

# Mapping basic structures of the extended supplier network

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### **Abstract**

Many authors argue that the traditional dyadic approach in network analysis is severely limited since it is not capable of analysing dynamic phenomena. Limitations of this dyadic approach is especially obvious, when supply networks are investigated from the perspective of logistics service provider firms (LSPs). The key task of these LPSs is mediation between dyads of traditional buyers (or customers) and suppliers inevitably extending the smallest unit of analysis from dyads to triads. Analyzing these triads is a real challenge. Actually, when we try to understand merely one transaction that is carried out in such an extended supply network, it turns out that the triadic approach has severe limitations too, the quadrat, the pentagon, or the octagonal has to be the basic unit of investigation. The objective of the paper is therefore to map the typical smallest building blocks of such extended supply networks, and in order to accomplish this to identify the dimensions that specify their structures.

**Key words:** extended supply network, network structures

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## Introduction

Many authors argue that the traditional dyadic approach in network analysis is severely limited since it is not capable of analysing dynamic phenomena (Choi – Wu, 2009; Ritter, 2000; Madhavan et al., 2004). Limitations of this dyadic approach is especially obvious, when supply networks are investigated from the perspective of logistics service provider firms (LSPs). The key task of these LSPs is mediation between dyads of traditional buyers (or customers) and suppliers inevitably extending the smallest unit of analysis from dyads to triads (Andersson et al et al., 2011). Analyzing these triads is a real challenge. Actually, when we try to understand merely one transaction that is carried out in such an extended supply network, it turns out that the triadic approach has severe limitations, the quadrat, the pentagon, or the octagonal has to be the basic unit of investigation. The objective of the paper is therefore to map the typical smallest building blocks of such extended supply networks, and in order to accomplish this to identify the dimensions that specify their structures. Consequently the paper is a basic, conceptual work. Without this theoretical ground work in depth analysis of such networks cannot be carried out. Therefore we think it is also a prerequisite of any practical oriented research, too. First we present a few real life case studies that focus on describing the structure of the extended supply network involved. Using empirical induction we then specify the dimensions along which the smallest unit of such extended supply networks can be determined. Finally, we give a summary and highlight future research directions.

## Real life cases in the extended supply network

The aim of the chapter is to present a few real life cases, each of them representing a typical solution in today's extended supply networks. Based on these short descriptions, we will be able to identify those characteristics that determine the build-up of these networks and by using that the smallest unit of analysis can be specified.

We present five real life extended supply network cases that were identified in a workshop organized by the authors and attended by three practitioners, all of them leaders of well-established and internationally successful logistics service provider firms. The five cases are the following:

1. ***The local triad***, consisting of a supplier, a customer<sup>1</sup> and a 2PL logistics service provider responsible only for the actual transport of the products sold by the supplier. Both the customer and the supplier are local, located in the same country.
2. ***The local, integrated quadrat***, consisting of a local supplier and a local customer, and again a 2PL logistics service provider firm. But in this case the supplier serves the customer using a sophisticated supply chain technique, actually the so called Vendor Managed Inventory (VMI) system. The LSP firm is a 2 PL responsible for the transport of the goods only, but because of the VMI has to be integrated into the traditional supply dyad to a higher degree compared to the first case.
3. ***The simple local quadrat***, consisting of a supplier, a customer, a 4PL logistics service provider that organizes the flow of materials between the actors of the traditional supply

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<sup>1</sup> Let us suppose now that the byer (customer) of the goods transacted in the classic supply dyad, and the buyer (customer) of the logistics service is the same firm. This is not necessarily always the case, but this does not influence our analysis that aims identifying the basic building blocks of extended supply networks.

dyad but also a subcontracted 2PL logistics service provider firm that actually performs the delivery. Let us point out, that here we have three actors (customer, supplier and the mediating logistics service provider), while four actual actor types, since the mediating logistics firm does use a subcontracted smaller one in order to fulfil the actual contract made with the customer. Here all actor types are local, too.

4. ***The local, integrated pentagon*** consisting of a supplier, a customer, a 4PL and a 2PL logistics service provider. But here the supplier serves the customer through VMI. All the partners involved in the transaction are local ones.

