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The impact of logistics cluster benefits on the firms' logistics performance

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Abstract

Purpose: The logistics industry contributes about 9% to Australia's GDP with $132 billion value added and 1.2 million people employed, providing the context of logistics clusters. This paper aims to explore the logistics benefits (LCB) impacts on the firms' logistics performance (FLP).

Design/methodology/approach: This study empirically explores the outcomes of LCB within a conceptual framework developed around LCB. A survey was conducted across five thousand participants in logistics, retail, manufacturing, and agro-industries in Australia by email over six months, with 289 usable responses received. Confirmatory factor analysis (CFA) and structural equation modeling (SEM)was used to analyse data.

Findings: Three labour-related variables of LCB have a positive relationship with the two elements of FLP, namely efficiency and service quality.

Practical implications/Originality/Value

This study provides unique empirical evidence of the outcomes of LCB complementing research by Rivera and Sheffi. The relationship between LCB and FLP is unique, as is the identity of the measures for both factors. The ability to quantify benefits of logistics clusters provides better operational and strategic decision tools for firms and industry both. Additionally, policy makers can make decisions on urban form and around the establishment of logistics intensive regional industrial clusters, to drive economic growth.

Keywords

Logistics benefits, clusters, Firms' logistics performance, Factor analysis, Structural equation modelling.

1. Introduction

Logistics clusters (LC) comprise industrial firms that have a significant part of their operations comprising logistics activities "includes companies offering logistics services, such as transportation, warehousing, distribution" (Sheffi, 2010, Sheffi, 2013). The concept 'logistics cluster' emerged in the work of several authors such as Chhetri et al. (2014); Rivera et al. (2014); Rivera et al. (2016a). This relatively recent interest in the field is supported by the observation of Rivera et al. (2016a) who noted that "*although there is a notable industrial clusters literature, the research on logistics clusters is still in its infancy" (p 242)*.

The research gap on the outcomes of logistics cluster benefits of (LCB) and its impact on the firms' logistics performance (FLP) is investigated in this paper. This research is significant because logistics represents 9% of GDP and employs about 1.2 million people (Australian Government 2021, Freight Australia 2019). Despite this economic significance, the nexus between the outcomes and opportunities to industry arising from the creation of logistics cluster benefits has not been investigated empirically. Therefore, the decisions of governments and firms on potential investment leveraging location of clusters lack an evidence-based foundation. By validating the outcomes of logistics cluster benefits (*LCB*) on the logistics performance of firms *(FLP),* firms and policy decisions of governments are empowered by the strategic potential of relationships between *LCB* and *FLP*.

The research uses an empirical approach to investigate the research question:

- How does LCB influence the firms' logistics performance (FLP)?

The remainder of this paper is presented as follows: A review of literature in Section 2 relevant to the outcomes of LCB culminates in the model used for empirically evaluating this relationship which is discussed in Section 3. Section 4 discusses the research methodology, Section 5 is an analysis of data, and Section 6 a discussion of discussion of findings, managerial and academic implications, and future research directions.

2. Literature review

Sheffi later expanded the definition of LC above (Sheffi 2010, p. 468) to include all firms with logistics-intensive operations, consisting of three types of companies and activity mixes as follows.

- Logistics services providers such as transportation carriers, warehousing, specialised consulting, and IT providers, 3PL's, forwarders and customs brokers. (The terms 3PL/4PL Logistics Service Provider (LSP) are used hereafter to refer to an entity that combines activities of transport, warehousing, special storage, quarantine clearance, surveying, customs, documentation, consolidation, break-bulk etc.)
- Companies with logistics intensive operations.
- The logistics operations of industrial firms such as distributors for retailers, after-market parts suppliers.

Research around the concept of hubs and clusters (Bolumole, Closs & Rodammer 2015; Zhou, Wang & Sun 2014) did not specifically mention the concept 'logistics cluster' until it emerged in the work of several authors such as Chhetri, Butcher and Corbitt (2014); Rivera, Sheffi and Welsch (2014); Rivera, Gligor and Sheffi (2016).

Cluster activity relating to freight and logistics occurs in logistics hubs that are really logistics clusters. Additionally, similar cluster activity occurs in freight distribution centres and freight logistics centres function as quasi-inland terminals. Altona, Barnawatha, Ettamogah, Moorebank, Chullora, Parkes offer cargo consolidation, deconsolidation, and value-added logistics services. Parkes is a designated dry port with additional customs and AQIS services and thus functions as an inland terminal. Overseas

examples of inland terminals which operate on a larger scale also require significant networked logistics infrastructures, e.g., Antwerp, Charleroi, Ostend, Zeebrugge, Liege and Ghent in Belgium (Meersman and Nazemzadeh 2017), Zaragoza a commercial built for purpose facility, the Pearl River Delta, China (Sheffi, 2012a) and state-owned ports like Singapore, Dubai Shanghai, and port cities where clusters evolved over centuries, London, Antwerp, Rotterdam, Hamburg. The footprint, type and scale of value-addition varies significantly across small and large-scale facilities and the port cities discussed.

Hallock et al. (2018) differentiates incremental capital investment in Australia on transport infrastructure with large-scale infrastructure above . Targeted investment in logistics infrastructure is driven by the need for continuity, timing, certainty, network optimality, access to markets and labour, proximity to the location of supply chain partners and intermediaries such as 3PL/4PL by enabling leveraging of value added logistics services (VALS). This enables VALS related LCB and creation of FLP (Hallock 2021).

