The Design of Service System for SMEs Collaborative Alliance: Cluster Supply Chain

Xiao Xue
Lab of Service Science, Henan Polytechnic University, Jiaozuo, Henan, P.R.China
xuexiao@tsinghua.org.cn

Zhe Wei and Zhifeng Zeng
Information Network Security, Yunnan Police Officer Academy, Kunming, P.R.China
{weizhe1026, hhzzf}@163.com

***Abstract*—In order to help small and medium enterprises (SMEs) cluster to face the global challenges, the definition of "cluster supply chain" is put forward as a new type of management pattern, which is the combination of industrial cluster and supply chain management. However, the related research on cluster supply chain is still in its infancy, and it is difficult to put theory results into practice. Based on the background, this paper presents an analytic framework to bridge the gap between theory and practice in the field. The framework includes four views - business modeling, specification modeling, realization modeling, system evolution, and integrates methods from value network modeling, agent oriented modeling and service oriented analysis &design. In the end, we utilize a case study of China textile industry for demonstrating how to apply the framework to provide new insights into the construction and development of cluster supply chain.**

***Index Terms*—cluster supply chain (CSC); service system design; agent modeling technology; collaborative alliance.**

I. INTRODUCTION

With advancement of technology & science and development of productivity, continuously increasing customer consumption level, ever-rising competition among firms and huge economical and social changes make the whole market more and more uncertain. In the context, the coalition of enterprises is becoming a kind of common economic phenomenon, which exerts the best effect of each element [1] and other advantage of local networks, thereby reducing the risks and uncertainties, achieving the goals difficult for individuals to reach, and maximizing the value of the overall system. For enterprises, the collaboration between them has been defined as a process: "enterprise organizations improve each other's capabilities through the exchange of information and resources, to face with common challenges and opportunities."[2].

This work is supported by National Nature Science Foundation under Grant 60905041,Fundamental Science Research Foundation of Henan Province under Grant 092300410216, and Young Scientist Foundation of HPU under Grant 649100.
Xiao Xue, Henan Polytechnic University, Jiaozuo, 454000, China (phone: 86-391-3989805; E-mail:xuexiao@stinghua.org.cn)

However, in developing countries (e.g. China), it can be found that small and medium enterprises (SMEs) are often locked in their routines and unable to introduce innovative improvements to their products and processes. Industrial cluster and supply chain management, acting as effective regional economic cooperation platform and organizational management paradigm, are becoming key points where SMEs can survive and develop. Supply chains are defined as a set of vertically organized transactions representing successive stages of value creation. The literature on supply chain analysis (SCA) suggests a systemic understanding of resource allocation and information exchange between firms engaged in sequential stages of production [3]. Cluster network analysis (CNA), in turn, provides numerous tools to depict the structure of inter-organizational relationships or "ties" based on network structure constrains and firms' actions [4]. Unlike SCA, CNA is not particularly concerned with sequentially organized ties, but rather with horizontal relationships between firms. Even though both SCA and CNA stress the importance of collaboration between firms and how inter-organizational relationships can be a source of competitive advantage, the integration of their core concepts and analytical tools are still omitted.

Obviously, it is worth making some research on how to make full use of the benefits of both to help the development of SMEs organization. Based on the background, the definition of ``cluster supply chain'' is put forward as the combination of industrial cluster and supply chain management[5], i.e. a set of networks comprised of horizontal ties between firms within a particular industrial cluster, at the same time these networks being sequentially arranged based on the vertical ties between firms. Through horizontal cooperation (i.e. with other SMEs occupying the same position in the value chain), enterprises can collectively achieve economies of scale beyond the reach of individual capability, e.g. obtaining bulk-purchase with lower price, achieving optimal scale in the use of machinery, pooling together their production capacities to satisfy large-scale orders, and even competing with industry giant in international market. Through vertical

doi:10.4304/jsw.6.11.2146-2153

cooperation (with other SMEs occupying different positions along the value chain), enterprises can specialize some core business and give way to an external division of labor. Inter-enterprise cooperation also gives rise to a collective learning space, an “invisible college”, where ideas are exchanged and developed and knowledge is shared collectively in an attempt to improve product quality and occupy more profitable market segments. In a word, through cluster supply chain, individual SME can address the problems related to their size, help each other and strengthen their competitiveness.