5. ***The global octagonal setup***. This is a global structure consisting of the parent company of the supplier who contracts with the parent company of the customer, the local supplier who actually manufactures the ordered product, as well as the local subsidiary of the customer firm, who actually uses the ordered product. In this setup we have a 4PL logistics service provider organizing the flow of the material with subcontracting the actual delivery to a 2PL logistics service provider. This structure is one of the basic structures of extended supply networks in our global environment consisting of eight actual nodes in the network. In such a case the octagonal form is the smallest unit of analysis and consequently should serve as the basic unit of any scientific research.

## **Dimensions specifying the unit of analysis in extended supply networks**

An extended supply network not only incorporates the traditional supply chain relationship (between supplier and customer), but also the actor(s) of the aligned logistics network. The structure of such extended supply network can be given by the number of interlinked nodes and the relationships among these nodes. Based on the previous short case descriptions the following dimensions seem to directly influence this structure and specify the smallest unit of analysis:

1. the types of logistics service provider firm(s) involved in the actual transaction;
2. the geographical coverage of the actors in the network (local or global);
3. type of nodes in the network;
4. applied governance mechanisms between partners.

### ***1. Types of the LSPs***

Based on the complexity of the service outsourced to the external logistics service provider firm, we can differentiate multiple types of LSPs. In case the logistics service is kept in-house, literature uses the term 1PL (Vasiliauskas – Jakubauskas, 2007). 2PL service is the first step in outsourcing logistics activities to an independent service provider. Here the 2PL carries out only the basic elements of the whole logistics process (mainly transportation, custom clearance in case of international shipments) on transactional basis. An outsourced 3PL service is more complex. This LSP takes the responsibility of not only transporting but also warehousing the goods, managing related operational and information processes. This type also may offer supplementary added value services (e.g. customer service, co-packing). Because of the complex service package offered, a more dedicated long term partnership develops between the LSP and its customer. A 3PL type of LSP has own assets but also works with subcontractor

2PL type of service firms. An even more complex service package offered by LSPs is 4PL, where the logistics firm takes the whole operative management of the customer's supply chain. 4PL is also called non-asset based LSP, since it preferably does not own tools or vehicles. Its task is to organise the subcontractors (3PL or 2PL firms). A 4PL must be integrated in the customer's materials and information flow from planning to delivery (KPMG, 2009).

Several authors (Anderson et al., 2007) point out the importance of the logistics service package managed by the LSPs. Araujo et al. (1999) and Anderson et al. (2011) highlight that the different types of LSPs develop different types of interfaces with the supply chain partners. We agree with this and treat the type of LSPs – that is the scope and complexity of the outsourced logistics service – as an important dimension that directly influences the structure of the network.

## ***2. The geographical coverage – Local or global companies in the network***

Globalization has an important influence on the structure of supply chains and networks. The intense outsourcing and offshoring activity by multinational corporations creates really complex networks. Managing the interface between supply and logistics networks on local level is complex. In case geographically dispersed networks the challenge of managing interdependencies in that network is really big (Håkansson – Persson, 2004).

While mapping the structures of network an essential dimension is the geographical extent of the actors' operation. We distinguished local and global networks. In the first case all actors in the transaction are local firms. In case of a global network a multinational supplier and/or customer is linked to a probably also multinational LSP firm which have to cooperate in order to accomplish the logistics task.

## ***3. Types of nodes in the network***

Any network is interpreted as a set of interlinked nodes and the relationships between these nodes. Andersson et al. (2011) suggest that the basic unit of analysis in an extended supply network should be the triad. This is because the node is interpreted the same way as the actor. Actors in any network have special function to carry out but also can chose between different realizations of that function; and the number of nodes in the network depends on the actual realization of the function.

In case we have a holistic and theoretical, general view of the network, triad is really the smallest building block of the network here: one customer, one supplier and the contracted logistics service provider firm. But in case of a closer look, the structure gets more complicated. In case the contracted LPS is for example a non-asset based 4PL type of firm, it must apply a subcontractor to carry out the actual delivery, so the number of involved nodes becomes four. The situation gets even more complicated, when the traditional supply dyad is working in an integrated way, applies for example VMI. In this situation the supplier firm cannot be considered as one node of the network, but two: he one is the plant producing the goods, while the other one is the VMI warehouse storing and directly supplying the customer's plant.

