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## **Resource Development and Interaction**

### **- The function of partial connections**

*Work-in-progress paper*

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## **Abstract**

Interaction has been identified as a main feature of technological development (see e.g. Dosi 1988, Lundvall 1988, Rosenberg 1994, Håkansson & Waluszewski 2002). In addition, industrial network studies have pointed at the importance of recognising connections among relationships (Blankenburg & Johanson 1992, Pedersen 1996). We have argued elsewhere that these connections are always partial to their character. In this paper we will address the issue of how these partial connections develop as a result from interaction between firms and their resources.

A single case study focusing on the interaction between two firms provides the empirical platform for the discussion. One of the firms is a provider of an ERP (Enterprise Resource Planning)-system and the other is a producer of textiles used mainly for car seats. Their interaction is focused on trying to develop three new ERP-system modules that will enhance the textile manufacturer's ability to deal with a complicated production planning situation both internally and in relation to suppliers and customers. In this process, a number of related resources become involved as part of the considered resource constellation since various resource interfaces have to be adjusted.

The theoretical framework applied is based on the four types of resource items identified by Håkansson & Waluszewski (2002); products, facilities, business units and business relationships. The analysis is thus focused on how these resource items interact during the development process. In particular, the effects on the development of partial connections to other relationships are in focus.

## Introduction

This paper deals with particular aspects of how resources develop in interaction. As in other studies of development in and of industrial networks we assume that resources are heterogeneous and that their value thus depends on what other resources they are combined with (Håkansson and Snehota, 1995; Holmen, 2001). This assumption implies two things. First, resources cannot be analysed as isolated items, and second, the connections or ties between resources are of central importance for any understanding of their development. Since resources interact across firm boundaries, we will start by discussing some crucial aspects of inter-firm networks before introducing the frame of reference.

Inspired by sociologists industrial network researchers often define networks as "two or more connected relationships" (Cook and Emerson, 1984). Connections between relationships point to the complexity of, what other sociologists refer to as, embeddedness (Granovetter, 1985; Uzzi, 1997). Within industrial network studies the managerial importance and effects of connections between relationships has been stressed (Blankenburg and Johanson, 1992; Pedersen, 1996; Ritter, 2000). Ritter (2000, p. 321) argues that "we can see that an inter-organisational relationship can hinder, weaken, strengthen or enforce another relationship". Furthermore, he identifies 10 different cases describing the possible impacts among inter-organisational relationships. Based on this categorisation of effects he suggests it to be a way of looking into the black-box of interconnectedness by deconstruction of the general notion of interconnectedness.

Business relationships have been conceptualised differently in different fields of research (Dubois and Håkansson, 2002). While industrial network researchers emphasise their multidimensional content and different functions sociologists mainly consider their social content. For instance, Knoke and Kuklinski (1982) identify four elements of a research design for network analysis available for (social) network researchers: the choice of sampling units, the form of relations, the relation content, and the level of data analysis. When the nodes or elements on the lowest level of a network are individuals these choices are a matter of grouping individuals together. For instance, these nodes may be grouped in different ways to construct higher-level nodes such as departments, communities or nations. When studies of business relationships are concerned, however, these are not mainly focused on capturing aspects of social structures. In addition to social aspects, the conceptualisation of business relationships emphasises technical and economic links between business units. Their content and function in relation to other business relationships therefore varies. Furthermore, there are no "given" or natural unit of analysis at the "lowest level" when industrial networks are concerned. Rather, many interrelated units of analysis need be included in the analysis and this, in turn, makes it difficult to address different levels of analysis. Since the network notion is mainly based on sociological definitions, the complex nature of business relationships is not often captured, or at least not dealt with explicitly, when connections are concerned (for an exception see Pedersen, 1996). If our aim is to better understand how resources develop we need to regard that the firms involved in a relationship represent many resource elements that

may be more or less (and directly and indirectly) connected in different ways making it impossible to analyse connections between relationships in general.

Knoke and Kuklinski (1982) also discuss attributes and relations where attributes are "intrinsic characteristics of people, objects or events" (p. 174). In contrast, "a relation is not an intrinsic characteristic of either party taken in isolation, but is an emergent property of the connection or linkage between units of observation" (ibid, p. 174). Furthermore, they argue that where attributes persist across the various contexts in which an actor is involved, relations are context specific and alter or disappear upon an actor's removal from interaction with the relevant other parties. If we apply these concepts on business relationships and the connections between them we may identify efforts to conceptualise their attributes and relations. Håkansson and Snehota (1995) defined a relationship as a combination of three attributes: activity links, resource ties and actor bonds. These links, ties and bonds have different functions in relation to the single firms involved in the relationship, the dyad and the network/third parties. However, when the connections, or relations as in Knoke and Kuklinski's framework, are concerned, problems of multidimensionality appears. That is, the content in any business relationship is seldom or never "completely" connected to another relationship. Rather, we suggest that connections are always partial to their character (Dubois et al., 2002).

