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ARTICLE TITLE: **4th party logistics service providers and industrial cluster competitiveness: collaborative operational capabilities framework**

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4th party logistics service providers and industrial cluster competitiveness

Collaborative operational capabilities framework

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Nachiappan Subramanian
Nottingham University Business School, The University of Nottingham Ningbo China, Ningbo, China
Angappa Gunasekaran
Department of Decision and Information Sciences, Charlton College of Business, University of Massachusetts Dartmouth, North Dartmouth, Massachusetts, USA
Thanos Papadopoulos
Kent Business School, University of Kent, Chatham, UK, and
Pie Nie
Nottingham University Business School, The University of Nottingham Ningbo China, Ningbo, China

Abstract

Purpose – Firms within industrial clusters are subject to challenges such as globalization, limited resources, volatility of international markets and financial instabilities. 4th party logistics (4PL) service providers are supporting individual firms to overcome such challenges by using collaborative operational capabilities from within an industrial cluster to their enhance competitiveness. The purpose of this paper is to focus on China and proposes a collaborative operational capabilities framework to illustrate the role of 4PL in industrial cluster competitiveness.

Design/methodology/approach – The paper follows an extensive literature review and structured interviews in two types of clusters, drawing on resource-based view and importance-performance matrix analysis.

Findings – The paper proposes six elements (that is, synergy of logistics, expansion of industrial chain, financial ability, creativity and innovation ability, cooperation of companies and flexibility of supply chain) that comprise collaborative operational capabilities, and highlights the role of "creativity and innovation ability" and "supply chain flexibility" in the use of 4PL for industrial cluster competitiveness in Chinese context.

Research limitations/implications – The paper focusses on China and hence it could also be tested in the developed countries' context with the support of large-scale empirical data to investigate further its usefulness and to identify other constraints.

Originality/value – The study contributes to the 4PL literature in that it proposes a framework that extrapolates the importance of 4PL in industrial cluster competitiveness in China.

Keywords Collaboration, Fourth party logistics, Importance-performance matrix analysis, Industrial clusters, Operational capabilities

Paper type Research paper

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1. Introduction

Nowadays competition takes place at industrial cluster level rather than at the firm level. Industrial clusters (hereafter: clusters) have common themes such as dynamic interactions, systems recognition, social infrastructure and geographic scope (Kleinhardt-FGI report, 2002; Trappey *et al.*, 2010; Zelbst *et al.*, 2010). Humphrey and Schmitz (2002) suggest that clusters share characteristics with value and supply chains, in that both acknowledge the importance of competition in global markets and the role of governance to coordinate economic-related activities through non-market relationships. However, supply chains and industrial clusters differ in that they operate in "distinct loci" (p. 1018), that is, different areas of focus. In supply chains multiple firms join together to produce products whereas in industrial clusters multiple firms would produce similar products and are located in a single region. In clusters resources are usually stemming from within the locality and they become competitive when they also work with external service providers and to improve additional operational capabilities through collaboration. Collaboration reduces inter functional and inter organizational conflict and promotes the development of a distinctive relational advantage (Nicovich *et al.*, 2007; Allred *et al.*, 2011). It is different than coopetition, in that in coopetition the relationship is between competing firms, which cooperate first with each other to jointly create value and establish themselves in a bigger market, and then they individually compete to gain market share and value in the market they have created (Brandenburger and Nalebuff, 1996; Ritala and Hurmelinna-Laukkanen, 2013). Gnyawali and Park (2011) define coopetition as the simultaneous pursuit of collaboration and competition. However, the importance of linking clusters with the external context has been weakly theorized, although frequently acknowledged (Humphrey and Schmitz, 2002).

4th party logistics (4PL) service providers are useful integrators in developed countries to improve the competency as well as to scale up the clusters' collaborative operational capabilities, defined as inter-firm sets of skills, processes, and routines used to create synergy to jointly overcome challenges (Kleinhardt-FGI report, 2002). Scholars analyzed how different logistics resources such as physical resources, human resources, information resources, knowledge resources and relational resources can be bundled together to assist in achieving sustainable competitive advantage (Wong and Karia, 2010; Somsuk *et al.*, 2012; Phusavat *et al.*, 2013). However, they argued that empirical evidence on how resources and their bundling for collaboration enable the competitiveness of clusters is needed. There is limited research that investigates the process on how clusters transform firm and supply chain resources into distinctive capabilities (Allred *et al.*, 2011). Additionally, there are differences between developing and developed countries, as integration does not take place at the same rate (Humphrey and Schmitz, 2002). Therefore, it is necessary to shed light upon how sets of firms within clusters in developing countries collaboratively align with 4PL to leverage capabilities and attain competitive advantage.

To address these research gaps, this paper proposes a collaborative operational capabilities framework drawing on the resource-based view (RBV) of the firm (Barney, 1996, 2001, 2012; Wu *et al.*, 2006; Chae *et al.*, 2014). Interviews are carried out in two prominent industrial clusters (that is, electronic home appliances and textile manufacturing) in Ningbo, which is one of the major industrial cities in China. Dominant factors are identified using importance-performance matrix analysis. Following Wu *et al.* (2010), we propose a framework that extrapolates major collaborative operational capabilities, that is, "synergy of logistics," "expansion of industry chain," "cooperation of companies," "flexibility of supply chain," "financial ability" and "creativity and innovation."

The contribution of this paper is twofold: proposes a collaborative operational capabilities framework with its constituent strategic competent factors between 4PL and industrial clusters; and analyzes the influence of collaborative operational capabilities and competent strategic factors between 4PL and industrial clusters in China.

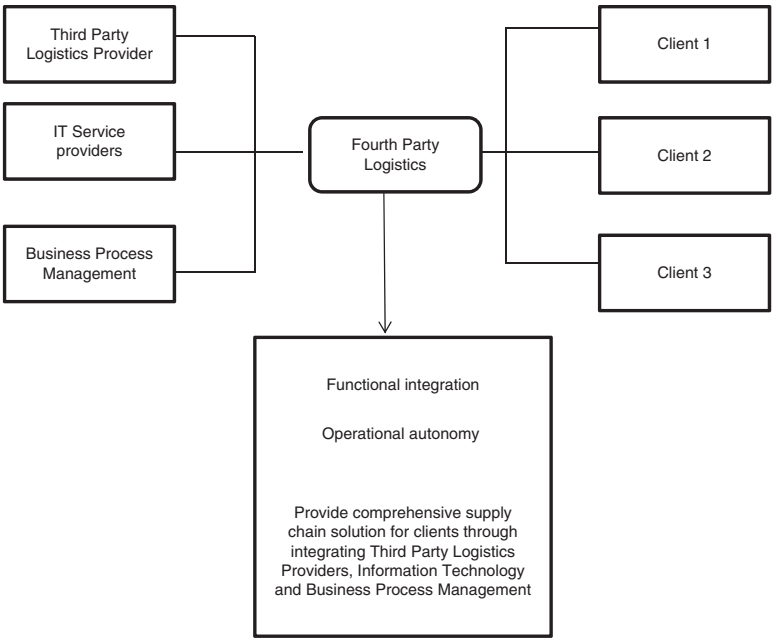
The remainder of the paper is structured as follows. Section 2 reviews the studies related to 4PL and industrial clusters. Section 3 details the collaborative operational capabilities framework and its constituent factors. Section 4 describes the methodology adopted in this paper. Section 5 lists the findings of the study. Section 6 discusses the major outcome and compares it with previous studies. Section 7 concludes with future directions and major limitations of the current study.

2. Literature review

2.1 Studies on 4PL

Q1 John (1998) first referred to 4PL as integrating resources, capabilities and technologies of organizations in order to design, build and run comprehensive supply chain Q10 solutions as shown in Figure 1.