Globalization also influences the number and types of actual nodes in the network. All of the actors may internationalize and develop their own complex global value chains (Gereffi et al., 2001) with several subsidiaries interpreted as separate nodes of the corporation's internal network. All the three actors in our network may establish subsidiaries in other countries or regions. These subsidiaries are owned by the focal firm, still separate legal units, separate firms, nodes in the network.

Let us recognize that a more sophisticated and refined set of phrases is needed here to be able to specify the actual structure of the extended supply network and define the smallest unit of analysis for further scientific investigation. In a structural approach the *node* should be used generally indicating one of the two basic elements of any network. (The second basic element is the relationship between these nodes.) A node of the network can be an *actor* as interpreted in the IMP literature (Håkansson – Snehota, ed. 1995), but also an *actor type* that denotes the specific type of realization of the actor's function. A good example illustrating the difference between actor and actor type is the LSP as the actor and the 4PL and/or 2PL type of logistics service providers, as actor types. Actor types themselves may possess several nodes in the network, since an international 4PL logistics service provider has several actual subsidiaries performing the outsourced logistics function. We will call this type of node as *acting firm*. But one actor firm may also have several actual nodes operating in the network, just think about the plant and the VMI warehouse of the supplier mentioned previously. This type of node is called *node of action* in the paper. In case an analysis aims to understand the actual operation of the network, the node of action should be the level of specificity we have.

#### ***4. Governance mechanism in the network***

Based on the Transaction Cost Economics (Williamson, 1979; Ouchi, 1980), but also B2B literature (Jap – Ganesan, 2000; Wang et al., 2008) we distinguish three basic coordination and their aligned governance mechanisms as follows:

1. Market coordination and its governance mechanism the contract.
2. Hierarchical (or bureaucratic) coordination and its governance mechanism, ownership and property rights.
3. Relational coordination, where relational characteristics (e.g. trust) play the role of governance.

In case of market coordination mechanism a market-based exchange is carried out between the business partners, while in case of hierarchy the exchange is carried out within an organization (i.e. parent company - subsidiary). In a market based transaction the relationship of parties is set by the contract they sign, that handles uncertainties and problem solving mechanisms. In a hierarchical situation the legitimation of the parent company to govern its subsidiary is obvious because of the ownership. These two types of governance mechanisms are also called formal governance (Yu et al., 2006). However, there are complex company relationships that are existing for a long time, covering multiple levels of cooperation probably on multiple hierarchical levels. In this case transactions are frequent, uncertainty and problem solving requires more sophisticated tools than a contract or series of contracts. In this case a special government tool, the relational governance appears. Relational governance is a coordination mechanism that involves the social characteristics (trust, power, altruism) of cooperating parties (Medlin et al, 2005). As we will point out, different governance mechanisms are simultaneously present in the networks we specified.

### **Mapping the structure of the cases presented – Identifying the smallest unit of network analysis**

#### ***(1) The local triad***

In the first case we have a local supplier (S) producing products to a local market and selling them to a local customer (C). The supplier does not perform the delivery itself rather delegates the task to a 2PL logistics service provider. No integration in the supply chain is present. We have three nodes in the network. The order information flows between the C and the S, and is forwarded from S to LSP, while the material flows from S to LSP and then to C.

The governance structure of the relationship between the supplier and the customer as well as between the supplier and 2PL firm is formal (contract based), however we certainly see relational governance between C and the 2PL firm in order to be able to manage the material flow successfully. In case of a close relationship between S and C the contract is more like series of contracts (Ouchi, 1980). The other contract between the S and LSP is probably more transaction-based and the LSP itself can change from time to time.