2.1. Logistics cluster benefits (LCB)

The logistics benefits of clustering of activity Rivera et al. (2016a) have been analysed to comprise outcomes and opportunities (Hallock 2021), that are linked via collaboration in service provision as well as being self-supporting. Therefore, the anticipation of such benefits motivates firms to cluster driven by collaboration. Diseconomies include noise, pollution, congestion.

Accordingly, benefits comprise possible outcomes (see Table 1) that include productivity gains (Duranton and Puga, 2004, Puga, 2010), cost efficiency, job growth at multiple levels, upward mobility in jobs, and regional growth Hallock et al. (2018,2021), which Rivera et al. (2016a) identify as logistics cluster benefits (LCB). Job diversification can induce industry formation in sub-clusters offering value added services that attract other service providers and suppliers, Porter (1998, 2000).

Opportunities to collaborate are a key benefit of clustering specifically linked to the ability to make available Value added logistics services (VALS) to others in the cluster (Hallock et al., 2018). Co-location in the cluster confers a business benefit of services that may not be competitively provided when outside the cluster. The opportunity to partner (collaborate) with an incumbent, either horizontally , vertically or in both forms in ports, Notteboom and Rodrigue (2005), is a benefit arising from location in a logistics cluster (LC). The benefit of such collaboration is lower logistics transport costs, customer retention and greater customer intimacy (customer engagement) (Bowersox et al., 2000, Porter, 1991). Cluster theory in classical economics, has identified collaboration in industrial clusters Sheffi (2013), following Grandori and Soda (1995), so the occurrence of this phenomenon in a LC is expected.

Positive outcomes can result when opportunities for collaboration are fully used (Hallock 2021). Collaboration creates linkages upstream and downstream as well as horizontal linkages e.g., with logistics service providers or third- and fourth-party logistics providers (LSP's,3PL/4PL). Such linkages are recognised Krugman (1990) as backward and forward linkages that create positive feedback via a self-perpetuating process, "reciprocal reinforcing feedback mechanism makes it more attractive as it grows" (Sheffi, 2013). This process contributes to the LCB of regional growth. A Delphi panel Hallock et al. (2018) identified the related factor of focused investment contributing to regional growth and an impact on labor supply (Hallock et al., 2018). Classical economists refer Table 1, (Arrow, 1962; Marshall 1890; Porter, 1998a; 2000; Romer 1986) , (Glaeser et al. 1992; Glaeser et al. 2010) and (Krugman 1990) explore regional growth and labors' importance in detail.

2.1.1. Antecedents of logistics cluster benefits (LCB)

Whilst Section 2.1 describes LCB, this section summarises the pre-requisites for LCB. Investigations of logistics clusters (Rivera et al., 2016a, Rivera et al., 2014), spatial logistics clusters (SLC) Chhetri et al. (2014), empirical investigations of relationships between LCB and outcomes on the firms

logistical performance (Hallock 2021) are relevant to this discussion. Additionally, agglomeration theory and cluster theory (co-location) of industrial organisation identified location-based benefits that are anticipated *'a priori'* by logistics intensive industries. The prerequisites for LCB are: 1) Superior transport services. 2) Lower transport costs. 3) Availability of skilled labour and labour pooling. 4) Agglomeration effects. 5) Potential to collaborate via interfirm networks. 6) Leveraging government planning via Targeted logistics infrastructure investment inducing concentration of like industrial/commercial activities. 7) Efficiency gains from economies of scale and scope and. 8) Potential for future cluster growth and wealth creation for the region.

Table 1: The literature relating logistics cluster benefits.

	Classical economics	**Logistics clusters** (Rivera et al., 2016a, Sheffi, 2012)	**Delphi, exploring Logistics clusters (Australia)** (Hallock et al., 2018)	**Remarks**
Variables			***Investment pipeline certainty***	New benefit
			Business Benefits	New benefit
Impacting labour				
• Pooled market for specialised labour	x	x	x	
• Availability of non-specialised labor	x	x		
• Specialised skill pools develop	x	x	x	
• Varied labour markets are created	x	x	x	
• Knowledge spill overs	x		x	
• Technological spillovers	x		x	
• Mobility	x	x	x	
Spatial			***Market access***	New benefit
• Transport cost and Accessibility	x	x	x	
• Proximity	x	x	Co-location x	Re wording
• Collaboration/ • networking	x	x	x	
• Enhanced buyer/seller interaction	x		x	
• Scale/scope economy	x			
Macroeconomic				
• Local competition	x		x	
• Local monopoly	x		x	
• Regional growth	x	x	x	
Logistics specific				
• Availability of value-added logistics services		x		

Source : Hallock (2018,2021), (Rivera et al., 2016a, Sheffi, 2012): *New benefit* is initially identified in Hallock (2018,2021).

