

Forming Supply Chains in a Business Network

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ABSTRACT: *This paper discusses the complexity issues in the formation of supply chains (as sub-networks) in a specific complex business network. Supply chains formed in the network are different from normal ones. They are formed and dis-formed frequently, and the roles of the actors switch rapidly between vendor and client. The relationships and interactions among actors are of a dynamic and paradoxical nature. Inquiring into a real business case, we illustrate the formation process of supply chains in such a unique network based on a conceptual framework that is a combination of boundary specification for sub-networks from social network theory (with three focuses—actor, relation and event), and contingent self-organization from complexity theory.*

Keywords: Business network, complexity, boundary specification, supply chain, interaction

INTRODUCTION

Satellite service as a means to transmit the signal (comprising video and audio information) has become increasingly popular for both business and broadcast purposes. Some large supermarket chains use satellite as a vehicle to send consolidated "point of sales" (POS) data between the headquarters, distribution centers and retail shops on a daily basis. Many international companies hold tele-conferencing meetings regularly to coordinate business tactics and practices. Global news agents employ satellite services on a real-time basis.

Satellite service cannot function alone, but must be in a chain from production, to transmission, to uplink, to satellite service, to downlink, to broadcast, to consumption. Since this supply chain can start and end at any place on the Earth, the set of possible supply chains is a complex business network.

Compared to a manufacturing-centered supply chain, this special type of supply chain formed in such a business network is analogous in the format of linkage between demand and supply, client and vendor, and in the requirement of value-adding. However, it is very different in the nature of the relationships between actors, and thus in the formation process of such relationships. Because the product (the signal) is temporary and "perishable" and the role-switching between signal producer and consumer is rapid, supply chains in the specified network are formed and dis-formed frequently, and the roles of actors can switch in no time. Obviously, any type of supply chain can benefit from the improvement of and efficiency of actors and the response speed between their connections. On top of that, the supply chains in our case also benefit from the speed of forming new supply chains, that is to say, the more supply chains are formed, the better capacity utilization, and the more likely that profit can be gained. Sometimes, for instance, if a chain can be formed fast enough for some important news, a premium price can be charged. Moreover, in some cases, such as a tele-conferencing meeting, two product flows may move in opposite directions in the same chain at the same time. These phenomena seldom appear in normal supply chains. The unique characteristics of the network and the supply chains in it reveal dynamic and paradoxical roles of, and relationships between, the actors.

The major concern of this paper is the criteria of forming supply chains in such a unique network. The model and characteristics of the business network are discussed in section 2 and section 3. We introduce our theoretical framework (an integration of tentative selection and contingent self-organization) in section 4 and then apply the framework to the analysis of the business situation in section 5.

BUSINESS CONTEXT AND MODEL

The supply chain discussed in the business network is comprised of a bi-directional sequence of activities or functions, starting from signal production to signal consumption, centered on a satellite service (see Fig.1).

"The signal" is the product in this chain. The product flow is the signal flow. Production refers to signal generation. The signal, embedded with some content, is valuable to some audience or consumers. The signal, including both audio and video ingredients, can be produced and/or captured by specialized equipment in some chosen place, such as a studio, a sports field, a conference room, or a combat site.

The consumption happens when an audience consumes the signal for their purposes. For example, the signal, as a real-time message, can be consumed by managers in tele-conferencing room for business purposes, or can be displayed on TV sets at home for entertainment purposes.

In the transmission/broadcast stage, the signal is carried and transferred from one location to another, within a local area, with no satellite transmission involved. This function provides a signal channel between the location of production or consumption and the place where uplink or downlink facilities are available.

Uplink and downlink are two versions of the same function but in opposite directions. The uplink facility is designed to link the signal from the ground to the satellite, and the downlink vice versa.