Scholars (Huiskonen and Pirtilla, 2002; Xin and Peng, 2002) identified how 4PL is used by logistics networks to lower logistics costs and enhance efficiency and coordination. Bourlakis and Bourlakis (2005) suggested that 4PL is used to reduce high transaction costs in buyer-seller relationships and highlighted the role of IT to reduce and absorb complexity. Later studies (Huang *et al.*, 2013) dealt with operational problems category such as routing problem in 4PL, developing a programming model based on credibility theory and a two-step genetic algorithm with fuzzy simulation.



Source: Büyüközkan *et al.* (2009b)

Figure 1.
4PL The flow chart

Other scholars (e.g. Remko and Ian, 2001; Xiu *et al.*, 2003; He *et al.*, 2004; Christopher, 2005; Feng and Juan, 2005) highlighted the strategic nature of 4PL, suggesting that 4PL ensures supply chain coordination, integration and competitiveness. Competitiveness was related to the provision of competencies related to knowledge availability, information technology and skills in forming and sustaining successful supply chain relationships (Coyle *et al.*, 2003). Later studies (e.g. Yongbo and Daoping, 2007) acknowledged the use of 4PL in both the operational and strategic level that is, from collaborative operational mode to industry innovator mode, whereas others (e.g. Krakovics *et al.*, 2008) proposed 4PL performance indicators. Jianming (2010) concluded that the successful operation of 4PL integrates resources of a supply chain reasonably, efficiently and flexibly. In a later study, Papadopoulou *et al.* (2013) acknowledged the importance of collaboration through 4PL partnership building, proposing thereby a framework that emphasizes on the pre-selection phase by 4PL providers when forming global logistics networks. They suggested that 4PL "is constantly evolving within the complex environment of supply chain and logistics, thus denoting its innovative nature" (p. 176).

The aforementioned review acknowledges the importance of 4PL for the achievement of particular objectives and hence competitive advantage. Before we explicate the role of 4PL within clusters, a brief overview of clusters is presented in the next section.

2.2 Studies on industrial clusters

Porter (1998) proposed that an industrial cluster is a strong and sustainable competitive advantage network of interconnected companies and institutions in a particular value chain where it encompass an array of linked industries and other entities important to competition and cooperation. In a later study in 2000, an industrial cluster was defined as a geographic concentration of competitive firms or establishments in the same industry that either has close buy-sell relationships with other industries in the region, use common technologies, or share a specialized labor pool that provides firms with a competitive advantage over the same industry in other places (Edward and John, 2000). Scholars in the 1990s were mostly interested in how clusters enable efficiency and cooperation (Dyer, 1997; Jorg, 1998), as well as the technological dynamism and shifts required to unravel the technological underpinnings of industrial clusters' long-term competitiveness (Martin and Michael, 1999).

Later studies (e.g. Ian and Philip, 2000; Hubert and Schmitz, 2002; Pandit *et al.*, 2002; Jici, 2002) proposed typologies of models of processes that underlie spatial concentrations of related activities within clusters, and investigated characteristics of members within industrial clusters and the role of policy to enhance national competitiveness through clusters. Other scholars (Dahl and Pedersen, 2004; Piero, 2004) underlined the role of contact among firms as important for establishing knowledge flows, and investigated the degree of knowledge integration within clusters as an important dimension of economic performance. Later studies have looked into how clusters contribute to competitive advantage by sparking entrepreneurial behavior within the cluster, how they deal with the inflexibilities of vertical integration and what is the role of technology in this innovative and entrepreneurial behavior (Feldman *et al.*, 2005; DeWitt *et al.*, 2006; Iammarino and McCann, 2006). Within developing countries, Humphrey and Schmitz (2002) conducted research on clusters where producers found themselves in asymmetrical relationships with their customers and explained how insertion into global value chains affects local upgrading strategies.

Later studies have embarked on a discussion of how clusters influence firm and cluster performance either by using case studies or by investigating how different types of cluster-based shared resources impacts on cluster firm performance (Li and Geng, 2012). Scholars have drawn on the RBV of the firm (Barney, 1996, 2001, 2012) to suggest that the performance of cluster firms is much dependent on the capabilities they possess and utilize, and when combined with the firms internal resources constitute the competitive advantage of the cluster and impact on performance (Hervas-Oliver *et al.*, 2008; Hervas-Oliver and Albors-Garrigos, 2009; Wu *et al.*, 2010). Li *et al.* (2015) have examined the entrepreneurial capacity of firms in leveraging resources within clusters to achieve competitive advantage, based on RBV. Other scholars have looked into conditions under which clusters innovate, highlighting social proximity, collaboration and innovation/entrepreneurship in clusters (Alecke *et al.*, 2006) and how different types of proximity (that is, how geographic, institutional, organizational, cognitive and social proximities) interplay and enable collaboration and innovation (Letaifa and Rabeau, 2013; Molina-Morales *et al.*, 2015). Other recent studies have focussed on incorporating sustainability issues within clusters, investigating the role of Eco-industrial parks as a solution to increase sustainability and competitiveness of existing industrial clusters (Taddeo *et al.*, 2012), or how clusters and global value chains interact in terms of economic and social upgrading in developing countries (Jerefee and Lee, 2016). Such a shift denotes the importance some scholars pay on the contribution of industrial clusters to promote corporate social responsibility (Lund-Thomsen *et al.*, 2016).

Still, there is literature to explore how clusters are formed to achieve sustainable competitive advantage looking at the use of technology and acquisition of resources and subsequently capabilities. The role of 4PL as a support mechanism in enabling the acquisition of operational capabilities by clusters to compete globally, is briefly discussed next.

2.3 The development of industrial clusters and 4PL

Hubing (2009) investigated the role of logistics within clusters, suggesting that enterprises could harness the benefits of information sharing if they collaborate. Furthermore, Xiaogang (2011) has suggested that it is individual demands of companies that force them to collaborate within clusters and share information to achieve customer satisfaction. However, as designs and products become individualized and customized, enterprises cannot grasp all the information needed from clients, especially in cases where this is not within their core competencies. Hui *et al.* (2006) suggested that clusters and supply chains are compatible and complementary, since supply chains could enlarge the effect of the economies of labor division and scale, promote the local specialization, agglomeration and share the advantage of global labor division (Li and Peng, 2006). Therefore, with the support of 4PL clusters could share information and obtain benefits, related for instance to shortening the lead time of designing and devising customized products. Hingley *et al.* (2011) have identified such benefits as well as barriers entailed in the use of 4PL as a catalyst for horizontal collaboration. However, so far studies have not explored the role of collaborative operational capabilities facilitated by the use of 4PL for the competitiveness of clusters. To address this gap, this research proposes a framework that extrapolates the importance of 4PL in industrial cluster competitiveness, developed in the subsequent sections.

3. Collaborative operational capabilities framework

RBV (Barney, 1996, 2001, 2012; Wu *et al.*, 2006; Chae *et al.*, 2014) considers those sets of resources (for instance, assets, capabilities, processes, knowledge, information) available that enables the firm to achieve sustainable competitive advantage. Within logistics, RBV has been widely used, inter alia, to illustrate the importance of strategic logistics (Olavarrieta and Ellinger, 1997), investigate the antecedents and the consequences of IT capabilities among 3PL providers (Wu *et al.*, 2006; Lai *et al.*, 2008), identify those resources to be acquired and bundled by logistics providers to achieve competitive advantage and superior performance (Wong and Karia, 2010). Recently RBV has been used to investigate the way boundaries of human capital-intensive firms are changing as the firms are adopting 4PLs (Cezanne and Saglietto, 2015). In this research we use RBV to conceptualize the use of resources and the development of capabilities within clusters. We argue, following RBV, that resources combined within the cluster will develop synergistic capabilities that underlie the firm's and cluster's ability to achieve competitive advantage and therefore, competitiveness (Coates and McDermott, 2002; Wu *et al.*, 2010). Synergistic capabilities within the cluster are the foundation for the firm and cluster strategy and their more valuable when combined (Ordanini and Rubera, 2008). Drawing, hence, on RBV, we suggest that competitiveness lies in the ability of the firm and cluster to use both internal and external resources in order to devise strategies that enable the achievement of competitive advantage.