2.2. Firms' Logistics Performance (FLP)

The logistics benefits or outcomes of clusters are both macroeconomic as well as specific to firms in the cluster (Porter 1998a; 2000; Rivera et al. 2016a). This discussion focuses on the logistics performance of firms in areas related to both efficiency and customer quality that enjoy logistics benefits of cluster activity (Hallock 2021). Logistics performance measures Chow et al. (1994) include cost efficiency, social responsibility, flexibility, integrity, on-time delivery, product availability, customer satisfaction, sales growth, working conditions and profitability. Recent research (refer to Table 2.) is consistent with this view of performance. Table 2. categorises variables based on the literature, which is grouped under headings that may be used to measure FLP.

The usefulness of models used to measure the logistics performance of firms has been well researched. Estampe et al. (2013) analyse many performance evaluation models that considered the decision level, types of flows, level of supply chain maturity, benchmarking, contextual and quality factors. The elements chosen are compatible with the Framework for Logistics Research, Supply Chain Operations Reference (SCOR) (Ntabe et al. 2015) or European Foundation for Quality Management models (EFQM) (Chia et al. 2009; Ntabe et al. 2015) with a preference for SCOR and EFQM. The Balanced Score Card (Kaplan and Norton 2001), though popular, is not tailored for logistics. The SCPAT model (Banomyong and Supatn 2011) measures cost, timing and reliability, is suited to SME's and is a quantitative self-assessment tool. It is a good tool for supply chain performance measurement. Several shortcomings of the SCOR and Balanced Scorecard approach have been noted, (Dweekat et al. 2017; Gunasekaran et al. 2004; Gunasekaran and Kobu 2007; Arzu and Erman 2010; Estampe et al. 2013) who identify the following shortcomings:

- No clear connection with strategy nor demarcation between metrics at the strategic, tactical, and operational levels contributed to the inability to have a balanced approach to integrating financial and non-financial metrics missing leading to issues of being static, short term, and profit oriented.
- Incompleteness, inconsistencies, and the absence of relational structures in process management and metrics.
- Too many metrics, which make it difficult to distinguish the critical from the trivial.
- A focus on local optimisation and not a comprehensive supply chain view by being too inward-looking at the expense of customers, suppliers, and competitors.

Additionally, there is no discussion in the literature of a link between LCB and potential areas of FLP. This gap was explored in Hallock (2021) and the ensuing discussion.

Table 2: Elements of the Firms' Logistic Performance

Measure	Reference
Timeliness	
Service effectiveness – shippers and consignees, documentation Delivery speed, flexibility, lead times,, working capital management	Green (2008), Yuen and Thai (2017a), Flynn et al. (2010), Lai et al. (2002)
Cost	
Cost reductions – order management, facilities, warehousing, transport, logistics administration Asset utilisation improved – cash to cycle time	Yuen and Thai (2017b), Lai et al. (2002), Kim (2009)
Quality of service	
Flexibility – customisability of offering, time to market, problem solving, dependability	Yang et al. (2015), Flynn et al. (2010)
Quality availability and extent of offerings	Yuen and Thai (2017b)
Customer service	Flynn et al. (2010)
ROPMIS – image and reputation perceptions, staff knowledge of customer wants	Thai (2008)

Measure	Reference
Others	
ROPMIS – resource related, skilled labour facilities SCPAT	Thai (2008) Banomyong and Supatn (2011)
Financial growth /Sales growth	Kaplan and Norton (2001)

Lower logistics and transport costs brought about by proximity and the use of 3PL/4PL impact efficiency in FLP that can flow-on to service quality of FLP. Hallock (2021) shows SCI, e.g., such as external and internal integration (EI and II), in combination with VALS offerings, can have an impact on FLP via efficiencies in integrating internal processes and efficiency arising from integrating external resources for effective collaboration. SCI also facilitates agility, requiring both EI and II. Agility contributes to efficiencies in the firms' logistics performance on cost and customer experience (Chen et al. 2009, Stank 2000). Therefore, SCI facilitated by II eliminates duplication and non-value-adding tasks fostering efficiencies. Thus, the ability to deliver efficiency is a vital aspect of FLP.

The meeting of end-user needs transcends the provision of efficiency by also impacting customer experience and thus service quality. A measure such as Resources, Outcomes, Process, Management, Image, Social responsibility (ROPMIS) (Thai 2008) has the potential to address both the efficiency and service quality aspects of FLP. However, research on ROPMIS has not explored a link to LCB or FLP.

The behaviour of firms underlying how to achieve efficiency in FLP can be explained by a focus on costs. According to Transaction Cost Economics (TCE) Williamson (1981), an entity seeks to minimise the transaction costs of its operations. Therefore, firms seeking efficiency in operations can be expected to adopt a strategy of minimising their costs. Transaction Costs (TC) arise from uncertainty (Heide and Stump 1995; Stump and Heide 1996) and the existence of asset specificity (Halldorsson et al. 2007). Transaction-specific investments or asset specificity are an investment in assets that are unique to a particular relationship exchange. In a supply chain relationship, this could include specialised containers, lifting equipment, storage facilities, and specific software resulting in unique assets of no or low value outside the relationship (the potential to be stranded assets). The importance of asset investment is also noted in ROPMIS under resources (Thai 2008).

