CONSTRUCTS IN PORT EFFECTIVENESS RESEARCH

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ABSTRACT

Almost all of the past effort in port performance measurement has focused on the technical performance of port assets such as land, cranes, berths, and labour; that is, it has focused on their efficiency. Very little port performance research has focused on whether the inefficiencies or inadequacies of ports have created problems for users that require the injection of more assets or the application of performance improvements to improve service delivery. Users are in the best position to determine if the port, and its tenants and partners, are able to deliver the services required. If the delivery of services does not match expectations, the port does not deliver a value proposition to its customers, and is therefore seen as ineffective. The objective of this research paper is to examine how users evaluate port effectiveness and identify those constructs of relevance to that evaluation. The three user groups are defined as carriers, cargo interests and suppliers of services at the port to the first two. As this phase of the research is focused on the development of effectiveness constructs and the survey instrument in one geographic market, it is our intention to validate these findings in other geographic markets in the future research program.

The study team developed an on-line survey instrument and delivered it to Canadian port users with the assistance of eight industry organizations. The findings of the research are based on the contributions of 57 decision-makers with port usage experience, many of whom fit into more than one group of users. The study concludes that the evaluation criteria influencing users' perceptions of satisfaction, competitiveness and service delivery effectiveness are different, and so while the determinants of these constructs have considerable overlap, they are different constructs. This paper also illustrates how third-party evaluation of port performance might be used by a port to strategically improve its service to users, and therefore have value from a port perspective in its strategic planning.

BACKGROUND AND PURPOSE

Governments need to be able to evaluate the effectiveness of the port system in meeting the needs of their trading communities; supply chain participants also need to evaluate whether ports meet their needs. As a result, a program of regular performance measurement is recommended. In most port performance assessments, measurement focuses on efficiency but fails to include effectiveness by those who 'use' a port system. It is the starting premise of this paper that efficiency measurement must be accompanied by the measurement of effectiveness in order to improve the overall and specific performance of the port system. Furthermore, companies that receive third party effectiveness research learn where continuous improvement activities will pay off in future performance improvements, whether the company itself or its suppliers provide the service.

The purpose of this study is two-fold:

- To understand the evaluation criteria by which users determine that a port's performance is satisfactory (or effective in meeting their needs). As will be seen below, this has not yet been adequately addressed in the scholarly literature. Therefore, the port competitive environment is not well understood as is the case for airports (also discussed).
- To facilitate the assessment by relevant decision-makers—whether governments, port authorities, or service providers—of port service delivery, and to indicate such findings to ports so that they may fine tune operations to meet customers' expectations and competition. Without such understanding, governments are unable to assess when investment decisions in port infrastructure, or port policy adjustments are required to meet the needs of the market, port authorities are less likely to make the optimal resource allocations to improve the competitiveness of their port, and service providers will be frustrated in their efforts to grow and exploit business opportunities.

Identifying the user's perceived importance of different dimensions of a service is therefore the first step in evaluating the port's competitiveness relative to other options in the supply chain. Knowing how a port performs is the first step in a program of continuous improvement of benefit to both ports and their users.

Users are more than just the buyers of the port's services. Other supply chain partners may not be the purchasers of those services but have experience with and influence on the delivery of port services. The three user groups are defined as carriers and cargo interests, as well as suppliers of services at the port to the first two. Our goal is to understand how port users evaluate ports, what is most important to them in terms of the services received, and how they evaluate the performance of ports they use. In this study, participants were asked to rate the importance of various performance criteria and then to apply them to ports they use by evaluating that port's performance on those dimensions. Based on the findings, port

users will be able to see how ports perform on the various dimensions of port performance, and the findings should assist ports in benchmarking their performance against others they see as competitors, and therefore guide them in improving the quality of their services, which will be a significant benefit to the port users.

LITERATURE REVIEW

The Port Performance Literature

Port performance research can be divided into effectiveness research and efficiency research. These two are like yin and yang, complementing each other. **Efficiency** has been noted as "doing things right" while **effectiveness** is "doing the right things." The right things are those that are important to the customer. If a negative and significant gap exists between the importance of those right things and the performance of them, dissatisfaction is the by-product. In combination, these two port performance components also provide government policy-makers with the essential feedback for assessing the governance structure of ports in meeting national strategic objectives (Brooks and Pallis, 2008)

There is certainly no shortage of research on measuring technical efficiency in container ports; this has been a predominant focus of port research for the last 10 years. This is not irrelevant as ports seeking growth often aim to attract large-scale companies, draw extra investments and exploit resources in order to attain certain technical efficiencies. Most notable is the work of Cullinane and Wang (2006), but as a discussion of port efficiency is not the focus of this research, we recommend readers to Gonzalez and Trujillo, 2009 for a comprehensive review.

However, improving technical efficiency is not the total story. Such efficiency measures do not provide an indication of how well a port is managing its assets or serving its customers (by, for example, providing reduced container dwell times or faster vessel turnaround). Even when efficiency indicators are extremely positive from a port perspective, port users' complaints may still arise, with such complaints not being reflected in efficiency indicators used (Farrell, 2009). Recognizing and fully understanding port users' needs is a starting point for developing strategies that serve unmet needs that have the potential to grow new business or acquire market share.

Very little research, however, has focused on whether the inefficiencies or inadequacies of ports have created problems for users that require the injection of more assets or non-tangible resources like better communication plans. Users are in the best position to determine if the port, and its tenants and partners, deliver the services required. If the delivery of services does not match expectations, the port does not deliver a value proposition to its customers, and is therefore seen as ineffective. Aiming to fill this gap, **the focus of this research is to examine how users evaluate port effectiveness and what evaluation criteria they use in the process, as well as to understand the antecedents of the three constructs—satisfaction, competitiveness and effectiveness in service**

delivery. The study also enables us to explore whether these antecedents are the same for each of the constructs.

