

What factors impact logistics cluster benefits for firms?

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Abstract

The aim of this paper is, to develop a literature based conceptual framework to support subsequent research. A literature search has explored the relationship between logistics cluster benefits (LCB) and proximity, supply chain integration (SCI), provision of value added logistics services (VALS) and logistics investment (LI), on firms in a cluster. These factors have been identified as enablers of logistics cluster benefits. LCB in turn generate efficiencies in the firm's logistics performance.

However the literature does not identify how enablers of LCB can be quantified nor have the impact of LCB on a firm's logistics performance been understood. Therefore this research addresses problems identified in the literature and generates a research question of, "*what form of benefits influence a firm's decision to locate in a logistics cluster?*" Sub questions:

How do SCI strategies influence LCB?

How does proximity influence LCB?

How do value added logistics services (VALS) influence LCB?"

How does logistics infrastructure investment influence LCB?

The conceptual framework will enable evaluation whether LCB are influenced by; SCI, proximity and VALS logistics infrastructure investment and that LCB can be empirically validated.

Keywords

Logistics clusters, firm's logistic performance, VALS, SCI, proximity, infrastructure

1 Introduction

1.1 Background

Logistics is important to the economy being estimated in 2013 to contribute value added of \$132 Billion, comprise 9% of GDP and employ 1.2 M, Australian Logistics Council (2014). These figures understate the total contribution because of definitional issues, Norman et al. (2013) in how ABS compiles data. If operational efficiencies in a firm's logistics performance (FLP) result from logistics cluster benefit (LCB) changes then there is a flow on productivity impact on gross value added and GDP which creates a causal input-output link justifying resourcing of logistics infrastructure (road, rail, location of distribution centres etc.). In this context this research is important because both location and operational factors are being used to explain possible differences in benefits for firms in clusters. There are several types of clusters needing to be differentiated. They are industrial clusters, logistics clusters, spatial logistics clusters Chhetri, Butcher and Corbitt (2014) and special examples of logistics clusters namely, Port Centric Logistics (PCL), Mangan, Lalwani and Fynes (2008) and export processing zones Lu, Liao and Yang (2008).

The concept of an industrial cluster was defined by (Porter 1998, 2000) who extends it downstream to channels of distribution and customers, laterally to manufacturers of complementary products, institutions such as those performing research and the government and specialized entities. His example of the Californian wine cluster includes links into tourism, food and the Californian agricultural cluster, showing the lateral nature of cluster relationships. He also notes citing the example of the medical services in Massachusetts that clusters can be "hidden" for years and not obvious to anyone. Porter's definition is the widest possible available (Vom Hofe & Chen 2006, p. 9) and is preferred for this reason over two others.

Logistics clusters (LC) are similar to industrial clusters which are "*groups of inter-related firms that co-operate and compete to create wealth within a certain geographical area*" Porter (2000, pp. 15-42). Logistics clusters may include industrial firms who have a significant part of their operations comprising logistics activities (Sheffi 2010, 2013). A simple definition for logistics clusters (LC) by Sheffi (2010, pp. 11-7), was "*include companies offering logistics services, such as transportation, warehousing, distribution*". This simple definition, was expanded to a more detailed one Sheffi (2010, p. 468) to include **all** firms with "*logistics-intensive operations*", identifying three types of companies (and activity mixes) who would thus comprise a logistics cluster.

- 1) "*Logistics services providers such as transportation carriers, warehousing, specialized consulting and IT providers, 3PL's, forwarders and customs brokers.*
- 2) "*Companies with logistics intensive operations.*
- 3) "*The logistics operations of industrial firms such as distributors for retailers, after-market parts suppliers.*"

LCB comprise internal value added created in the logistics performance of a firm reliant on the cluster as well as macroeconomic benefits. LCB from the firm's point of view are, improvements to a firm's logistics performance, better access to markets and labour and opportunities to collaborate (Porter 1998; Rivera, Gligor & Sheffi 2016). Prerequisites for the realisation of LCB are logistics investment targeted at specific locations, the ability of firms in these locations to provide VALS and their ability to achieve SCI. Macroeconomic benefits of LCB arise from the value added

induced by the activities of all firms and related industries in the region (Graham, Daniel J. 2007b) proximate to the cluster.

1.2 Aims/objectives

The aim of this paper is to develop a literature based conceptual framework for an ongoing research project. Key themes in the literature will be operationalized in the next stages of research. To do this the paper explores what logistics cluster benefits are and how they can be used by incumbents, potential entrants, to guide a firm's decision to locate in a cluster. Such a decision requires knowledge of and ability to identify efficiencies and benefits of, proximity, supply chain integration, and the availability of value added logistics services.

1.3 Research questions

The research question explored is "*what forms of benefits impact a firm's decision to locate in a logistics cluster? And sub questions of:*

1. *How do SCI strategies influence logistics cluster benefits (LCB)?*
2. *How does cluster location influence logistics cluster benefits (LCB)?*
3. *How does Value added logistics services (VALS) influence logistics cluster benefits (LCB)?*
4. *How does logistics infrastructure investment influence LCB?*

1.4 Significance

This research validates knowledge of the enablers of logistics cluster benefits, Sheffi (2010, pp. 11-7) like collaboration, value added services, postponement, reverse logistics and labour market as well as their impact on the firm's logistics performance.

Since firms are rational entities using their resources to maximize their logistics and strategic investments Lynch, Keller and Ozment (2000), participation in a cluster using this knowledge creates value added for the firm. Efficiencies enjoyed by firms enable them to leverage their participation in an industry that contributes value added of \$132 Billion, comprises 9% of GDP and employs 1.2 M, Australian Logistics Council (2014).

1.5 Structure of the paper

Section 2 discusses clusters, logistics clusters and logistics cluster benefits (LCB). This leads on to the precedents or enablers of LCB and thereafter the outcomes of LCB from the point of view of the firm's logistic performance (FLP). Section 3 reviews theories relevant to the enablers of LCB, the influence of LCB on FLP. This provides the basis of hypotheses which can be tested within a conceptual framework (CF) model depicting the relationships between constructs. Section 4 outlines the next steps and Section 5 summarises the expected contribution of this research.

2 Literature review

This section will focus on exploring the literature on:

- Clusters
- The nature of logistics cluster benefits(LCB)
- The role of SCI processes enabling logistics cluster benefits,
- The relevance of proximity to LCB
- The influence of VALS on LCB
- The firm's logistics performance
- The relevance of AE and WEBS to a discussion on cluster benefits.

