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Enablers of logistics cluster benefits: An exploratory study

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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 factors which may lead to logistics cluster benefits (LCB).

Design/methodology/approach: This study empirically explores the enablers of LCB within a conceptual framework developed around LCB. A survey was conducted across logistics, retail, manufacturing and agro-industries in Australia across 3000 participants by email over four months, from which 58 responses were received. Exploratory factor analysis (EFA) was used to analyse data.

Findings: Three factors Operational collaboration, Service quality in Value added logistics (VALS_QOS), Industry character were identified. Operational collaboration identified both tactical collaboration with the state on the adequacy and timing of Government investment in logistics infrastructure in the region, as well as intra firm collaboration on; relationships, aggregate purchasing of logistics services, resolution of common problems, joint development of industry practices and standards, supply chain (SC) planning and operational processes. For VALS_QOS the ubiquity, responsiveness and availability of the VALS offering at the firm's location was identified. Industry character is a factor that identifies the scale , magnitude as well as the variety of industry in a location.

Practical implications/Originality/Value

This study provides empirical evidence of enablers of LCB expanding on research by Rivera and Sheffi who advocated investigation of logistics clusters (LC). New information about LC in Australia is available for decisions by policy makers and firms seeking guidance on resourcing infrastructure investment and promoting logistics activities.

Keywords

Logistics benefits,clusters, value added logistics services (VALS), EFA

1 Introduction

Logistics clusters (LC) comprise industrial firms who have a significant part of their operations comprising logistics activities (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. (2016). This relatively recent interest in the field is supported by the observation of Rivera et al. (2016) who noted that "*although there is a notable industrial clusters literature, the research on logistics clusters is still in its infancy"*

There is an extensive literature on the characteristics and benefits of industrial clusters, but little is known about the antecedent/enablers of logistics clusters and, their benefits to firms in the clusters. This gap also applies to the recent spatial logistics cluster (SLC) concept Chhetri et al. (2014) where research is yet to establish the policy benefits of SLC to the logistics industry. This paper therefore addresses these research issues by investigating the antecedents or enablers of logistics cluster benefits.

The research question explored in this paper is "what factors or enablers can lead to logistics cluster benefits (LCB)?" The research uses an empirical approach to investigate this research question. This research is significant because logistics represents 9% of GDP and employs about 1.2 Million people (Allen, 2014). Despite this economic significance, the nexus between the factors creating benefits (enablers) and the creation of logistics cluster benefits has not been investigated empirically. Therefore, the decisions of governments and firms on potential investment in clusters lack an evidence based foundation.

The remainder of this paper is presented as follows: A review of literature in the Section 2 relevant to antecedents and enablers of LCB culminates in a proposed model for investigation based on an initial conceptual framework (ICF). This is discussed in Section 3. Section 4 discusses the research methodology, and Section 5 is an analysis of data and discussion of findings. Section 6 concludes with a discussion of future research directions.

2 Literature review

Logistics clusters were defined by Sheffi (2010, pp. 11) as, "*includes companies offering logistics services, such as transportation, warehousing, distribution"*. This was later expanded (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, specialized 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. These centres perform cargo consolidation and deconsolidation on a small scale and come under the jurisdiction of local authorities e.g. Altona, Barnawatha, Ettamogah, Moorebank, Chullora, Parkes in Australia. In these locations value added logistics services are provided. Parkes is an example where all the preceding activities occur in addition to its being a designated dry port by authorities 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). Further examples are of Zaragoza in Spain a vast commercial built for purpose facility, the Pearl River Delta, China (Sheffi, 2012a) as well as state owned ports like Singapore, Dubai Shanghai and port cities that have seen clusters evolve over centuries, London, Antwerp, Rotterdam, Hamburg. The footprint, type and scale of value-addition varies significantly across small and large scale facilities and port cities discussed.

Logistics cluster benefits (LCB) are discussed next followed by that of enablers.

2.1 Logistics cluster benefits (LCB)

The benefits of clustering of logistics activity (Rivera et al. (2016) can be analysed to comprise outcomes and opportunities. The two are linked via collaboration in service provision and support one another as will be shown.

Outcomes (see Table 1) include productivity gains (Duranton and Puga, 2004, Puga, 2010), cost efficiency, job growth at multiple levels and upward mobility in jobs,and regional growth which (Rivera et al. (2016) 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). This process generates opportunities for workers at many levels including upward mobility. The above outcomes arise from opportunities for collaboration and provision of value added services (VALS). These are LCB that are relevant to the discussion on enablers.