The problems of multidimensionality appear since the firms or business units involved in a relationship are also always sets of resource elements such as products and facilities of various kinds. Furthermore, if considering business units and business relationships as resource elements in addition to products and facilities, as suggested by Håkansson and Waluszewski (2002), the complexity resulting implies that generalised notions on connections and networks are not analytically useful. Rather, focusing on different particular resource elements entails identification of different networks of relevance. Conversely, the connections identified between relationships are then necessarily functions of the resource element put in focus. And, since the relationships may have other contents and functions than what surface when focusing one particular resource element we chose to refer to these connections as *partial*. These partial connections between relationships appearing when focusing on individual resource elements are focused in this paper. Hence, we suggest another way of deconstructing the general notion of connections. This choice is motivated by our interest in resource development and interaction. Furthermore, it is a reaction against a too strong focus on relationships as being manageable and against oversimplified views on effects being either generally positive or negative in relation to a particular firm or relationship.

## **Frame of reference**

Following the latest model within the Industrial Network Approach (Håkansson & Waluszewski, 2001), technical development is primarily related to the resource layer. The focal idea behind this model is that interaction between different resources entails development, i.e. development is entailed when different resources are adapted to each other. Håkansson & Waluszewski have identify four different resource entities:

- 1) **Products:** The features of a product (goods and/or services) are often the result from interaction between a buyer and a seller. The buying/selling process can create imprints on the products exchanged in a number of ways, in order to relate a set of products to each other. This imprint reflect the fact that the product is part of both a “selling” and a “using” system. However, these sets of products might be changed, which changes the role of the product and can give rise to new features.
- 2) **Facilities:** Facilities include equipment and other facilities used to produce or transform the products. The facilities may, like products, be developed through interaction, as companies organize their facilities in relation to each other. Most facilities have latent features. During the interaction process, where a certain facility is related to other facilities, such features can be discovered and brought forward.
- 3) **Business Units:** Business Units organize both products and facilities, and in addition they contain intangible resources, such as knowledge, skills, and abilities. Another vital characteristic with business units is their existence over time, as they hold memories regarding how to organize products and facilities due to previous actions.
- 4) **Relationships:** Relationships tie business units together through interaction. The relationships together with business units thus organize for exchange of products as well as connect facilities. The resources in a single firm’s resource collection can be used, controlled or influenced by other firms or become adapted to others through their relationships. Hence, relationships imply more than the mere phenomenon of inter-organizational interaction. They can better be characterized as “quasi-organizations”, emerging as governance modes for organizing and coordinating economic exchange between organizations (Blois, 1971; Richardson, 1972). Relationships are important by being a way to connect situations over time. They do not only include memories of what has taken place but also expectations of future activities.

All four types of resources are highly dependent on each other. In order to produce a product, we need a facility that is owned by a business unit and in order to sell the product we need a relationship. Thus, it is important to include all of them in an analysis where the intention is to understand technological development in an industrial setting. (Håkansson & Waluszewski, 2001)

## **Empirical example**

The case concerns technical development taking place within a relationship between a customer (firm B) and a supplier of a computerized business system (firm A). A computerized business system consists of several different information processing functions where information can be gathered, stored, searched, transformed and presented. This is controlled by certain rules that depend on different business operations and computer software. In the past it was common that companies developed their own solutions, either by the help of their computer departments or

together with external specialists. However, it has been common that external specialists develop standard systems which, during implementation, become more or less adapted to certain customer needs. Companies that choose a standard system often buy an ERP-system (Enterprise Resource Planning). Such a system is built around the idea that the company consists of some generic processes and functions, which can be integrated into one package.

## **Firm A**

Firm A develops and sells an ERP-system based on about 60 standard modules, which can be combined in several different ways to create standard solutions for construction, production, distribution, service, administration, and economy control. The firm's main concern is to develop and sell systems that in efficient ways support the customers' coordination activities. However, since different customers need to coordinate their activities in different ways, it is impossible to create a system that fits all. Firm A therefore tries to identify some "target segments", i.e. segments of companies with similar coordination activities that firm A's system is able to support.