Definitions and cluster perspectives are examined first. Thereafter enablers of LCB like SCI, VALS, logistics investment and proximity as well as benefits to the logistics performance of the firm are discussed.

2.1 Clusters

Summary of theory

The views on clusters have evolved over time and an attempt is made to discuss the most prevalent contributions with a view to understanding how cluster theory impacts logistics clusters. Table 1 below summarises the seminal authors and schools of thought in cluster theory.

The Classical School is the starting point of cluster theory. The triad of localisation advantages(Marshall 1890), a pooled market for specialised labour, availability of specialised inputs and technological spillovers has been built on to include economies of scale and scope within a firm, development of varied labour markets and pools of specialised skills, enhanced interaction between suppliers and customers, reduced transport costs and shared infrastructure. Glaesser et.al (1992) Arrow (1962) and Romer (1986) are associated with Dynamic Externalities view and the Marshall –Arrow-Romer (MAR) model. They argued that dynamic information externalities evolve over time, improving productivity, skills, innovation and thereby economic growth, hence local monopoly is conducive to growth because it allows a firm to internalize technological or knowledge advantages. Their view is contrasted with the work of Porter (1990) who argues that competition via interfirm rivalry is better at enhancing economic growth. In all other aspects (Porter 1998, 2000) there is agreement with essence of what Porter claims and the classical school.

The New Economic Geography (NEG) School agreeing with the classical school introduces a transport perspective. Transport shapes agglomeration and is an enabler of AE and growth Banister and Berechman (2003, pp. 9-19). Accessibility (Fujita et al. 1999; Fujita & Thisse 1996; Krugman, Paul 1990) and cost (Spulber 2007)also qualify the importance of Marshallian AE.

Classical theories have given rise to linkages and interdependencies between firms in a cluster which is central to Growth Pole Theories (Perroux 1950, Parr 1999). The focus on propulsive industries in a limited number of locations in an attempt to boost economic activity Cella (1984) is similar to what (Porter 1998, 2000)advocates but is akin to “picking winners”.

Flexible specialization, regional specialization and knowledge spillovers explain the success of small clusters which rely on untraded dependencies (Storper 1995 and Newlands 2003). Untraded interdependencies are considered region-specific assets, like proximity and networking which foster collaboration.

2.2 Logistics clusters

Clusters have been identified and discussed by (Porter 1998, 2000) who identified the lateral nature of cluster relationships in the Californian wine cluster and that clusters can be “hidden” for years and not obvious to anyone e.g. medical services in Massachusetts.

A theme of clustering around logistics hubs is explored by (Notteboom* & Rodrigue 2005) who discuss the importance of land transport and government incentives in the context of port regionalisation, a role for inland terminals for cargo consolidation and deconsolidation and suppliers of value added logistics service. They also cite the examples of logistics parks and free trade zone facilities near ports benefitting reduced cargo on roads and bulk cargoes with volumes suited to rail and barge transport. These logistics parks also provide flexible storage, (postponement) and provision of value added logistics services.

The example of Alliance Texas is cited by (Rivera, Sheffi & Welsch 2014; Sheffi 2013) of a privately developed logistics hub. It incorporates the Dallas /Fort Worth airport and dedicated roads linking nodes. The road system created user efficiencies that that overcame the axle limits of the US public highway system (Bolumole, Closs & Rodammer 2015). The benefit of logistics and transportation infrastructure investment to sustain economic growth at the regional level is also noted by (Bolumole, Closs & Rodammer 2015; Graham, Daniel J 2007; Graham, Daniel J. 2007b).

Research (Bolumole, Closs & Rodammer 2015; Zhou, Wang & Sun 2014) around the concept of hubs and clusters did not specifically mention the concept ‘logistics cluster’ until it emerged in the work of (Chhetri, Butcher & Corbitt 2014; Rivera, Gligor & Sheffi 2016; Rivera, Sheffi & Welsch 2014). In the article (Rivera, Gligor & Sheffi 2016, p. 242) note “ *although there is a notable industrial clusters literature, the research on logistics clusters is still in its infancy*”. A critical point is that what constitutes the scale of the cluster. Antwerp/Rotterdam/Duisburg covers Belgium, Holland and Germany (inland rail junction). Singapore is a nation state but with a maritime cluster and airport based cluster, these and other examples are elaborated on by (Sheffi 2013).

Two special cases of logistics clusters are that of spatial logistics clusters (SLC) and free trade zones (FTZ). Spatial logistics clusters (SLC) is a term coined by Chhetri, Butcher and Corbitt (2014, p. 231) which can be defined as “*an area of high concentration of aggregate logistics industries or employment surrounded by other areas of high concentration*”. SLC’s warrants further consideration in this research because Chhetri, Butcher and Corbitt (2014, pp. 228-30) have analysed the composition of industry enabling SLC to be used as the base of a ‘logistics cluster’.

In the absence of FTZ’s and changes to manufacturing industry in Australia free trade zones (FTZ) will not be discussed further. Neither will port – centric logistics (PCL) a special form of logistics cluster Mangan, Lalwani and Fynes (2008) obtained from the trade literature (Falkner 2006; Wall, 2007; Analytiqua 2007).

A discussion on logistics cluster benefits follows.

2.3 Logistics cluster benefits

Logistics clustering results in four specific benefits for firms; those deriving from collaboration opportunities and value added services, opportunities for upward mobility, job growth at multiple levels and regional growth. (Rivera, Gligor & Sheffi 2016, pp. 252-5). The authors note,

*“...logistics clustering provides specific benefits to companies. These benefits **derive** mostly from **opportunities** for collaboration and offering value added services. Logistics clusters also offer upward career mobility for employees”.*

(Sheffi 2013, pp. 44-7) notes that collaboration is a phenomenon also observed in industrial clusters Grandori and Soda (1995). The growth of jobs and upward mobility are predicted in cluster theory by several scholars refer Table 1.

What is noteworthy is that a logistics cluster has an positive feedback element of growth which is a benefit *“reciprocal reinforcing feedback mechanism makes it more attractive as it grows”* (Sheffi 2013, p. 481). Krugman, Paul (1990) expressed this as “manufactures production will tend to concentrate where there is a large market, but the market is large where manufactures production is concentrated”.