The need to understand both efficiency and effectiveness in port performance has been only recently recognized by the industry. For example, in 2008 Germanischer Lloyd launched the Container Terminal Quality Indicator, a certification process for quality standards in container terminals. In the European context, consultation towards the definition of such indicators was initiated (European Commission, 2007), and recently the European port authorities have announced a collective effort towards this end through the establishment of a European Port Observatory to monitor such indicators (European Sea Ports Organisation, 2009).

These recent efforts by interested parties in the marine industry head towards an effectiveness (service quality delivery) evaluation that other industries have already implemented. For example, more than a decade ago, the Airports Council International (ACI) teamed up with the International Air Transport Association (IATA) to provide third-party independent customer surveys (first the Global Airport Monitor and later the Airport Service Quality program). The airport industry now measures 34 service items for 130 airports worldwide (http://airportservicequality.ch/participants), administering in excess of 220,000 surveys annually. Each airport is not only able to evaluate through quarterly reports its performance in a rank order sense, but is able to conduct a gap analysis against other selected airports (whose performance sets a best practice benchmark) or against the industry average. While airports certainly have a different type of user (and more of them) than ports do, the concept is directly relevant to what this research intends to assist ports to do.

In port research, one can find miscellaneous endeavours for an overall Business Performance Measurement (Guardado *et al.*, 2004; Su *et al.*, 2003). The focus, however, expands to include externally generated information, such as users' perspectives on port choices (i.e. Lirn *et al.*, 2003; Tongzon, 2008; Saeed, 2009) and port attractiveness (Ng, 2006). There are also few recent attempts (Ugboma *et al*., 2007, 2009; Pantouvakis *et al.*, 2008) to access port users' satisfaction via the application of SERVQUAL, a well-known multi-item scale developed to assess customer perceptions of service quality in service and retail businesses; this scale decomposes the notion of service quality into five constructs (i.e., tangibles, reliability, responsiveness, assurance, and empathy). However, SERVQUAL-based research has serious issues; while SERVQUAL has been successfully adapted in an educational context (e.g. Ford *et al.*, 1993); criticisms of the SERVQUAL model focus on: (1) the potential inappropriateness of the five dimensions of choice criteria used by SERVQUAL (Cronin and Taylor, 1992; Carman, 1990) and (2) the inability of expectations to remain constant over time (Carman, 1990).

All of the above studies introduce a different research agenda from that set by port studies to focus on port choice based exclusively on either the examination of the geographical centrality of a port, the ex-post analysis of throughput direction in a port or region, or the technical efficiency of a port based on parameters pre-defined by the researchers. Yet, there is not any tool developed for measuring port users evaluations per se.

The best effectiveness metrics (from the managerial perspective of the port) come from questionnaires to users (e.g. Ng, 2006; Sánchez *et al*., 2003; U.S. Department of Transportation, Maritime Administration, 2004). Those studies that do try to get to the heart of the matter are usually one-off exercises and not replicated elsewhere in the literature or year over year. There is not a user standard survey for the industry. What we wish to measure is port service quality delivery, as measured by perceived performance on individual activities and by the relationship of these with overall satisfaction, whether it is delivered by the port or by the port's partners in the supply chain. Moreover, effectiveness and 'port choice' exercises in ports focus on one type of actors only, whether these are carriers (Saeed, 2009), shippers (Lirn *et al*., 2003; 2004), forwarders (Tongzon, 2008), or even terminal operating companies (De Langen and Chouly, 2009). The scope of our research is to assess the views of all these actors in a single integrated way.

The development of a 'usable' effectiveness instrument is important for an additional reason: ports have developed to functionally and spatially regionalized entities that are embedded in complex supply chains (see: Notteboom and Rodrigue, 2005). In this reality, the interdependencies (i.e. sequential, pooled, reciprocal) of the supply chain partners increase. In turn, this rising interdependency increases the role of satisfactory port performance as a lever for the competitive advantage of the various actors involved. All these have triggered suggestions for developing strategies that will exploit the different interdependencies in order to satisfy them (De Martino and Morvillo, 2008), as well as empirical research on the various operational and commercial relations wherein these interdependencies emerge and value is generated (Pallis and Vitsounis, forthcoming).

The Literature on Our Approach

Importance–Performance Analysis, first popularized by Martilla and James (1977), is a commonly used technique for evaluating both customer satisfaction and service quality. It does this by determining the relevance (stated importance) of evaluation criteria or attributes to customers and their assessments of the organization's performance on these criteria. The gaps between importance and performance ratings are then used to identify areas where management should focus their resources when developing a marketing strategy. A two-dimensional graph with mean or median importance and performance ratings on each axis (referred to either as an importance performance space or an action grid) is used to assess how resources should be applied to maximizing customer satisfaction and service quality. The approach has been applied in numerous fields since then, including education (Ortinau *et al*., 1989; Ford *et al*., 1999), food services (Sampson and Showalter, 1999), tourism (Oh, 2001), government services (Van Ryzin and Immerwahr, 2007), and professional training (Siniscalchi *et al*., 2008).

Martilla and James (1977) identify two issues that need to be considered when implementing this technique, first the evaluation criteria selected must be carefully chosen using sound qualitative techniques and second the importance and performance questions need to be separated in order to minimize multicollinearity problems. We discuss the first in a later sub-

section and ensured the second by asking the importance questions in a separate section before the performance questions were asked.

Early on it was recognized that reliance on self-reported importance ratings has shortcomings (Neslin, 1981; Chu, 2002). The direct ratings tend to be high and thus grouped very closely; this is due to the fact that the researchers tend to only include attributes they know are salient to the customers (Chu, 2002; Gustafsson and Johnson, 2004). This compression of rating near the top, or "concavity bias" (Doyle, Green and Bottomley, 1997) makes it difficult to statistically distinguish among the more important attributes and easier to distinguish among the less important attributes in a set. Also, self-rating of importance has been found to be subject to response bias due to the influence of social norms. In a business-to-business context, this could be seen as the influence of business cultural norms that may bias responses. However, the most important shortcoming of importance ratings is that they may not be predictive of satisfaction or any other construct of interest to the researchers. If these ratings are to be used for developing strategy, then there should ideally be a causal relationship between performance on the evaluation criterion and customer satisfaction. The whole purpose of the exercise it to determine where to allocate resources, but resources allocated to an area that has no actual influence on the customer are wasted.