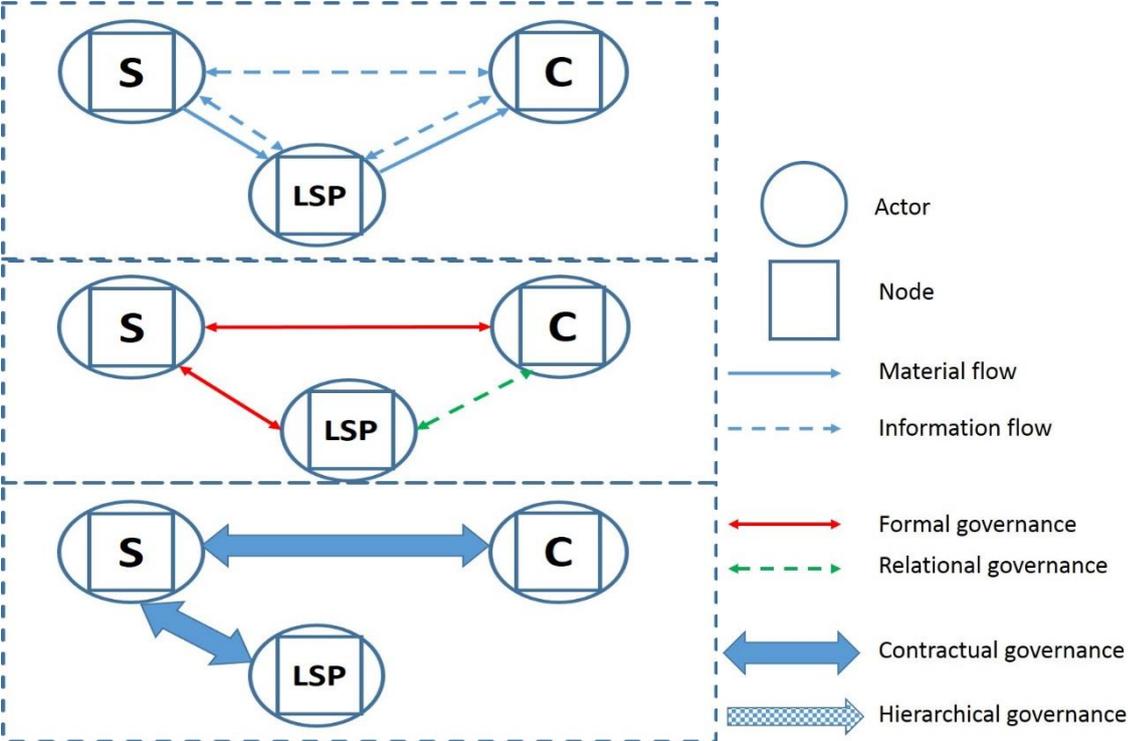


Figure 1. The local triad

**(2) The local, and integrated quadrat**

In this setup the supplier manufactures products to a customer and keeps it in a storage facility near the customer and serves it using VMI. In this case we have three actors (S, C, and LSP), three actor types (S, C, a 2PL type of firm), but actually four nodes: Both the customer and the LSP have one node, but the supplier has two: the production plant (S<sub>p</sub>) and the dedicated warehouse (S<sub>wh</sub>) as a special node of action. The information flows between all the nodes, C and S<sub>p</sub> as well as S<sub>wh</sub> about ordering, problem solving, and is forwarded to the LSP. The LSP necessarily has to change information with the customer as well, even if the relationship between them is not formally governed. In the VMI system the material first flows from the production place to the dedicated warehouse and then the supplier replenishes customer's inventory if it is needed (defined in the contract) using the logistics service provider firm. In this case the information transfer is more complex and intense than in the previous case, it is

the basis of a capacity, inventory and replenishment planning process, as the VMI dedicates operative decision rights to the supplier.

Besides the obvious formal governance structure (between S-C and the S-LSP), in this particular VMI situation relational governance has a more important role than in the first setup. The supplier establishes a warehouse to serve the customer and also dedicates inventory and planning resources to this specific relationship. We may find high level of trust and commitment from both sides. Regarding the formal governance methods in depth, the supplier-customer relationship is governed by series of contracts, while the S-LSP relationship can be transaction-based, since no complex service is needed from the LSP.