Despite much effort from government and SMEs, the actual construction and operation of cluster supply chain does not show successful results than it should be. How to design the service system to support the cluster supply chain strategy effectively remains a problem unresolved. This has led to the attention to the transition between business theory and practical operation, i.e. “how to apply IT technology to support the business strategy on cluster supply chain.”[6]

This paper focuses on how to introduce the concept of service system to bridge the gap mentioned above. The design of service system will serve as clues to integrate the research results from different disciplines, in order to support the construction and operation of cluster supply chain. The rest of this paper is organized as follows. Section 2 introduces the research background for cluster supply chain. Section 3 provides some related research work and current challenges in the field. The modeling framework for cluster supply chain is described from three different views in section 4. The completed modeling process will be presented through a case study in section 5. The concluding remarks will be given in section 6.

II. BACKGROUND

Currently, it is the turning point when China is facing the process of economical transit and melting into global economical system. The uncertainty from inter and outer environment brought by “3C”(Customer, Competition and Change) forces domestic firms to carry out organizational and institutional innovation in order to sharpen their edges of international competition. Although a lot of regional governments take an emphasis of regional economical development and supply chain management strategy diffusion, actual operation does not show successful results than it should be. Therefore, how to develop regional economy, to upgrade its industry, to join the forces of small-medium sized firms that is capable of competing with much larger companies that might otherwise dominate them, all of which are currently waiting to be explored.

Cluster supply chain is a promising business pattern that enables enterprises to quickly acquire new or critical resources and competencies at minimal cost. In figure 1, the structure of “cluster supply chain” is summarized from the view of value networks[8]. In the structure, there are not only a couple of core enterprises, but also it exists many upstream and downstream firms which conglomerate in the same region[7]. The business pattern enables participating firms to leverage each other's strengths and to collaboratively achieve higher overall performance levels. It gives the enterprises an opportunity to increase the speed and flexibility of their response and enables a connection with their partners for collaborative execution. Consumers encounter with core enterprises directly, which decides what goods or services should be provided. Core enterprises are linked together through horizontal collaboration at a tie of the whole supply chain(such as supply, sales or manufacture etc..). Auxiliary partners provide producer-oriented service to core enterprises, such as maintaining service, auxiliary service, R&D service and so on. Because of geographic clustering and industry association, the three of them (core enterprises, partners, and consumers) not only cooperate within a single chain, but also cooperate and compete across different chains. Public coordination & management institutes and public IT service providers act as the infrastructure to link the three parts support the operation of cluster supply chain. As a consequence, the entire cluster can respond to environmental challenges in a much better and more effective way, and develop from some low-added value, non-core ties to high-added value ties along value chain by utilizing shared capabilities and resources.

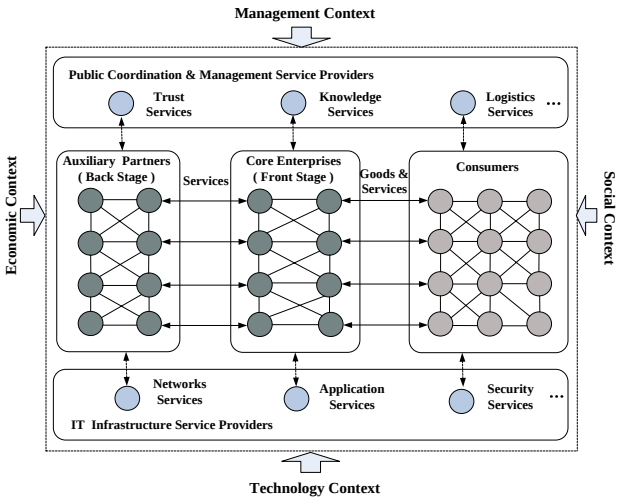

Figure 1. The structure of cluster supply chain.

