
21	Prompt cargo handling through check gate	○	○	○	○	○	○	○	○	○	○
22	Well-skilled port workers	○	○	○	○	○	○	○	○	○	○
23	Communication with port workers(language)	○	○	○	○	○	○	○	○	○	○
24	Port workers' supportive and cooperative attribute	○	○	○	○	○	○	○	○	○	○
25	Stable supply of workforce	○	○	○	○	○	○	○	○	○	○

26	Safety awareness training for port workers	○	○	○	○	○	○	○	○	○	○
27	Low possibility of cargo damage, missing, and pilferage	○	○	○	○	○	○	○	○	○	○
28	Low failure rates of handling equipment	○	○	○	○	○	○	○	○	○	○
29	Safety operation of port equipment	○	○	○	○	○	○	○	○	○	○
30	Efforts for security and safety in port	○	○	○	○	○	○	○	○	○	○
31	Well-equipped Navigation aids for safe vessel calling	○	○	○	○	○	○	○	○	○	○
32	Evacuation policy for emergency case	○	○	○	○	○	○	○	○	○	○
33	Clean port spaces and facilities	○	○	○	○	○	○	○	○	○	○
34	Periodic inspection for equipment and facilities	○	○	○	○	○	○	○	○	○	○
35	Restricted entrance	○	○	○	○	○	○	○	○	○	○
36	Quick ship repair services	○	○	○	○	○	○	○	○	○	○
37	Convenient arrangement for spare parts and ship's materials delivery	○	○	○	○	○	○	○	○	○	○
38	Convenience for bunker and water supply	○	○	○	○	○	○	○	○	○	○
39	Convenience facilities for crews	○	○	○	○	○	○	○	○	○	○
40	Emergency services for crews	○	○	○	○	○	○	○	○	○	○
41	Port authority' constant efforts for port development	○	○	○	○	○	○	○	○	○	○
42	Port authority' positive marketing activity	○	○	○	○	○	○	○	○	○	○
43	Try to listen to customer request	○	○	○	○	○	○	○	○	○	○
44	Efficient use in multi-modal transportation	○	○	○	○	○	○	○	○	○	○
45	Proximity of CY, CFS, and warehouses	○	○	○	○	○	○	○	○	○	○

3. This part is about customer satisfaction of a port you use. Please read each of the following questions and mark your answer ¡ in the blank that most appropriately represents your opinion.

3-1. Please answer the following question.

No.	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	A port I use has high level of overall service quality					

3-2. Please answer the following questions.

No.	Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	I'm satisfied with port equipment and facilities					
2	I'm satisfied with provided port information					
3	I'm satisfied with other support activities					
4	I'm satisfied with port development plan					

4. This is about recommendation & word of mouth, revisit Intention, etc. Please read each of the following questions and mark your answer ¡ in the blank that most appropriately represents your opinion.

No.	Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	I'll recommend a port by word of mouth					
2	When I need to change, I'll consider a port as priority					
3	I'll maintain the number of vessel's calling or make it crease					
4	I'll continuously use a port if there is no unavoidable reason					

o Thanks for your participation~!!