Therefore in the context of a cluster that is growing collaboration takes many forms. Horizontal collaboration is facilitated by the presence of a logistics provider, to coordinate use of ship/aircraft, warehousing capacity, and demand based expansion and contraction of capacity and availability of specialized workers. So, it can be seen that logistics management activities are part of the realisation of LC benefits, an observation by (Sheffi 2013).

Job diversification to sub-clusters and value added services which attract other service providers, suppliers was noted by (Porter 1998, 2000). (Sheffi 2013) gives the example moving to value added services, of YCH global logistics which evolved from a simple passenger transport company to a regional 4PL and developing specialised supply chain software which it now sells via a subsidiary Y3, similar to UPS which offers dedicated supply chain solutions to customers.

2.4 Cluster benefits

Table 1. Benefits of Clusters

Benefit or advantage	(Marshall 1890)	(Ohlin 1933) (Hoover 1937, 1948)	(Weber 1929)	NEG (De Palma et al. 2011; Krugman, P 1998; Spulber 2007)	(Fujita et al. 1999; Krugman, Paul 1990)	(Storper 1995, Newlands 2003)	(Porter 1998, 2000)	MAR (Glaeser 1992, Marshall 1890)	Logistics clusters (Rivera, Gligor & Sheffi 2016; Sheffi 2012a)	Growth pole (Perroux 1950, Parr 1999) Cella (1984)
Impacting labour										
1) Pooled market for specialised labour	X			X			X		X	
2) Availability of non-labor specialised inputs	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 spillovers							X	X		
Technological spillovers	X						X	X		
Mobility							X		X	
Spatial										
Transport cost and 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						
Economies of scale and scope within a firm		X		X						
Macroeconomic										
Localised competition							X			
Local monopoly								X		
Economic growth					X		X	X	X	X

2.5 Enablers/ influencers/precedents of LCB

Enablers facilitating LCB are VALS and its components, SCI, proximity and logistics infrastructure investment which are discussed next. In the ensuing discussion an attempt will be made to link the enablers to the logistics performance of firms as well as how the concepts could be measured.

2.5.1 Proximity of location

The benefit of spatial proximity (nearness) is fundamental to classical cluster theory and the NEG, being one of the agglomeration economies (AE) identified (Fujita & Krugman 2004; Graham, Daniel J 2007; Marshall 1890).

Proximity is important because it gives rise to co-location of firms which has been identified by Chhetri, Butcher and Corbitt (2014, p. 225) citing Hofe and Chen (2006), as enabling efficiency gains from AE. Chhetri et al (op.cit) also suggest that part of this gain is from 1) co-location savings from proximity effects by clustering to avoid “forward and backward transactions” and reduced transport costs as benefits internal from being within a cluster and, 2) the diversity of products exchanged within the cluster.

To the firm proximity is synonymous with co-location and together with collaboration generates efficiencies which Rivera, Gligor and Sheffi (2016, pp. 256, table 4), identified. These efficiencies are transport related but facilitated by collaboration, e.g. LCL consolidation, co-loading, back-haul utilisation, optimal capacity haulage, value added activities such as consolidation, cross docking, packaging, labelling, and assembly, which rely on proximity to make this cost effective. A detailed discussion on the importance of transport to agglomeration citing seminal theoretical contributions follows later in this discussion.

Proximity is the reason for firms choosing to locate together which makes it an enabler of LCB.

2.5.2 Value added logistics services (VALS)

The benefit of value added services to logistics clusters are identified by (Rivera, Gligor & Sheffi 2016, p. 252) as a “*logistics clustering provides specific benefits....derive mostly from opportunities ...for offering value added services*”. In other words if there was an opportunity for offering value added services then the benefits of clustering can be reaped. Their importance stems from their being a precedent or enabler of logistics cluster benefits supported in the literature.

Value added services in logistics management relies on a strategy of combining service components. The combination of individual services is a process called servitisation following Vandermerwe and Rada (1988), in which firms consciously develop service offerings that support their products to gain differential competitive advantage. When this concept is applied in a logistics context, e.g. the product is in a distribution center as opposed to a company warehouse, provision of a range of supply chain activities which meet customer needs, in a timely manner may occur. Specific services such as this are value added logistics services (VALS). An example of the success of value added services noted by Rivera, Gligor and Sheffi (2016, p. 262) is having the opportunity to “*postpone certain activitiesopportunity to provide reverse logistics activities*”. Others Christopher and Towill (2002); (Gligor, Holcomb & Stank 2013; Hazen, Cegielski & Hanna 2011; Li, Goldsby & Holsapple 2009; Lu, Liao & Yang 2008; M. Gligor & Holcomb 2014) have identified activities which lend themselves to servitisation with the consequent flow-on advantage to firms in a LC. So VALS through servitisation meets customer needs of availability, quality of offering and extent of offering.

The component activities of VALS are discussed next.

2.5.2.1 Agility/ Postponement/ information management

Postponement, agility and reverse logistics are examples of value added services in a cluster (Christopher 2000; Christopher & Towill 2002) facilitated by proximity as well as buyer/manufacturer/supplier integration. Rivera, Gligor and Sheffi (2016) identified postponement, consolidation of all operations beyond production as activities that facilitated agility, which is the meeting customer needs of availability.

Supply chain agility (SCA) is defined by Li et al. (2008, p. 422) as, a “*supply chain’s alertness to changes (opportunities/challenges) – both internal and environmental – with the supply chain’s capability to use resources in responding (proactively/reactively) to such changes, all in a timely and flexible manner*”. Volatility, uncertainty and variable demand conditions characterising a rapidly changing business environment requires quick and timely response which agility provides. Agility is enhanced by the proximity of firms and availability of a mobile skilled work force, both of which are present in clusters. Agility thus contributes to LCB by promoting collaboration among firms in the cluster. Agility is extensively discussed by (Gligor, Holcomb & Stank 2013; Wilding et al. 2012) with Christopher (2000) including additional enablers; market sensitivity, (capture and transmit point of sale data), create virtual supply chains based on information rather than inventory, process integration via collaboration between buyers and sellers and networks.

However the literature does not explicitly identify a need for a 4PL as an enabler of services like tagging, picking, merchandise preparation for retail point of sale display or quick response capability as a success of value added offerings.

2.5.2.2 Reverse logistics and the green supply chain

Rivera, Gligor and Sheffi (2016) found in a survey that the opportunity to provide reverse logistics activities supported the provision of value added services which was identified as an advantage. They also cite how a manufacturer collaborated with FedEx providing 36 hour turnaround on repairs, and a 4PL who invested in Panama to enable cost effective refurbishment and repair for its US client. Selling the services to other manufacturers enables economies of scale for the 4PL.