To be able to do this, firm A needs to deal with two things. First firm A needs, to a reasonable cost, develop functionality which increases the usability of the standard version of its ERP-system. The system's usability can be increased in several different ways. One way is to make it more adapted to certain customers needs. Another way is to make it more flexible and thus applicable in an increased number of different settings. Second firm A needs to implement its ERP-system in an efficient way, i.e. to reasonable implementation, service, and maintenance costs, make the system able to support individual customer's coordination activities. However, the two different sub issues are interrelated. Many adaptations made during implementation are integrated into the standard version. This makes the system more adapted to certain customers' needs or increases the number of different settings in which the standard system can be used.

From firm A's perspective the focal products are the modules within its ERP-system. These modules have to be developed in order to match the developments of their customer's demands. It is therefore important for the ERP-supplier to interact with customers with demanding, but yet typical, problems. However, changes made in one module often calls for changes in related modules. Hence, there is interdependence between different modules within the ERP-system. To facilitate updating of previous versions every new standardized version needs to be adjusted to every previous version. Hence, there also exist interdependencies between the different versions of the system.

## **Firm B**

The customer (firm B) is a sub-contractor on the second tier in the automotive industry. Its production is divided between three different production facilities. The original and main facility is a knitting work including both round and warp knitting machines. When the fabric has been knitted it is sent to firm B's second facility where

it is colored. About 35% of the colored fabric is distributed directly to the customers. However, the remaining 65% are sent to firm A's third facility, or to an external contract worker (firm I), where it is laminated with a thin layer of foam rubber and a plastic film. The third facility is also connected to a sew work (firm J) which sews curtains on contract.

Owing to a large number of different product variants, production sequences and extensive production lead-time, firm B cannot cope with the planning problem only by maintaining sufficient stocks of material in progress. This is owing to great variations in their output and in their customer's orders. In order to cope with these problems firm B need a system which can handle plans and orders simultaneously.

The firm strive to have an internal activity structure, which in an efficient way, combine the utilization of different resources in the form of production equipment, manpower, and input material, i.e. an internal activity structure which makes the firm able to meet its customers orders and to, as efficient as possible, utilize its production facilities. This internal activity structure has to be coordinated with the external activity structure, i.e. with activities performed by firm B's different customers and suppliers.

Firm B's most demanding customer (firm X), in terms of lead-times, is one of the main suppliers of seats to the car and truck producers. This firm makes its call-offs a week prior to delivery while the time required by firm B to produce the items is about 9 weeks including the time required to get yarn deliveries. Besides the call-offs the customer provide its suppliers with delivery plans. These plans span about 60 weeks and are up-dated once a week. Although their accuracy becomes improved when getting closer to call-off, they may be subject to substantial deviations. These deviations make it difficult for firm B to efficiently co-ordinate its production.

From firm B's perspective the focal products are the yarns, the fabrics, and the different chemicals, which constitutes the inputs and the outputs in its different production facilities. The focal facilities are the three internal facilities and the two facilities of firm I and J that are closely related to its operations. The ERP-system can be seen as an additional facility that helps firm B to co-ordinate their activities.

From firm B's perspective the ERP-system will be used to facilitate its co-ordination of activities taking place within and between the internal facilities, and the facilities of its counterparts.

### **Adaptation and development of firm A's scheduling modules**

In co-operation with firm B, firm A made adaptations directly into the standard version. This was made because firm B's problems were considered as being general within the automotive industry. The most important adaptations concerned a scheduling function which could handle both plans and orders. This scheduling function consisted of two different modules, one receiving orders and plans from customers and one sending orders and plans to suppliers.

The fact that both these modules could handle orders and plans simultaneously, made it possible for firm B to produce some quantities on speculation and at the same time, to a large extent, base its production on actual orders. Hence, it put firm B in a better position to deal with its internal lead times and to utilize its facilities as efficiently as possible.

The implementation did not result in a one way adaptation, i.e. it was not only firm A's modules that were adapted to firm B's coordination activities, but Firm B's co-ordination activities, performed between its three different production facilities, were also adapted to firm A's modules. Hence, both firm A's scheduling modules and the co-ordination activities between firm B's different production facilities were developed.

### How the interaction between firm A and firm B was affected by earlier interactions

The development, made in interaction between firm A and firm B, was affected by previous development (as in Figure A-1). Prior to the interaction with firm B, firm A had managed to develop a working version of a scheduling module receiving orders and plans from customers (pa1), while the scheduling module sending orders and plans to suppliers only existed in the form of a specification list (pa2'). The initial interaction was based on firm A's module and specification list, and on a specification list (pb1) earlier developed by firm B in interaction with another system supplier (firm C) and an external consultant (firm D). They had tried to implement firm C's system (pc1) but had failed since it had turned out that firm C's system could not support firm B's co-ordination activities. Never the less, their efforts had resulted in a carefully documented specification list.