As a new type of enterprise network, cluster supply chain is a dynamic system with the inherent complexity. On the one hand, each enterprise can be independent in decision-making and management, with the goal of maximizing its own profit. Due to the openness nature of cluster supply chain, firms can join or withdraw freely and only be linked together loosely through some kind of agreement. On the other hand, individual autonomy should not conflict with enterprises alliance to keep the stability of collaborative organization. Each SME needs to have the reciprocal knowledge to adjust strategies continuously to reach an equilibrium between individual interests and common task[4]. If the absence of the supply chain characteristics in the cluster, it will result in the homogenization tendency in products and the final vicious competition between firms. If the absence of the

network features, the cluster will turn out to be an inefficient organization as a result of only cooperation without competition. Therefore, it is necessary to establish dynamic competitive (competition & cooperation) balance between two or multi single supply Chains [9].

In China, the business of many SMEs has been in operation without cooperation, and their isolated mindset undermines the cluster supply chain strategy. The success of cluster supply chain depends on the government, firms and third-party to work together. Lack of trust and having isolated mindset, reluctant to share the knowledge, technology and information are the basic reasons for the absence of horizontal linkage among the local small and medium industries. At the same time, high expenses in clustering and high infrastructure cost are also viewed as the main barriers, followed by other reasons, such as profit sharing, location, brand, labor, uncertainty. Majority of the enterprises believe that trust and strong laws and regulations are essential to the success of cluster supply chain, and cooperation spirit and market are necessary in the practice of cluster supply chain. Therefore, it is appropriate to follow the "step-by-step" approach in the construction of cluster supply chain.

III. Related Work

Currently, many of the concepts, techniques, and curricula on cluster supply chain originate in and emphasize different disciplines, such as economics, management, sociology and information science. Generally, those categories concentrate on describing cluster supply chain at different levels of abstraction, including business level, specification level and realization level. Figure 2 gives several different perspectives for studying cluster supply chain, as well as their relationships. The details are shown as follows:

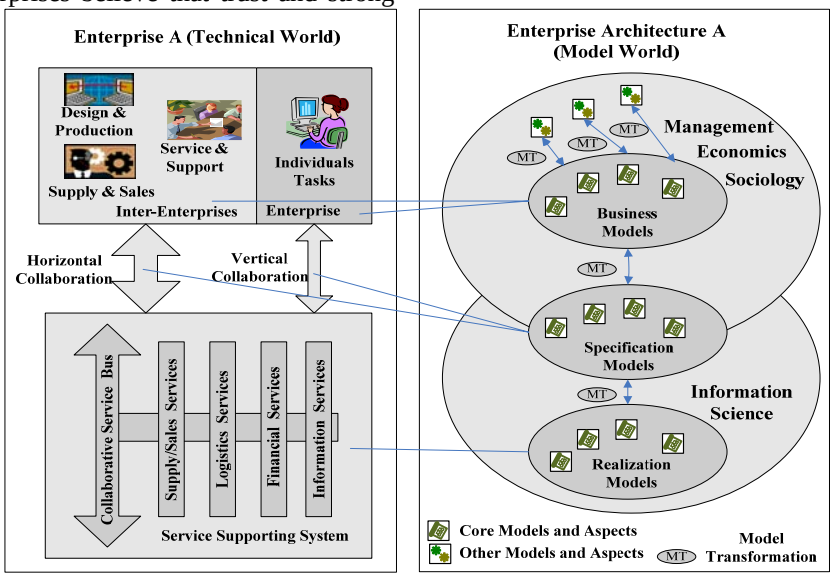

Figure 2. The gap between different research perspectives

- **Economic approach**: Consider an industrial cluster as a peculiar organization of the economical units, characterized by the existence of agglomeration economies both external as individual entity, and internal as the local set of SMEs. SMEs included inside are not only specialized in one industrial sector, but also linked by "vertical" or "horizontal" relations, which means supplier-to-customer relations (as in a typical supply chain) or relations among potential competitors of a same product/component (as in a group of parallel producers) respectively. The elementary form of coordination is between a market and a hierarchy: each internal SME can fruitfully participate in the internal transactions but a commonly accepted agreement dedicated to assure a real cooperation exist, and reduce as much as possible self-interested behavior[10].
- **Management approach**: Model an industrial cluster as a complex production system composed of many specialized production units. They are located in a specific region and interact through a capillary network of logistic and information. The scope of this analysis approach is mainly to estimate the behavior of those internal enterprises to understand how their inclusion in the cluster could increase their profit, as well as to evaluate the coordination mechanism of the cluster in order to know its effectiveness [11].
- **Sociological approach**: Analyze cluster as a very complex social structure able to give rise to collaborative links between enterprises and other types of industrial/economic/institutional agents operating in the same geographical area. Thus, the capital and the knowledge generation and transfer may happen in the SMEs network. The internal learning mechanism between individual SMEs, occurs and is favored by both the high labor specialization and division, and by the greater opportunity of personnel to change employment from one SME to another. The SME cluster characteristics emphasized by the sociological

approach surely appear to be significant conditions for a robust cluster organization [12].