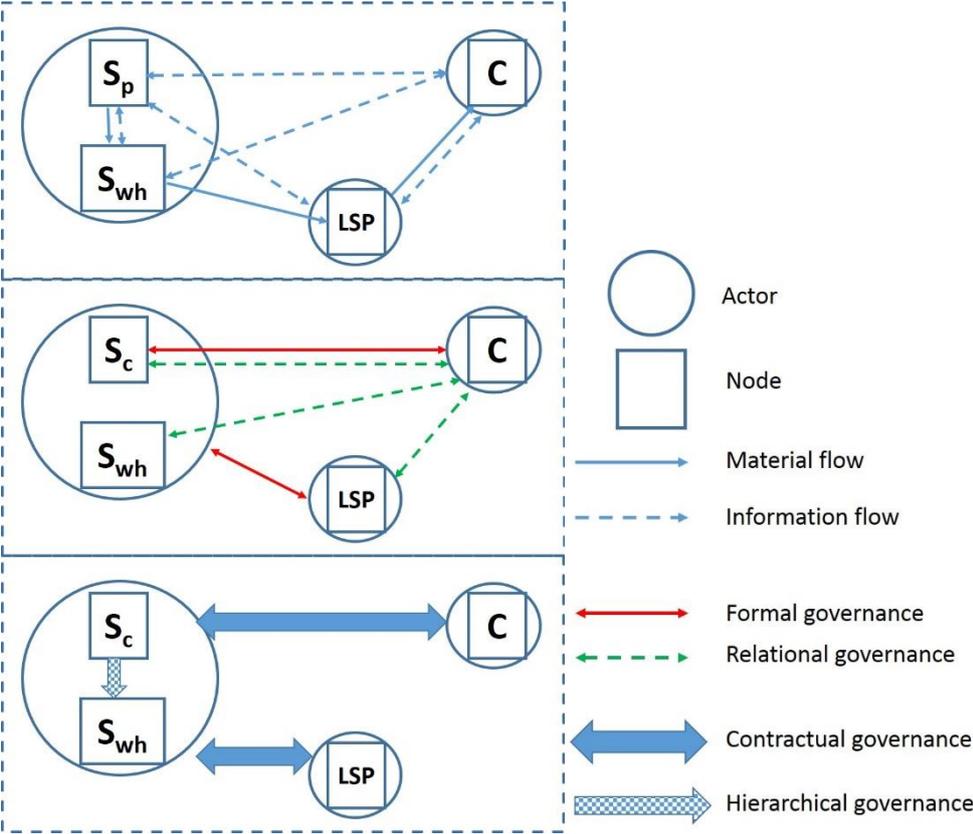


Figure 2: The local, integrated quadrat

**(3) The simple local quadrat**

In this structure the local supplier uses a 4PL logistics service provider to deliver its products to a local customer. The 4PL LSP organises the material flow involving a 2PL firm to carry out the actual shipping process. The actors are S, C, and LSP; the actor types S, C, 4PL and 2PL logistics service firms. The number of actual nodes in this case is also four.