The solution is to incorporate the concept of determinant attributes into the technique. Myers and Albert (1968) defined determinant attributes as "attributes that are both important and that differentiate meaningfully among alternative offerings, the 'hot button'." Operationally determinant attributes are the attributes where the firm's performance on the attributes predicts customer satisfaction (or some other construct such as perceived competitiveness, or value that is hypothesized to attract the customer to the service). These approaches use the perceptions of the customer to derive what is important.

There have been several methods proposed for estimating the determinance of attributes. Multiple Regression (MR) is the most often used but this is now recognized as the least effective method (Ryan et al. 1999, Gustafsson and Johnson, 2004) since the performance measures suffer from multicollinearity which leads to very unstable coefficients. Furthermore, because in multiple regression the variables compete for weight, the results are very sensitive to the set of performance measures included in the analysis. There have been several methods suggested for overcoming these problems including the use of Partial Least Squares (PLS) using either formative or reflective constructs, Principal Components Regression (PCR), and Normalized Pairwise Estimation (NPE) (Gustafsson and Johnson, 2004). The last compared direct measurement to the five methods of deriving determinant attributes (MR, PLS, PCR, and NPE) on four criteria—satisfaction and loyalty variance explained, diagnostic value, and negative measures. All approaches excelled on at least one of the criteria and were weak on others. MR suffered from negative importance weights, which theoretically should be impossible, and indicates the overall inappropriateness of the approach. The reflective PLS, formative PLS and PCR approaches tended to have lower variance explained but better diagnostic properties. The NPE had high variance explained, for both satisfaction and loyalty, and no negative importance for attributes, which means it

overcame the problems of multicollinearity that plagues multivariate analysis. It did however tend to have inflated importance measures for poorer quality measurement models and was deemed to be less diagnostic (less able to identify customers' most important attributes).

Gustafsson and Johnson (2004: 137) concluded that if "the goal is simply to explain variation and provide attribute importance measures that completely avoid the problems of multicollinearity, then NPE would be a suitable approach. If, in contrast, the goal is to identify those benefits and attributes that are most diagnostic in affecting satisfaction, our results suggest that the reflective PLS method is the method of choice, and formative PLS and PCR are close substitutes. Recall, however, that the choice of reflective and formative PLS depends on just how comprehensive the attribute specifications are." The last point in the authors' opinion rules out the use of PLS and PCR in order to derive determinant attributes as they require a large number of statements that would make the survey instrument unwieldy. We instead have decided to use NPE which we will describe in more detail in the section on Methodology.

None of those comparing derived importance to stated importance have suggested that the former should replace the latter (Gustafsson and Johnson, 2004; Van Ittersum, 2007; Van Ryzin and Immerwahr, 2007). The two measures are viewed as complementary, each providing a different perspective on the value of the criterion. The stated-importance approach can be used as a backup if use of the performance measures to derive determinance does not work; because the stated-importance measures can be used in the importance-performance grid (space), this also facilitates communication with management (Van Ryzin and Immerwahr, 2007).

Conclusions from the Literature

Importance measures derived based on performance perceptions are more likely to be those attributes that are subject to a greater range of qualities, and are more short term in nature. This means the quality of information provided to customers will vary substantially based on the customer and the situation. Thus there will be greater variance in perceptions and greater opportunity for the variable to predict satisfaction. An attribute whose performance changes little in the eyes of customers over time, such as the physical layout of the port, will therefore be a poor predictor of satisfaction. However, a change in the port's physical layout may have a very substantial impact on customer satisfaction when it occurs. This suggests that attributes that have low variance in perceived performance across customers are better measured using the stated importance approach. This also means the stated importance measure looks more toward the future while the derived measure is more based on the past and is therefore more useful in the immediate future and day to day operations.

This leads to the conclusion that stated importance could be more important for governments as they can change the provision of some service features, such as the connectivity of the port to landside infrastructure through targeted infrastructure investment or the safety and security of the port through security program grants or loans. The service provider can work

on other, more deterministic attributes that have a more immediate effect on satisfaction such as 'fulfillment of special requests.'

METHODOLOGY

Introduction

Effective performance by a supplier is always measured in terms of what the user of the service expects by way of performance. Satisfaction occurs when the performance of a supplier meets or exceeds expectations on the criterion (or criteria) of importance to the user. Hence, in order to understand performance, we need to assess evaluation criteria using a pair-wise methodology in a two-step process of capturing not only the importance rating of a criterion but the performance rating for the port used as well. In other words, we are not only interested in the criteria perceived as important but those where the performance of the port has an influence on outcomes, be they feelings of satisfaction with a port, or a high rating on its performance in effectively delivering a service.

First, it is our goal to **understand the evaluation criteria** by which users determine that a port's performance is satisfactory, and hopefully effective in meeting their needs. We also asked port users to rate the port in terms of its competitiveness to see if these three concepts (satisfaction, competitiveness and effectiveness in service delivery) had similar or different causes. We viewed competitiveness as a proxy for efficiency. Second, for individual ports, each port will want **to understand its user evaluation criteria,** so that it may improve its own performance relative to what its users seek in the way of service delivery.

To achieve these two requires a three-step process: 1) develop the list of evaluation criteria, 2) seek an understanding of the relative importance of each of the criteria to the users of a particular port, and 3) conduct a paired analysis of the gap between the importance a particular port's user places on the criterion and that same user's assessment of the performance of that port on that criterion. This type of analysis provides ports with insights on where continuous improvements would pay off from a user and/or customer perspective.

