Measuring port effectiveness: Does supply chain partner performance measurement matter?

12 January 2015

Goal and Approach

- **Goal:** to develop a formative construct useful for measuring a port's performance from the point of view of supply chain partners.

- **Approach:** measure user response on a large set of candidate criteria, assess criterion relevance using four measures, eliminate redundant statements using VIF analysis.

Critical Literature

- There is a long history of efficiency research available (UNCTAD, 1979; DeMonie, 1987; Hamilton, 1991; BITRE, annual; reviews by Cullinane, 2010 and Woo and Pettit, 2010)

- Limited effectiveness research until recently (Brooks, 2007; Brooks, Schellinck and Pallis, 2011a,b; Schellinck and Brooks, 2014; Brooks and Schellinck 2014; 3 conference presentations/ posters in 2013-2015, of which this is one.)

- International Transport Forum (2008) identified hinterland connections as critical to port competitiveness.

- A absolute dearth of research on port effectiveness involving supply chain partners (delivery of connectivity), yet numerous articles on SCP inefficiencies at the container yard gate. (Tioga Group [2011] has extensively documented efficiency problems in trucking operations in North American ports, while Guiliano and O'Brien [2007] focused on port congestion solutions and Maguire *et al* [2010] focused on stakeholder strategies.

What We Did …

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- Internet survey of users of seven North American container ports over 250,000 TEUs in 2012
- Each participating port supplied a list of more than 500 contacts for all three user-groups (Cargo Interests, Shipping Lines and Supply Chain Partners)
- One respondent from each company was selected by researchers to receive a personalized invitation to participate in an Internet survey
- Each port received its own results for port investment and marketing planning
- The American Association of Port Authorities received an overall report on aggregated findings
- 50 surveys were completed by those who self-identified as Supply Chain Partners and we have analyzed this user sub-group data.

How Do We Define Supply Chain Partners?
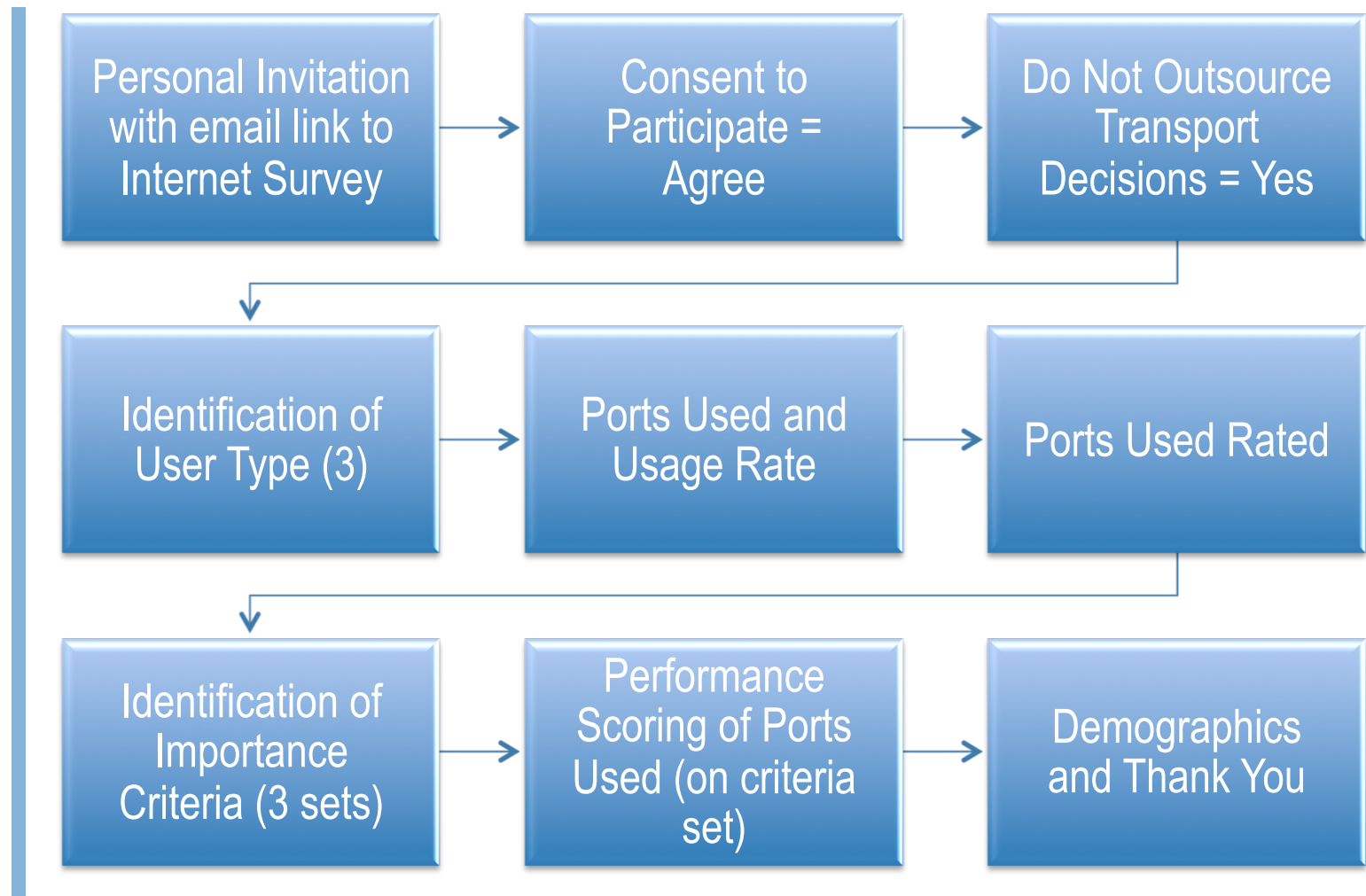
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- Warehouse operators that service port(s) with container handling facilities;
- Asset-based logistics service suppliers that use port(s) as part of the services provided;
- Trucking or rail companies that service port(s) with container handling facilities.