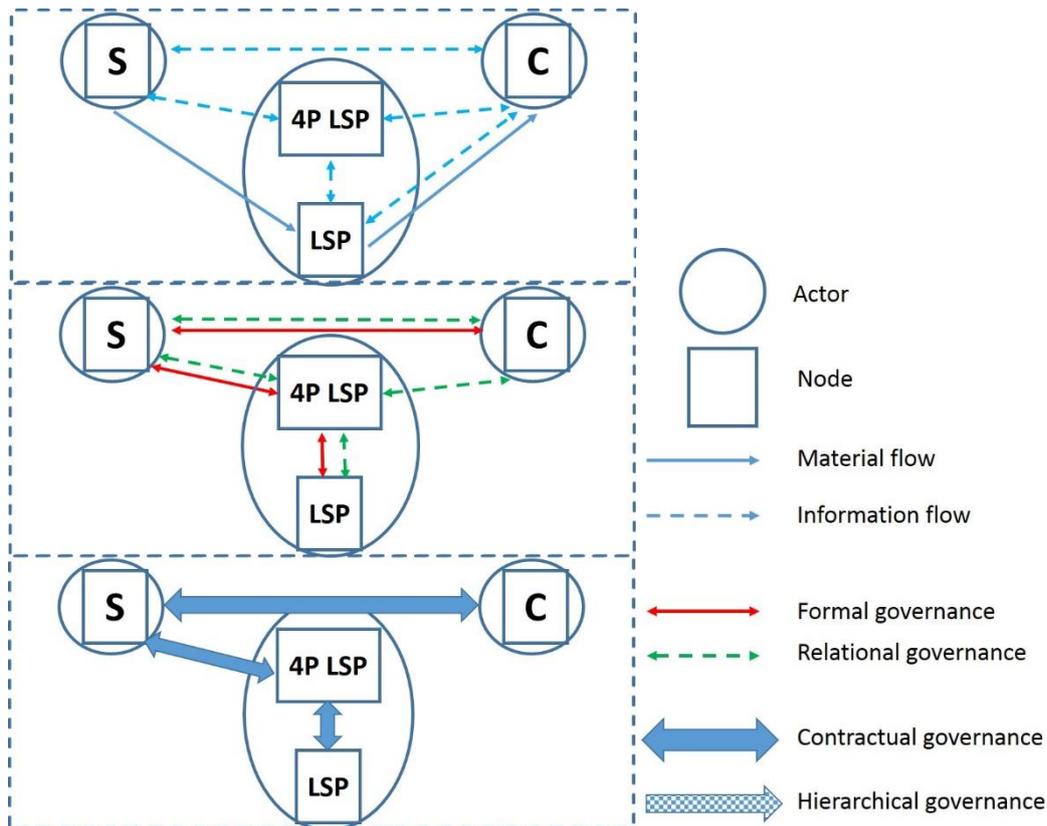


Figure 3: The simple local quadrat

In this quadrat information again necessarily flows between all the nodes. Regarding the material flow, product is manufactured by the supplier, handed over to the 2PL LSP (organised and controlled by the 4PL) that delivers it to the customer. Relationships between C and S, as well as between S and 4PL, but also between 4PL and 2PL service firms are all formally governed. Informal governance is also present in all dyads of the network structure. Core relationships between S – C and the 4PL firm may last for a long time, involving trust, commitment and transaction-specific investments, but relationship between 4PL and 2PL might be more transaction based.

#### (4) The local, integrated pentagon

In case of this structure we have different number of actors, actor types, and actual nodes in the network. Actors are, as in all previous cases, the supplier, the customer and the logistics service provider. The actor types in this specific case are the local customer, the local supplier, the 4PL and its subcontractor, the 2PL logistics firms, four altogether. Number of acting firms is also four. Since a VMI system is in operation, the supplier has actually two geographically different node of action, the production facility ( $S_p$ ) and its dedicated warehouse ( $S_{wh}$ ). So we have three actors, four actor types and acting firms but five actual nodes.