Whether a port is eventually chosen or selected by users is not the purpose of the study. While satisfaction today may not lead to choice tomorrow, dissatisfaction will likely lead to rejection except for those who are captive. When an individual port understands its performance in the context of the expectations of its users, they are able to understand why their users are unhappy or dissatisfied, why they lose business, or how they may win additional business, particularly if they benchmark their performance against other ports they see as being competitors.

Identifying the Evaluation Criteria—The Initial Constructs

Research Question 1: What are the appropriate evaluation criteria 'users' use to evaluate port performance?

Research Question 2: Once research question 1 has been determined and performance data collected on the ports used, how may a port use that information to improve performance?

This paper focuses on answering the first question, and then uses the results to demonstrate how the second might be answered for a sample port.

For all stakeholders, carriers and cargo interests, there are a number of factors about port performance attributes or factors that are common and some that are specific to each of the three user groups. In all cases, the survey instrument was constructed to ensure that all qualified respondents answered a common set of services attributes sought by all users, followed by a criteria set specific to their particular user group or subgroup, before a common closing section seeking corporate demographics.

For each of the performance factors, the respondent is asked to rate the importance of the factor to them in their decision to use the named port (scale 1-7 where 1=not at all important and 7=very important). Also for each of the performance factors, respondents are asked to rate the performance by selecting a level of service provided **in the named port** (scale 1-7 where 1= very poor and 7=very good). In a few cases, the assessment was on a 1-7 scale of 1=strongly disagree and 7=strongly agree. A 'no experience' option was always provided. The statistical pair-wise evaluation of importance and performance provides the framework to users' perceptions of performance and port effectiveness in service delivery.

The value of each attribute will be determined based on the normative importance according to respondent ratings. However, normative importance is not the same as deterministic importance in that perceptions on some dimensions that may not as important from a normative point of view can substantially influence satisfaction. To assess the deterministic importance of the attributes, correlation analysis will be conducted with the attribute ratings for each port as the independent variables and the overall performance assessment measures as the dependent variable. An attribute is more likely to be retained if their perceptions on these dimensions significantly contribute to the respondent's satisfaction with the port. We will develop models for each of the three segments, for five ports and for three overall measures of port performance: satisfaction, competitiveness and effectiveness of service delivery.

To determine what influences perceptions of port performance, we need to identify those dimensions that are correlated with port performance. For example, if an increase in a user's rating of port performance increases its perception of the port's ability to fulfill special requests (i.e., these two measures are highly correlated), then we assume that changing a user's perceptions about a port's ability to fulfill special requests will likely lead to a corresponding increase in the user's assessment of the port's performance.

Preliminary multiple regression analysis using the twelve general evaluation criteria to predict the three port performance measures (overall satisfaction, competitiveness and effectiveness of service delivery) found a large amount of multicollinearity among the predictor variables with between seven and nine of the variables in the MR models having a variance inflation

factor above the recommended cut-off of 5.0 (Kleinbaum *et al.*, 1988; Stevens, 1996), which confirms the point made by Gustafsson and Johnson (2004) that multiple regression is an inappropriate method for deriving the importance of attributes as the derived weights will be unreliable. Therefore, for analysis of the Port Performance Instrument we have adopted Normalized Pairwise Estimation (NPE), which relies on correlations between the performance rating and the construct of interest, normally satisfaction. According to Gustafsson and Johnson (2004) and Giannoccaro (2008), the method is applied employing the following steps described by Rust and Donthu (2003). First, correlations are obtained between each of the predictor variables and the dependent variable. An ordinary least squares (OLS) multiple regression is run, and the R^2 obtained. If the predictors are uncorrelated, then the sum of the squared correlations equals the R^2 from the multiple regression. If the predictors are correlated, however, the sum of the squared correlations will be larger than the R^2. Let us call the sum of the squared correlations S^2, and let r^2_i be the square of the correlation between predictor (attribute) i and the dependent variable (e.g., satisfaction). Then the estimated importance measure for predictor i is equal to (r_iR/S). Conceptually, NPE adjusts individual correlations based on the total correlation in the model. To be reported the R between the performance rating and the measure of interest (e.g., satisfaction) must be statistically significant.

Developing the Criteria Used in the Study

How did we derive these criteria? Over the past several years, there has been a concerted effort by various academics within the Port Performance Research Network[1] to understand those factors of importance to the various players using port services. In addition to examining the port performance literature since 2000, two PPRN researchers (Dr. Mary R. Brooks and Dr. A. A. Pallis) assembled a detailed list of both efficiency and effectiveness performance metrics from a literature search of more than 80 journal articles and studies. Through field research and earlier discussions with industry experts, the list of potential evaluation criteria was winnowed to those most important in past studies and endorsed by experts in interviews in 2008. The survey was then designed to test both common evaluation criteria used by all users, with a second section for specific users.

Pre-testing the Instrument

To pre-test the instrument design, several individuals were approached to go through the preliminary draft. As changes were not substantive, the draft became the final survey instrument. This pilot study was limited to Canadian companies using three Canadian ports and two U.S. ports. To reach the target audience of users, the assistance of eight industry

[1] The Port Performance Research Network was founded at the meeting of the International Association of Maritime Economists in Hong Kong in July 2001. It includes more than 40 researchers interested in port performance in terms of efficiency, effectiveness and governance. It is perhaps best known for the Brooks and Cullinane (2007) publication.

associations was solicited. The company recruitment message was e-mailed by the industry association to its members, and the e-mail message contained a hot-link to the survey. The industry association sent a first request, a follow-up reminder two weeks later, and a final reminder in the few days before the web site link closed.

The Pilot Study

Users are more than just the buyers of the port's services. Other supply chain partners may not be the purchasers of those services but have experience with and influence on the delivery of port services. The three user groups are defined as carriers and cargo interests, as well as suppliers of services at the port to the first two. To allocate responses, users were classified based on their responses to a statement describing their company.