Hazen, Cegielski and Hanna (2011) examined the adoption and impact on competitive advantage of green supply chain management practices (GSCM) in particular, green reverse logistics (GRL) commenting (p 375 op cit) 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 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 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.

Supply chain integration (SCI) as an enabler of LCB is discussed next.

2.5.3 Supply chain integration (SCI) strategies and processes

An early definition of SCM, Stock and Lambert (2001) captured the key concept of integration of business processes along the supply chain, namely the management of; customer relationships, customer service, demand, order fulfillment, manufacturing flow management, procurement, returns, information management, product development and commercialization. Subsequently Burt, Dobler and Starling (2003) included environment management. SCM's focus as an integrating process is on creating value added. (Flynn, BB, Huo, B & Zhao, X 2010, p. 58) notes many attempts to define Supply Chain integration (SCI) arguing that research has been "*characterized by evolving definitions and dimensions*". The authors extend a Webster dictionary definition of 'integration' to the SCM context and derive a definition of SCI being "*the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra and inter organization **processes***"(op.cit p.59).

(Yuen, KF & Thai, VV 2017) cite (Chen, Daugherty & Roath 2009) defining SCI as "*the management of various sets of **activities** that aims at seamlessly linking relevant **business processes** within and across firm, and eliminating duplicate or unnecessary parts of the **process** for the purpose of building a better functioning supply chain*". On another occasion (Yuen, KF & Thai, V 2017) cite (Cao et al. 2010) defining SCI as "*a set of practices or a partnership process where firms execute and plan their supply chain operations towards achieving mutual benefits and goals*". The latter definition of Yuen and Thai(op.cit.) corresponds broadly to that of (Flynn, BB, Huo, B & Zhao, X 2010), emphasizing partnership and process with Flynn including the customer(op.cit p. 59). The distinction between process and activity will be discussed later as it is of relevance to the measurement of SCI.

(Yuen, KF & Thai, VV 2017, p. 446) note the academic consensus on recurring themes on what is critical in a definition viz. connectivity and simplification. Connectivity focusses on the linking of external and internal operations, between firms in respect of inputs and between operational units intra organization. Simplification entails the elimination of superfluous processes and activities that do not add value(Chen, Daugherty & Roath 2009).

In order to achieve connectivity and simplification Yuen and Thai (op.cit) identify the importance of integration at levels of information, operations and relationships. Information integration comprises, systems collaboration, EDI, warehouse management and automatic replenishment systems, demand forecasting. Operational integration is intra –firm process simplification through joint activities and work processes e.g. vendor managed inventories, integrated production planning. Process integration helps connectivity and simplification and requires a commitment to long term relationships. Finally according to (Yuen, KF & Thai, VV 2017) there needs to be a strong commitment to integrate processes evidenced by a commitment to long-term relationships. In the manufacturing context, (Kim 2009) cites several scholars who argue that the lack of effective internal and external integration underpin, cost, and quality and delivery problems. In the logistics and SC context (Yang, Yeo & Vinh 2015) showed intra(top management support, internal integration IT capability and extra organisational(sharing, commitment, long term relationships) capabilities positively influenced extra organisational integration as well as extra-organisational integration positively impacting SC logistic integration.

Collaboration it can be seen from the above underpins internal integration (II) focusing on intra-firm collaboration and external integration (EI) which refers to partnering with SC members,

concentrating on collaborating to achieve synchronized and manageable processes that are customer-focused (Yuen, KF & Thai, VV 2017).

SCI as evidenced by EI and II are important to this research because they are enablers of LCB, VALS and FLP.

EI and II are process components of SCI which enables the delivery of VALS such as postponement, agility and reverse logistics partnering with a 4PL to strategically perform the EI. 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, Gligor & Sheffi 2016) in respect of FEDEX and the 4PL who invested in Panama as well as the instances in respect of green reverse logistics (Hazen, Cegielski & Hanna 2011) are evidence on how SCI enables VALS. So in this example LCB are generated by SCI indirectly via VALS.

LCB may be enabled by future opportunities to partner with an incumbent horizontally and vertically. A firm offering such partnering opportunities could be a magnet to other firms who would use its services and is consistent with cluster theory predicting collaboration (Porter 1998; Rivera, Gligor & Sheffi 2016). LCB may also be directly enabled because SCI could result in benefits of diversification, driven by the desire to mitigate risk. e.g. Shipping lines diversified into acquiring 3PL/4PL and some into owning terminals and land transport all requiring a base which could be located in a logistics cluster. (Notteboom & Winkelmann 2001; Notteboom* & Rodrigue 2005). In such circumstances SCI gives rise to a LCB of lower logistics transport costs and in some cases customer retention. This could arise by shared assets in a cluster as well as through interdependence of firms.

2.6 Logistics infrastructure investment -why important

Logistics investment (LI) is an enabler of cluster formation and can be focused on locations whereby the proximity of firms and concentration is most likely to succeed. LI contributes to logistics cluster benefits by providing the infrastructure support to the cluster location enabling efficient provision of VALS. Logistics infrastructure comprises the inter-capital road and rail networks and last mile urban networks; nodes for interchange like seaports and air ports and inland “dry ports” and dedicated infrastructure which has evolved by design or organically where industry locates. The location and concentration of industry into clusters is associated with the concept of agglomeration which gives rise to agglomeration economies (AE) discussed in previously by various cluster theorists. The theory relating to these concepts is discussed in section 3 along with other theories. The foregoing literature shows the importance of infrastructure investment for freight.

An economic history approach of the economy wide benefits of investment in rail for the carriage of commodities was taken by (Lakshmanan 2007) the 19th century from England and Wales as well as early 20th century in USA, Russia, France, Germany, Spain Belgium, Mexico, Argentina, India, Brazil. Elsewhere (Lakshmanan & Anderson 2002) note a consequence of increased logistics investment is the benefit of lower costs and increased accessibility to labour, customers, new markets and mutually sustaining growth.