TCE also explains behaviours of firms (Halldórsson et al. 2015) in SCM relationships, seeking efficiency in SCM. Trust-based relationships (Ganesan 1994; Stump and Heide 1996) among supply chain partners entering into long-term collaborative relationships mitigates the risks of uncertainty (Lai et al. 2002) and thus the risk of cost increases. The objective of TCE is to design efficient (cost-effective) mechanisms for conducting an activity which is determined by the level of effort the buyer and seller exert to complete an economic exchange or transaction (Williamson 1975). TCE also guides firms on the selection criteria to minimise transaction costs during supplier selection (Sancha et al. 2016). All the approaches show reliance on labour to create efficiencies in the FLP.

A firm's logistics performance may be also impacted by a choice of techniques of green supply chain management (GSCM) and use of reverse logistics, which enables the logistics performance of the firm to meet efficiency objectives of SCI of firms in the cluster while contributing to the individual firm's environmental credentials. SCM focuses on environment management (Burt et al. 2003) and the need to manage customer relationships, which relates to the quality of the offering. These are not conflicting goals, as environmentally responsible companies gain competitive advantage by cost savings arising from reduced waste and collaborate with global partners who similarly value environmental awareness (Sarkis 2006; Rao 2003). Another perspective on the benefit of managing the impact on the environment is provided by Huscroft et al. (2013, p. 319), who identify an attitude that customers do not wish to negatively impact the environment: "*compliance with regulations and updating policies…is one our largest activities"*. Consequently, the authors suggest that green supply chain

activities are an area of emerging importance. The authors add a caveat that although firms may wish to promote green logistics practices compliance with regulatory requirements has a cost: "*our skies are darkened with environmental and regulatory auditors"* (Huscroft et al. 2013, p. 319). Metrics relating to GSCM reflecting compliance for statutory reasons as well as the demonstration of CSR can form part of monitoring a firms' logistics performance.

Green reverse logistics (GRL),which is reuse, remanufacture (repair, refurbish) and recycle, together with GSCM was examined by Hazen et al. (2011) as VALS that would impact on competitive advantage commenting (p. 375) that, "*employing GRL for implementing GSCM may be thought of as an innovation because it can provide new business opportunities*." The ability to perform reverse logistics and GSCM is attractive to firms offering both service quality and efficiency in *FLP*. The ability to perform reverse logistics (RL) and GSCM is attractive to firms choosing to locate in a cluster because it creates other opportunities like knowledge-based services and opportunities to on-sell offerings and is thus an enabler of LCB. The efficiency and scope of FLP has been shown to be measurable and practical as above.

2.2.1. Value added logistics services (VALS)

In Section 2.1 the opportunity to provide VALS was noted as a potential logistics benefit of clustering. The opportunity to provide VALS requires collaboration especially the ability to integrate externally, discussed in the preceding section. The provision of VALS meets customer needs of availability, quality of offering and value for money of the offering, enabling supply chain transactions to proceed smoothly (Rivera et.al 2016).

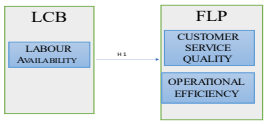
Basic logistics services comprise offerings from transportation carriers, warehousing, forwarders and IT integration(Christopher, 1998) that can be supplemented by value added services (VALS) in logistics using a strategy of '*servitisation*' (Vandermerwe and Rada (1988). For example, the combination of postponement (holding off production or assembly till the last practical moment), agility (quick responses), reverse logistics services (return of goods including unserviceable items), IT integration and green supply chain management (practices that minimise adverse environmental impacts), (Rivera et al., 2016a).

Lower logistics and transport costs brought about by proximity and collaboration with a logistics service provider (3PL/ 4PL) Trentin (2011) enables efficiency and service quality to the firms' logistics performance via value added offerings. Hallock (2021) shows some enablers e.g., SCI, such as EI and II, in combination with VALS offerings, can have an impact on FLP via efficiencies in integrating internal processes and efficiency arising from integrating external resources for effective collaboration. SCI also facilitates agility, requiring both external and internal integration. Agility contributes to efficiencies in the firm's logistics performance on cost and customer experience (Chen et al. 2009, Stank 2000). Therefore, SCI facilitated by II eliminates duplication and non-value-adding tasks fostering efficiencies. Thus, the ability to deliver efficiency is a vital aspect of *FLP.*

3. The proposed model of LCB

A conceptual framework (CF) Figure 1. depicting the LCB- FLP relationship is an extract of an Enabler-LCB-FLP framework that was derived from literature and a Delphi process (Hallock et al., 2018), refer Fig 2. Hallock (2021). The Enabler-LCB- FLP framework was empirically validated. However, this discussion focusses on a portion of that model pertaining to the **LCB-FLP** relationship. Hallock (2021) discusses the Enabler-LCB-FLP framework in its entirety and the influence of mediated relationships, which is outside the scope of this discussion.

Figure 1: Conceptual framework -extract from (Hallock 2021)- see Fig 2.



The relationship between LCB and FLP having been demonstrated in Hallock (2021), the examination of hypothesis (H1) can proceed:

H 1 The logistics benefits of clusters is positively related to the firms' logistics performance.

4. Research Methodology

Hallock (2021) used a positivist research paradigm Creswell, 2017) and a quantitative approach (survey) to validate a conceptual framework (Figure 1), by testing the hypothesis *H1*.