- **Technology approach**: Focus on the construction of IT infrastructure to support the operation of cluster supply chain, including "transactional information technologies" (acquiring, processing and communicating raw data from customers and partners, such as e-commerce), "management information technologies" (monitoring, controlling and scheduling enterprises' own operation process, such as ERP) and "analytical information technologies" (analyzing raw data to help managers, which is a task at a higher level, such as customer relationship management)[13]. As the infrastructure, current IT solutions lack effective ways to support the dynamic evolution and derived phenomenon of cluster supply chain.

As shown in figure 2, a majority of current studies are divided the two categories: economics /management /sociology and information science. The former adopts the "top-down" approach and focuses on the display of cluster supply chain at the level of business abstraction, including the interaction network model, information and knowledge exchange, collaborative standards and methods between enterprises. Although a lot of related results have been made, the business model remains at a qualitative and descriptive stage, which is difficult to reveal dynamic evolutional mechanism and derived phenomenon of cluster supply chain. In the field of information technology, researchers adopt the "bottom-up" approach to study how to apply IT to support the special demands of cluster supply chain. As the supporting platform of enterprises collaboration, realization model lacks effective ways to absorb the fruits of the former and provide guides for enterprises collaboration in the cluster. In a word, few experts embed both of them to analyze cluster supply chain, which has posed a challenge in its research and practice.

The multi-disciplinary or trans-disciplinary character of cluster supply chain makes it intrinsically difficult to define a new, unifying analytic framework. In addition, there may be some substantial debate about how to describe the transition and the implications of different disciplines for research and practice. This uncertainty and ambiguity is inevitable during the startup phase of any emerging discipline, but it means that calls for integrating several research perspectives in support of the effective& convenient construction and operation of cluster supply chain. Given this growing importance of integrated view, it is therefore no surprise that both the academic and practitioner communities are showing great interest in exploring and developing the integrated analytic framework. We will employ service process as the clue to integrate other researcher's methods and theories, design a set of analytic framework for cluster supply chain, and further explore the flexible way to develop SMEs cluster and region economy.

IV. SERVICE ORIENTED MODELING FRAMEWORK

A. The service oriented modeling Framework

Much like manufacturing a product composed of hundreds or thousands of components, cluster supply chain integrates (or outsources) investments in numerous assets, processes, people, and materials to deliver the "planned" service and create the "expected" value. It can be seen that the concept of "service" can act as a clue for the whole lifecycle of cluster supply chain. To ensure that the services fit the needs of end customers, the design of cluster supply chain must focus on how to operate and manage the service process. Therefore, it may be an appropriate means to unify different disciplines conceptually and methodologically [14].

In designing a new service or redesigning an existing service, managers and designers must make decisions about each component of service process, from major decisions like market strategy to seemingly minor decisions like workforce training. For even a relatively simple service, numerous decisions are made from the idea through the design stage to the final delivery. The large number and wide variety of decisions required to design and deliver a service are made at several levels: business level, specification level and realization level. Before, during, and after service delivery, in order to deliver the correct service to targeted customers, a major challenge is ensuring that decisions at each of these levels are made consistently.

This idea highlights a critical shift in conceptual categories, which uses service process as a more useful concept for organizing our research. When the economy was dominated by large horizontally and vertically collaborative organization, the firm can be seen as the unit of analysis. In the context, a service oriented modeling framework for cluster supply chain is proposed. As shown in figure 3, the framework is built around the service process of cluster supply chain, including four major functional units: analysis of service provider, analysis of service customer, service design, and service operation. Aimed at each unit, there are a corresponding modeling phase to depict its various aspects, i.e. business modeling, specification modeling, realization modeling and system evolution.