Firm A had developed the first embryo of the scheduling function in interaction with a car manufacturer in Sweden (firm E). The interaction concerned a development of an "automotive segment" and resulted in many new ideas regarding modules that should be included into this segment. One of these ideas concerned a module dealing with orders received from customers (pa1''). The embryo was a specification list that could later be used in a joint project with a car manufacturer in England (firm F). Firm F needed a system to support its suppliers' delivery plans and therefore wanted to develop a prototype in co-operation with firm A. In relation to the development of this prototype, firm A began to recognize that there could be a general need for this kind of solution and therefore decided to, based on the features of the prototype, develop a specification list on a module (pa1') which could simultaneously handle both plans and orders.

The first working version of the scheduling module receiving orders and plans from customers (pa1) was implemented at a company in Malmö (firm G) producing plastic items for the automotive industry. Since the variation in its inputs was low, and since its internal production activities were not divided between different production units, this firm did not have firm B's need of a scheduling module for orders sent to suppliers. Firm G main co-ordination problem was its long transportation times and

that many of its products were on the road. Like firm B, firm G therefore needed a functionality preventing deliveries from being skipped or doubled due to the fact that the customer not yet had received all shipped orders when sending the schedule. Hence, it needed the scheduling module receiving orders and plans from customers (pa1).

## How the interaction between firm A and firm B affected and resulted in other interactions

The interaction between firm A and firm B was not only affected by earlier interactions, but also affected and resulted in other interactions (as in Figure A-2). Through the products used as inputs and outputs, firm B's facilities are subjected to different interdependencies with one another. These interdependencies made it necessary for firm A to make the two scheduling modules able to communicate. One alternative was to use EDI (Electronic Data Interchange) technology. However, firm A's ERP-system did not include EDI-functionality, nor did firm B have any current EDI-solution. Hence, in order to decrease the implementation time, they decided to use a system internal solution called MHS (Message Handling Service). However, these kinds of messages could only be used efficiently within the firm boundary. Hence in order to communicate more efficiently with its customers and suppliers, firm B needed an EDI-solution. Firm A soon realized a need to include an EDI-functionality into the standard version of its ERP-system since many of its customers requested it. However, firm A did not consider EDI-conversion as a part of its business and therefore decided to use an EDI-converter (ph1) developed by an external provider (firm H).

Firm H's EDI-converter is able interpret all different kinds of messages, used in the available EDI-standards, into MHS-messages that firm A's module, receiving and sending messages to external systems (pa3), is able to read. Conversely, it interpret all messages which firm A's module, receiving and sending messages to external systems, sends out into messages which are readable by all available EDI-standards.

The use of firm H's EDI-converter did not result in any major adaptations in firm A's ERP-system, nor did firm A's system, in any substantial way, affect firm H's EDI-converter. However, firm E had to make it possible for the EDI-converter to read and write in firm A's module, receiving and sending messages to external systems, which was accomplished by some "standard" adaptations of the interface.

Changes made in one module often calls for changes in related modules. In this case, the changes made in the scheduling module receiving plans and orders from customers (pa1), resulted in some adaptations in the module creating customer's orders (pa4). The most important adaptation was to make the module able to read in the scheduling module every time it created a new order.

The incorporation of the scheduling module, sending plans and orders to suppliers (pa2), caused some adjustment in the purchase module (pa5). Instead of, as before, only creating a purchase request, it is now creating a delivery schedule including a

delivery plan. Firm A also modified the purchase module in order to store information, about raw material arrivals, provided from the scheduling module. However, the adaptation of the purchase module also required some adaptations of the scheduling module. First, it required that the scheduling module, sending plans and orders to suppliers, should be able to divide a one day need between different times of delivery. Secondly, it required that the scheduling module should also be able to divide a need between different suppliers, all because firm B, for some products, is using more than one supplier.

The implementation of the scheduling modules made firm B change many of its coordination activities. As an example, the modules made it possible to design the planning part of the system as three separate ones, which enabled each one of the plants to plan according to their own particular restraints. This decentralization increased the communication between the different plants (fb1, fb2, fb3), which improved the coordination between their different planning activities. By the use of the ERP-system they were more able to access the same information, which reduced the risks of misunderstandings.