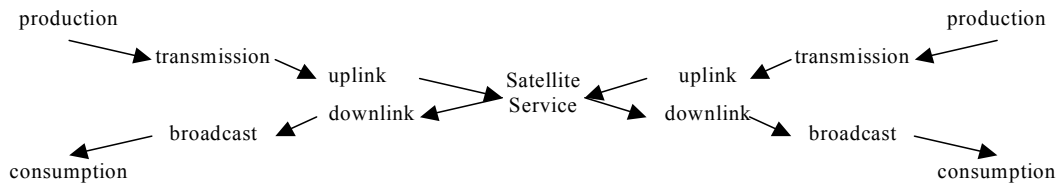


Fig.1. The Supply Chain of Signal Transmission Supported by Satellite Service

Satellite service, as the core of the supply chain, provides the "space" or "channel" for the signal by making use of satellites as vehicles. Some satellite-space providers may own their own satellites, but most of them lease the satellite-space from satellite owners. Satellite service is an essential element. Any supply chain has to go through at least one satellite service provider. Administrators working in a satellite service company are responsible to promote usage of satellite space which is owned or leased, to co-ordinate internal and external activities related to the formation of the supply chain, such as negotiating and scheduling, and to guarantee reliable and timely signal transmission. To most satellite service providers, the amount of available satellite space is determined by definition in the leasing contract. Therefore, the efficiency and profitability of this satellite service provider is an issue of capacity utilisation. In summary, satellite service can move the product (the signal) by means of the vehicle (the satellite space) in a relatively long-hauled route. This adds value to the product through delivering a quality service, whilst the provider is aiming at the business target of full capacity utilization. In terms of capacity utilization, satellite service is similar to airline service, in that unused space (and a profit opportunity) at a particular time is lost forever once that time is passed.

The Business model is shown in Fig.2. It is simplified, but still is able to illustrate the key features of the business network and the supply chains in it.

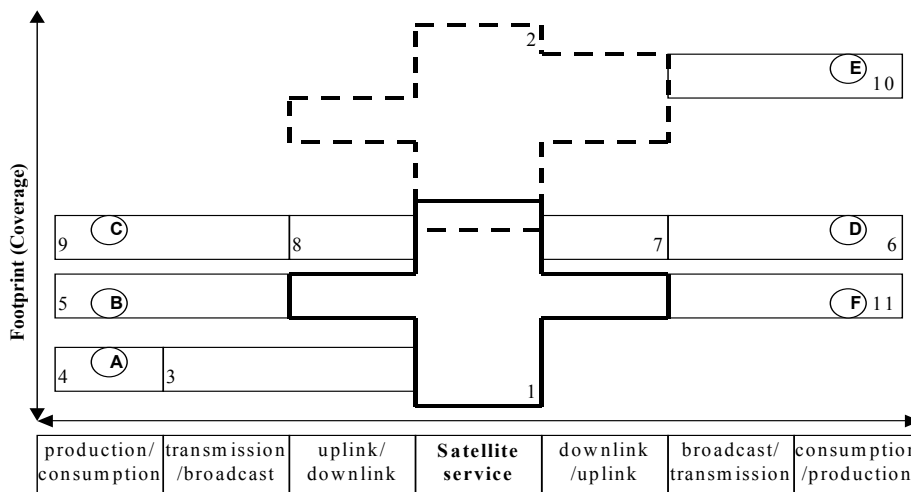


Fig. 2. The Business Network of Satellite Service in Focus

The horizontal dimension is a series of services which are arranged in the sequence of a supply chain. The vertical dimension is the footprint (a notion used to define the service coverage in terms of geographical range). The various shapes (1-10) in Fig.2 represent different service providers (SP1-SP10) whose services may vary in footprint and function. Alphabets A to F in circle are denoted as business/individual consumers or producers.

The SP1 in Fig.2 is the company in focus, an Australasian company, called Anzad Satellite Service (Anzad, an anonymous name). Anzad leases a fixed amount of "space" or "channel" from two satellites which can jointly cover a region (footprint) from Turkey eastwards to the west coast of America in longitude, and from Japan southwards to New Zealand in latitude. Anzad provides satellite service to the nations in the footprint, and also possesses uplink and downlink equipment in major cities of Australia and New Zealand. To supply the signal from one major city to another in these two countries (e.g. from business B (in Perth) to business F (in Auckland)), Anzad SS is able to provide both satellite service and uplink/downlink service. The specified supply

chain for this purpose could be (B/SP5↔SP1(Anzad SS) ↔SP11/F). But to form the linkage for two businesses between Australasia and the States, Anzad has to get another satellite service provider involved. For instance, if business E (say, in New York) intends to consume the signal (say, the image of America Cup challenge) provided by business B (in Auckland), a supply chain (B/SP5 → SP1 → SP2 → SP10/E) may be formed for the purpose in the desired time period.