Cargo interests were those that answered positively to either of the following statements:

- We are responsible for the purchase of some of the transportation services for goods we sell/buy.
- We are responsible for the purchase of transportation services for goods on behalf of some importer and/or exporters.

Shipping lines were those that answered positively to either of the following statements:

- We are a shipping line that calls ports with container handling facilities.
- We are a shipping line that calls ports with bulk cargo handling facilities.

Supply chain partners were those that answered positively to any of the following statements:

- We are a warehouse operator that services (a) port(s) with container handling facilities.
- We are an asset-based logistics service supplier that uses ports as part of the services we provide.
- We are a trucking or rail company that services ports with container handling facilities.

As we wanted those who had experience with the port, respondents were disqualified from participating in the survey if they answered positively to the following statement:

- We outsource all purchases of transportation services to freight forwarder(s) or other third party logistics service supplier(s).

Respondents

From all port user groups, 102 participants clicked onto the on-line survey; of these, 24 did not complete the survey. Of the 78 completed surveys, the decision-makers in 25 companies did not have direct usage experience with ports but outsourced their decisions to a logistics

service provider. The findings of this research are based on the contributions of those with port experience, many of whom fit into more than one group of users. In the end, we had 57 usable surveys, 52 complete and 5 mostly complete.

Of those surveys that were usable, the cargo interest group was the largest respondent group at 40 of the 57 companies responding, with seven of the companies in this group both purchasing for themselves as well as for others. The smallest group of respondents was those offering marine transportation services, but even they may be acting on behalf of cargo interests, offering logistics services or trucking operations. There is considerable overlap in terms of supply chain partners and those who are acting as agents for cargo owners (or the direct cargo owners). For example, of the supply chain partners offering trucking (or rail services), more than half are also acting as cargo owners or their agents. As a result, many who responded to the survey would have found it excessively long to answer and so the structure of the survey will need to be re-designed to ask individuals to 'put on only one user hat' when completing the survey.

FINDINGS ON EVALUATION CRITERIA AND DISCUSSION

General Quality Criteria

We start by looking at the importance of evaluation criteria for the entire group of respondents, and then for each of the sub-groups. This is presented in Table 1. What becomes clear in reviewing Table 1 is that samples are small but the numbers are illustrative of possible outcomes. We did not have enough respondents in either the supply chain partner category or the shipping line group to draw any definitive conclusions. However, we did have enough of the cargo interests respondents to understand what it is that is of considerable importance to them.

In research of this type, it is common to find a narrower distribution range on importance scores, particularly where the criteria have been refined through a personal interview approach. As this research has had a number of earlier studies contribute to the pool of evaluation criteria being tested, it is not surprising that these general criteria all have a mean above 5 on a 7-point scale (Table 1). If we look more closely at the ranges for each of the criteria from all groups (not provided here), it is noticeable that the full range of 1 to 7 has been indicated for all criteria. In other words, not all criteria are relevant for all types of respondents. A clearer picture should be available with a second round of research.

General Determinants of Satisfaction, Competitiveness and Effectiveness of Service Delivery

The importance scores reported in Table 1 indicate what users consider to be important to them when they consider the performance of a port. However, at any given time these particular factors may not be influencing their perceptions of the relative performance of the

ports. For example, connectivity to rail/truck/warehousing companies is generally rated as important by users, but if this factor is independent of the users' perceptions of the port's performance (perhaps because all ports are perceived as equally connected or because users then ignore this aspect when assessing a port's performance), then their perception of the port on this dimension will not influence their perceptions of port performance. If a port wishes in improve users' perceptions of its performance, it needs to focus its efforts on those factors that actually influence those perceptions.

Table 1: The General Evaluation Criteria—Importance Ratings

Evaluation Criteria (1)	Mean Importance All Groups	Mean Importance Supply Chain Partners	Mean Importance Shipping Lines	Mean Importance Cargo and Agents
Provision of accurate information	6.05	5.75	6.64	6.05
Overall quality of cargo handling	6.04	5.75	6.73	6.13
Overall reliability of the port	5.98	5.60	6.64	6.15
Connectivity/operability to rail / truck / warehousing companies	5.89	5.95	6.18	5.85
Provision of adequate information	5.84	5.70	6.27	5.80
Provision of on-time updates of information	5.84	5.65	6.18	5.90
Port is (perceived as) safe	5.81	5.35	6.36	6.03
Port is (perceived as) secure	5.72	5.10	6.18	5.95
Incidence of cargo damage	5.63	5.40	5.73	5.73
Availability of direct service to the cargo's destination	5.49	5.20	6.27	5.53
Overall reputation of port	5.30	4.75	5.82	5.38
Fulfillment of special requests	5.26	5.25	5.73	5.20
n=	57	20	11	40

Note: (1) These criteria have been sorted by overall ranking. For 'Port is (perceived as) secure' and 'Port is (perceived as) safe', the question of importance includes "perceived as" while in rating the performance of a specified port, the question does not.

Table 2 presents the results of NPE analysis that examines the relationship between perceptions on the evaluation criteria and the output measures—overall satisfaction, competitiveness and effectiveness of service delivery. The evaluation criteria are listed in order of their relative influence on overall satisfaction (Column 1).

Of particular note, 'fulfillment of special requests' has the most influence on both 'satisfaction' and 'effectiveness in service delivery' (0.287 and 0.280 respectively) and is one of the top four influences on perceived 'competitiveness. (0.210)' This is in direct contrast to the overall rated importance of 5.26 (Table 1), which is the lowest among the twelve evaluation criteria rated. Most users, therefore, do ***not*** see this as relatively important, but if they feel the port is good at fulfilling special requests, then they are more likely to rate the port's performance as better. Because users tend to rate this as low importance, ports may not know the value of this aspect of their service in influencing user perceptions and, therefore, may not provide or emphasize this aspect of service when communicating or dealing with users; this results in a missed opportunity to improve service (and offset a competitive weakness) if other ports are doing this.