In the context of China (Hong 2007) accessibility to transport infrastructure was a key determinant of logistics firms' location with accessibility enabled by state incentives for Free Trade Areas (FTA) infrastructure provision. Government incentives were also important (Notteboom* & Rodrigue 2005) for land transport in the context of European port regionalisation where the provision of infrastructure required operating subsidies e.g. the case of an Albany Express Barge operation. Cross subsidy of logistics parks and free trade zone facilities near ports appears justified by the benefit of reduced cargo on roads and diversion of bulk cargoes with volumes suited to rail and barge transport. A privately developed investment e.g. the logistics hub of Alliance Texas is cited by (Rivera, Sheffi & Welsch 2014; Sheffi 2013). It incorporates the Dallas /Fort Worth airport and dedicated roads linking nodes, that overcame the axle limits of the US public highway system (Bolumole, Closs & Rodammer 2015). The benefit of logistics and transportation infrastructure investment to sustain economic growth at the regional level is also noted by (Bolumole, Closs & Rodammer 2015; Graham, Daniel J 2007; Graham, Daniel J. 2007b).

In a study of Portuguese municipalities (Melo, P, Graham & Noland 2010) the role of transport infrastructure as a determinant of new plant openings was investigated. The authors found that a 10% increase in motorway density could increase the number of new plant openings by between 2.7% to 5.1% and in comparison the impact of rail density being increased by 10% had an impact on new plant openings by 0.9% and 2.7%. (Farhadi 2015) analysed 18 OECD economies going back 140 years and concluded that a 10% increase in the share of transport investment was likely to increase labour productivity by 0.14 percentage points. The transport infrastructure effect on Belgium with reference to its networked logistics infrastructure of Antwerp, Charleroi, Ostend, Zeebrugge, Liege and Ghent was analysed by (Meersman & Nazemzadeh 2017). Therefore policy interventions impacting locational decisions by influencing the resourcing of transport infrastructure in localities can become a tool for development.

For economically efficient resourcing decisions appropriate decision criteria are needed. The discussion on WEBS section 3.2 below, suggests how this may be approached for logistics investment.

2.7 Firm's logistics performance (FLP)

Benefits of a logistics cluster extend both to the wider economy as well as to individual firms in the cluster (Porter 1998, 2000; Rivera, Gligor & Sheffi 2016). This discussion focusses on the logistics performance of individual firms who enjoy cluster benefits created by SCI, VALS, proximity and SCI discussed earlier. The discussions on enablers have identified efficiency and customer focus as being important factors in FLP

(Estampe et al. 2013) analysed several performance evaluation models which considered the decision level, types of flows, level of supply chain (SC) maturity, benchmarking, contextual and quality factors. The measures chosen for possible use (Table 2) are based on the AFNOR, Supply chain operations reference (SCOR) or EFQM models with a preference for SCOR and EFQM. Balanced score card (BSC) though popular is not tailored for logistics.

Several shortcomings of the SCOR and BSC approach have been noted with Dweekat (op.cit) citing: ((Arzu Akyuz & Erman Erkan 2010; Estampe et al. 2013; Gunasekaran, Angappa & Kobu 2007; Gunasekaran, A., Patel & McGaughey 2004) who identified the following:

- lack of a; clear connection with strategy and a clear distinction between metrics at the strategic, tactical, and operational levels, balanced approach to integrating financial and non-financial metrics;
- focus on local optimization and, thus, the absence of a comprehensive SC context;
- incompleteness, inconsistencies, and absence of relational structures and metrics;
- a large number of metrics, which make it difficult to distinguish the critical from the trivial
- too inward-looking and, consequently, focusing insufficiently on external parts (customers, suppliers, and competitors); and
- too static, short term, and profit oriented.

Table 2 categorises variables based on the literature which may be used to measure FLP.

Table 2. Constituent measures of FLP

Measure	Authority
Efficiency	
Service effectiveness shippers and consignees Delivery: speed, flexibility, dependability, lead times, problem solving, documentation	(Kenneth W. Green 2008)Vinh ;(Flynn, BB, Huo, BF & Zhao, XD 2010; Lai, Ngai & Cheng 2002)
II evidence	
Cost reductions –order management, facilities, warehousing, transport, logistics admin, Asset utilisation improved, cash to cycle time, working capital	Vinh,(Lai, Ngai & Cheng 2002) (Kim 2009)
Quality	Vinh
Flexibility- customisability of offering, time to market	Vinh,(Flynn, BB, Huo, BF & Zhao, XD 2010)
EI collaboration, quality availability and extent of offerings	
Market factors	(Kim 2009)
Sales growth	
Financial growth	
Agility	(Christopher, Harrison & van Hoek 2016) (Chen, Daugherty & Roath 2009; Stank 2000)
Customer service	(Flynn, BB, Huo, BF & Zhao, XD 2010)

In the discussion on LCB driven by VALS, SCI and proximity, efficiency in FLP is impacted by reduced logistics and transport costs brought about by proximity and the use of a 3PL/4PL. SCI when used as a “*strategic lever for performance improvement*” (Kim 2009, p. 329) results in additional benefits :

- External integration (EI): creating customer benefits because of better collaborative processes resulting in positive customer experience e.g. meet end-user needs of availability, quality and extent of offerings.
- Agility which contributes to efficiencies in the firm’s logistics performance on cost and depth of customer experience. (Chen, Daugherty & Roath 2009; Stank 2000)
- Internal integration (II) which eliminates duplication, non-value-adding tasks

(Flynn, BB, Huo, BF & Zhao, XD 2010) notes that although Saeed 2005 found a positive relationship between II and operational performance and efficiency, (Gimenez 2005; Koufteros, Vonderembse & Jayaram 2005) came to the opposite conclusion However when (Yuen, KF & Thai, VV 2017) compared service and product chains they found that it was not possible to

generalize the claim that service firms should experience greater operational benefits from II of their supply chains. Their findings suggested that II was associated with greater operation fit in the case of product rather than service SC. This finding is relevant since if manufacturing industry is transitioning overseas (as in many developed economies) and is being replaced by distribution or service industry (Chhetri, Butcher & Corbitt 2014; Mangan, Lalwani & Fynes 2008; Sheffi 2012a) then the impact on FLP may not accord with the literature which presumes a manufacturing base.

A firm's logistics performance may also be impacted by choice of techniques of green supply chain management (GSCM) and use of green reverse logistics which enables the logistics performance of the firm to meet objectives of corporate social responsibility of firms in the cluster whilst contributing to the individual firm's environmental credentials.

SCM has focus both on environment management Burt, Dobler and Starling (2003) and the need to manage customer relationships which relates to the quality of the offering. These are not conflicting goals as (Rao 2003; Sarkis 2006) note that environmentally responsible companies gain competitive advantage by cost savings arising from reduced waste and collaborate with global partners who similarly value environmental awareness. The ability to successfully manage impact on the environment was a benefit, Huscroft et al. (2013, p. 319) identifying an attitude that customers do not wish to negatively impact the environment "*compliance withregulations and updating policiesis one our largest activities*". Consequently the authors suggest that green supply chain activities could be an area of emerging importance.