Data collection that targeted middle and senior management, was in two waves between November 2018 and May 2019 under the auspices of RMIT. The first wave comprised participant members of peak bodies e.g., the Chartered Institute of Logistics and Transport (CILTA), the Supply Chain and Logistics Institute Australia (SCLAA) and Chambers of commerce, distributed in an email survey to 2,500 potential member respondents. Despite reminders, the 59 valid responses received were insufficient, so a second wave of collection was undertaken via a panel data provider with data purchased, 2500 respondents were surveyed with 230 usable responses received.

Forty-three questions, answered on a Likert scale (1 to 5) was common to both phases. Screening of respondents was undertaken prior to dispatch for the first wave and for the second wave was incorporated in an elimination filter in a preamble to the survey. Three questions ensured pre-qualification: working in one of six sectors, management of a logistics or supply chain function and work experience. The screening at the start of the survey ensured unqualified respondents were unable to participate minimising response bias.

Non-response bias was not an issue. Non-response bias (NRB) can measure those who made a decision not to participate in a study; that is, the differences between those who cooperated versus those from whom data were not gathered (Paul 2008). NRB was not an issue for many reasons. Firstly, the demographics targeted respondents from the logistics sector or whose industries had a reliance on logistics, and a process of filtering ensured only those who were interested entered the survey. Further, the agreement with the paid data provider, CINT, was that a quota of responses that met the researcher's quality requirements be met. Consequently, non-response bias was not an issue.

Sample bias that may have arisen because of two cohorts of data was analysed, initially by the Mann-Whitney and Levene tests. Since there was no homogeneity of variance the Kruskal-Wallis test for non-parametric data as well as post-hoc multiple comparison tests (Games-Howell) were run for responses received midway during sampling (Hallock 2021).

5. Analysis of data - and results

Factor analysis (EFA) examined components and isolated those with factor loadings with eigen values > 1, to assess the unidimensionality, measurement properties of the survey items and to ensure the validity of the observed measures (Field, 2013). The Promax and Oblimin rotations generated a pattern and structure matrix enabling culling of cross-loading variables.
The internal consistency of constructs scale reliability (Cortina, 1993, Field, 2013) was assessed by Cronbach's alpha, where an alpha value closer to 1.0, (LCB 0.8 and FLP 0.85) indicate high reliability

of the measurement scale (Nunnally, 1978, (Hair et al., 2013), Tabachnick and Fidell, 2007, Drost, 2011, Meyers et al., 2013). No factors were identified where the alpha value increased on deletion, supporting reliability and construct validity.

A simple explanation of variables of LCB and FLP, summarising the survey questions is described refer Tables 3. & 4. Factor loadings (weights) refer Table 5., follows these descriptors.

Table 3: Explanation of variables comprising the factor Logistics Cluster Benefits (LCB)

LCB	Code	Description
Labour availability	LCB_Labsk	Ability to recruit skilled labour at a location
	LCB_Labrecr_locl	Ability to recruit any labour locally
	LCB_Labrecr_tmp	Ability to recruit any labour to meet temporary needs locally.

Table 4: Explanation of variables comprising the factor Firms' Logistic performance (FLP)

Code	Description (Firms' activities)
FLP_Log_CSR	Logistics operations comply with its CSR goals.
FLP_Log_CSQ_Scsecure	Logistics operations at location ensure secure product supply chains.
FLP_Log_CSQ_Custexpect	Logistics operations accommodate customer expectations.
FLP_Log_timely	Logistics operations at location are performed in a timely manner.
FLP_Log_CSQ_Agile	Logistics operations at location are flexible and meet unplanned requests from customers.

Table 5: LCB and FLP EFA Output

Pattern Matrix	**Labour**	**Growth**	**FLP**
LCB_Labrecr_tmp	0.738		
LCB_Labsk	0.875		
LCB_Labrecr_locl	0.809		
LCB_Mktacc_locn_optcost_S		0.699	
LCB_Public_ben_localbiznew		0.639	
LCB_F_coop_KnowTech		0.797	
FLP_Log_CSR			0.778
FLP_Log_timely			0.648
FLP_Log_CSQ_Scsecure			0.741
FLP_Log_CSQ_Custexpect			0.795
FLP_Log_CSQ_Agile			0.79
FLP_Log_CSQ_err			0.835

The EFA results were confirmed by conducting CFA on all variables identified in the EFA model resulting in variables in the "growth category in LCB and *FLP_Log_CSQ_err* refer Table 5.3 dropped. The CFA showed that all constructs satisfied requirements of validity and the final solution was identified as well-fitting with RMSEA 0.05, RMR 0.05 and CFI 0.96 (Hallock 2021). Details of the EFA and CFA metrics Measurement and structural model are elaborated in Hallock (2021). For this discussion, relevant CFA metrics are extracted below. The Kaiser Meyer Olkin measure of sampling adequacy is 0.883 & 0.895, greater than the suggested 0.6 (Hair et al., 2013) and Bartlett's test of sphericity is significant (p=0.000), indicating suitability for factor analysis.

5.1 Construct validity and reliability

Confirmation of convergent validity (Tabachnick and Fidell, 2007, Du et al., 2012; Campbell, Parks & Wells 2015) was satisfied when all loadings in the EFA confirmed unidimensionality i.e., loaded

strongly on only one factor (Cortina 1993, Grayson 2004) substantially (factor loadings above 0.5) on their underlying constructs.