Table 2: Relative Influence of General Evalution Criteria on Perceptions of Port Performance

General Evaluation Criteria	Port Performance Component		
	Overall Satisfaction	**Competitiveness**	**Effectiveness in Service Delivery**
Fulfillment of special requests	0.287	0.214	0.280
Overall reliability of the port	0.284	0.174	0.252
Overall reputation of port	0.277	0.214	0.250
Overall quality of cargo handling	0.263	0.192	0.271
Port is (perceived as) secure	0.209	0.238	0.195
Provision of adequate information	0.207	0.163	0.184
Provision of on-time updates of information	0.202	0.219	0.182
Port is (perceived as) safe	0.198	0.162	0.145
Connectivity/operability to rail / truck / warehousing companies	0.197	0.167	0.194
Incidence of cargo damage	0.194	0.132	0.186
Provision of accurate information	0.185	0.146	0.159
Availability of direct service to the cargo's destination	0.100	0.113	0.096

Note: Read as "The fulfillment of special requests is the most influential evaluation criterion in determining a user's overall satisfaction with a port with an NPE score of 0.287."

In contrast, provision of accurate information, is seen as relatively important (6.05, ranked first in Table 1) but comes out near to last in terms of influence for all three aspects of port performance (0.146–0.185 in Table 2); while most users rate this as important, it rarely enters into their consideration of a port's performance. This could be due to the fact that once a port is selected, the connectivity does not change much over time and the other day-to-day

dealings, such as fulfillment of special requests, reliability, cargo handling, security and the provision of information, are more likely to influence perceptions of port performance. Therefore, although connectivity is reported as an important criterion in port evaluation, it is really less influential in that role than its importance rating would suggest.

Table 3: Importance of Evaluation Criteria to Supply Chain Partners

Evaluation Criteria	Mean Importance	Range (1-7)
Efficiency of documentary processes	6.16	4-7
Incidence of delays	6.16	4-7
Accessibility to port for pick-up and delivery (gate congestion)	6.11	1-7
Adequacy of integrated communications infrastructure	5.95	3-7
Availability of capacity	5.89	1-7
Availability of labour (do we have to wait to find someone?)	5.84	1-7
Invoice accuracy	5.79	3-7
Speed of stevedore's cargo loading/unloading	5.68	1-7
Ocean carrier schedule reliability/integrity	5.53	1-7
Punctuality of arrival times	5.53	1-7
Reasonableness of port charges	5.53	1-7
Punctuality of departure times	5.42	1-7
Timely vessel turnaround	5.26	1-7
n=	19	

Note: These criteria have been sorted by mean importance from highest to lowest.

Table 2 also illustrates that security (0.238) has the highest level of relative influence on the outcome measure of competitiveness, with the customer relationship factors provision of on-time updates of information (0.219) and fulfillment of special requests (0.214) not far behind. The overall reputation of the port (0.214) is also an important determinant of competitiveness. For effectiveness in service delivery, fulfillment of special requests (0.280) and overall quality of cargo handling (0.271) are key determinants of performance, with the overall reliability (0.252) and reputation (0.250) of the port also influencing perceived effectiveness of service delivery.

What we can conclude from these results is that all three aspects of port performance have common influences, in particular the fulfillment of special requests, the overall reputation of the port, and the overall quality of cargo handling, but that security is particularly influential when it comes to perceived competitiveness.

Criteria Specific to Each of the Three User Groups

We also tested criteria used by the three user groups that were specific to each group.

Supply Chain Partners (Port-related Rail / Truck / Warehousing Companies)

Nineteen of 20 supply chain partners assessed the performance of ports against specific criteria for the sub-group. Mean importance scores on the criteria were above a threshold of 5 on a scale of 1-7; however, as can be seen in Table 3, the range on some of these indicates that the occasional company did not see the criteria as being of importance to them.

The number of respondents in the supply chain partner sub-group was insufficient to evaluate performance of individual ports against importance. What can be said is that three ports had a wider range of performance scores than the other two, but port numbers were too low to draw any conclusions from this pattern (Halifax n=9; Montreal n=11; New York n=4; Seattle n=3; Vancouver n=10).

Shipping Lines

Only five of the 11 shipping lines responding chose to answer these questions on their specific criteria (Table 4). We believe that this was because of the considerable overlap between supply chain partners and lines, and they had already responded to the supply chain partner criteria reported above. Also, there are also fewer companies of this type than for the other groups. Unlike the previous set, the range was not the full range possible, indicating that it is possible the criteria presented are relevant to this group but we must focus on this group further in future research to confirm that their criteria are both different and appropriate.

A quick survey of performance ratings by this group (Halifax n=3; Montreal n=4; New York n=2; Seattle n=2; Vancouver n=4) indicates that three ports had performance scores on these criteria in the 4-7 range. However, two ports had received some 1s on their performance on some of these criteria indicating that there are service failures for some customers. The number of respondents in this group was insufficient to meaningfully evaluate performance against importance, and whether or not there was a significant importance–performance gap.

Cargo Interests

Mean importance scores on the evaluation criteria were all above a threshold of 5 on a scale of 1-7; however, as can be seen in Table 5, the range on some of these indicates that the some companies did not see the criteria as being of importance to them. Performance scores for the five ports (Halifax n=19; Montreal n=23; New York n=7; Seattle n=5; Vancouver n=23) on these evaluation criteria was generally wide, with scores ranging from 3 to 7 but two ports

received some 1s and 2s on their performance on some of these criteria indicating that there are service failures for some customers.