Number of Other Roles	Cargo Interest n = 106	Shipping Line n = 47	Supply Chain Partners n = 50
1	8.5%	19.1%	32.0%
2	0.9%	19.1%	2.0%
Total with Other Roles	9.4%	38.2%	34.0%
No Other Role	90.6%	61.8%	66.0%

Profile of Supply Chain Partner Respondents

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Role in the use of ports	Supply Chain Partners N= 50
A warehouse operator that services (a) port (s) with container handling facilities.	26.0%
An asset-based logistics service supplier that uses ports as part of the service we provide.	44.0%
A trucking or rail company that services ports with container handling facilities.	42.0%
A shipping line that calls ports with container handling facilities.	0.0%
Responsible for the purchase of some of the transportation services for goods we sell/make/buy.	14.0%
Responsible for the purchase of transportation services for goods on behalf of some importer and/or exporters.	22.0%

Survey Instrument (Step-by-Step)

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┌─────────────────────┐     ┌─────────────────────┐     ┌─────────────────────┐
│ Personal Invitation │     │     Consent to      │     │  Do Not Outsource   │
│ with email link to  │ ──▶ │   Participate =     │ ──▶ │     Transport       │
│  Internet Survey    │     │       Agree         │     │   Decisions = Yes   │
└─────────────────────┘     └─────────────────────┘     └─────────────────────┘

┌─────────────────────┐     ┌─────────────────────┐     ┌─────────────────────┐
│  Identification of  │     │   Ports Used and    │     │                     │
│   User Type (3)     │ ──▶ │     Usage Rate      │ ──▶ │  Ports Used Rated   │
│                     │     │                     │     │                     │
└─────────────────────┘     └─────────────────────┘     └─────────────────────┘

┌─────────────────────┐     ┌─────────────────────┐     ┌─────────────────────┐
│  Identification of  │     │    Performance      │     │                     │
│ Importance Criteria │ ──▶ │  Scoring of Ports   │ ──▶ │    Demographics     │
│     (3 sets)        │     │  Used (on criteria  │     │   and Thank You     │
│                     │     │       set)          │     │                     │
└─────────────────────┘     └─────────────────────┘     └─────────────────────┘
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Both Importance and Performance ratings used 1-7 Likert scales.

Criterion Relevance: Divergent Messages On Four Measures (with Rank)

Performance Criteria	Mean Importance	Normalized Pairwise Est.	Mean Perf. Rating	Std. Dev
Accessibility to port premises … (gate congestion)	**6.42 (1)**	0.24 (7)	5.07 (5)	**1.75 (5)**
Overall reliability of the port	**6.38 (2)**	**0.28 (3)**	5.32 (9)	1.71 (6)
Provision of adequate, on-time information	**6.24 (3)**	0.25 (6)	5.48 (12)	1.37 (12)
Incidence of delays	**6.12 (4)**	**0.29 (2)**	**4.66 (1)**	**1.81 (4)**
Port security	**6.06 (5)**	0.20 (12)	5.79 (15)	1.28 (14)
Speed of stevedore's cargo loading/unloading	6.02 (6)	0.20 (11)	**4.81 (3)**	**1.96 (2)**
Ocean carrier schedule reliability/integrity	6.00 (7)	0.18 (13)	5.57 (13)	1.27 (15)
Terminal operator responsiveness to sp. requests	5.94 (8)	**0.26 (5)**	**4.93 (4)**	**1.97 (1)**

Note: Table ordered by importance rank (on 8/15 criteria); **red bolded** figures in top five. NPE provides advice to individual ports but not guidance across ports; standard deviation indicates competitive advantages (disadvantages) at the individual port.