The phases are indicated in figure 3 as circles with a number and include: 1) based on existing business theory, the evaluation of business situations and all kinds of resources available from service provider (partners, public coordination institutes, IT providers); 2) by means of agent modeling technology, the identification of particular collaboration requirements by depicting the characteristics of service consumer(partners, core enterprises and end customers); 3) according to the above models, the design of service system to support the construction of cluster supply chain; and finally 4) the operation and reconstruction of the actual service system, including the management of service system, the evaluation of system performance, and the optimization based on feedback information.

Based on the framework, we can unify different research perspectives (Economics, Sociology, Management and Technology) on the same thing (the

construction and operation of cluster supply chain), and pave the way for the final successful application of cluster supply chain. However, it is worth noting that one firm may play both “service provider” and “service customer” at the same time. Because each firm belongs to one node of service chain, it may act as “service provider” to back nodes and “service consumer” to previous nodes. For example, in terms of core enterprise, it provides services to end customers, and consume services from three other partners (auxiliary partners, public coordination institutes, IT service providers) at the same time. Therefore, during the phase of analyzing service provider or service customer, we aim at the whole service chain, not a separate entity.

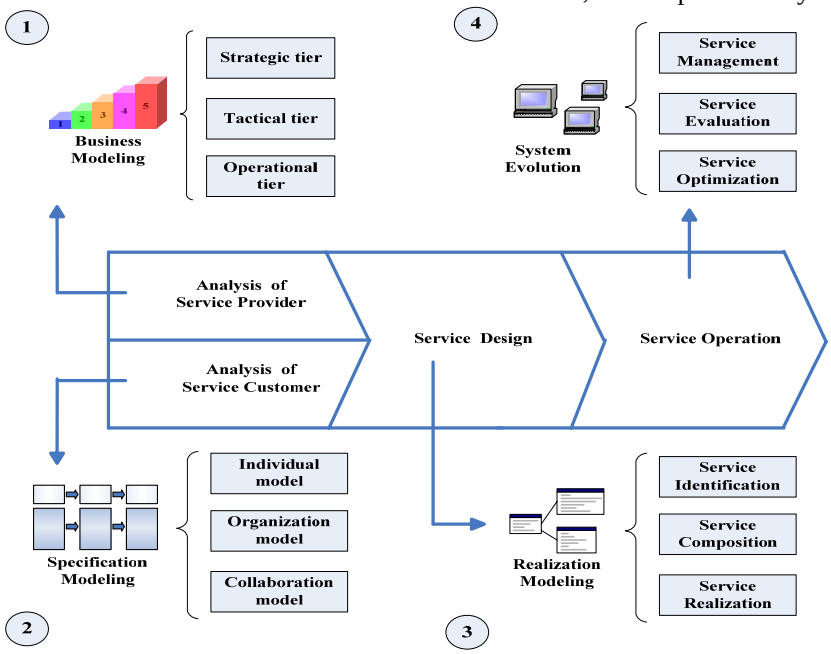

Figure 3. The Modeling Framework for Cluster Supply Chain

B. The detailed modeling phases

As a virtual economic organization consisting of heterogeneous firms gathered in vast dynamic and virtual coalitions, cluster supply chain is depicted from four different aspects in the framework. In the subsection, we will give the details of each modeling phase.

Business Modeling : Business models need to clarify what kind of services can be provided by cluster supply chain[15], that is decided by sources of value emanating from it, and all kinds of factors to impact it, including coordination mechanism, IT infrastructure, business context, customer participation etc.. Based on business models, we can evaluate current situation of the whole network organization, and decide whether cluster supply chain is an appropriate choice. Business modeling typically falls into three tiers: strategy, tactical and operation. The categories are based on the planning horizon, the apparent width of the opportunity window, and the level of precision required in the supporting information.

Specification Modeling : The phase will identify how to apply the services from cluster supply chain to improve internal structure of enterprise organization. Aimed at the problems found in the previous phase, organization needs to make changes and improvements in itself, maybe including enterprises' own competitiveness, network architecture, coordination mechanism etc.. What's more, a few new inter-firms collaboration patterns may be found based on the new services. The agent oriented modeling technology may be an appropriate means to depict all these characteristics. Here is divided into three parts: individual modeling, organization modeling and collaboration modeling.