Opportunities to colaborate are a key benefit of clustering. Collaboration is closely linked to the ability to make available VALS to others in the cluster**.** Colocation in the cluster confers a business benefit of being able to provide such 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, as in ports (Notteboom and Rodrigue (2005), is a benefit arising from location in a LC The outcome of such collaboration is lower logistics transport costs, customer retention and greater customer intimacy (customer engagement) (Bowersox et al., 2000, Porter, 1991) all of which have relevance to the enablers of LCB. 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 logistics cluster (LC) is expected

Opportunities for collaboration when grasped can produce positive outcomes. Collaboration can result in the evolution of 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 in economic theory 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 and is of relevance as an enabler. A summary of relevant literature in classical economics and logistics is tabulated in Table 1.

Therefore, the anticipation of such benefits motivates firms to cluster with collaboration noted as a key element. Accordingly, a discussion of the factors required for the realisation of benefits i.e. the antecedents or enablers of LCB follows.

Table 1. Benefits of clusters in the literature

Benefit or advantage	(Marshall, 1890)	(Ohlin, 1935)) (Hoover, 1937, Hoover, 1948) (Weber, 1929)	(Weber 1929)	(De Palma et al., 2011, Krugman, 1998, Spulber, 2007)	(Fujita et al., 1999, Krugman, 1990)	(Storper 1995, Newlands 2003)	(Porter, 1998, Porter, 2000)	(Glaeser et al., 1992) Arrow 1962, Romer 1986 Marshall 1890)	(Perroux 1950, Parr 1999) Cella (1984)	(Rivera et al., 2016, Sheffi, 2012)
Impacting labour										
1) Pooled market for specialised labour	x			x			x			**x**
2) Availability of non-specialised labor	x						x		x	**x**
3) Specialised skill pools develop	x			x			x			**x**
4) Varied labour markets are created		x		x			x			**x**
5) Knowledge spill overs							x	x		
Technological spillovers	x						x	x		
Mobility							x			**x**
Spatial										
Transport cost Accessibility		x	x	x	x			x		**x**
Proximity	x			x	x		x			**x**
Collaboration/networking						x	x	x	x	**x**
Enhanced buyer/seller interaction	x	x		x						
Scale/scope economy		x		x						
Macroeconomic										
Local competition							x			
Local monopoly								x		
Regional growth					x		x	x	x	**x**
Logistics specific										
Value logistics added services										**x**

2.2 Antecedents or enablers of logistics cluster benefits (LCB)

The antecedents, or enablers that give rise to LCB are, co-location (proximity), VALS and its components, and supply chain integration (SCI). Enablers of LCB have been explored in reference to logistics clusters by (Rivera et al., 2016, Rivera et al., 2014) as well as by Chhetri et al. (2014) in their discussion on spatial logistics clusters (SLC). These authors drew on a long history of research on agglomeration theory and cluster theory (co-location) in the industrial organisation literature. They identify the following key sources of anticipated benefits that enable a decision to co-locate to be made by logistics related industries:

i) Superior transport services;
ii) Lower transport costs;
iii) Availability of skilled labour and labour pooling;
iv) Agglomeration effects
v) Potential to collaborate via interfirm networks;
vi) Leveraging government planning preferences directed towards logistics infrastructure investment, which can encourage concentration of like industrial/commercial activities;
vii) Efficiency gains from economies of scale and scope and;
viii) Potential for future cluster growth and wealth creation for the region.

Recent investigations on enablers of logistics clusters by Hallock et al. (2018) identified both modifications and additions to enablers noted above
The classical literature (Table 1) as well as (Rivera et al., 2016, Rivera et al., 2014) use proximity as a factor, whereas Hallock et.al (2018) using a Delphi process identified a modification to proximity namely co-location as a source of benefits. Targeted logistics specific investment was an enabler identified by Hallock et.al op.cit. that summarises “leveraging government planning……commercial activities” (vi) above. The authors found that Targeted logistics specific investment influenced the decision to co-locate.