If we consider Fig.2 as a business network with two dimensions, then businesses and SPs are actors. For one purpose, a supply chain is formed, it functions for the desired period of time, and then it is dis-formed; for another purpose, a new supply chain will be formed, validated, and dis-formed. The formation can be triggered by events such as the Olympic game, the Australian Open, the America's Cup, which are of interest to some people in some nations. It would also be triggered by activities such as a teleconferencing meeting. In some cases, a specified supply chain for the event/activity may be formed during the specified period, and then dis-formed immediately after. For some other purposes, for instance, the routine transmission of "point of sales" data for retail companies, the formed supply chains may remain functional for a longer time.

Another interesting issue is that bi-directional product flows seems possible in some situations (e.g. a teleconferencing meeting between businesses B and E, with a supply chain of B/SP5 ↔ SP1 ↔ SP2 ↔ SP10/E). Technically speaking, it is not feasible for one satellite channel to transmit and receive signals at the same time. However, it is doable by making use of two satellite channels — one for transmission and one for receiving. There are multiple channels on any one satellite.

The main duty of Anzad's administrators of satellite service is to interact with other actors in the network and form supply chains. At any point of time, maximum ten supply chains can be formed because Anzad leases ten satellite channels. In the formation of any supply chain, cost, quality, and capacity utilization are of concern. The administrator is like a "spider" weaving lines in the net so as to minimize cost and maximize utilization.

Many companies are providing satellite service and other related services, and their footprints and functions overlap. The competition is fierce in the industry. The client tends to choose a vendor who is better and cheaper (getting "more for less"). The ability to both rapidly and frequently form supply chain is a critical success factor.

CHARACTERISTICS OF THE BUSINESS NETWORK

In the normal format of an industrial supply chain, the product flow is moving in one direction from supplier to customer, while information flow is moving bi-directionally. The product moves from manufacturer to distribution intermediaries, then to retailers, then to end users. The directional supply-demand relation between two adjacent actors will not be reversed unless the business natures of those actors change dramatically. Sometimes two trading companies may buy and sell from each other, and exchange their roles as buyer and seller from time to time. But such a double-faced role is rarely seen in all actors in the whole supply chain.

What we are surprised to see in the network of satellite service is that the actors are born to be "two-faced". Supply chains are formed and dis-formed frequently. Two actors can switch their supply-demand relation in just a "moment". At this moment, a piece of news is being transferred from New York to Sydney by going through some service providers; and then 5 minutes later, the image of a tennis game may be sent from Sydney to New York by going through the same service providers. Since the signals flow in opposite directions, the functions of service providers are swapped (uplink to downlink, transmission to broadcast, production to consumption), and the roles of them (as either client or vendor) are exchanged.

Furthermore, in a situation such as a teleconferencing meeting, any actor in the chain must carry simultaneously two product flows heading in opposite directions. The actor transmits a signal to the neighboring actor, and at the same time receives another signal from the same neighboring actor. The actors at the very ends of the supply chain are both "sink" and "source". Technically speaking, in such a case, two satellite channels have to be used and both uplink and downlink equipment have to function in each location. Therefore, another explanation for such a phenomenon of "bi-directional product flow" is: there are two supply chains in parallel, of which each has one one-directional signal transmission flow and consists of the same actors in reversed sequence, working concurrently for the same objective. In either explanation, the actor becomes double-faced, both vendor and client. The supply-demand relationship disappears, and the win-win partnership emerges. It is the equal cooperation that validates a supply chain and benefits every actor in the chain.