Realization Modeling : To leverage the advantages of cluster supply chain effectively, it is necessary to bridge the gap between front room organization collaboration processes and back room service support processes by means of service system. Therefore, the agent-oriented specification needs to be transited into service-oriented realization models. Currently, the concept of Service Oriented Architecture (SOA) has become prominent. Services can be regarded at a higher level of abstraction than objects in object oriented programming. A service can be implemented by an object, a group of objects, or even a business process. In our work, the transition process will be implemented from three levels: service identification, service composition and service realization.

System Evolution : The target of cluster supply chain is not mere tools and accelerators for cluster, but to organize all enterprises as an organic entity. Based on the feedback on service delivery, we need to optimize service solution to drive business level to higher levels of accuracy, efficiency, and financial predictability. In order to be accepted by customers, system evolution has to adopt step-by-step policy and give full consideration of existing legacy systems, from electronic business (front end), to enterprise resource planning (core), to customer relationship management (back end)[16]. In the process of improving the performance of cluster supply chain,

three key problems have to be faced with: (i) how to manage the service system to make the best of its effectiveness; (ii) how to evaluate whether the service system can meet the demands of customers; (iii) how to reconstruct the whole service system with the fast-paced customer demands.

C. The customized modeling process

The modeling framework is the composition of model, tools and process, which needs to ensure that the development of system can be progressed in the controlled manner. Process is generally considered to be the core of the framework, which describes how to adopt the models to design a service system. Because of the difference in geography environment, culture, specified industry and cooperation levels, the structure and operation of cluster supply chain may be different. Therefore, it is necessary to customize the modeling process according to actual demands.

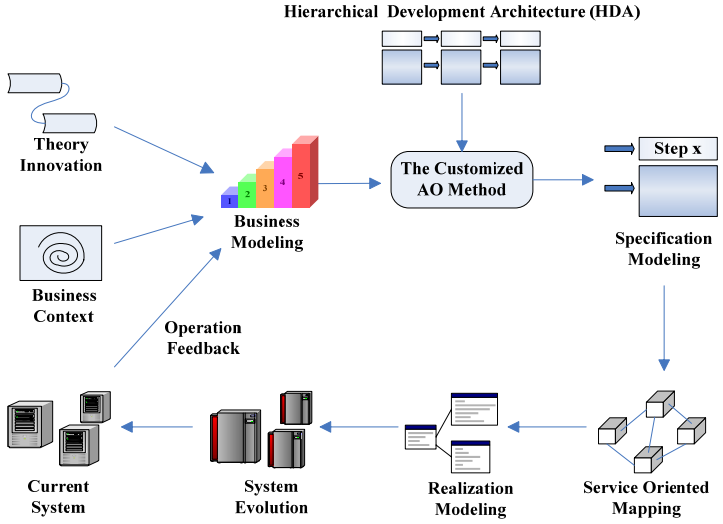

Figure 4. The customized modeling process.

Figure 4 gives a customized modeling process for the above modeling framework, which achieves the transition between four modeling phases. Business modeling is derived from three sources: theory innovation, business context and the feedback from current system operation. Specification modeling bridge the gap between the front stage (business modeling) and back stage (realization modeling). Based on the mapping theory, we can achieve realization models and the evolution of existing system. As the key conjoining business analysis and system implementation, how to realize the customization for specification modeling is the key of the whole modeling process.

Cluster supply chain is decentralized rather than centralized, emergent rather than planned, and concurrent rather than sequential. Based on Wooldridge [17]'s definition of agent, the agent paradigm is a natural metaphor for specifying cluster supply chain. Each partner in the cluster supply chain (plant, workshop, etc.) has the same characteristics as agent:

- **autonomy**: a company carries out tasks by itself without external intervention and has some kind of control over its action and internal state;
- **social ability**: a company in the supply chain interacts with other companies, e.g. by placing orders for products or services;
- **reactivity**: a company perceives the market environment and responds in a timely fashion to changes that occur in it. In particular, each firm modifies its behavior to adapt to market and competition evolutions;
- **pro-activeness**: a company can not only simply act in response to its environment, but also initiate new activities, e.g. launching new products on the market.