2.2.1 Co-location

Opportunities for collaboration were noted as a LCB (Sec 2.1). Opportunities for collaboration are enhanced when firms are co-located (in proximity) to one another. Co-location of firms is an enabler because it results in the creation of clusters with an expectation that known benefits including those that are logistics related will materialise. Marshall (1890) introduced the importance of spatial proximity (nearness) in his seminal contribution to the concept of clusters. He argued that firms experience external economies of knowledge sharing, labour pooling, development of a supplier base and increasing returns called agglomeration economies (AE) when they co-locate in geographical proximity. Traditionally, these Marshallian AE are localization economies that occur when similar plants from the same industry locate in spatial proximity. AE induce wealth creation external to the firm arising from regional economic growth (Sheffi 2012a, 2012b). Wealth creation can result in the success of a cluster making it attractive to potential investors, thereby ensuring perpetuation of the cluster (Rivera et al., 2016, Krugman, 1990). Simply, the economic benefit is that a cluster becomes a magnet to firms and perpetuates itself.

Co-location of firms generates efficiency gains, as noted by Chhetri et al. (2014), and Vom Hofe and Chen (2006). This efficiency gain from co-location is:

1) Creation of savings in transport that classical economists postulate is driven by proximity (Banister and Berechman, 2003, Fujita and Krugman, 2004, Fujita et al., 1999, Fujita and Thisse, 1996). However, classical theory does not identify logistics benefits like changes and benefits to production fulfilment from just-in-time production (JIT), which is facilitated by proximity.

2) Associated with the diversity of products and transactions exchanged within the cluster. The resultant transaction based logistics landscape is facilitated by proximity (Waldheim and Berger (2008), which Chhetri et al. (2014) claim has emerged in Australia..

3) Network efficiencies from the formation of interfirm networks. Examples are sharing of activities, resources including employees and capabilities (Chhetri op.cit.2014)(Rivera et al., 2016). Also included are transport related; consolidation, back –haul utilisation, optimal capacity haulage, cross docking, packaging, labelling, and assembly, which rely on proximity and collaboration, and drive cost effectiveness (Rivera et al., 2016).

The co-location of firms enables targeted logistics infrastructure (TLI) investment to be directed where it fits state policy objectives (Chhetri et al. (2014) and as in the Zaragoza facility (Sheffi (2012). TLI comprises the inter-capital road and rail networks and last mile urban networks; nodes for interchange such as seaports and airports and inland “dry ports” and dedicated infrastructure, which has evolved by design or organically where industry locates. This infrastructure can be also funded by private enterprise (Bolumole et al. (2015), as in the Fort Worth Alliance facility. The importance of dedicated logistics assets and infrastructure was identified by Hallock et.al (2018) in the context of Australian logistics industry.

Agglomeration economies(AE) can result from two outcomes of co-location , concentration and diversity of industries arising from infrastructure availability and accessibility (Fujita and Thisse, 1996, Fujita and Thisse, 2013). An example of AE is described in the concept of spatial logistics clusters which are *areas of high concentration of aggregate logistics industries or employment surrounded by other areas of high concentration* (Chhetri et al. (2014). Chhetri et.al made specific observations relevant to the nexus between AE and co-location:

I. Harnessing agglomeration effects of logistics hubs (service industry), to replace declining manufacturing industry, by creation of a transforming growth pole;
II. Governments can use cluster based policy to promote growth, optimal freight corridors and create growth poles; and
III. The co-location and the interaction of firms can lead to further wealth and cluster creation.

AE as discussed above is consistent with the concept “optimum location” requiring both accessibility and a concentration and variety of industries in a specific location Hallock et.al (2018).
The provision of VALS, enabled by co location is discussed next.

2.2.2 Value added logistics services (VALS)

In Section 2.1 the opportunity to provide VALS was noted as a potential LCB. As discussed below, the opportunity to provide VALS also requires collaboration. The provision of VALS is an enabler because it 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).

Ordinary logistics services comprise offerings from transportation carriers, warehousing, forwarders and customs brokers and IT integration.(Christopher, 1998) Value added services in logistics in contrast are developed using a strategy which combines service components called '*servitisation*' (Vandermerwe and Rada (1988). Servitisation requires the development of service offerings supporting a firm's products to gain differential competitive advantage. 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), can result in the opportunity to provide value added logistics services (VALS) (Rivera et al., 2016).

Postponement, agility and reverse logistics are examples of value added services in a cluster (Christopher, 2000, Christopher and Towill, 2002) facilitated by proximity as well as collaboration through buyer/manufacturer/supplier integration. Agility is the quick response to meeting customer needs of product availability and is linked to postponement, consolidation of all operations beyond production ((Rivera et al., 2016). Supply chain agility (SCA) is important because volatility, uncertainty and variable demand conditions characterising a rapidly changing business environment require quick and timely response which agility provides (Li et al., 2008). A logistics cluster is conducive to agility because of the proximity of firms and availability of a mobile skilled work force, both of which are present in clusters.