Table 6: Validity analysis

Constructs	CR	AVE	MSV
FLP	**0.824**	**0.484**	**0.429**
LCB	**0.768**	**0.524**	**0.429**

Thereafter, construct validity as part of the CFA process (see Table 6.) was explored. Construct validity comprises convergent validity, discriminant validity and nomological validity. Convergent validity was evaluated in three ways. The approach advocated in Hair 2013 (p. 619) uses construct reliability (CCR), where a value of >0.7 is an indication of good reliability. CCR can be contrasted with the average variance extracted **(**AVE) method.

In the average variance extracted (AVE) method, constructs > 0.5 and, factor loading loadings >0.7 are retained because they indicate good reliability. Convergent validity exists when CCR is greater than 0.7 or AVE is greater than 0.5 (Fornell and Larcker 1981). Since the AVE for FLP is approximately equal to 0.5 and since the value is greater than the corresponding MSV , the condition for discriminant validity is met. Further, the CR results are also well in excess of the threshold values thus, the results are accepted. Discriminant validity (Gaskin and Lim 2016) passed the more rigorous test advocated by Hair (2013) based on the comparison with AVE. Nomological validity was established when the meaning of each item variable was assigned to a factor based on its relevance to be grouped with other like items of similar connotation, refer Tables 3 & 4.

Table 7: Extract of CFA Metrics

Constructs	Variables	Regression loadings	S.E.	C.R.	P	SMC	Cronbach
FLP	FLP_Log_CSQ_Agile	0.667	0.081	1.413	0.158	0.445	0.854
FLP	FLP_Log_CSQ_Scsecure	0.700	0.078	1.413	0.158	0.490	0.853
FLP	FLP_Log_CSR	0.702	0.078	1.415	0.157	0.493	0.855
FLP	FLP_Log_timely	0.710	0.083	1.414	0.157	0.504	0.852
FLP	FLP_Log_CSQ_Custexpect	0.700	0.080	1.415	0.157	0.490	0.853
LCB	FLP	0.712				0.508	
LCB	LCB_Labrecr_locl	0.693	0.116	1.428	0.153	0.481	0.857
LCB	LCB_Labsk	0.731	0.119	1.433	0.152	0.534	0.857
LCB	LCB_Labrecr_tmp	0.699	0.127	1.441	0.149	0.489	0.855

Notes: *Standard error (SE) is an estimate of the standard error of the covariance; Critical ratio (CR) is the critical ratio obtained by dividing the estimate of the regression by its standard error to obtain a standardised value that can be compared easily. A value exceeding 1.96 represents a level of significance at 0.05 confidence level.*

Table 7 summarises relevants CFA metrics, regression loadings, standardised regressions and Cronbach values supporting statistical analysis of the hypothesis.

5.2. Testing of hypotheses

Figure 2 is an extract of the structural equation modelling (SEM) results with r^2 shown on each path. SEM was used to test the hypothesised relationship between *LCB* and *FLP.* The structural model (SM) had a good fit. Mediation effects that rely on the enablers of the model are explored in Hallock (2021) and cannot be explored here because of reliance on Enablers that are out of current scope.

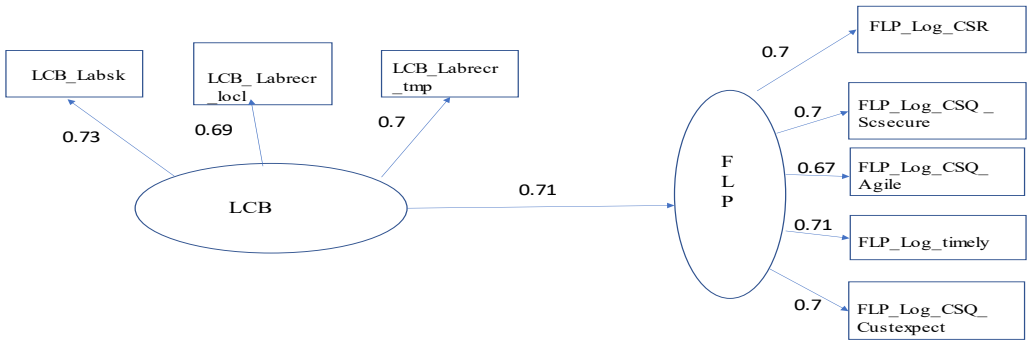
Table 8: Assessment of hypothesis *H1*

Conditions	Relationship
*** p<0.001; ** p<0.05 Bootstrapped bias corrected. two -tail significance	LCB → FLP 0.712
	***
Status	Accept

6. Findings and implications

The findings of the analysis to the research question "How does LCB influence the firms' logistics performance (FLP) follow in Sec 6.1. Sections 6.4, 6.5, and 6.6 and 6.8 discuss implications, limitations, and future research prospects.

Figure 2: Extract of LCB-FLP results of main SEM model (Hallock 2021)



6.1. Summary of findings

Efficiency and service quality are identified as key concepts in FLP. They rely on proximity and location that is critical to the achievement of optimum cost and timeliness of access to suppliers and markets. 'Timeliness' depends on inputs of labour to achieve the *FLP* measure of service quality (SQ), noting a qualification in (Hallock 2018) the Delphi panel identified a payoff between cost and quality of service.