Accordingly GSCM and GRL could be measures of FLP.

3 Discussion of theory RBV, Cluster

Discussion on theory below includes; economic theory supporting why proximity is important and the relevance of transport to location; the resource based view and dynamic capability theory relevant to how LCB links with FLP and enablers link with LCB.

3.1 Economic cluster theory

Exponents of the classical view of clusters enhanced by the NEG theorists (De Palma et al. 2011; Fujita & Krugman 2004; Fujita & Thisse 2013) and (Porter 1998, 2000) provide the economic legitimacy of the role of proximity, labour related benefits, collaboration, and economic growth and transport costs in the analysis (Table 1).

Classical theory explains why Agglomeration economies (AE) arise and what they are. The benefits of proximity, e.g. localization economies that occur when similar plants from the same industry cluster in spatial proximity. These give rise to economies of scale and scope and increasing returns and explain regional economic growth. A link between AE and logistics clusters is made by (Sheffi 2012a, 2012b) who argues that logistics clusters create agglomeration economies and benefits external to the firm from regional economic growth.

Transport shapes agglomeration and is an enabler of AE. Banister and Berechman (2003, pp. 9-19) trace the relationship of transport to development giving historical examples; e.g. (Thünen 1826) and (Krugman, Paul 1991).

Since production is rarely only for local consumption it is not possible to minimise or eliminate transport expense. If economic activities are not perfectly divisible, then, because of the need for increasing returns to scale, some transport is unavoidable (Koopmans 1957, Krugman 1995). Transport is important when accessibility to “spatially dispersed markets” is considered. Accessibility influences location of firms and consumers (Fujita & Thisse 1996, 2013) and gives rise to costs for which Spulber (2007, pp. 17-24), uses the mnemonic of “4T’s”.

- *Transaction costs*, the drivers of which arise from doing business at a distance—differences in business practices and customs, political and legal climates;
- *Tariff and non-tariff costs* like, pollution standards, anti-dumping rules and regulations restricting trade and investment;
- *Transport costs*, caused by the final place of consumption being at a distance from where goods are produced;
- *Time costs*— which arise from communication impediments arising from widely dispersed manufacturing and distribution facilities and the need to cater to specific market needs by customisation.

Therefore the benefit of agglomeration and its economic impact is determined by the level of transport costs La Fourcade and Thisse (LFT) in De Palma et al. (2011) also citing (Fujita et al. 1999; Krugman, Paul 1990). All these scholars argued that high transport costs lead to less inter regional shipments (as opposed to local), greater dispersion and localised production and conversely low transport costs lead to a concentration of manufacturers at the core and agricultural production at the periphery (the core-periphery model was developed by Krugman, Paul (1991)). LFT in De Palma et al. (2011) have the following arguments regarding the importance of transport ;

- Falling transport costs foster the agglomeration of mobile production factor in a small number of regions
- When obstacles to trade are sufficiently low that spatial inequalities may vanish.
- Lower transport costs make firms more sensitive to minor differences between regions”.
- Transport policies impact the cost of goods sold because they can affect where firms and workers locate, interregional distribution etc.

The foregoing enables understanding of why proximity is an enabler of LCB. It also explains why lower and falling transport costs can be expected when LCB impact FLP.

3.2 Wider economic benefits of transport

This section posits that scholars have made a sound case to include AE in examining targeted logistics infrastructure investment.

The impacts of agglomeration are called wider economic impacts or wider economic benefits, with wider economic benefits (WEBs) used here. The presence of WEBs is a reason for resourcing infrastructure investments in clusters as the enable assessment of an investment’s economic viability. Banister and Berechman (2003) have argued for the inclusion of WEBs which comprise agglomeration economies, labour market imperfections, network economies and environmental effects which are external benefits of regional effects of growth. Hensher, Ellison and Mulley (2014, p. 463), when analysing the Melbourne to Sydney high speed rail observe WEBs solutions as, “*growing interest in establishing additional evidence, under the umbrella of the wider economy impacts of transport infrastructure projects, to support transport projects in general and public transport projects in particular that struggle to obtain benefit–cost ratios sufficient to gain the support of financial agencies*”.

To implement WEBs requires supplementing current decision frameworks advocating cost benefit analysis (CBA) used by policy makers (DTF 2013; Gateway 2015) and which exclude WEBs, to now **include** WEBs. Scholars have extensively debated the use of WEBs both in isolation and conjunction with CBA as a policy tool in the context of passenger transport, key views of which are summarised below.

Lakshmanan (2007) acknowledges a need to supplement CBA but notes both agreement and “sharp disagreements” in the literature providing so offering a valuable critical perspective. He cites examples from 8 countries (developed and developing) over 30 years which do support the thesis that “transport infrastructure contributes to growth and productivity”. The disagreements according to Lakshmanan (op.cit) arise when conflicting results are noted; within a country and between countries showing a lack of transparency in the causal chain linking transport infrastructure investments with output and productivity. Lakshmanan’s analysis of the literature rather than empirical results could be argued to be a shortcoming.

An opposite conclusion is arrived at in Graham, Daniel J (2007), wherein econometric analysis showed a relationship between economic activity, accessibility and productivity for investment in passenger transport.

Agglomeration economies were demonstrated to exist in a cross sector analysis of a magnitude between 10-20%. Graham’s (op.cit) derived agglomeration elasticities, were used by the UK Department of Transport to note an increase of 25% in the total benefits of passenger transport investments in the Cross rail project in London and in Yorkshire Humberside a 10-20% increase over conventional benefits.

Dutch studies Hof, Heyma and van der Hoorn (2012) question the value of fine tuning WEB calculations when the standard direct welfare effects of CBA analysis appeared to better explain wide variances in results. Although their findings may be questioned on grounds of the synthetic case study used, the consistent proportion across 5 models by which direct benefits exceeded WEBs (WEBs < 10% of direct benefits) raises issues that merits further exploration.