Another example of VALS provision is the opportunity to provide reverse logistics activities (Rivera et al., 2016). The authors (op.cit.) cited how a manufacturer collaborated with FedEx (providing 36 hour turnaround on repairs), and a 4PL that invested in Panama to enable cost effective refurbishment and repair for its US client.

Green reverse logistics (GRL) together with green supply chain management practices (GSCM) were 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*." They identify reuse (unused or lightly used, no upgrade needed), remanufacture (repair, refurbish) and recycle (recovery of anything requiring value or environmentally driven compliance) as components of GRL. GSCM, which uses reverse logistics, contributes to LCB because it boosts perceptions of the environmental footprint of the cluster and the collective corporate social responsibility of firms in the cluster whilst contributing to the environmental credentials of the firm's logistic performance (FLP). The ability to perform reverse logistics 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 co-ordination of offerings of postponement, agility and reverse logistics requires collaboration as well as the services of an intermediary who is often a 3PL/4PL (Sheffi (2013). Location in a logistics cluster is conducive to collaboration (Sheffi (2013), which is a requirement (Trentin (2011) for strategies of postponement. Collaboration with a logistics service provider (3PL/ 4PL) Trentin (2011) is critical for the execution of postponement services like tagging, picking, merchandise preparation for retail point of sale display and for quick response capability, all of which are critical to the success of value added offerings. Collaboration relies on the ability to integrate externally, which is discussed in the next section on supply chain integration.

2.2.3 Supply chain integration (SCI) strategies and processes

Supply chain integration (SCI) relies on external integration (EI), internal integration (II) and collaboration to be an effective enabler of LCB. Yuen and Thai (2017b) noted connectivity and simplification as critical elements of EI and II . Connectivity is the linking of external operations between firms and operational units' intra-organization. Simplification is the elimination of superfluous processes and activities that do not add value (Chen et al., 2009). In order to achieve connectivity and simplification Yuen and Thai (op.cit) identified the importance of integration at levels of information, operations and relationships. The idea that Supply Chain Integration (SCI) requires the management of activities, seamless linking of processes within and outside the organisation was identified by Flynn et al. (2010) and Yuen and Thai (2017a). That SCI should also include a joint approach to planning the supply chain as well as partnering in the process is noted by Cao et al. (2010), emphasizing collaboration.

Effective collaboration in SCI beneficially impacts the delivery of VALS. This is because EI is a key component of SCI which enables the delivery of VALS. Strategic partnering with a 4PL requires EI which enables VALS such as postponement, agility and reverse logistics to be enjoyed by the firm. Successful execution of SCI in this context also includes the management of customer relationships and customer service via the servitisation of offerings. The examples cited by Rivera et al. (2016) in respect of FedEx and a 4PL who invested in Panama as well as the instances of green reverse logistics (Hazen et al., 2011) are evidence of how SCI enables VALS. Therefore, in this context LCB are generated by SCI indirectly via VALS. According to Yuen and Thai (2017b) and Kim (2009), there needs to be a strong commitment to integrate processes evidenced by a commitment to long-term relationships(collaboration) if connectivity and simplification of processes are to be achieved. Such long-term relationships can span the boundaries of a firm and be networked with outsiders yet embedded into the firm's networks (Lin et al., 2009, Prajogo et al., 2016). External integration (EI) impacts efficiency and long-term customer relationships (Kim, 2009, Yang et al., 2015, Yuen and Thai, 2017a, Yuen and Thai, 2017b) . In the context of a cluster where the intent is to be efficient, collaborate and optimally use resources, SCI helps achieve these goals

Prajogo et al. (2016) argue that where the logistics processes are highly integrated, the buyer and supplier embed strategic resources to develop capabilities and relationships and improve processes. The unique difference is that such highly integrated activities are hidden from competitors and thus not imitated and thereby confer competitive advantage. This is similar to the resource based view (RBV) (Barney et al., 2001, Barney, 2001) but because it emphasises cooperation and collaboration it is referred to as the *relation based view of* (R)RBV (Prajogo et al. (2016). In this instance, it is the development of capabilities that is most important as it leads to efficiencies.

Therefore, SCI enables the most efficient use of resources and the use of strategic relationships to enable delivery of LCB both directly and via a mediated influence on VALS.