FLP has five indicators, of which three indicators are related to the measurement of operational excellence and efficiency and have a flow-on effect on perceptions of service quality. These measures are *Supply chain security in logistics, Timely logistics operations,* and *Customer focused flexibility in logistics operations*. Two directly measuring customer service quality (CSQ) are, *CSR* (corporate social responsibility) *goal compliance in logistics* and *Customer expectations met in logistics operations.*

The distinction between service quality (CSQ) and customer satisfaction is nuanced and not readily apparent. The difference between CSQ and customer satisfaction is dependent on flexibility of physical distribution, demand-side flexibility arising out of interactions with users over time, that are contributory factors to customer satisfaction (Zhang et al. 2005, Daugherty et al. 1998) as well as post-purchase dissonance that affects customer perceptions (Kim et al. 2009). These aspects of CSQ are explored in Thai (2007; 2013; 2016) and measured by *FLP* in this research.

Compliance with CSR goals in logistics measures CSQ that transcends supply chain partner relationships and reflects performance directly measurable by customer and corporate indicators and indirectly by operational measures. The focus in CSR of its logistics operations requires compliance with higher goals than short-term profit orientation.

LCB's measures are, first, *Skilled labour locally*, which measures the benefit of the extent to which the firm was able to procure highly specialised or skilled labour locally. Second, the measure of procuring any labour locally, *all labour locally*, represents easier procurement. Finally, the *presence of a source of a temporary supply of labour*; noting that the survey did not explore whether labour was outsourced from non-local sources.

Collectively, a firm can benefit from the availability of all aspects of this labour pool to enjoy flexibility in logistics operations and to meet unplanned requests from customers. The three types of pooled labour supply, together with the availability of focussed infrastructure investment enables the delivery of a range of specific *VALS* via 3PL/4PL (third-and fourth party logistics providers). Dependence on a self-sustaining pooled labour was identified by the classical theorists refer section 2.1 and Table 1. and logistics literature. Rivera et al. (2016a) note that a logistics benefit of clustering is that labour has the opportunity of upward mobility as well as access to continuing work based on the availability of short-term, stop-gap work to meet fluctuations in business activity. The mobility of highly skilled labour results in rapid inter-firm movement of highly skilled labour, and the dissemination of ideas among neighbouring firms, which is a secondary benefit to industries in a cluster (Glaeser et al. 1992; Glaeser et al. 2010). The consistency in the findings of the extant literature, the Delphi panel (Hallock 2018) and validation of this factor in (Hallock 2021) indicates the importance of these constructs.

6.2. The link between LCB and the FLP theme of efficiency

Location is a determinant of labour supply in this research as the context of all survey questions was, "*in your current location*". The location specific nature of LCB is a determinant of operational efficiency in FLP *and* of the impact of *LCB* on *FLP*.

The efficiency-related measures of *FLP* are *Timely logistics operation* and *Customer-focused flexibility in logistics operations* that measure timeliness and flexibility. These measures of efficiency impact perceptions of CSQ by the customer and are related to the measure of *Customer expectations met in logistics operations.*

DIFOTIS (**D**elivery **i**n **F**ull **o**n **T**ime **i**n **S**pecification) is a measure of efficiency used by many industries (Hallock et al. 2018; Janjua 2018) and is an appropriate starting point. The individual achievement of timeliness as a measure of *FLP* enables these measures to be used as the metric of the 'on time' aspect of DIFOTIS. Similarly, 'in Full … in Specification' influences CSQ. A less rigorous DIFOTIS target range requires fewer resources with exacting targets needing better resourcing in a mix of labour and of logistics assets.

Labour availability influences responsiveness. 'Lead time' determines the required level of agility or responsiveness to fulfil a request, complements timeliness. Lead time responsiveness is measured in *Customer-focused flexibility in logistics operations* and the optimal level of transaction cost required to deliver a premium service level above the 'normal level' of service. The specific metrics for time, cost and service quality were noted by the Delphi panel Hallock (2018) to be part of supply chain negotiations and are readily available for implementation. These metrics vary from customer to customer.

LCB constructs affect timeliness and flexibility therefore, some indicators impact both efficiency and service quality.

6.3. The link between LCB and the FLP theme of customer service quality

Skilled labour enables delivery of the capability of *VALS*, facilitating flexibility, efficiency, timeliness and quality and is essential to efficiency and CSQ. These capabilities enable delivery of a service capability measured by efficiency and CSQ. Thus, *FLP* and *LCB* are linked through the capability to fulfill the need of flexibility and timeliness.

Labour availability generates CSQ measured by the *FLP* indicators, *Supply chain security in logistics* and *CSR goal compliance in logistics.* Corporate Social Responsibility (CSR) influences CSQ e.g., successful firms value security (and safety), (Piecyk Maja and Björklund 2015) because these attributes have positive perceptions in a competitive environment. Customer expectations also encompass the need to be considered a good corporate citizen including choices in sourcing of LSP's who adhere to principles of CSR. The indicators *CSR goal compliance in logistics* and *Supply chain security in logistics* form a group of attributes that contribute to meeting customer expectations.

Adherence to principles of green supply chain management (GSCM) principles and of the Triple bottom line (TBL) where applicable, can be measured by CSR *goal compliance.* However, compliance with the use of ethically sourced labour when undertaking offshore logistics requires monitoring that may not be feasible where sub-contracting of procurement of non-industrial manufacturing processes are involved. The service quality of CSR can also be influenced by the efficiency impacts of safety, security, and procurement.