Given the variation in findings above Lakshmanan(2007), the Dutch studies and Graham(2007), recent literature using meta-analysis provided mixed results, Melo, PC, Graham and Brage-Ardao (2013). The authors found in the sample (563 elasticity estimates 33 studies):

- Data quality issues and estimation issues of simultaneity bias

But useful conclusions:

- Higher productivity for roads compared to rail, ports and airports, which the authors argue may skew future policy
- Higher estimates for US than Europe
- More long term than short term effects
- An estimate that a 10 % increase in investment results in a 0.5% increase in output, which is significantly more modest than that derived by Graham, Daniel J (2007).

Graham (op.cit) in the context of passenger transport investment, points out limitations in measuring WEBs:

- a. The process and source of externalities unknown so far,
- b. Predictions of the literature such as, labour market benefits, knowledge spill overs and input sharing have not been empirically validated as to their relative importance as well as productivity effects. Therefore the link between agglomeration and transport movements (business trips, commuting, and freight) is still unclear.

- c. The extent to which the intensity of the benefit may decay /diminish from source. This has been tested for New Zealand by Maré and Graham (2009) and for UK Melo, PC, Graham and Brage-Ardao (2013), where it was shown for UK that service industries experienced rapid diminishing of agglomeration benefits, but for New Zealand results were inconclusive.

The conclusion from this is that WEBs are a useful tool in the quantifying of cluster benefits because clusters generate AE. These quantified benefits can be used as input to establishing *ex-ante* policy guidance to examine appropriate resourcing of logistics clusters. Supplementing CBA with WEBs is an appropriate method of implementation.

3.3 Resource based view of the firm and dynamic capabilities

The resource base view (RBV) is associated with (Barney 2001) and several others who provide alternate perspectives (Eisenhardt & Martin 2000; Teece, Pisano & Shuen 1997; Wernerfelt 1984). In essence it claims that if a firm can accumulate resources and capabilities that are rare, valuable, non-substitutable and difficult to imitate, then conditions for competitive advantage exist. A firm's operations relies on business processes and activities in its value chain Porter (1985). In a logistics context primary activities comprising SC processes and activities are conducted to ensure operational efficiencies and the achievement of competitive advantage for the firm, Christopher (2016); (Okorie, Tipi & Hubbard 2015). (Christopher 2016) also observes that outsourcing activities and by extending the firm's value chain outside its boundaries generates cost efficiencies competitive advantage. Thus firms will explore all means to use their resources efficiently to generate competitive advantage consistent with Christopher's opinion (op.cit) making RBV relevant to this analysis.

As ((Kim 2009, p. 330)) states, practical SC capabilities are the "*building blocks for supply chain strategy and a source of competitive advantage*". (Eisenhardt & Martin 2000) argue that the resource based view can be supplemented with a dynamic capability view to further competitive advantage where industry conditions are changing and the firm has the capability of adapting internal processes to meet that change. The specific conditions they require are that a firm is able to apply its capabilities "*sooner, more astutely and more fortuitously*" (op.cit p1117). (Barney 2001) calls this nimbleness, ability to change quickly, alertness to change adaptability to changing markets. This approach fits well with SCM and logistics as they describe characteristics of the logistics concept of agility (Christopher 2000; Gligor, Holcomb & Stank 2013; Li et al. 2008).

3.4 The proposed LCB conceptual framework (CF)

The foundations for conceptualising the LCB CF model have been laid in previous discussions discussed and comprise; enablers or precedents like enhanced logistics specific infrastructure, proximity, VALS and SCI; benefits like LCB; outcomes which are benefits arising from LCB like the firm's logistics performance. SCI is a precedent for LCB and VALS and enhanced logistics infrastructure investment a precedent for proximity (location) and LCB. Latent constructs in oval cannot be directly measured but can be measured when the variables are operationalised using measures in Table 3.