3 The proposed model of LCB

An initial conceptual framework (ICF) Table 3 was derived from literature and a Delphi survey Hallock et al. (2018) identifying, enablers or antecedents of LCB which comprised , Targeted logistics specific investment, Co-location, VALS and SCI. The 'descriptions' heading below is a paraphrase of questions in the survey. Respondents were instructed to provide answers in the sole context of their current location.

Table 3 Description of codes

ENABLER	CODE	DESCRIPTION
TARGETED LOGISTICS SPECIFIC INVESTMENT	Targ_GInv_Log_Tim	Knowing the timing of government investment in logistics infrastructure at the firm's location
	Targ_GInv_Log_ok	Adequacy of state investment in logistics infrastructure in the region
SCI	SCI_EI_coop_Bhaul	Collaborate on potential back-haul opportunities
	SCI_EI_coop_Oproutine_SC	Collaborate with supply chain (SC) partners to develop and implement common tasks at current location.
	SCI_EI_coop_Proc_SC	Share procurement information and capacity constraints with our supply chain (SC) partners.
	SCI_EI_coop_Tech_SC	Collaborate on technical capability with our supply chain (SC) partners
	SCI_EI_logpln_SC	Logistics planning is integrated with our supply chain (SC) partners.
VALS	VALS_L_Acc	A high degree of accessibility to VALS in the firm's current location.
	VALS_L_SP_Bud	Availability of VALS at location that meets budget requirements.
	VALS_L_SP_need	Always find VALS at their location that meets the needs of my firm.
	VALS_L_SP	At firm's current location there is a choice of providers of VALS.
	VALS_L_SP_OD	VALS service provider services any origin or destination.
	VALS_L_SP_T	VALS provider always provides services within specified lead time
CO LOCATION	Colocn_F_SC_TrptAcc	Location's accessibility by all modes of transport to/from my supply chain (SC) partners.
	Colocn_F_coop_log	Collaborate on logistics with SC partners at its current location.
	Colocn_F_coop_purch	Collaboration on aggregate purchasing of commonly used logistics services occurs.
	Colocn_F_coop_StakPln	Collaboration with supply chain (SC) partners to establish planning and operational processes
	Colocn_IndF_Ttl	Many industries and firms from the same value chain located near firm
	Colocn_F_SCP	Many supply chain (SC) partners located near the firm. .
	Colocn_IndF_Var	A variety of industry types where my firm is located.
	Colocn_F_coop_StakStds	Stakeholders jointly develop industry practices and standards.
	Colocn_F_coop_StakPr	Stakeholder groups sharing forums to resolve common problems.

4 Research Methodology

The positivist research paradigm that is used in this study is discussed in Creswell (2007). This research looks at firms in the context of the world they operate in and the participants in the context of their business experiences, which are explored in detail. Therefore, in the specific context of this research and based on a need to validate a conceptual framework, a quantitative approach is needed to test the hypothesis framing the research question. The research question is, "what are the enablers of LCB? "

Data collection used a survey approach. Given the strategic nature of the survey, middle and senior management were the focus of distribution. Respondents were formally invited under the authority of RMIT with a letter of invitation and an ethics clearance evidence of compliance with RMIT quality standards.

Two waves were required. The first wave of participants was approached via peak bodies e.g. the Chartered Institute of Logistics and Transport (CILTA), the Supply Chain and Logistics Institute Australia (SCLAA) and Chambers of commerce, who consented to distribute an email survey to their member bases with a potential of 2,500 respondents. A low response rate of 4% with peak bodies, after running the survey Dec 2018 to April 2019, necessitated a contingency plan being put into action. In this phase chambers of commerce in Toowoomba, Wetherill Park, Victorian Department of Economic Development Eastern Ranges industry office were approached in March 2019. Access to their member base where the target was various industries, wholesaler distributors, logistics service providers shippers, consignees was sought. A list of industries and incumbents was derived from secondary sources. This approach did not meet with success either facing obfuscation or disinterest. The response rate from the peak bodies, SCLAA and CILTA and the Australian Federation of International Forwarders was 100 responses of which 25 were usable. Dialogue with the secretariats of the peak bodies indicated that the contemporaneous distribution of several similar surveys was causing survey fatigue.

Therefore, a second wave of collection was required for which a panel data provider CINT was used and data purchased over the period Mid-April 2019 to May 2019. The second wave went out to 1500 respondents with an initial target of 150 responses of which 35 usable responses have been received to date.

The goal of data collection was to collect a sample of 300 responses for analysis. This metric is advocated by Field (2009) and Iacobucci (2010) as suitable for providing a stable factor solution enabling further analysis.. This metric is not universally agreed upon and the literature presents various points of view on this. The Kaiser-Meyer-Olkin measure of sampling adequacy can be used to test this number. If 300 responses of required quality could not be acquired, then alternate methods of analysis could be employed on a smaller number of responses.