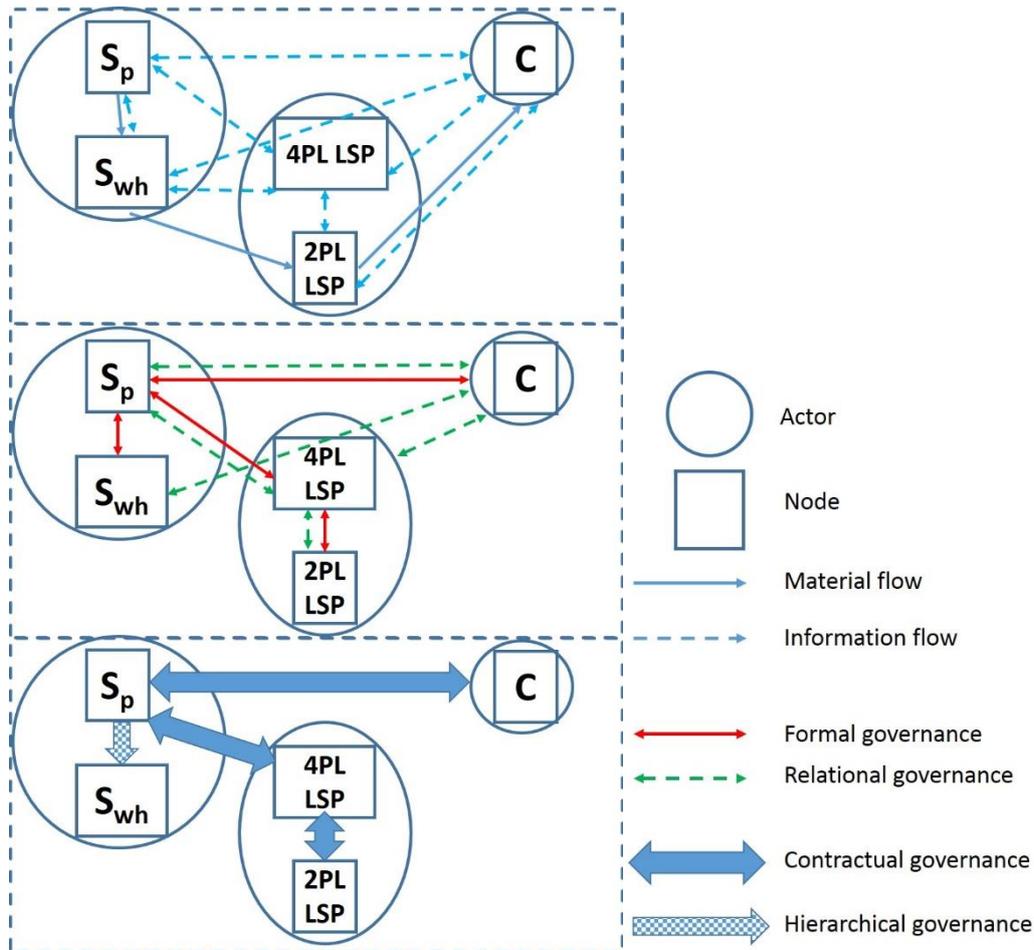


Figure 4. The local, integrated pentagon

After the supplier's production facility finished the product, it is delivered to the dedicated warehouse and later shipped to the customer. Information flow is complicated compared to the previous case. The customer provides information to both  $S_p$  and  $S_{wh}$  about ordering, inventory status, and replenishment. The information flows from both supplier nodes to the 4PL LSP that is requested to plan and organize the material flow, so it passes over the information to the 2PL LSP to carry out the shipping process. Although not formally governed, but necessarily there must be some information flow between the customer and the 2PL firm.

In this complex structure both formal and informal governance structure have huge importance. Formal governance methods are used in the relationships of  $S$  and  $C$ ,  $S$  and 4PL LSP, 4PL LSP and 2PL LSP, as well as between the supplier nodes ( $S_p - S_{wh}$ ). The former ones are mainly contractual, but the latter is ownership based. The informal governance methods are used in all dyads. The relationships between  $C$  and  $S$ -nodes, and  $S$  and 4PL LSP where trust, commitment, common problem solving and long term view are essential to sustain the cooperation.

##### (5) The global octagonal setup

In this global structure we describe a real life situation of our intensely internationalizing business world. We have also three actors (customer, supplier and logistics service provider).

All actors are international corporations, with parent companies in Europe (EU), and subsidiaries in China (CN), all have several acting firms within their internal networks (or global value chains).

In the presumed situation, the customer's European headquarter ( $Ch_{EU}$ ) orders a product for one of its European manufacturing plant ( $Cp_{EU}$ ) from the European Headquarter of the Supplier ( $S_{EU}$ ), but the product itself is manufactured at its Chinese subsidiary ( $S_{CN}$ ). The material flow is carried out by logistics service providers. The 4PL involved is also a global company, with subsidiaries in both Europe and China and subcontracting local 2PLs. Consequently, when the product is ready,  $S_{CN}$  contacts 4PL  $LSP_{CN}$  to organize the delivery process (with subcontractor 2PL in China). 4PL  $LSP_{CN}$  contacts 4PL  $LSP_{EU}$  and they organize the way of the product from China to the Customer's production plant in Europe, dividing up the organization process based on their in-house agreement about the geographical responsibility. (For example, 4PL  $LSP_{CN}$  organizes 2PL  $LSP_{CN}$  until the departure port and the shipping company, then at the arrival port 4PL  $LSP_{EU}$  organizes 2PL  $LSP_{EU}$  to deliver the product to the Customer.) The information flow is present in all dyads.

While informal governance must be present in all relationships (not depicted because of its complexity), the formal one is missing between the two 2PL service firms. The basic governance structure is the contract except between actors of the same global value chain. The relationships between  $Ch_{EU}$  and  $Cp_{EU}$  or 4PL  $LSP_{CN}$  and 4PL  $LSP_{EU}$  for example governed by hierarchy.