The range of indicators in CSR reporting vary, with some reports typically measuring environmental impacts, labour practices and work conditions, as well as social performance (community and anti-corruption initiatives) (Piecyk, Maja and Björklund 2015). Piecyk et al. (2015) also comment that the promotion of a firm's attitude to CSR and its green credentials is part of building its corporate image in the logistics industry. Although CSR reporting is still evolving towards less financial focus using the Global Reporting Initiative frameworks (Capaldi et al. 2019), it is nevertheless feasible as a measure that can be implemented. For this reason, the findings on CSR compliance as a measure of *FLP* are important.

Successful logistics operations generates competitive advantage and more of the factor of production at their location associated with their success in a self-perpetuating sequence. Therefore, the availability of *LCB* created by a skilled labour supply has a link to the *FLP*. The finding on the *LCB* factors validates predictions of classical economic theory (refer to Table 2.) that benefits of labour pooling, and a flexible and skilled supply are generated when firms are co-located, and concentration occurs in a cluster.

The research question has thus been answered: *LCB* has a positive impact on *FLP*. *FLP* is characterised by efficiency in the conduct of its operations and the achievement of service quality.

6.4. Academic implications

LCB comprises three measures relating to the availability of labour that contribute to the causal relationship *LCB* has with *FLP*. Labour availability in *LCB* is a positive externality of co-location (refer to Table 1). Rivera et al. (2016a) call for validation of the availability of labour as an *LCB* to verify the qualitative findings of grounded theory. This research empirically validates the nexus between labour availability and logistics activity in clusters.

The main academic implication of this research is that *LCB* is related to *FLP*. Arising from this, the availability of varied labour categories enable the offering of sophisticated and varied logistics services (*VALS)* to facilitate meeting the *FLP* goals of the firm. Success in *FLP* is in turn associated with the economic process of self-sustaining growth Krugman (1990)that

represents the symbiotic relationship between the growth in firms at a location and the supply of all labour at that location. The exploration of the link between *LCB* factors and *FLP* (H_1) is unique to this research and is new knowledge.

Potential users now can have confidence in the levers that can influence the desired outcome of *LCB and FLP*. For example, knowing the composition of *LCB* and causal links with *FLP* allows researchers to explore specific relationships by varying combinations of types of labour supply to achieve specific outcomes. This process enables the identification of tailored offerings to niche markets and guidance to policymakers who wish to maximise interventions in cluster related initiatives.

Additionally, since *FLP* is a composite of indicators of service quality and operational efficiency, future research on the examination of each of these themes as separate factors of *FLP* is a contribution to knowledge.

6.5. Managerial implications

DIFOTIS is a practical marketing metric, that may be incorporated into an accountability framework for *Customer expectations met in logistics operations.* It can be used to measure the firms' behaviour in the efficient use of resources and achievement of cost targets (Barney 1991; Williamson, 2010). Since DIFOTIS measures logistics operational activities, firms and LSPs can structure operations using specified efficiency and customer satisfaction metrics. At macroeconomic level, the creation of local labour pools can inform planning of urban form, the co-location of industry, and the creation of regional impacts. The ROPMIS model also presents a structure that can be integrated into metrics of FLP framework.

Academics and the state can collaborate in the refinement of economic guidelines used to assess an investment's economic viability (Gateway, 2015, DTF, 2015, DTF, 2013).The inclusion of quantified cluster benefits based on agglomeration economies (AE) (Fujita and Krugman, 2004), is accepted by some transport economists. These AE can be used as input to establish *ex-ante* policy guidance to examine the appropriate resourcing of logistics clusters. This research identifies measures of *LCB* and *FLP* which can be quantified and used as inputs for logistics related WEBs.

Given that the potential for the creation of many *LCB* has been validated, there is an opportunity for the state and industry to partner in strategic collaboration for the realisation of these benefits.

6.6. Limitations

Survey fatigue was an issue despite two data collection sources. A follow up qualitative stage would have been useful to test nuances emerging from the quantitative stage. This investigation has treated all clusters as one. Changes affecting differences in recent developments of clusters in Australian industry and supply chain are out of scope.

6.7. Future research directions

The current framework can be used to evaluate whether significant differences exist between different types of cluster and comparisons cross countries. Focussing on the importance of Asian and S-E Asian nations in international supply chains, whether clusters based on Ports and airports related to export processing or free-trade zones, are different. The role of clusters in mitigating geopolitical risks to the supply chain is also an area of research.

6.8. Conclusion

The research question driving this investigation has been answered, a rigorous examination of the data showing that LCB has a clear link with FLP. Several causal links between LCB and FLP can now be explored, building on the theoretical relationship established here. Exploration of how logistics offerings can be tailored to niche markets by industry and the strategies by which policymakers can maximise interventions in cluster related initiatives, is also possible.

The key impacts on industry and policy are that development of labour skills and resultant specialist labour pools can support planning decisions on urban form. These decisions can foster the co-location of industry, and the promotion and creation of regional impacts for the public good. When firms cluster and undertake logistics activities, metrics like DIFOTIS and the ROPMIS model can be used to evaluate the impacts on Customer Service Quality and Operational efficiency. Future research directions offer opportunities to expand the application of these concepts.

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