Criterion Relevance: Divergent Messages On Four Measures (with Rank)

Performance Criteria	Mean Importance	Normalized Pairwise Est.	Mean Perf. Rating	Std. Dev
Availability of labour (do we have to wait to find someone?)	5.84 (9)	**0.28 (4)**	**4.77 (2)**	1.62(7)
Efficiency of documentary processes	5.82 (10)	**0.29 (1)**	5.25 (8)	1.49 (10)
Port authority responsiveness to special requests	5.64 (11)	0.21 (8)	5.11 (7)	**1.82 (3)**
Incidence of cargo damage	5.34 (12)	0.08 (15)	5.32 (10)	1.54 (8)
Invoice accuracy	5.34 (13)	0.20 (10)	5.38 (11)	1.50 (9)
Connectivity/operability to rail/truck/warehousing	5.32 (14)	0.17 (14)	5.57 (14)	1.31 (13)
Availability of capacity	4.62 (15)	0.21 (9)	5.08 (6)	1.47 (11)

Note: Table ordered by importance rank (on 7/15 criteria remaining); **red bolded** figures in top five. NPE provides advice to individual ports but not guidance across ports; standard deviation indicates competitive (dis)advantages at the individual port.

The Service Quality (Formative) Construct Sought VIF Scores <5

14 Remaining Performance Criteria	VIF Scores Original Set	VIF Scores Reduced Set
Accessibility to port premises for pick-up and delivery (gate congestion)	5.96	1.94
Availability of capacity	3.58	3.25
Availability of labour (do we have to wait to find someone?)	11.67	
Connectivity/operability to rail/ truck/warehousing	4.63	
Efficiency of documentary processes	8.51	3.70
Incidence of cargo damage	3.09	2.16
Incidence of delays	7.56	
Invoice accuracy	3.73	
Ocean carrier schedule reliability/integrity	5.47	
Port Authority responsiveness to special requests	5.07	
Port security	5.51	3.47
Provision of adequate, on-time information	9.42	4.85
Speed of stevedore's cargo loading/unloading	5.91	1.98
Terminal Operator responsiveness to special requests	9.14	4.50

Dropping Overall Reliability (V. High VIF 13.53) —> the SCP Port Assessment Construct.

Scholarly Contribution

- This method, analysis and instrument development is suitable for use by an industry association of government in evaluating the relevance of a set of criteria for evaluating performance.

- Determinance-IP Gap Analysis (Schellinck and Brooks, 2014) is useful at the individual port level but does not work if aggregated across ports.

- NPE scores provide useful insight into relative perceptions of all users across ports.

- Using only one or two of the four measures will provide misleading results; four methods provide a complete picture of opportunities and appropriate investments. Of course, the port decision to make the investments is its own to execute.

Conclusions (1)

- The four measures used demonstrate mixed results and therefore provide confusing advice when viewed independently.

- The methodology used (pilot studies, focus groups, survey) ensured that any of the possible criteria were included in the development. Data provide the ability to develop a formative construct of use to port managers.

- The use of Variance Inflation Factor analysis with a cut-off of 5.0 ensured the statements are relatively independent. A list of 8 statements resulted for future research and use by port managers.

- If the port, terminal and stevedores work together to reduce congestion and improve stevedore cargo-handling times, service delivery will be perceived to be effective and the port will be seen to perform better.

Conclusions (2)

- While a lower VIF score would reduce the number of statements for future N. American research, we do not wish to conclude that this result is transferable to ports in other geographic regions until that has been proven by future research.

- Overall reliability as a criteria has too much overlap with other statements and so is less useful that it component parts, and so is excluded from future statements.

Conclusions (3)

- Supply Chain Partners are a forgotten user group for some ports; with their own unique set of needs, as partners they need to be part of the solution in developing port strategic investments.

- This user group survey has been modified and incorporated into the **SEAPORT** (Service Effectiveness Assessment for PORT managers) tool. We have translated it so we can add ports in French and Spanish speaking countries to test if this formative construct is more broadly, globally, applicable.

Questions?
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