Data collection used an email questionnaire. In Section 2.1 and 2.2 concepts such as LCB, VALS, SCI and Targeted logistics infrastructure investment, were discussed. These concepts known as latent variables Byrne (2005) cannot be directly measured, so, a set of survey items or variables that define the concepts are used to measure the concepts(Schreiber et al., 2006).

The questionnaire was divided into subtopics from which details of enablers could be obtained. Questions relevant to this objective were; about the firm's logistics practices at their current location, infrastructure availability at that location together with the perceived impact on benefits.

The questionnaire (available on request) design varied slightly because two waves of responses were sought with the second wave being obtained from a panel data provider CINT. The body of forty-three questions answered on a Likert scale (1 to 5) was common to both phases. What differed was the demographic qualifications to participate in the survey for the second wave. The first wave was via peak bodies e.g. the Chartered Institute of Logistics and Transport (CILTA) and the Supply Chain and Logistics Institute Australia (SCLAA). The questionnaire to these bodies did not require

a mechanism for screening out potential respondents who did not qualify. The second wave used a screen-out process where three questions which ensured prequalification based on; working in one of six sectors, management of a logistics or supply chain function and work experience were placed at the start of the survey to screen out unqualified respondents.

5 Analysis-

Section 5.1 provides a descriptive analysis in order to explore the respondents' perceptions of enablers Table 4. This is followed by a data reduction technique -factor analysis in section 5.2.

Table 4 General perception of all enablers [1]

Description	Mean	Std. Deviation
EL 2 Knowing the timing of state investment in logistics infrastructure at the firm's location	3.23	1.21
EL 9 Jointly develop industry practices and standards.	3.02	1.395
EL8 Stakeholder resolve common problems.	2.98	1.316
EL 1 Adequacy of state investment in logistics infrastructure	2.96	1.117
EC 6 Collaborate on potential back-haul opportunities	2.88	1.297
EC 5 Collaborate with supply chain (SC) partners to develop and implement common tasks at current location.	2.77	1.296
EL 7 Collaboration on aggregate purchasing of commonly used logistics services occurs.	2.71	1.303
EC 4 Share procurement information and capacity constraints with our supply chain (SC) partners.	2.68	1.223
EC 3 Technical collaboration with supply chain (SC) partners	2.59	1.005
EL 10 Collaboration with supply chain (SC) partners to establish planning and operational processes	2.54	1.196
EL 11 Location's multi-modal accessibility to/from my supply chain (SC) partners.	2.4	1.28
EL7 Collaborate on logistics with SC partners at location.	2.37	1.071
EC 2 Logistics planning integrated with supply chain (SC) partners.	2.35	1.022
EV 5 VALS at location that meets our budget requirements	2.32	1.003
EL 4 Many industries and firms from the same value chain located near firm	2.28	1.048
EL 6 Many supply chain (SC) partners located near the firm	2.26	1.094
EV 6 Always find VALS at their location that meets the needs of the firm.	2.23	0.964
EV 2 At the firm's location there is a choice of providers of VALS.	2.07	0.904
EV 3 VALS service provider services any origin or destination.	2.02	0.842
EV 4 VALS provider always provides services within specified lead time	1.98	0.954
EL 5 A variety of industry types where the firm is located.	1.95	0.915
EV 1 A high degree of accessibility to VALS in the firm's current location	1.75	0.912

5.1 General perceptions of all enablers

The purpose of this section is to explore perceptions of respondents to the enablers in the proposed model. In Table 4, arithmetic means have been ranked so the priority in the perception of variables can be identified. A Likert scale was used in the survey where the following values were used: *1 Strongly agree ,2. Somewhat agree, 3 Neither agree nor disagree, 4 Somewhat disagree, 5. Strongly disagree*.

Means between 1.75 and 2.32 relate to variables where the strongest agreement was recorded and were for EV1,EV4,EV3,EV2 and EV 6. All these items relate to VALS. For example, its availability, the breadth of coverage to any origin and destination and the timeliness of the offering were perceived to be of relatively great importance because scoring had both *somewhat agree and strongly agree* "(2 and 1)" responses. The highest score was noted for *A high degree of accessibility to VALS in the firm's current location* in the 'strongly agree' band. This is to be expected because access to VALS is fundamental to logistics operations. The other variables relating to VALS which were grouped were *Always find VALS at their location that meets the needs of my firm., In my firm's current location there is a choice of providers of VALS, VALS service provider can fulfil our service needs for any origin or destination, VALS provider always provides services when required within specified lead time.* Firms thus place an emphasis on ,availability anywhere (ubiquity), accessibility, choice, flexibility and responsiveness when considering the VALS function. Taken together, VALS is a composite offering requiring all the above facets to be successful.