In this paper we follow the classification of operational capabilities of Wu *et al.* (2010), who extrapolates different factors considered for collaborative operational capabilities, as they stemmed from our extensive literature review. They are as follows: synergy of logistics (SL) (operational improvement), industrial chain expansion (operational reconfiguration), companies' cooperation (operational cooperation), supply chain flexibility (operational responsiveness), financial ability (FA) (operational customization) and creativity and innovation (CI) ability (operational innovation). Our research, however, differs from Wu *et al.* (2010) in that: we focus at the cluster and not firm level; and we are looking at the impact of capabilities within 4PL and industrial clusters on competitiveness whereas Wu *et al.* (2010) do not look at competitiveness, but provide a definition and typology of operational capabilities, highlight the difference with other related concepts, and develop and test a measurement instrument for operational capabilities. The details of each factor and the items used to measure are discussed in Figure 2.

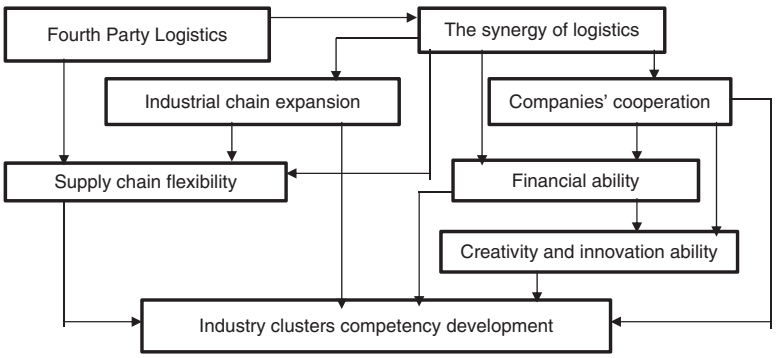


Figure 2.
Strategic collaborative operational capabilities competent factors

3.1 The SL

The SL represents, inter alia, data sharing, resources and information through internet between logistics companies. Various companies use different support such as MPRII and JIT to realize this synergy, but are unable to confront external competition and provide the regional service. Achieving synergy means for companies that they achieve complementarity and assist each other to expand their market share. The synergy provided by 4PL can help in understanding and addressing different demands of clients, as well as enabling them to take advantage of their own preponderances so that each company can focus on their core competencies. 4PL considers both logistics information and information on professional talents, management, service, technology as shown in Figure 3.

From the above figure, we can conclude that the relationship between logistics companies and manufacturing companies has been extended to government, financial institutions, customs, science institutions and associations under the assistance of 4PL. Hence, 4PL emphasizes the importance of information sharing and synergy, which overpass the simple integration of traditional logistics and manufacturing, procurement, sale. Undoubtedly, 4PL pays more attention to the entire business system value, which is made up of business flow, information flow, logistics and cash flow. Under the basis of synergy, 4PL can maximize the satisfaction to the supply and demand throughout the whole supply chain.

The most important synergy problems exist between suppliers, manufacturers, retailers and logistics (Wong and Karia, 2010; Cezanne and Saglietto, 2015). If these companies do not engage in creating cooperative relationships and in sharing manufacturing information various challenges related to, for instance, the inability of logistics companies to make transportation arrangements, calculate supply periods, for retailers to obtain the products on time will come to the foreground. Furthermore, companies would not have access to information if it is not within their core competencies to be IT-intensive, and hence they will be late in responding to market changes. Jointly formulating the manufacturing plan with upstream and downstream companies is another way to realize their synergy and minimize risks. Immediate feedback from clients through the SL will help companies enhance their service standards and quickly response to satisfy individual demands. Therefore, through these factors (Figure 3) the SL could be realized.

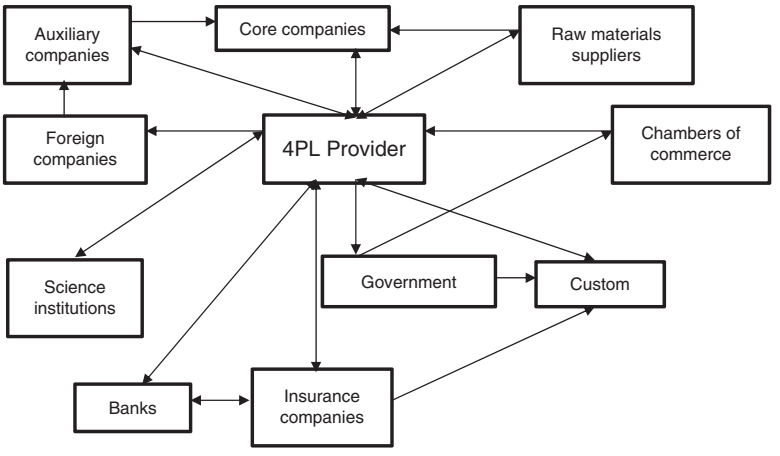


Figure 3.
The synergy of logistics elements/ items

3.2 Industrial chain expansion

4PL connect the upstream and downstream enterprises in the industrial clusters and integrate manufacturing, supply and demand. Nowadays companies are worried about how to establish a complete sale network. Under the command of 4PL, firms share resources and capabilities, enabling thereby the functions of procurement, processing, delivery, client management and information processing. 4PL is therefore contributing on using the existing operations resources of the cluster and firms and can deal with change and reshaping these resources in order to deal with changes in the external firm context (Wu *et al.*, 2010). Such a view is based on the dynamic capabilities (Teece *et al.*, 1997) that builds on RBV, in that firms and in our case, clusters, develop capabilities to respond to the changes in their environment (Pandza *et al.*, 2003a) and therefore this responsiveness and reconfiguration can lead to competitiveness. This integration (and collaborative synergy) is shown in Figure 4: the development and reconfiguration of the industry chain depends on the firm and the support by derivative industries. As the connector, 4PL can combine the main industry chain and other relative industries to achieve the expansion of industrial chains (EIC).

Four sub factors are considered: First, the ability of controlling cost for each company is getting more and more significant, and hence companies who cannot control cost will not provide competitive products; second, the existence of an alternative suppliers, especially when particular suppliers are related to high procurement costs; third, substitute suppliers that can promise the normal operation of manufacture; and fourth, whether companies can acquire products immediately.

3.3 FA

The cooperation of companies (CC) in clusters strengthens information sharing. Clusters, hence, are able to innovate more, optimize their logistics and adjust their structure, which will enhance their ability of managing capital and those capabilities related to path-dependent learning that will result in having particular processes that enable competitive advantage (Schroeder *et al.*, 2002; Wu *et al.*, 2010). Enterprises conduct analysis on new projects to avoid wasting time and cash, and need financial support, which, from external investments, becomes relatively easier. Under the synergy of 4PL, each company improves its information communication to reinforce the development of high-tech, high-value and high-competency products. Once the products are developed, information sharing with financial institutions will enable them to make decisions about whether to provide capital support. Therefore, there are five sub factors that should be taken into account. First, it is quite important

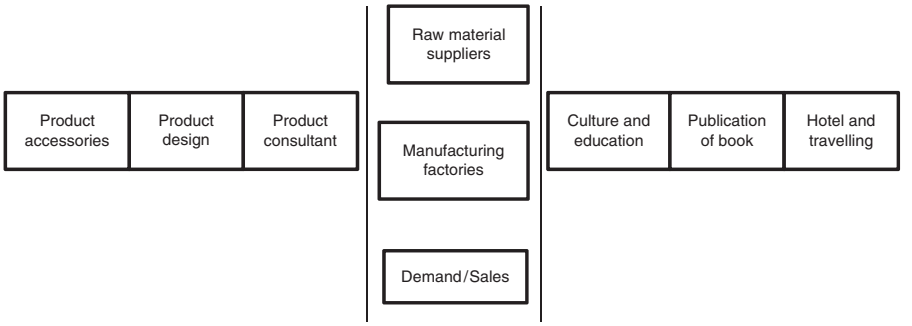


Figure 4.
Industrial chain expansion elements/ items

for companies to keep cooperative relationship with financial institutions. On the basis of such collaboration, sharing the information of manufacturing and finance will help them understand companies and make decisions on whether they should provide assistance, therefore assisting when necessary.