Therefore, multi-agent systems offer an appropriate choice for specification modeling. In fact, some researchers have applied agent technology to the industry, such as concurrent engineering, collaborative design, integrated scheduling and manufacturing system [18,19]. We have laid a solid foundation in the field of agent modeling, including the proposal of hierarchical development architecture (HDA) for AO (Agent Oriented) method customization, and its successful implementation in practical projects [20]. By means of reusing existing software assets (e.g. AO or OO model units), the new modeling method can be achieved. Then, we can apply the new method during the phase of specification modeling. The simulation platform may act as a test bed for the application and verification of the new method.

V. CASE STUDIES

Currently, globalization and the ease of transportation and communication have led many companies to move some or all of their operations to locations with low wages, taxes, and utility costs. For stable, labor-intensive activities such as manufacturing assembly and software localization, low factor costs are often decisive in driving location choices. In the context, China becomes the dominant makers of garment, steel, aluminum, cement, chemicals, leather and other goods, which drives the

rapid growth of its economy in recent years. However, the competitive advantage mainly relies on cheap labor and natural resources, and there is a real possibility of losing the competitive edge to cost competitors like Viet Nam, Philippines and Malaysia. With the advent of financial crisis and the intensification of environmental damage, it is becoming more and more difficult to remain the old development pattern.

The children garment industrial cluster in Zili Town of Zhejiang province is a typical example, which has existed since the early 1980's. Until 2009, there are more than 12,600 enterprises, 150,000 high-speed sewing machines, 250,000 employees in this area, which is with annual output of 400 million children's clothing (sets), annual sales of 15 billion RMB, more than 30% domestic market share, and 98% of the domestic market coverage. In recent years, the integration between enterprises along supply chain has begun to emerge, including material suppliers, textile processing, garment manufacturing, equipment parts providers, joint shipping stations, and some companies specializing in clothing design. However, the competitiveness of the whole cluster is still weak especially in some high-value added segments, such as the processing of high-grade fabric, clothing design and brand marketing. Textile processing and garment manufacturing occupies the core position of the cluster, which lies at the low-end of the global value chain.

Cluster supply chain can play an important role in the migration of the cluster to high-end of the global value chain. Different firms in cluster can collaborate in the pattern of cluster supply chain (including collaborative purchase, collaborative design, collaborative manufacture and collaborative sale), and try to optimize the market for their common benefits. In order to achieve the target, some public service system needs to be constructed to support the operation and upgrading of cluster supply chain, such as coordination center, information center, design center and other public platforms. The service providers may be from private and public sectors, as well as academia and nonprofit organizations.

The success of a cluster supply chain depends on the government, firms and third-party to work together. Today, high expenses in clustering and high infrastructure cost are also viewed as the main barriers, followed by other reasons, such as profit sharing, location, brand, labor, uncertainty. Integrating a package application into any enterprise environment can cost millions dollars and account for major application implementation delays and customer dissatisfaction. This area has been the focus of significant technology development in recent years. On demand, Web Services, Grid Computing, Autonomic Computing, Legacy Revitalization, and Integration Technologies are all being vigorously pursued by technology companies. Here, SaaS (software as a service) may be an appropriate choice to construct the open, integrated, autonomic and flexible service platform, which supports the integration of processes, data and systems within and between enterprises.

VI. CONCLUSIONS

Cluster supply chain is a new economic theory for SMEs to improve competitiveness and face global challenges through all kinds of collaborative strategies. Through vertical cooperation (i.e. the cooperation between upstream and downstream enterprises within a single supply chain), SMEs can strengthen their competitiveness to strive for high-value added segments by utilizing shared capabilities and resources. Through horizontal cooperation (i.e. the cooperation between homogeneous enterprises across different supply chains located in the same cluster), SMEs can achieve a breakthrough in some critical segments of the value chain (e.g. strategy development, core technology and workflow optimization) and even compete with industry giant in international market.

Based on the above background, the paper proposes a modeling framework to depict cluster supply chain from four views (business models, specification models, realization models and system evolution), which makes full use of service concept to bridge the gap between academic theoretical studies and practical realization regarding the application of cluster supply chain, and another one between research methods in management science and information science. Furthermore, we utilize a case study of China children garment industry cluster for demonstrating how to apply the framework to provide new insight into the construction and development of cluster supply chain. In the next step, we will design a set of Key Performance Indicators (KPIs) for performance evaluation, which will play an important role in verifying whether models can be in line with practice. Based on the feedback, we can improve current models and give better guides for the modification and upgrading of cluster supply chain.