Figure 1 Conceptual framework

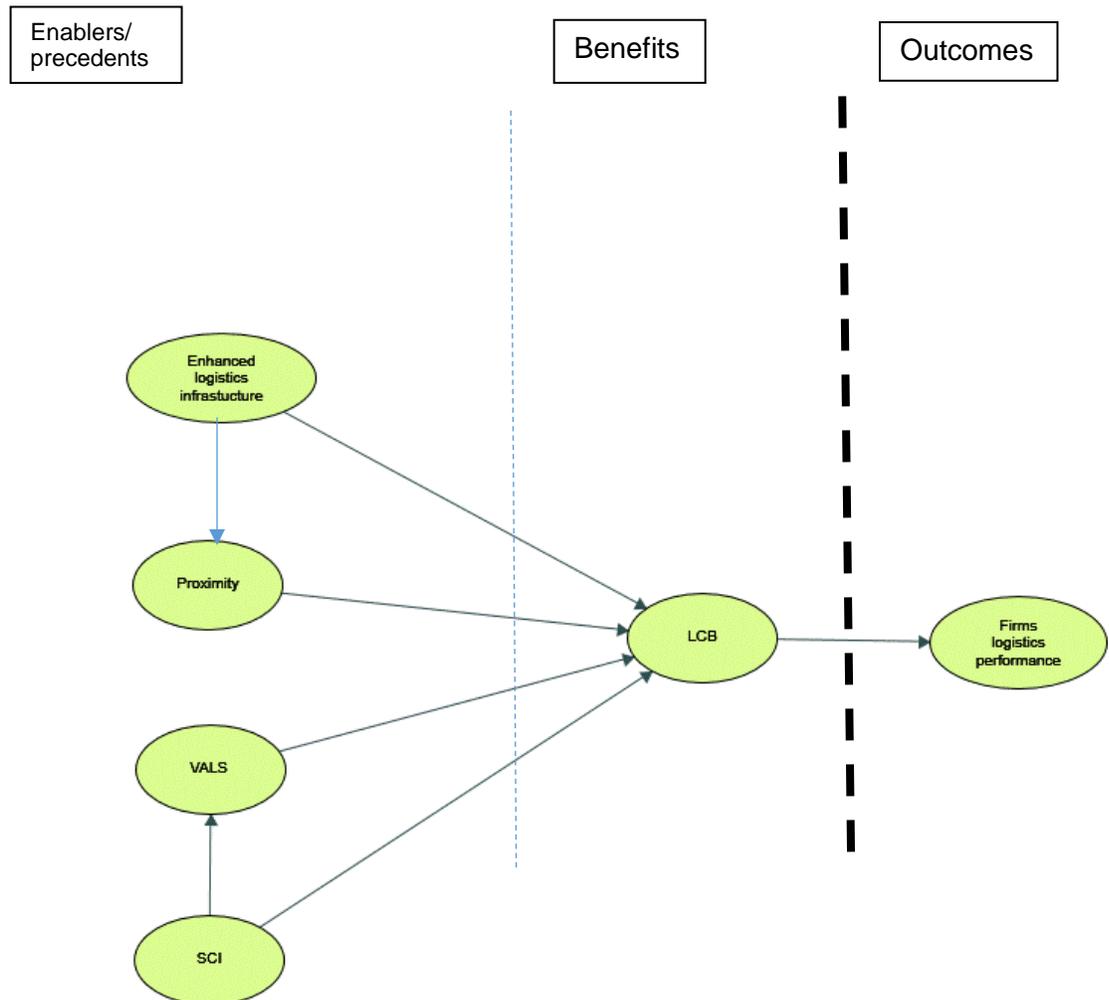


Table 3 Conceptual framework –constructs, variables measures

Concept/ Construct	Variables	Measure	References
Proximity	1) Industry & firms concentration in Cluster	1)# of firms locating by cross section of industry, size 1.1) LQ (location quotient) 1.2) Formation of local networks 1.3) generation of buzz	Rivera et al (2014);De Langen (2004) Tan & Thai (2015), citing Storper & Venables (2004)
VALS	1) Availability of VALS	1)Concentration of 3PL/4PL providers 1.1)Proportion of National or regional providers in cluster 1.2) Coverage & Frequency 2) Take-up of 3PL/4PI services	Rivera, et al (2016, p 262). Sheffi (2012)
	2)Extent of VALS	2) Scope of Full service offerings: 2.1)Service frequency 2.2) Coverage	Rivera, et al (2016, p 262). Sheffi (2013)Sheffi (2012)
	3)Quality of VALS	3) Take up of Collaboration & extent of take-up of bundled services.	Rivera, et al (2016, p 256,262). Christopher and Towill (2002) Christopher (2000) Huscroft et.al(2013) Grandori &Soda(1995) Okorie et al(2015)
Supply chain Integration	1) External integration e.g. collaboration based practices like VMI	2.1) Collaborative undertakings commenced 2.2) IT driven information exchange 2.3)integration with customers	Yuen & Thai (2017);Kim (2009)Christopher (2000)
	2)Internal integration	3)# Restructure driven by strategic change 3.1)# of processes changed	Yuen & Thai (2017)Gligor ,Holcomb, Stank(2013);Stank Keller & Closs (2001)
Firm's logistics performance	1)Market factors	1) Financial targets 1.1) Cost leadership, freight costs 1.2)revenue from increased product sales 1.3)Differentiated products 1.4)Innovation led # New Products	Chia & Goh (2009) Langfield-Smith & Smith(2005) Elrod et al (2013) Chhetri,Butcher,Corbitt(2014,p225)
	2)Customer view	2) Customer service 2.1)Cost leadership 2.2) Process efficiency 2.3)Logistics transport cost & reliability	Sheffi (2012); Shang (2004); Lu,Liao,Yang(2008) Spulber(2007); Van Hoek (1998), Beamon (1999) Lai et al (2002)
	3) Quality perspective	3.1)Internal integration 3.2)Customer integration 3.3)Supplier integration 3.4)Benchmarking 3.5)Structural initiatives 3.6)Logistical initiative	Flynn et al.2010 Kim (2009)
Logistics cluster benefits	1)Collaboration opportunities	Number of firms, industry concentration,	Sheffi (2012);Rivera et al (2016) (Storper 1995, Newlands 2003) MAR (Glaesser 1992,MArrow 1962,Romer 1986 Marshall 1890 Growth pole (Perroux 1950, Parr 1999) Cella (1984) Graham (2007); Porter (1998 & 2000)
	2)Market access	Access to more markets	Marshall (1890) Krugman(1990)Appold(1995) Rivera (2014)
	3)Labour market effects	3.1 Logistics Employment growth change : Elasticity of Productivity 3.1) Move2more productive jobs(M2MPJ)	Porter (1998,2000); Rivera et al (2016) Growth pole (Perroux 1950, Parr 1999) Cella (1984)

3.5 Next Steps

Similar approaches to this paper (Tan & Thai 2015) do not develop hypotheses at this stage. Therefore the variables in table 3 will be operationalized and hypotheses framed as a first step.

When the survey design, data collection and data analysis stages are undertaken then an appropriate methodology and research design will be developed.

However given that a CF with hypotheses to be validated will form part of the research design it is likely that there will be quantitative phase. Yet, there are aspects of how and why firms operate as they do, that require probing and are not conducive to the quantitative approach. Qualitative methods based on in-depth interviews will add value here (Caracelli & Greene 1997; Creswell 2009).

Accordingly the mixed method approach which uses both quantitative and qualitative methods in order to achieve the research objectives is likely to be used. Mixed method (MM) is a newer research technique (Bergman 2008), which takes the best of qualitative and quantitative methods and combines them. In doing so it emphasizes the use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques for the broad purposes of breadth and depth of understanding and validation (Johnson, Onwuegbuzie & Turner 2007, p. 123). As the literature states there is more to MM, '*mixing methods are not just about testing findings against each other. It is also about building a negotiated account of what the quantitative and qualitative findings mean together by allowing the data to talk to each as a mutually informative debate or conversation*' (Wilkins & Woodgate 2008, p. 26). Such a methodology is suitable for studying a research problem where questions cannot be answered solely by quantitative or qualitative research. (Plano /Clark and Ivanovka 2016 p61, 62) define this approach as mixing at the level of methodology as opposed to perspectives that emphasise philosophy.

Moreover, mixed method research is suitable where the given research topic is new, there is little published literature on the topic and there is a need to explore new issues, to collect new information and to draw new findings. This is the case with logistics cluster benefits where the most recent research identifies only four scholarly papers (Rivera, Gligor & Sheffi 2016).

4 Expected contribution

At the academic level this research provides a model to understand knowledge of the enablers of logistics cluster benefits, Sheffi (2010, pp. 11-7) like collaboration, value added services, postponement, reverse logistics and labour market as well as their impact on the firm's logistics performance contributing into an area unexplored. This research extends a limited body of knowledge pertaining to logistics clusters.

At a practical level once completed it will enable *ex-ante* use by firms who are rational entities to maximize logistics and strategic investments Lynch, Keller and Ozment (2000), by participation in a cluster.

Efficiencies enjoyed by firms enable them to leverage their participation in an industry that contributes value added of \$132 Billion, comprises 9% of GDP and employs 1.2 M, Australian Logistics Council (2014).

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