3.4 CI ability

Technology and design are two most important factors for those companies that aim to elevate their CI ability. Under the synergy of 4PL, getting enough capital undoubtedly ensures that those companies can develop products to satisfy individual demand. However, 4PL also enables collaboration and cooperation that promotes information sharing, which enables companies to experiment and change technology trajectories and associated uses of resources (Benner and Tushman, 2003). Hence, CI abilities refer to those skills that are related to "search, discovery, experimentation, and implementation" (Wu *et al.*, 2010, p. 728) and these enable firms enjoy complementary advantages.

Four sub factors are considered. First, companies should recognize whether they are high-tech or high-creativity companies. High-tech companies focus on new technology research, while high-creativity companies pay more attention to the designing shape, style and so on. For high-tech companies, it is significant to constantly develop new technologies to attract more customers, while high-creativity companies should always design fashionable products that appeal to customers. Patents should protect new technology or fashionable products, to ensure that companies stay leaders within their market.

3.5 CC

With the expansion of industry chains, cooperation results in synergy. Strategic alliances (Whipple *et al.*, 2002; Büyüközkan *et al.*, 2009a; Albers *et al.*, 2013; Sambasivan *et al.*, 2013) denote relationships between two or more parties to pursue a set of agreed-upon goals or to meet a critical business need while remaining independent organizations. The SL goes beyond cooperation on technology production, supply agreement, sales agreement and joint venture, but means investment in innovation through knowledge sharing and logistics optimization. Therefore, 4PL contributes to the development of those capabilities and mechanisms that deal with complexities when competing globally (Flynn and Flynn, 1999; Wu *et al.*, 2010). Six sub factors are considered, related to quality characteristics of information sharing that enables joint problem solving and helps cooperators improve product quality as well strengthens trust and relationship for further collaboration.

3.6 The flexibility of supply chain

A key dimension of supply chain performance is flexibility. Flexibility is always regarded as a reaction to environmental uncertainty (Gerwin, 1993). The system of flexibility of supply chain consists of research and development system, resource system, manufacturing system, logistics system, information system and strategy system (Yunbo *et al.*, 2004).

When flexible, R&D can help high-tech enterprises in industry clusters make quick responses to the individual demand and design relative products at appropriate cost. Under the coordination of 4PL, partners in industry clusters can share resources to realize rapid schedule so as to satisfy clients' requirements at an appropriate cost. Third, on the aspect of manufacturing system, 4PL can promote enterprises immediately arrange the production using current resources when confronting the

external environmental change. Once the manufacturing is finished, 4PL can devise a complete set of solution containing proper time and proper route for transportation in time. At the same time, the information system can give feedback to manufacturer so as to help them adjust production plan. 4PL can also facilitate the whole life cycle of supply chain to maintain an excellent dynamic. When there is information change, 4PL can promptly update these changes and make adjustments. On the perspective of strategy systems, strategy designers can utilize the platform of 4PL to put forward relative solution so that each enterprise in the industrial clusters could make correct selections. All the processes are shown in Figure 5. These processes, therefore, are related to skills, processes, and routines by 4PL to help the cluster respond quickly and easily to changes in input and output, so that customer demands are always met with limited penalties in time and cost (Swink *et al.*, 2005; Wu *et al.*, 2010).

There are five sub factors considered in this section. The first one is whether companies can shorten the lead time of manufacturing. Market uncertainty is a challenge for companies, and by spending more on lead time they will have risk products being out of fashion. Second, keep on launching new products is another sub factor, since new products could preserve competitiveness. Also, transportation firms need to always adjust their plan according to the manufacturing conditions or they may not be able to timely schedule for products. Furthermore, more and more individual demands, such as the color and shape of products, require companies to make a fast response so as to satisfy clients, respectively. Thus, they have to control stock in time and promptly provide customized products. This increases the request for factories that specially manufacture products for designing companies, since they should timely adjust the manufacturing plan to fit the taste of clients.

4. Methodology

4.1 Qualitative research approach

We adopted a qualitative approach because of the emerging nature of this topic (Miles and Huberman, 1994). Following scholars such as Eishenhardt (1989) and Glasser and Strauss (1967) we sought to extend current theory and generate new insights from the phenomenon under study. To further verify our framework, we conducted our research within four companies: a clothing designer company, a clothing manufacturer and two home appliances' manufacturers, due to the availability of large number of small

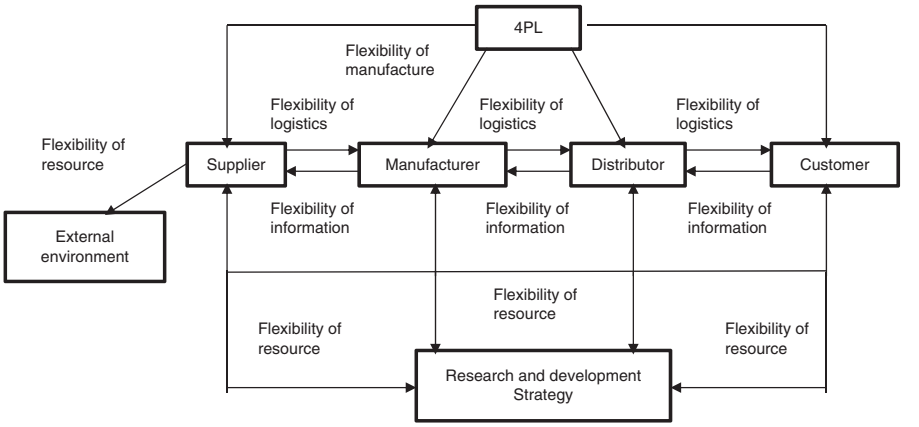


Figure 5.
Supply chain flexibility elements/ items

players, higher innovation rate, shorter product life cycle and continuous change in demand. Our choice of the four companies coincides with the view of scholars (Eishenhardt's, 1989; Eisenhardt and Graebner, 2007) that usually four to ten companies are sufficient to amplify external validity and assist in establishing theories.

Company A. This is a clothing company and focusses on the manufacturing of various kinds of garments established in 1992. With strong competitiveness, this company produces one of its leading product (suits) in more than 500,000 sets, 60 percent of which are sold to Europe, Middle East, USA, Hong Kong, South Africa and 40 percent of which are sold to Beijing, Shanghai and other provinces in China. Located in the center of Yinzhou District, Company A is situated in an industrial zone covering 50,000 square meters in 2002. This company also owns the world's leading whole production line, imports GGT computer typesetting system from America, KD pre-shrinking machines and MACPI complete sets of ironing equipment line from Italy, JUKI pocket-hole sewing machines and KG fusing press machines, and JUKI sewing equipment from Japan.

Company B. This is also a clothing company and focusses on the designing of fashion style. With more than 3,000 employees, Company B wishes to become a top brand all over the world. With a turnover of around 6.8 billion last year, Company B beat the majority of competitors and is currently within the top ten of Ningbo clothing companies.

Company C. Established in 1986, Company C is a home appliance company that manufactures air-conditioners. With more than 20,000 employees, Company C owns more than 12 billion of total assets, has an annual output of 7 million air-conditioners, and has already been within the top 500 Chinese enterprises. From 2009 to 2011, the total sale amount of air-conditioners sold had increased by 70 percent per year.

Company D. It is an electronic company that manufactures electronics such as electric wires. With around 300 employees, Company D has a turnover of 100 million. It continuously emphasizes the importance of efficiency and effectiveness to keep its clients satisfied. Every year Company D invests 10 percent of its expenditure to design new products. So far it is one of the main component suppliers for many electronic companies.