The next ranking set of responses were variables relating to collaboration which grouped together-EL7,EC3,EC5,EC6,EL10,EL9,EL8. These variables apart from collaborating with institutional stakeholders on the timing of investment, all related to some form of tactical co-operation in the firm's location. These have a common theme in being operationally focused; aggregate purchasing of commonly used logistics services, resolution of common problems, joint development of industry practices and cooperation to acquire return loads. This is to be expected because the areas of collaboration cover all aspects of the value chain- planning, processes, procurement, transport and future driven technological change The strength of response is better than a neutral response, for all variables that relate to collaboration, because many responses were in the "somewhat agree (2)" band.

On the other hand, collaboration items EL2,EL1 with institutional stakeholders (the state) were least agreed. Collaboration with the state relates to accurate and prior knowledge of investment timing of logistics infrastructure deployment as well as the adequacy of investment. These perceptions suggest that respondents seem willing to be takers of investment rather than active influencers of investment.

Industry character is one of the most agreed variables (EL5) which is influenced by a strong perception relating to the variety of industries rather than the scale (EL4) of industries locating in an area.

5.2 Exploratory factor analysis

Preliminary analysis has been conducted on 58 responses where data has been cleaned. The purpose of this analysis was to identify factors and data issues prior to analysis of the entire data set. The Kaiser-Meyer -Olkin (KMO) measures sampling adequacy and the closer a result to unity means the variables are well related to each other and able to be analysed using factor analysis. The strength of KMO inter-correlations was good based on the measure of 0.697 (Table 5) which exceeds the minimum suggested value of 0.600 Hair and Lukas (2014) ensuring the data can be analysed.

Table 5 KMO and Bartlett's Test (final run of factor analysis).

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.697

Factor analysis is used to; understand variables that cannot be directly measured called latent variables; reduce survey data and number of items to a smaller and more manageable set. Table 6 illustrates two requirements of validity ,that variables are associated strongly (load) on only one factor/component (Cortina, 1993), called unidimensionality and that all items load substantially (loadings above 0.5) on their underlying latent variables – demonstrate convergent validity (Tabachnick et al., 2007), (Campbell et al., 2015).

The data was then analysed guided by the Enablers in the conceptual framework (CF). Factor analysis adopted the principal component analysis (PCA) technique) and used mathematical techniques called rotation to iteratively fit data. Four iterations were required to produce the results in Table 6 where variables were unambiguously associated with one of three factors/components . A total of nineteen enabler variables initially analysed, were reduced to twelve, loading on the three factors/components. The three components explain 61% of the total variance in the data. Therefore, the enablers can be now represented by three factors. They are named; *Operational collaboration, VALS QOS, Industry character* because these headings best sum up the connotations of the variables which they represent. This practice is advocated by authorities in EFA (Byrne, 2005, Tabachnick et al., 2007)

Table 6 Isolation of factors for enablers

Rotated Component Matrix[a]

	Component		
	Operational collaboration (1)	VALS_QOS (2)	Industry character (3)
Targ_GInv_Log_ok (EL !)	.529		
Targ_GInv_Log_Tim (EL 2)	.730		
Colocn_F_coop_purch EL 7)	.735		
Colocn_F_coop_StakPr (EL 8)	.852		
Colocn_F_coop_StakStds (EL 9)	.890		
Colocn_F_coop_StakPln (EL10)	.695		
SCl_El_coop_Bhaul (EC 6)	.751		
VALS_L_SP_OD (EV 3)		.768	
VALS_L_SP_T (EV 4)		.675	
VALS_L_SP_need (EV 6)		.819	
Colocn_IndF_Ttl (EL 4)			.847
Colocn_IndF_Var (EL 5)			.813
Variance explained %	*32.935*	*15.329*	*13.123*
Cumulative variance explained %	*32.935*	*48.264*	*61.387*

Extraction Method: Principal Component Analysis". Rotation Method: Varimax with Kaiser Normalization.[a] ; [a] Rotation converged in 5 iterations.