It is easy to say that actors should work together. In the real world, we see the client normally has buying power and "buyer's attitude". In a highly competitive industry, the client demands more from less: low cost, high quality, and quick response. However, because the actors' roles as client and vendor are exchanged in no time, a paradoxical relationship among them emerges. Through these paradoxical and recurrent interactions, actors realize that it is the whole chain that really counts and with which they need to be concerned.

One administrator in Anzad tells us that she has got used to this type of "paradox". Recently, she was pushing a Spanish vendor to provide a better price to form a supply chain; then after a very short while, she is "pressed" by the same Spanish company to offer a better price to form another chain. Switching from one supply chain to another, the roles of Anzad and the Spanish company (as either client to vendor) are swapped.

In summary, the unique and interesting characteristic in the business network under study is that the roles of, and the relationship among, actors in the formation of supply chains are dynamic and paradoxical.

THEORETICAL FRAMEWORK FOR FORMING SUPPLY CHAINS

The cause for some actors (business parties) in a network to form a supply chain for their common objective is complex, and differs from case by case. Also, the formation process is dynamic. Two issues are relevant here. The first is the development of some useful criteria or guidelines for practitioners for selecting business partners. For this, we believe that "how to form a supply chain" is an equivalent question to "how to define a supply chain's boundary". Thus boundary specification in social networks can be applied as a framework. The second issue is about the contingency in the formation process which is a kind of self-organization as described in complexity theory. In this sense, contingency is the product of chaos at the edge of order and dis-order, between the object being formed and its environment, embedded in the dynamics of human interactions.

Boundary Specification for Sub-networks

In any system, focusing on different elements, or employing different approaches may result in different boundary mapping with regard to different world-views. Luumann et al (1983) give a generalised framework for specifying boundary in a social network. Defining boundary for a sub-network in the whole network is equivalent to forming a sub-network. Luumann et al suggest that three substantive focuses — actors, their relations, and events or activities can be used in attempts to define network boundaries.

The first and most commonly used definitional tactic to restrict a network is using some attribute or characteristic of the actors. Actors may be persons, corporate actors, or other collective entities or groupings.

The second definitional tactic is to specify the network such that it includes those actors participating in a social relationship of a specified type. An example is the method of locating community boundaries on the basis of interaction frequency and some other measures of the degree to which places are of common relevance to one another.

A third element used to set boundaries is by defining an event or activity, participation in which serves to select individual actors and the social relationships among them into a network. For example, co-ordinated behaviour is useful in defining the extent to which an individual is or is not the member of the organisation. Then, the boundary is set based on the degree of discretion for a sub-network to control an activity.

Self-organization in the Development of an Organism

In the study of the formation of an organism, Kauffman (1995) searches for "the laws of complexity" and identifies two of them — the principle of selection and the principle of self-organization. He claims these two principles are paradoxically and simultaneously operative in the formation of an order (e.g. an organism). In his study of the network within each cell of any contemporary organism, he realizes that "most of the beautiful orders seen in ontogeny is spontaneous, a natural expression of the stunning self-organization that abounds in very complex regulatory networks" and "order, vast and generative, arises naturally". (p25). (Here ontogeny is referring to "the development of an adult organism" (p24).) Furthermore, Kauffman believes that the true drive of self-organization arises from the interaction between stability and instability. "Networks in the regime near the edge of chaos — this compromise between order and surprise — appear best able to coordinate complex activities and best able to evolve as well." (p26)

We believe Kauffman's paradigm is also applicable in the formation of a sub-network in a complex business network which consists of autonomous individual agents. The order that emerges from agent interactions is a potential before it emerges as an actual pattern, something that is co-created by the agents. The overall pattern that recurrent interactions produce emerges in an unpredictable sense. Actors in a network expect something to happen but the expectation is not an already existing reality, rather it is a potential unfolded by experience — a movement into the space of the adjacent possible.

PRACTICAL ANALYSIS FOR FORMING SUPPLY CHAINS

The Selection Factors in Forming Supply Chains

We now apply the framework discussed in section 4.1 to the real case to determine selection factors in the boundary specification of a supply chain. (These factors are equivalent to those in the formation of a supply chain.) Three selection factors are discussed in the framework, namely, actor, relation and event.