REFERENCES

[1] Joseph Francis. Supply Chain Management &Business Financial Performance. *Http://www.supply-chain.org*. (2009)

[2] Himmelman AT. Communities Working Collaboratively for a Change. *The Himmelman Consulting Group, Minneapolis* (1992).

[3] Simchi-Levi, D., P. Kaminski and E. Simchi-Levi. *Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies*, New York, Irwin McGraw-Hill (2000).

[4] Villa A, Antonelli D, Cassarino I. Strengthening competitiveness through production networks. Issues in the management of collaborative demand and supply networks *In AAVV*, European Communities, Belgium, p47-57(2005).

[5] Jizi Li and Chunling Liu. Study on Cluster Supply Chain and its management (PHD thesis). Huazhong Agricultural University, Wuhan(2006).

[6] Biswas S, Roy S, Seshagiri S. Collaboration in Indian SME Clusters: A Case Study. *In the 3rd International Conference on Communities and Technologies*, p28-30(2007).

[7] Porter M.E. Cluster and the new economics of competition. *Harvard Business Review*, No.76, p77-90(1998).

[8] R. C. Basole and W. B. Rouse. Complexity of service value networks: Conceptualization and empirical

investigation. *IBM SYSTEMS JOURNAL*, Vol.47, No.1, p53-70(2008).
[9] Fudenberg D., Tirole J. Game Theory. Cambridge, MA: press(1991).
[10] Silijak DD. Large-scale dynamic systems: stability and structure. Dover, Mineola, NY(2007).
[11] Brenner T. Local. Industrial Cluster: Existence, Emergence and Evolution. Routledge, London(2004).
[12] Antoldi F. Between local tradition and global competition: introduction to phenomenon of Italian industrial districts. In: *Antoldi F (ed) Small Enterprises and Industrial Districts*. Il Mulino, Bologna(2006).
[13] Shapiro, J.F. Modeling the Supply Chain (2 edition). Duxbury (2006).
[14] Yuhong Yan, Juergen Bode and William McIver, Jr. Between Service Science and Service-Oriented Software Systems. *In the 2008 IEEE Congress on Services Part II*, p189-195(2008).
[15] L. Cherbakov, G. Galambos, R. Harishankar, S. Kalyana and G. Rackham. Impact of service orientation at the business level. *IBM SYSTEMS JOURNAL*, Vol.44, No.4, p653-668(2005).
[16] Pietro Mazzoleni and Biplav Srivastava. Business Driven SOA Customization. *ICSOC 2008, LNCS 5364*, p286-301, (2008).
[17] Wooldridge, M., Jennings, N.R. Intelligent agents: Theory and practice. *The Knowledge Engineering Review (10)*, p115-152(1995).
[18] Parunak, H.V.D. Industrial and practical applications of DAI. In Weiss, G., ed.: *Multiagent Systems - A Modern Approach to Distributed Artificial Intelligence*. MIT Press, Cambridge (Massachusetts, USA) , p377-424(1999).
[19] Shen, W., Norrie, D.H., Barth‘es, J.P.A. Multi-Agent Systems for Concurrent Intelligent Design and Manufacturing. Taylor Francis (London and New York)(2001).
[20] Xiao Xue, Zhi Sun. A Flexible Architecture for Representing Personality in Distributed Systems Development, *ICAL2007*, P1545-1550(2007).

Xiao Xue received the B.Tech. degree from the North China Electric Power University, Beijing, China, in 2001, and the Ph.D. degrees in 2007, from Institute of Automation, the Chinese Academy of Science. He is a post doctor at Tsinghua university, Beijing, China, focused on service science & engineering and agent oriented modeling technology. Prior to that, he was an Assistant Professor with the CS Department, Henan Polytechnic University. His research focuses on the development of agent-based modeling tools to support the design and management of complex enterprise IT systems exploiting recent advances in service science and knowledge engineering. He has published over 20 refereed research articles in academic conferences and journals in the areas of agent oriented methodology, cluster supply chain, information integration and emergency management.