Table 4: Importance of Evaluation Criteria to Shipping Lines

Evaluation Criteria	Mean Importance	Range (1-7)
Capability of dockworkers (can they accommodate our needs?)	6.80	6-7
Speed of stevedore's cargo loading/unloading	6.80	6-7
Timely vessel turnaround	6.80	6-7
Availability of capacity	6.60	6-7
Availability of labour (do we have to wait to find someone?)	6.60	5-7
Incidence of delays	6.60	6-7
Timeliness of maritime services (pilotage, mooring, etc)	6.60	6-7
Overall cost of using the port	6.60	6-7
Invoice accuracy	6.40	6-7
Quality of rail / truck / warehousing companies	6.40	6-7
Availability of rail / truck / warehousing companies	6.20	5-7
Reasonableness of port charges	6.20	5-7
Quality of maritime services (pilotage, mooring, etc)	6.00	5-7
Sufficiency of size of hinterland	6.00	5-7
Adequacy of integrated communications infrastructure	5.80	5-7
Availability of logistics providers serving the port	5.60	4-7
n=	5	

Note: These criteria have been sorted by mean importance from highest to lowest.

There were enough respondents in the Cargo Interests sub-group to provide a meaningful evaluation of the performance of ports for this specific group. NPE analysis was performed using the ratings of this group to predict their evaluation of the ports on the three performance components (Table 6).

It is clear that the main determinant of receiving an excellent performance rating by a service provider is responsiveness. Effectiveness of decision making, a measure of responsiveness, scores highest on all three components (0.384, 0.333 and 0.296 for overall satisfaction, competitiveness and effectiveness of service delivery respectively). Responsiveness to requests by the port authority is also rated highly for overall satisfaction (0.309) and competitiveness (0.299). Finally, an ability to develop tailored services to different market segments determines a port's competitiveness (0.270). Service Providers' rating of a port's

expensiveness in terms of overall cost of using the port proved to not be significantly related to any of the components of performance and was scored as 0.000 for all three. On schedule performance received the highest self-reported importance rating (6.03) but scored 0.215 – 0.295in terms of influence, ranking fourth for overall satisfaction and competitiveness and second for port effectiveness in service delivery.

Table 5: Importance of Evaluation Criteria to Cargo Interests

Evaluation Criteria	Mean Importance	Range (1-7)
On-schedule performance	6.03	3-7
Terminal operator responsiveness to requests	5.97	3-7
Overall cost of using the port	5.95	2-7
Availability of rail / truck / warehousing companies	5.73	3-7
Cost of rail / truck / warehousing	5.59	2-7
Capability of employees (can they accommodate our needs?)	5.51	2-7
Effectiveness of decision-making process (e.g., altering schedules, amending orders, changing processes to meet our demands)	5.46	2-7
Port authority responsiveness to requests	5.41	1-7
Ability to develop/offer tailored services to different market segments	5.08	1-7
n=	37	

Note: These criteria have been sorted by mean importance from highest to lowest.

SPECIFIC PORT RESULTS AND THEIR USE

It is important to consider, from the perspective of the port, the port's performance against those measures that are considered important by its users. The common approach is to identify the importance scores for all respondents, and then the aggregated performance scores of that port on those same criteria, and assess the gap existing between the scores. This may be misleading, as respondents not having experience with the port are included in the importance group. More accurate results can be gained by doing a direct pair comparison, by respondent, of the differences in scores and determine for those with experience in, say Port A, not only what is important to them but how Port A performs against those desires. It is reasonable to expect, in doing pair-wise analysis, a narrow distribution range on importance ratings with a broader distribution range but lower mean score on performance ratings.

Table 6: Determinant Attributes for Cargo Interests

General Evaluation Criteria	Port Performance Component		
	Overall Satisfaction	**Competitiveness**	**Effectiveness in Service Delivery**
Effectiveness of decision-making process (e.g., altering schedules, amending orders, changing processes to meet our demands)	0.384	0.333	0.296
Port authority responsiveness to requests	0.309	0.299	0.206
Terminal operator responsiveness to requests	0.300	0.178	0.211
On-schedule performance	0.295	0.257	0.215
Capability of employees (can they accommodate our needs?)	0.286	0.143	0.200
Ability to develop/offer tailored services to different market segments	0.267	0.270	0.205
Cost of rail / truck / warehousing	0.213	0.229	0.179
Availability of rail / truck / warehousing companies	0.190	0.184	0.118
Overall cost of using the port	0.000	0.000	0.000

Note: Read as "Effectiveness of decision-making is the most influential evaluation criterion in determining a user's overall satisfaction with a port with an NPE score of 0.384."

While a number of companies had experience with the ports of Seattle and New York, in this pilot project we only had enough responses to illustrate the performance gap results for three ports—Halifax, Montreal and Vancouver, and for the general criteria and those of the cargo interest sub-group. There were not enough respondents in the other two sub-groups for us to present a meaningful result. Therefore we present Table 7 to illustrate the results from a port perspective, and explain how a port might use the data in its strategic management and continuous improvement programs.

To explore how gap analysis can be used for continuous improvement, we use the data for one port, Port A, and take a closer look at the general evaluation criteria used by all users. How would the business strategist from Port A interpret the results found in Table 7? First, it is particularly interesting that on one criterion—overall reputation—this port performs better than sought by customers; this is unusual as gap analysis is generally used to identify areas for port continuous improvement efforts. Second, for eight of the 12 criteria—provision of accurate information, perceived safety, perceived security, overall quality of cargo-handling, fulfillment of special requests, provision of adequate information, the availability of direct service, and the incident of cargo damage—the performance of the port is not statistically different from the user's requirements. This leaves three criteria on which the port might wish

to take a closer look at its performance as all three have a measurable gap between the customer's stated level of importance and the performance it receives—in this case the provision of on-time updates of information, the port's connectivity/operability to rail / truck / warehousing companies and the overall reliability of the port.