The characteristics and profiles of respondents are shown in Table I. Although the sample is heterogeneous, it can provide rich information about the phenomena being studied (Miles and Huberman, 1994).

4.2 Data collection and analysis

We used structured interviews with managers in the four aforementioned companies. The structured interviews contained questions that referred to the six factors previously identified (each one with sub factors/items) resulting in a total of 33 questions. The interviewees assessed these items in terms of their importance and

	Respondent and company profile				
Organization	Position in organization	Age of company	Age of interviewer	Type of organization	Number of staff
Company A (textile)	Manager	10	40-50	Private	500
Company B (textile)	Manager	23	30-40	Private	3,000
Company C (electronic)	Manager	26	30-40	Private	20,000
Company D (electronic)	Manager	10	30-40	Private	300

Table I. Case companies profiles

performance in a Likert scale (1-5, 1 means low importance, 5 high importance) during May-August 2012. These scores are shown in Table II.

To analyze our data, we used the "importance-performance matrix analysis." It is a widely used technique used to measure the importance of attributes and performance that assists in the development of effective and efficient marketing programs (Martilla and James, 1977). This matrix has been used in the past to study improvement priorities (Slack, 1994), evaluate supplier performance (Ho *et al.*, 2012), assessing supply chain risk and partnerships (Hong *et al.*, 2014), and ~~study corporate social responsibility (Huang *et al.*, 2015) and~~ environmental practices in the supply chain (To *et al.*, 2015).

An importance-performance matrix analysis employs a 2×2 matrix format with four quadrants (Figure 6). The vertical axis stands for the perceived importance of the criteria from low to high and the horizontal one stands for the perceived performance of the criteria from "low" to "high." The interpretation of the importance-performance matrix grid can be illustrated with four quadrants: "low priority," "possible overkill," "concentrate here" and "keep up the good work" (Figure 6).

Low priority. This quadrant corresponds to items considered to be less important and their contribution toward performance is also low. Although the level of performance is low in this unit, there is no need for managers to pay more attention because the factor is perceived to be unimportant. Limited resources will be utilized on this low priority unit.

Possible overkill. In this quadrant, importance is considered to be low while the performance is relatively high. Customers are satisfied with the performance provided by the organization whereas managers are making less effort on this item.

Concentrate here. Attributes in this quadrant are perceived to be very important to respondents. They may have to invest a large amount of manpower, material and other resources to improve the performance.

Keep up the good work. Attributes are considered to be highly important to respondents. Meanwhile, the organization also performs at a high level on this item.

In our research the importance-performance matrix is utilized to analyze the influence of the six collaborative operational capability factors we have identified that is, SL, EIC, FA, CI ability, and CC and flexibility of supply chain. The results of this analysis are presented in Figures 7-12. The average of importance and performance is calculated based on the responses for each factor.

5. Results

5.1 The SL

Figure 7 illustrates that industrial clusters with 4PL (1) realize the significance of reducing the cost of logistics, (2) share the manufacturing information, and (3) receive the information of manufacturing, transportation, supply and sales belong to the quadrant of "keep up the good work." They feel other items in the synergy factors are important and they are not realizing their full potential now and they have to concentrate in the future and they are as follows (4) inform partners of manufacturing change, (5) share core business process, (6) jointly formulate manufacturing plan with cooperators, (7) promise the service standard, (8) satisfy individual demand, and (9) evaluate the clients' expectation.

5.2 The EIC

In this part, there are only four elements as follows: (1) control the cost of buying raw materials, equipment and price of sales as the most important elements. This element

Factors	Importance A	B	C	D	Average	Performance A	B	C	D	Average
1. The synergy of logistics										
Realize the significance of reducing the cost	5	5	5	5	5	5	5	5	5	5
Share the manufacturing information	5	5	4	4	4.5	5	4	4	4	4.25
Receive the information	5	5	5	5	5	4	4	4	4	4
Inform our partners of any manufacturing change	4	5	4	4	4.25	2	2	4	2	2.5
Share core business process	5	4	5	4	4.5	1	1	2	1	1.25
Jointly formulate the manufacturing plan	4	5	4	4	4.25	2	2	2	2	2
Promise the service standard	5	4	4	5	4.5	2	1	1	1	1.25
Satisfy the individual demand	4	4	5	5	4.5	1	1	1	2	1.25
Always evaluate the clients' expectation	4	4	5	5	4.5	2	1	1	1	1.25
2. The expansion of industrial chain										
Control the cost of procurement	5	5	5	5	5	2	4	4	4	3.5
Find the alternative suppliers	5	4	4	5	4.5	1	2	2	2	1.75
Find out the substitute materials	4	5	4	5	4.5	2	2	2	1	1.75
Obtain the products and services	4	4	5	5	4.5	2	2	2	2	2
3. Financial ability										
Have cooperated relationship with banks	4	5	5	5	4.75	2	4	5	4	3.75
Share manufacturing and finance information	4	4	4	5	4.25	2	1	1	2	1.5
Acquire the fund from bank immediately	4	5	5	5	4.75	2	1	2	2	1.75
Have complicated procedure to hand in the application	4	4	4	4	4	2	2	2	2	2
Satisfied with the services standard of banks	4	4	4	4	4	1	2	3	2	2
4. Creativity and innovation ability										
A high-technology company	2	2	5	5	3.5	2	2	2	1	1.75
A high-creativity company	5	5	4	4	4.5	2	2	1	4	2.25
Constantly develop new technology	2	2	5	4	3.25	1	2	4	4	2.75
Apply for patents to the government	2	5	5	5	4.25	1	2	2	4	2.25

(*continued*)

Table II.
Means of importance and performance perceived by companies

Table II.

Factors	Importance A	B	C	D	Average	Performance A	B	C	D	Average
5. The cooperation of companies										
Share correct information with cooperators	5	5	5	5	5	5	5	5	4	4.75
Share complete information with cooperators	4	5	5	5	4.75	2	3	4	2	2.75
Share ample information with cooperators	4	5	5	5	4.75	5	3	3	2	3.25
Share reliable information with cooperators	5	5	5	5	5	2	4	4	5	3.75
Always jointly solve the supply problems	5	5	5	5	5	2	2	2	2	2
Always help our cooperators improve product quality	4	4	5	4	4.25	2	2	2	2	2
6. The flexibility of supply chain										
Shorten the lead time of manufacturing	5	5	5	5	5	1	1	2	2	1.5
Improve the frequency of launching new products	5	5	5	5	5	1	1	1	2	1.25
Immediately adjust transportation plan	5	5	5	5	5	1	1	2	1	1.25
Make a quick response to the market change	5	5	5	5	5	2	1	2	2	1.75
Adjust manufacturing plan according the demands	5	5	5	5	5	2	2	2	2	2

falls into the "keep up the good work" quadrant. However, as shown in Figure 8, customers are not satisfied with the performance of companies regarding (2) finding the alternative suppliers, (3) finding appropriate substitute materials, and (4) obtaining the products, services and giving feedback immediately, notwithstanding the importance stated by companies. These three factors are in the "concentrate here" quadrant.