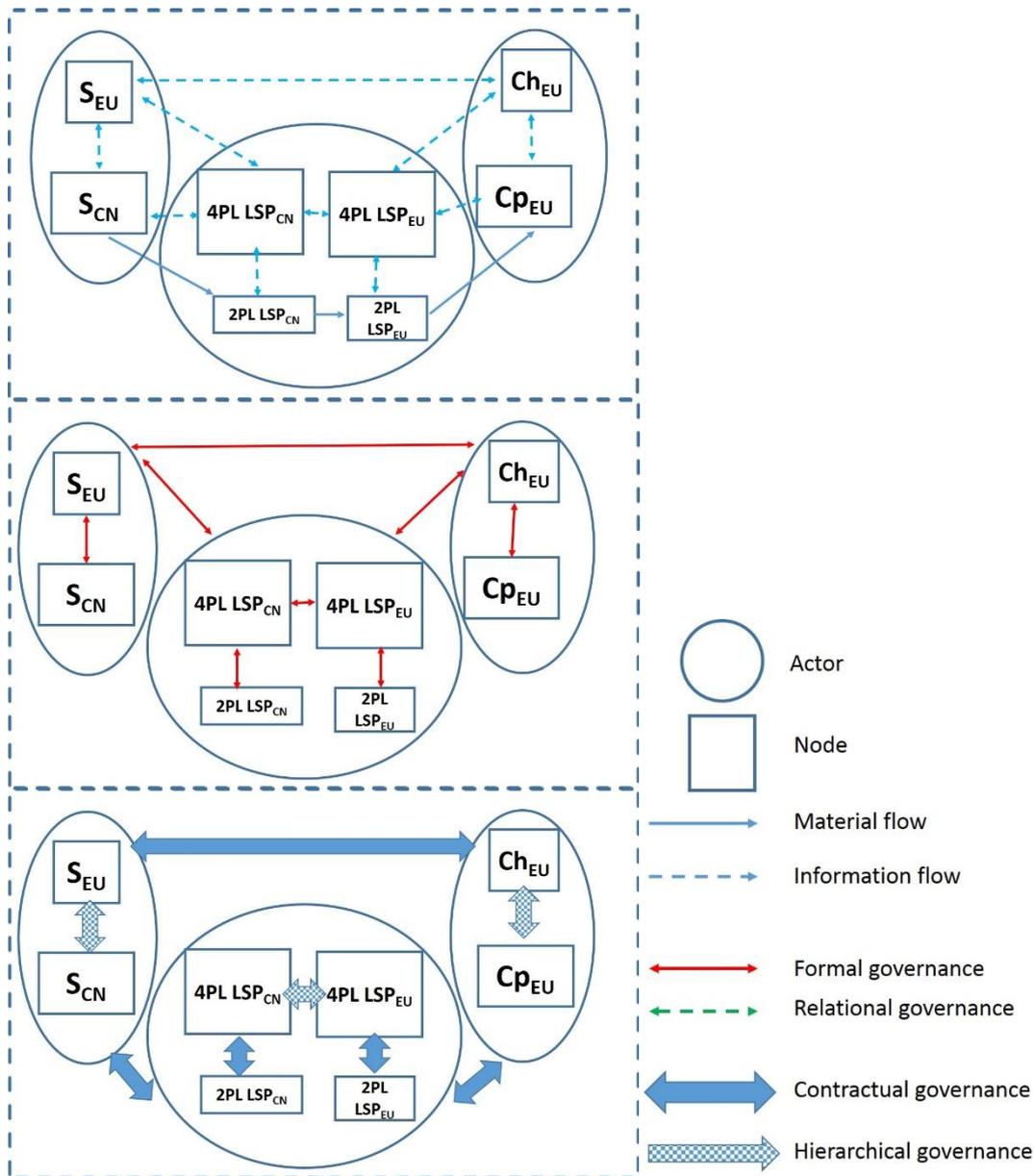


Figure 5: The global octagonal setup

## Summary and future research directions

We argued that if we want to understand the extended network, not only the dyadic, but also the triadic approach is inappropriate. We have suggested to use a more sophisticated set of phrases in order to be able to depict and map the structure of such networks and be able to specify the smallest unit of analysis. This is important even if the transaction is in focus. Understanding the transaction is the starting point of understanding relationship development (Holmlund, 2004) and also of network dynamics. Our paper has presented real life cases of extended supply networks and tried to identify those dimension that are relevant, when we aim at a structural description and at identifying the smallest unit of analysis. For further research there are many arising questions: Are there other relevant dimensions? What specific management challenges do the different setups have?

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