Table 7: Pairwise Comparisons on General Service Delivery Criteria for Port A

Criterion	Mean Importance Port A	Mean Performance Port A	Gap	Direction of Performance Gap	p<
Provision of on-time updates of information	**5.71**	**4.93**	**-0.79**	**Lower**	**0.056**
Connectivity/operability to rail / truck / warehousing companies	**5.90**	**5.14**	**-0.76**	**Lower**	**0.072**
Provision of accurate information	6.00	5.43	-0.57	Same	0.118
Overall reliability of the port	**6.17**	**5.83**	**-0.34**	**Lower**	**0.077**
Port is (perceived as) safe	6.00	5.66	-0.34	Same	0.252
Overall quality of cargo handling	6.14	5.82	-0.32	Same	0.142
Port is (perceived as) secure	5.86	5.59	-0.28	Same	0.368
Fulfillment of special requests	5.19	4.92	-0.27	Same	0.183
Provision of adequate information	5.68	5.43	-0.25	Same	0.458
Availability of direct service to the cargo's destination	5.55	5.34	-0.21	Same	0.576
Incidence of cargo damage	5.44	5.72	0.28	Same	0.356
Overall reputation of port	**5.17**	**5.69**	**0.52**	**Higher**	**0.066**

Note: These criteria have been sorted by the importance-performance gap rank (from largest negative to largest positive) to illustrate the interpretation. Using a 90% confidence interval, only those deemed to be statistically relevant have been **bolded**. (Those with a p value < .10 are the only ones deemed to be statistically different—e.g. the score on importance is not the same as the score on performance—and therefore relevant to the port at a 90% probability level.)

Second, if we do the same performance test on the other two ports, that we have called Ports B and C, do the same gaps occur? The answer is no. There are three differences: 1) neither Port B nor Port C have performance gaps where its performance exceeds importance in a statistically significant way; 2) Port B's performance scores are statistically inferior to the importance scores on five of the twelve criteria, not just the three criteria on Port A's list of

criteria needing improvement; and 3) Port C's performance is statistically inferior on seven of the twelve criteria, but one of these is not on Port A's list for performance improvements. If Port A had access, via a third party survey to information on the one criterion where it fails to meet importance scores and Port C does not, this would provide the impetus for Port A to focus on improving its performance on this metric to level the field if it felt Port C was its competitors. Meanwhile, it appears that Port A has less work to do to bring its performance up to the standard that meets its users' needs.

CONCLUSIONS

Scholarly Implications and Future Research

While there has been a burgeoning amount of research on the efficiency component of the efficiency–effectiveness performance dyad, not enough research on effectiveness has been found to provide meaningful constructs for an effectiveness of port performance instrument. Therefore, this research has focused on defining the constructs as well as the broader groups of users.

The companies responding had a wide range of port experiences and a multiplicity of roles, indicating that the survey would have taken them an excessive amount of time to complete. While we expected some supply chain integration, the extent of integration is greater than anticipated, and necessitates a survey structure modification to account for considerable integration within supply chains.

We have found that the evaluation criteria influencing users' perceptions of satisfaction, competitiveness and service delivery effectiveness are different, and so while the determinants of these constructs have considerable overlap, they are different constructs. The use of Normalized Pairwise Estimation (NPE) proved effective in identifying statistically significant determinant attributes even with the relatively small sample size in our pilot study. Identifying these attributes as well as self-reported importance provides considerably more useful information for the development of port management strategies. Determinant attributes tended to be those evaluation criteria that varied on a day to day bases and had more to do with the interactions between the parties than structural, stable properties of the port. This highlights the importance of the relationship maintained between the ports and their customers, particularly in terms of being responsive to their needs. Thus identifying determinant attributes has more value to port management in their operations while the self-reported importance are more useful in developing long-term strategies that may involve major changes and investments in the port's service characteristics.

We have been also able to illustrate how such third-party evaluation of port performance might be used by a port to strategically improve its service to users, and therefore have value from a port perspective in its strategic planning.

We have found enough confirmation of the proposed effectiveness criteria with this survey to test a revised survey instrument in other geographic markets.

Importance and performance ratings collected here, and used for gap analysis, can also be used to estimate attitudes and behavioral intention using a compensatory decision model as suggested by Fishbein (1967). When this approach is desired, the ratings are summed using the importance measures as weights to modify the impact of the ratings, and such data is used most notably for 'positioning,' e.g., implementing a strategy that positions the organization in the eyes of the customer such that certain customer segments will be more likely to choose that organization. As we are not dealing with port selection in this paper, but rather performance analysis as input for continuous improvement activities, we have not covered the theory related to these approaches and do not use them here.

Managerial Practice Implications

This paper is not about port choice but about how well ports deliver services to their customers. Much of the effectiveness research assumes that performance outputs like competitiveness drive port choice. We have made no such assumption but leave the port choice analysis for a later date. We have illustrated to ports that if this survey were used on a wider geographic scale, individual ports would be able to read aggregated users' assessments and compare their performance against the aggregated performance of other similar ports (similar in terms of size, geography, or operating characteristics). Then, if the factor of importance/determinance is not under the jurisdiction of the port, the rating of performance enables the port to go back to the responsible parties to indicate that the factor is of importance to the decision-maker and that there are performance shortfalls. Like a 'dashboard,' such an effectiveness evaluation program provides a basis for understanding what possibilities exist for continuous improvement. If done right, it focuses a particular port's improvement efforts on fixing performance on those importance factors, using pair-wise statistical comparisons, where performance is poor and an investment of resources will have the biggest impact. The ultimate better allocation of port resources benefits users and ports alike.

Furthermore, in recent years, there has been considerable debate about who chooses a port. Early thinking was that the shipping line chose the port and the cargo chose the shipping line. The rising power of global cargo interests and the consolidation of lines has meant that ports have less power in their relationships with these users than they previously had (International Transport Forum, 2009). Today, the power that cargo interests or large logistics providers wield makes it ever more important that ports make strategic changes fully informed and based on the group of users they wish to attract. Therefore, while this paper is not about port choice, its findings offer a first step in understanding what an individual port might do to enhance its ability to address contributing factors in its own users' satisfaction, perceptions of competitiveness or effectiveness in delivery of service quality.

The knowledge learned through wider application of this research has, therefore, both scholarly and practitioner contributions.

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