5.3 FA

There are five elements in this part as shown in Figure 9. With the average mean of importance 4.75 and performance 3.75, the element (1) that is, "have co-operated relationships with banks" falls into the quadrant of "keep up the good work." Another four elements which are: (2) "share manufacturing and finance information with banks

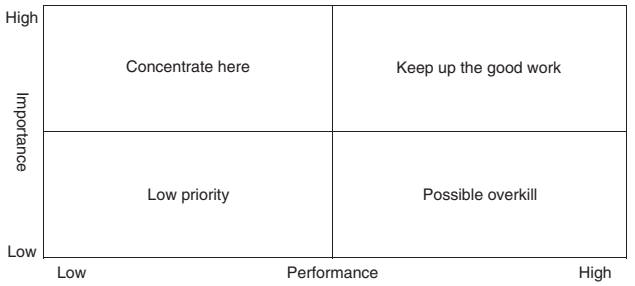


Figure 6.
Importance-performance matrix

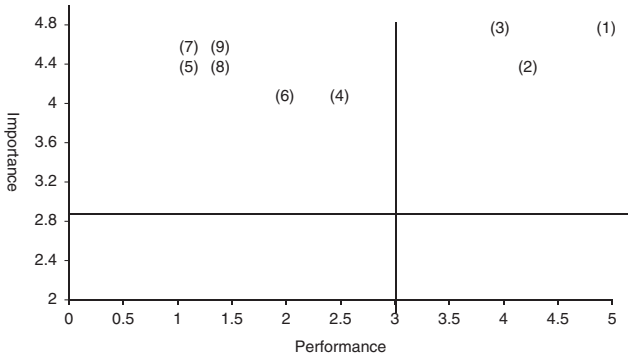


Figure 7.
Elements of synergy of logistics

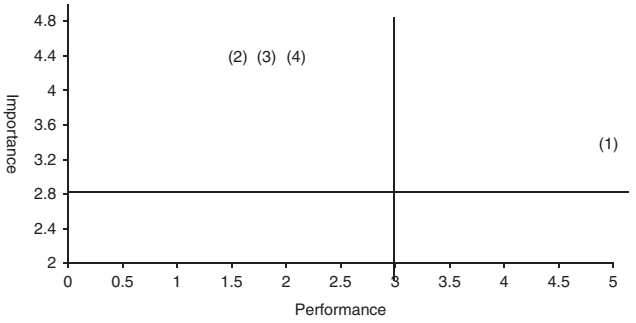


Figure 8.
Elements of industrial chain expansion

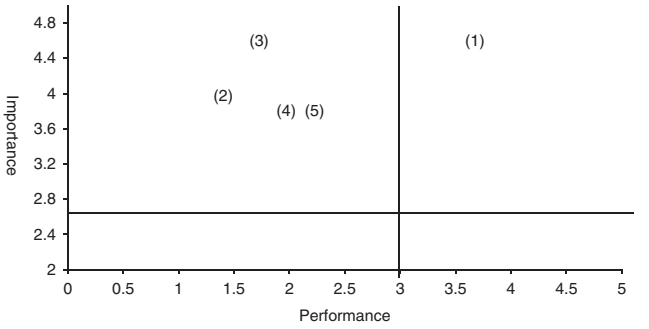


Figure 9.
Elements of financial ability

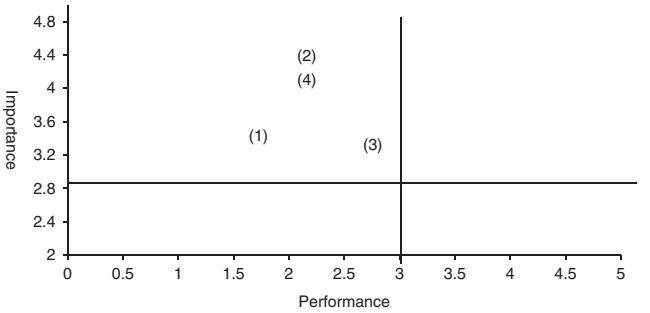


Figure 10.
Elements of creativity and innovation ability

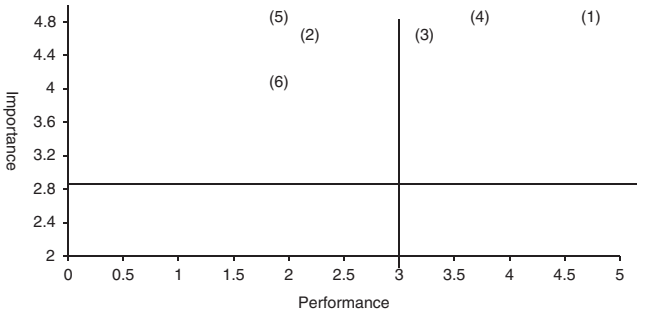


Figure 11.
Elements of cooperation of companies

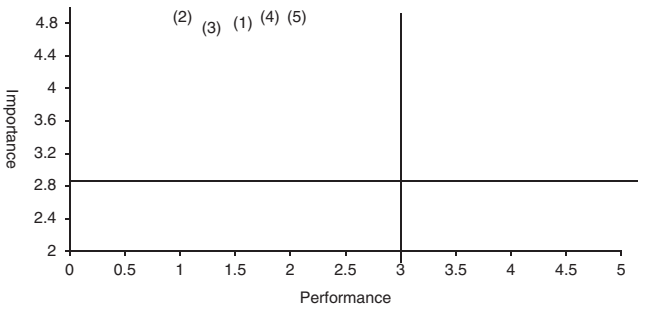


Figure 12.
Elements of supply chain flexibility

all long," (3) "acquire the fund from banks immediately," (4) "have complicated procedures to hand in the application of loans to banks," and (5) "satisfied with the services standard of banks" are all in the "concentrate here" quadrant.

5.4 The ability of CI

All the four elements are in "concentrate here" quadrant: (1) high-tech company, (2) high-creativity company, (3) constantly develop new technology and put them into practical application and (4) apply for patents to the government for new invention and innovation. From Figure 10 it can be inferred that there are no elements in the quadrants: "keep up the good work," "low priority," and "possible overkill."

5.5 The CC

This part consists of six elements (Figure 11): (1) share correct information with cooperators, (3) share ample information with cooperators and (4) share reliable information with cooperators fall into the quadrant of "keep up the good work." On the other hand, (2) share complete information with cooperators, (5) jointly solve the problems of supply shortage and supply surplus with cooperators and (6) help cooperators improve product quality are in the "concentrate here" quadrant.

5.6 Supply chain flexibility (SCF)

The last part includes five elements (Figure 12): (1) shorten the lead time of manufacturing, (2) improve the frequency of launching new products, (3) adjust the transportation plan immediately, (4) make a quick response to the market change on the aspect of product design, technology development and stock condition and (5) adjust manufacturing plan according to the clients' demands correspond to "concentrate here" quadrant.

6. Discussion

This paper assesses the relative importance and performance provided by four companies in two clusters i.e. textile and two home appliance manufacturers. Consolidated representation of all elements on the importance-performance analysis is shown in Figure 13. The analysis displays that around 21.2 percent of 33 questions fall into the quadrant of "keep up the good work" which means that companies emphasize the high level of importance on these 7 elements/items/criteria also suppose that company performances reach customers expectation. None of the items falls into the quadrant of "low priority" and "possible overkill." Around 78.8 percent of 33 questions were classified into the quadrant of "concentrate here" which means companies realize the importance while customers are not satisfied with their performance.

6.1 The "keep up the good work" quadrant

In this quadrant, the factors are perceived as the high importance and high performance which means companies emphasize the significance of these factors and distribute more resources on them; customers are satisfied with the actual performance of these factors.

In detail, on the aspect of the SL, the elements (1) realize the significance of reducing cost, (2) share the manufacturing information and (3) receive information from partners are in the "keep up the good work" quadrant. With the mean of 5 on both importance and performance, respectively, companies appear to stress the importance of reducing cost.