Attribute or characteristic of the actors

In choosing partners in the formation of a supply chain, the quality of the actor is the number one concern. We are told that in satellite service business, "no quality, no talk". Cost is becoming more critical due to the rise in

availability of service and hence in the level of competition. Flexibility is another important measure to judge the attribute of an actor. Actors should be able to adjust schedule and capacity rapidly according to variations in the demand for signal transmission, such as, the sudden requirement to send a piece of breaking news. The capability of dealing with the contingency depends on the degree of internal mobility (e.g. the flexibility of technical supports) and external accessibility (e.g. the reliability of strategic partnerships).

Relationship

The second factor is concerned with the social and business relationship among actors. The interaction frequency among a cluster of actors can be interpreted as one of measures of the degree of relationship.

Strategic alliances are common in the satellite service industry. Normally, long-term partnerships are formed among those who can complement each other in business. For instance, service providers who provide different coverage (footprint) in geography, or perform different functions in the supply chain, are more likely to tie together as alliances. For instance, Anzad has a long-term relationship with the BBC who often brings signals from Australia and New Zealand, who are also members of commonwealth nations, back to the UK. In the chain, the BBC usually plays the roles as both producer and broadcaster. Also, Anzad forms an informal partnership with an American satellite service provider Tele-net Enterprises who can assist Anzad to build channels to the US from time to time.

Relationship could be personal. An Australian company providing uplink/downlink services offers an attractive price to Anzad. But the administrator does not want to try the company simply because she feels uncomfortable talking with the manager in "that company". And when the manager in "that company" bypassed her and goes to persuade her boss, the relationship becomes even "sourer". Another example is the fact that Anzad hires one Chinese and one Singaporean to handle businesses in the greater China and Singapore region. The strategy really works, and many profitable projects are brought in due to language and cultural intimacy.

Event/Activity

A third element used to set boundaries and to form sub-networks in a large business network is that of a defined event or activity. Actors who participate in these events become a cluster (or, in our case, a supply chain) which can facilitate the process of those events.

For example, the final of the America's Cup is between New Zealand and Italy. During the period, Anzad was required by many Italian broadcasters and news agents to set up a "full service/full time" channel from Auckland to Rome. Anzad became the key coordinator. Because Anzad has no facilities in Italy, one British partner was involved in the chain. At the same time, Anzad had to schedule for other nations to watch some hot pieces of the America's Cup on a "piece meal" basis. Many companies involved in this specified supply chain (in fact, supply network) may be only one-time partners. It is the event that brings them together for the period.

The Self-organization Perspective in Forming Supply Chains

In section 4.2, we introduced Kauffman's theory that attempts to mate Darwinian selection tradition and self-organization in examining the development of an organism. Two issues are considered here with regard to self-origination in the formation of supply chains. First, the contingency affects the formation process. Unexpected events happen from time to time in the interactions among actors. New actors are included or old actors are excluded due to some emergent concerns. Second, the true drives of self-organization is from the interaction between the supply chain being formed and its environment whereby variety of new forms are generated. The compromise between order and surprise appears best able to coordinate complex activities and best able to evolve. The case in section 5.3 can explain further on this point.

A Case

It is a story told by one of Anzad's satellite service administrators and recorded in the original words. The story shows the process of forming a specified supply chain during KDP's election (KDP, an anonymous nation in Asia). The administrator in Anzad first formed a supply chain based on business purpose and tentative selection, then adjusted it to cater for "surprises" emerging down the road. Through chaotic and recurrent interactions at the edge of "tentative selection" and "contingent self-organization", the supply chain is finally formed.

It's about the project we did for KDP's Election. Previously our network didn't cover KDP. After some "creative thinking and arrangement", we could do that now. Let me tell you the story.

It started when we got a request (that) was from a Singaporean broadcaster MCS (an anonymous name) who asked if we could carry something from KDP, particularly during the election. But they were very cost-sensitive. That meant we could not use Intel-sat's satellites, which is the largest satellite service provider in the world. So we started to investigate the most economic way to carry KDP's feeds.