Operational Collaboration (component1) is so named because it comprises two limbs, one of which requires strategic collaboration with institutional stakeholders. One form of collaboration is managing relationships with the state through lobbying for adequate investment in logistics infrastructure (EL1) as well as knowledge of the timing of this investment (EL2). The other limb comprises variables encompassing interfirm relationships. These are, collaboration on aggregate purchasing of commonly used logistics services (EL7), stakeholders cooperating to resolve common problems (EL8),

firms jointly developing industry practices and standards (EL9), collaboration with supply chain (SC) partners to establish planning and operational processes (EL10) and specific co-operation to share transport backhaul (empty running) opportunities (EC 6). All of these require strong business oriented relationships with other firms and collaboration outside the firm's boundaries. Such collaboration is based on the best use of resources in the relationship and is evidence of supply chain integration (SCI) in practical operation as well as an example of the *relational resource based view of* the firm (R)RBV (Prajogo et al. (2016). The mean scores of the extracted items for this factor is 2.89 suggesting firms answered in the "somewhat agree" band of responses closer to the neutral "neither agree nor disagree" response. Based on this metric firms were indifferent to collaboration !.

Industry character is named because it identifies both the scale and magnitude of industry in an area (EL 4) as well as the variety of industry (EL 5) in that location. The scale and variety of industry accords with concentration and diversity of industries arising from infrastructure availability and accessibility (Fujita and Thisse, 1996, Fujita and Thisse, 2013). The mean response was 2.11 suggesting a positive attitude towards working with the variety of industry in the cluster.

VALS QOS or Quality of service in VALS provision, identifies the importance of the ability to service any location which is ubiquity of offering (EV 3), ability to meet lead times always reflecting reliability and responsiveness (EV 4) and ability to cater to the needs of the firm when needed, signifying availability (EV 6), of the VALS offering at the firm's location. The quality of service (QOS) by which a VALS offering is judged requires that underlying variables supporting the QOS should combine with synergy complementing one another. Therefore, VALS availability everywhere, needs to be supplemented by the ability to respond in a timely manner to customer requests as well as the capability of meeting customer's needs both planned and unplanned. The average response was 2.08 again suggesting a positive disposition towards adoption of VALS activities.

Finally, the analysis must demonstrate scale reliability as illustrated by Table 7 where the Cronbach alpha statistic for items loading on the three factors/components is 0.814 an indication of very good internal consistency/ reliability as the expected outcome of this test is that the alpha coefficient should be >0.7 (Pallant 2013). In this research scale reliability is particularly important because the research covers hitherto unexplored areas and thus does not benefit from readily usable scales based on prior research.

Table 7 Reliability Statistics Enablers
Overall Alpha =0.814

VALS QOS alpha =0.642
Operational Collaboration alpha = 0.874
Industry character alpha =0.646

6 Conclusions

Factor analysis of the enablers has generated three constructs which have impact on LCB. These three constructs, Operational collaboration, VALS QOS and Industry character represent the twelve variables that identify enablers. Operational

collaboration encompasses collaboration that is both inter-business and business to state. VALS QOS comprises ,demonstrates traits required in business of service provision- ubiquity, responsiveness and availability of the service provision. Both these factors are relationship and customer focused requiring partnership with other members of the supply-chain, adherence to superordinate rather than individual goals as well as a win-win culture.

Industry character reflects what firms look for when deciding to locate in an area and is a precondition for the effective operation of other factors. Industry character suggests potential incumbents most value variety and next perceive concentration of industry as important. This is because the presence of many and varied industry groups enables business relationships with existing firms to be deepened and new firms to be established.

The academic significance of this research is that it is one of the first studies that has empirically validated the enablers of LCB. filling a gap in the research that has existed since from Rivera, Gligor and Sheffi (2016) demonstrated this gap. Targeted logistics infrastructure investment is a new enabler, warranting future academic research in regional and urban development. The next steps are to combine these results using the full model hypothesised in Hallock et al. (2018) which includes the constructs for logistics cluster benefits (LCB) and Firm's logistics performance (FLP) further consolidating the academic importance of this research

This research is also of practical value because it provides ex-ante information to governments and firms who may wish to make decisions on infrastructure investment to promote cluster formation, wealth creation, growing logistics activities with flow on benefit to firms in the region.

A limitation of this research is that it would have been useful to have a representation of manufacturing industry from across the nation. The immediate follow up of this study is to validate exploratory factors generated over all 300 responses Future work could be undertaken to extend this approach outside Australia, using the conclusions of this study as a comparator.

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