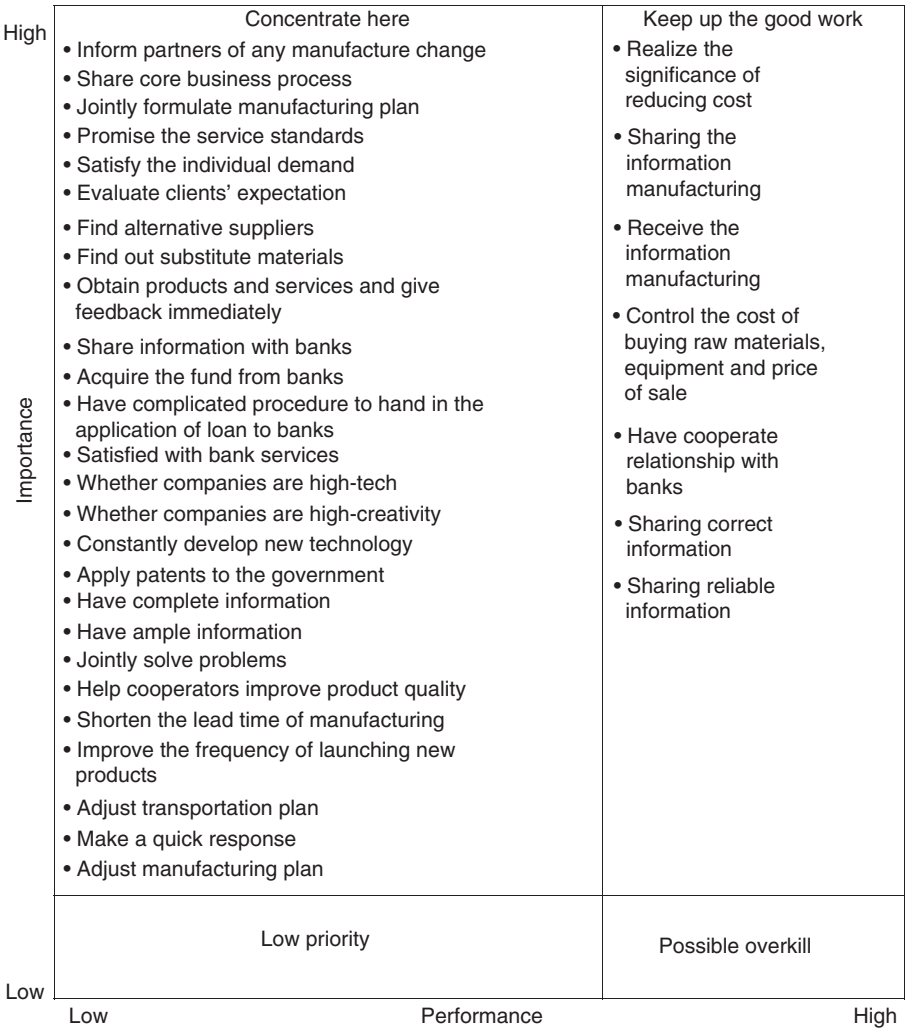


Figure 13.
Consolidated representation of collaborative operational capabilities elements

They wish to reduce the expenditure of cost to improve profit. From the perspective of customers, they are satisfied with enterprises' consciousness. The element "Share the manufacturing information," holding 4.5 on importance, appears to be one of the criteria for companies to realize the SL which means companies should positively share their information with upstream and downstream entities. With a mean rating of 4.25, customers can receive the information from these companies timely. Similarly, when companies share information with upstream and downstream partners, they also wish to receive information from them. With the high mean of 5 on importance, the performance also obtains 4, and this means companies can indeed receive information from their partners.

On the aspect of the EIC, only element (1) "control the cost of buying raw materials, equipment and price of sale" is in the "keep up the good work" quadrant. With the average mark of 5 on importance, all four companies give highest mark on this factor.

They suppose that the cost of procurement takes the largest percentage of expenditure. However, Company A performed disappointedly with the rating of 2, which means this company does not have the ability to control the cost of procurement. The other three companies performed relatively well.

On the aspect of FA, element (1) "have cooperated relationship with banks" falls into the "keep up the good work" quadrant. With the high rating of 4.75 on importance, companies positively collaborated with banks. This is because companies think banks can assist them to solve fund problems. In the same vein, customers are pleased with their performance.

On the aspect of the CC, the elements: (1) share correct information with cooperators, (3) share ample information with cooperators and (4) share reliable information with cooperators are classified in the "keep up the good work" quadrant. With the high rating of 5, 4.75 and 4.75, respectively, companies still take these requirements in mind and pay attention to the properties of information. From the customer perspective, the shared information can indeed help them meet their demands. Correct information is of the highest importance because it may influence companies make correct strategies.

6.2 The "concentrate here" quadrant

This quadrant contains the remaining elements of all the factors. Surprisingly most of the items were in this quadrant. On the aspect of the SL, six items are to be improved. With the average rating of 4.25 on the element (4) inform partners of any manufacturing change, companies keep informing their partners of any manufacturing change. However, from the perspective of customers, this behavior should be changed. Companies A, B and D may not provide appropriate information to their partners and subsequently they may make their customers disappointed. Companies always share core business process with their cooperators such as the efficiency of manufacturing and the establishment of product line. What they endeavor to do cannot sometimes satisfy their customers. Many customers suppose that what companies share is not real core information so they criticize the performance of these four companies. Similarly, companies usually jointly formulate the manufacturing plan, which can help them reduce uncertain factors. The customers' evaluations suggest that what companies perform cannot always meet their requirements. With such comments, (5) share core business process and (6) jointly formulate the manufacturing plan fall into the section of "concentrate here." The next three factors, that is, (7) promise the service standard, (8) satisfy the individual demand and (9) always evaluate the clients' expectation all illustrate the expectation of customer services. With the recognition of enhancing service standard, customers give a surprised common for these four companies. They are quite disappointed with the service offered by companies. Companies often ignore the after-sale service so that many broken products cannot be maintained freely. Customers have to pay for fixing components. On the other hand, companies will not evaluate customers' expectation, since companies are reluctant to spend much cost on it.

On the aspect of the EIC (2) find the alternative suppliers, (3) find out the substitute materials and (4) obtain the products and services still to be improved. With the fierce competition between companies, they realize that they have to enhance the bargaining power when negotiating with partners. If raw materials suppliers increase the price of raw materials, companies would not like to continue to cooperate with this supplier. So they suppose that the ability of finding alternative suppliers is one of the key factors in beating other rivals. However, finding alternative suppliers is not so easy. Some raw materials suppliers monopolize the provision so that there is no second one can supply

the same material. With such situation, the actual performance is marked low to 1.75. Similarly, with the limited resources to be utilized, companies still attempt to find out the substitute materials to avoid the deficiency of current materials. As high importance for each company, the performance is not satisfying. Utilizing substitute materials should resolve the technical problems such cost control; this is reflected on the mean rating of 1.75. Low performance is also reflected on the element (4) "obtain the products and services immediately and give feedback." Bullwhip effect is may be the result of the industrial chain expansion. Delays in information and product may result in loss for companies. However, due to the ability of company itself, customers are not satisfied with the companies' performance and hope that they can proceed to changes.

"Financial ability" is the third measurement. In the quadrant of "concentrate here," there four factors: (2) share manufacturing and finance information, (3) acquire the fund from bank immediately, (4) have complicated procedure to hand in the application and (5) satisfied with the services standard of banks. All companies highlighted that sharing manufacturing and finance information will help them obtain fund easily. But in fact, all of them would not like to share such confidence with banks because of potential issues with revealing information to their competitors. This was reflected on the low average rating of 1.5. On one hand, companies are reluctant to share their core information but on the other hand they would like to acquire funds from banks. Apparently, it is impossible for banks to provider support if they are not have up-to-date information on companies; the mean rating of 1.75 explains the result. Undeniable, complicated procedures have a deep influence on the efficiency of companies. The mean rating of 2 can certify that there is a large room for companies to improve. Under these scenarios, the banks cannot meet the customers' services and the performance obtains 2.

All the factors fall into the quadrant of "concentrate here." Whether companies are high-tech or high-creativity is of significance for their future development. However, almost all of them would like to adopt both strategies: the mean rating on performance of 1.75 for high-tech and 2.25 for high-creativity. For high-tech companies, new technology is the promise for them to attract more customers. Companies should develop new technology constantly to keep competitiveness whereas the actual performance is only 2.75. Companies could increase their expenditure on technology to change the current situation. New product development, reflecting high-creativity is also low, corresponding to 2.25.