Finally we found that we could get signals from a small satellite space provider CHTV (an anonymous name) there. The footprint of their satellite space well covers Singapore and Hongkong. After negotiations, we could offer a very competitive price to MCS. However, we also realized that MCS could downlink from that satellite

space by themselves without our help. Had we carried for them, we would only add cost to it, and add no value. We finally decided to inform MCS and CHTV that they can do business directly without our involvement. Our sincerity gained some respect from both MCS and CHTV. As a result, CHTV and us decided to create a long-term network to carry KDP's signals with a very competitive price.

After that agreement, we coordinated with KDP side, did a test, and decided on the route. Then the "news release" was sent out by our marketing manager, an operations manual is made up, and our technical staffs were informed of this service. Soon after, we had a couple of responses.

Before the election, we heard that only Reuters was to bring in their own uplink facility in the venue. And they were offering very expensive price for 10 mins transmission. What we offer was only 65% of that price. Most people thought that we had sent our uplink facility there, and even our crew. But what we did was to just tie with CHTV, and all our clients just went there and did their transmissions. The extension of our network had attracted many businesses for us, and the most important thing was that we had earned a much better reputation from our clients. Associate Press (AP) and Reuters are competitors and AP had been worried how they could bring in the news "cheaply" out of KDP while they could avoid using Reuters' facility.

But the first feed AP requested had been cancelled and that all sounded very interesting to us. So, we tried to track down why they cancel the transmission, out of our curiosity basically. Ha, we found that, apart from Reuters, and our facility, AP managed to book with a Hong Kong broadcaster BTV (an anonymous name). BTV has its own under-ocean fiber optics linking to KDP. BTV offered AP to transfer signal from KDP to Hong Kong, and send it back through AP's original channel across Pacific Ocean. By doing so, AP could save some cost. Gosh, should other clients be aware of that, we would lose many businesses out of there! I became quite worried. Fortunately, later on I realized that not all customers could go through BTV and to Hong Kong. Due to some technical reasons and competition concerns, most of my customers could stay with me. Some of them did not want to work with BSTV because they were competing with each other in some business territories because BTV was a large consortium and doing many businesses at the same time. Now, even after the election, we continue to carry signals from KDP for clients in the US and the UK, and also in Hong Kong and Japan.

*Recently, our regional manager sent an email to the GM, congratulating us of the success. We had made a good business, and we did make a good profit. The business development manager for Japan was also quite happy about this development since his Japanese clients are interested in this new network. The business network manager came to us and discussed how we could include CHTV into our formal business network in the long run as he expected most of our clients would be very interested if we could include it in! Anyhow, as it's a profit making business and it did help with our exposures and reputation, our GM was very happy about it!**[end]***

Because most Australasians are not interested in the election in KDP, the project was a surprise triggered by a request from Singapore. After going through a selection process based on the framework of actor, relation and activity, CHTV is chosen as a key service partner in the supply network. And then some normal marketing functions were performed to attract other actors, especially client actors. Although due to some reasons, MCS and the first customer (AP) were not included in the final supply network, the established business accessibility (in particular, the partnership with CHTV) helps bring in many unexpected but profitable businesses. The expansion of the business network not only serves the initial purpose during the election but also gains competitive advantages in the long run. Actors interact in a tentative and predictive way with a selection criterion acting as a general norm. But due to the chaotic nature of the business context and the paradoxical role of the actors, the formation of the supply network becomes some kind of contingent self-evolution.

CONCLUSION

This paper investigates the complexity issues in the formation of supply chains (as sub-networks) in a dynamic business network. The network is quite unique because (1) the supply chain is formed and dis-formed in a dynamic manner; (2) the product flow in the chain can be bi-directional in its physical nature; (3) the actors can switch between client and vendor very fast, and even be both at the same time. Hence, many issues under study, such as identity and role of, and relationships and interactions among, actors are of a paradoxical nature. We intermingle a theoretical framework with some real cases to discuss the formation process of supply chains in such a unique and complex network. The formation process is the combination of tentative selection (by specifying boundary for sub-networks with three major concerns — actor, relation and event, from social network theory) and contingent self-organization (at the edge of the object being formed and its environment, from complexity theory). In conclusion, the theory is matching with the reality.

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