The next element is the CC. In this part, the elements (2) share complete information with cooperators, (5) always jointly solve the supply problems and (6) always help cooperators improve product quality are distributed in the "concentrate here" part. Sharing complete information is a fundamental principle for cooperators. Whether information is complete will decide the fact that companies can understand their cooperators comprehensively. As a result, the mean mark of 2.75 reflects that companies would need to provide more complete information. With the average rating of 5 on importance, companies usually jointly solve the supply shortage or surplus whereas they perform disappointedly. Some companies may put forward a one-sided solution, which may not solve the problem. Similarly, helping cooperators improve product quality is highly important. Consequently, both factors are marked 2 on performance.

The final element is the flexibility of supply chain. All five factors are in the "concentrate here" quadrant. For manufacturer, shortening the lead time of manufacturing will definitely reduce the risk of market change. Many companies would like to introduce such idea to their companies. However, the actual situation is dissatisfied. Owing to the collaboration problems, there is always overproduction that

takes place in companies resulting in overstocked products. The mean rating of 1.5 reflects the above phenomenon. With the average mark of 5, companies always concentrate on improving the frequency of launching new products. On the contrary, the performance rating is not corresponding. Being short of ability to technology development, companies cannot keep such frequency and obtain the performance of 1.25. With the same mark of 1.25 on performance of adjusting transportation plan, companies have to change themselves to make an immediate change on transportation. Making a quick response to the market change is perceived as highest importance whereas companies acquire 1.75 on performance. Also due to their capabilities, they cannot respond to the fast market change so as to take responsibility for loss. The last factor is the ability of manufacturing plan adjustment. According to the market change, the manufacturer should timely make decisions whether they should adjust the production plan so as to satisfy customers' taste. On the contrary, high importance does not bring excellent performance. Customers are disappointed with the companies.

6.3 The "low priority" and "possible overkill" quadrant

In our analysis we did not identify elements as low important. The possible reason is that respondents consider those 33 items are highly significant for companies' improvement. They hope these factors can perform more satisfactorily in the future to realize the benefits of 4PL and industrial cluster integration.

6.4 Theoretical and managerial contribution

This research contributes to the literature on industrial clusters and 4PL by extrapolating the role of 4PL in the clusters' competitiveness (Hubing, 2009; Xiaogang, 2011). It extends other studies (e.g. London and Kenley, 2001; Hui *et al.*, 2006) in that it does not only focus on antecedents and benefits of clusters, but suggests a framework that shows particular elements in the form of resources and hence capabilities (Barney, 1996, 2001, 2012; Wu *et al.*, 2006; Chae *et al.*, 2014) and their role and ranking in achieving competitiveness. Our study is in line with other scholars (e.g. Li and Peng, 2006), in that it proposes that resources and subsequently their operational capabilities should be complementary and shared within partners within the cluster in order to promote specialization and enable companies reach sustainable competitive advantage. It underlines the role of physical and information resources in building sustainable competitive advantage (Nicovich *et al.*, 2007; Wong and Karia, 2010; Allred *et al.*, 2011). Our framework, following Wu *et al.* (2010) has particular importance for developing countries, since it addresses the gap in the relevant literature (Humphrey and Schmitz, 2002) regarding the role of clusters in competitiveness in the specific context.

Our study aligns with those scholars suggest that the competitiveness of clusters is much dependent on both their own resources and capabilities, but also on the combination of their internal resources with those of the cluster (Hervas-Oliver *et al.*, 2008; Hervas-Oliver and Albors-Garrigos, 2009; Wu *et al.*, 2010) within developed countries. We are not, however, investigating different types of proximity between cluster firms and how they influence collaboration and innovation (Letaifa and Rabeau, 2013; Molina-Morales *et al.*, 2015). We highlight, as in previous studies (Xiaogang, 2011) the role of 4PL as a collaborative mechanism within clusters (Hingley *et al.*, 2011) but our study is distinct in that we propose and classify operational capabilities following Wu *et al.* (2010). We investigate 4PL as a support mechanism that enables firms within the cluster to acquire operational capabilities and increase their competitiveness within

developing countries. Furthermore, within developing countries, studies may have discussed how knowledge systems and technology influence long-term competitiveness (Bell and Albu, 1999; Giuliani, 2013; Manning, 2013) or technological capabilities (Wang and Zhou, 2013), but the role of 4PL in operational capabilities has not been studied. In this regard, our study particularly states the importance "creativity and innovation ability" and "supply chain flexibility" in the use of 4PL for industrial cluster competitiveness in the developing countries' context.

In terms of managerial significance, our paper and proposed framework can be applied in cases where companies would like to engage in creating clusters for competitiveness and companies that are already participating in clusters. For our proposed framework would provide useful guidance on the particular resources and capabilities, as well as on the way complementarity and importance between resources and capabilities could help in achieving the cluster's and cooperates' targets. Our proposed framework could be used as an "aide memoire" by managers within the cluster and companies that would like for instance to assess the level of resources and capabilities possessed within the cluster and companies and adjust them, in order to gain sustainable competitive advantage and higher performance. The next step for managers and practitioners would be to check which resources that have been rated highly lie within the company, which are acquired from within the cluster, as well as how the company and cluster could acquire resources differently (e.g. recruitment) to ensure that they possess the necessary resources and capabilities and remain competitive.

7. Conclusion

This paper aimed to develop a collaborative operational capabilities framework for 4PL and industrial cluster integration. This paper using RBV as a lens and studies the effect of usage of resources across firms and its performance to achieve sustainable competitive advantage. Comprehensive literature reviews have been carried out to identify the six factors that constitute the collaborative operational capabilities framework. The major factors identified are SL (operational improvement), industrial chain expansion (operational configuration), companies' cooperation (operational cooperation), supply chain flexibility (operational responsiveness), FA (operational customization) and CI ability (operational innovation). Interviews have been carried out in four companies from two industrial clusters to understand the integration influence in the developing country context. Our results indicate that totally the integration between 4PL and industrial clusters haven't realized the potential of CI and supply chain flexibility and they are short of competitiveness when they compete with other rivals. To some extent, they are good in other four factors. However, it is surprising to note that many firms in China were not aware of the potential benefits of 4PL integration. In the process of our study we realized that managers are not reluctant to spend a large amount of time and capital on certain projects that are very clear in making profits. Managers were also afraid that they could not take back capital they invest on it if something goes wrong later on. On the other hand, many companies misdoubt the information revealed to others which may sometimes mislead them. It is also evident that companies in the industrial cluster are not willing to take risk. Under these circumstances, the government should take responsibilities to build the 4PL-industrial cluster integration to attract more companies to take part in it. Certainly it will help the firms within the clusters to gain mutual benefits and to their prosperity.

There are few limitations of our study. The collaborative operational capability framework could be tested in the developed country context on a large-scale empirical

data to find out its usefulness and to identify other constraints. Additionally, since we did not examine why managers provided these answers in the matrix, it may be fruitful to further discuss why managers in developing and developed countries provide such scores in the importance-performance matrix and explain differences in their behavior. In this research we looked at issues of collaboration and cooperation, but not coopetition; it may be that future research looks at the role of 4PL and coopetition in establishing competitiveness within industrial clusters. Furthermore, the findings may slightly for different industrial clusters in the same country context. In future researchers can develop dynamic collaborative operational capabilities frameworks to incorporate and address any uncertainties to render cooperation more resilient. It is also interesting to study the effect of 4PL-industrial cluster integration using alternative organizational theories and mediators. In this vein, since we did not examine issues of power-resource dependency using, e.g. resource dependency theory (Pfeffer and Salancik, 1978; Hillman *et al.*, 2009) within the cluster and future studies could look at the role of power within 4PL mechanisms that influence competitiveness.

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Corresponding author

Thanos Papadopoulos can be contacted at: A.Papadopoulos@kent.ac.uk