Furthermore, the planners got a more standardized way of working. The different planners at firm B had earlier developed totally different working routines, which made it difficult for one planner to take on when another planner was absent. On the other hand, many activities are now considered to be hidden into the ERP-system.

The influence on firm B did not stop at the company border, but also affected its relationships with other companies. As an example, a company, which sews curtains on contract (firm I), was directly connected to the ERP-system. The main reason was that firm B needed to have better access to information about firm N's stock rates and about the process stages of a different articles. Firm B needed to have this kind of information because it sends invoices, for the goods leaving firm I's facility, to the customers. It also needed to know the exact location of each specific article in order to support its customers' just-in-time production.

As previously mentioned, the implementation of the scheduling modules required extensive investments in EDI-technology. However, firm B's external laminator (firm J) could not make this quite heavy investment. Firm B only constituted 30% of firm G's production, and in its communication with other customers it used another ERP-system which did not include an EDI-application. Firm B solved this emerged problem by increasing its use of its internal capacity. However, in the long run, this solution may complicate firm B's relation with one of its major end customers (a large car manufacturer in Gothenburg). This end customer, which buy in large quantities, demands that its fabric is laminated by firm G. This demand, in turn, is related to its efforts to, by the use of single sourcing, increase the economy of scale in its supply chain.

After implementing the system at firm B, firm A's first succeeding customer (firm L) was a producer of plastic items used in mobile telephones, vacuum cleaners etc. Some of its customers did not send their production plans through EDI. As an example, one large producer of mobile telephones instead placed its production plans on its home page, and then it was up to the suppliers to deal with these plans in which way they

choose to. Hence, at first, firm L chose not to implement the scheduling module. However, during implementation firm L changed its mind about the scheduling modules, and thus decided to include them into its version of firm A's ERP-system.

Since the variety in input/output was less in this case, firm L did not experience problems concerning the late changes. For instance, if a car manufacturer decides to produce 1000 striped patterned seats instead of 1000 squared patterned seats, it does not effect the colour of the plastic items used in these seats. Apart from this, it is easier for Firm L to increase the production of plastic items than it is for the car manufacturer to increase its production of cars. Hence, firm L's customers only had to send plans. However, in order to work efficiently Firm A's ERP-system needed both plans and orders. Firm A therefore made a customer specific solution in which the most immediate plan was automatically transformed into an actual order. A producer of hydraulic-, electric tools, electric engines and gaskets (firm M) later implemented a modified version of this solution. In that version the products were not divided according to time, but instead divided into two different groups. The first group consisted of articles which they surely needed. The second group consisted of articles which they might need. Only articles within the first group were then transformed into actual orders. The customer-scheduling module was here used as a forecast generator. Forecasts are usually produced by another module used for centralized planning. However, firm M thought this module would result in a more complex administration. Hence, it was only the scheduling module, sending plans and orders to customers, that was used in the way it was created for. Firm M used the module towards small workshops needing forecasts reaching one year into the future.

A third company, which implemented the ERP-system, was a company (firm N) producing film tapes used in the production of mobile telephones. The input consisted of tapes as well as plastic or foam rubber films. Firm N's production was based on customer's orders. However, since the lead times from its suppliers is much longer than the lead times requested by its customers, firm N produce on speculation. Hence, firm N needed to make reliable forecasts. Unlike firm M, firm N used the Head planning module (pa6) as a forecast generator. However, this module is not compatible with the scheduling modules. Consequently firm N decided not to implement the scheduling modules. When the scheduling module receives a new plan, the corresponding quantities are not automatically redrawn from the quantities calculated by the head-planning module. Hence, an implementation of both the head planning module and the scheduling modules would therefore result in generating double needs.

## **Concluding discussion**

Despite the apparent complexity featuring the case, it is an illustration of the development of only one very 'small' resource item in a complex network setting. The focal resource item is considered a product in the perspective of the supplier, and a part of a facility in the perspective of the customer.

The case may illustrate two different and important aspects of embeddedness. First, the embeddedness of every resource item makes the set of interfaces to other resource

items, such as other products, facilities, business units and business relationships, complex and highly specific to that individual resource item. When developing resource items the interfaces to other resources therefore become of importance in different ways. First, every change implies learning of the current interfaces, some of which may be perceived as restraints in the process. Second, new resource interfaces need to be created among existing resources.

Another form of embeddedness is that past interaction among interfaces result in that certain features are built into resource items (Wedin 2001). The case illustrates how Firm A's interaction with previous customers impacted on the interaction with Firm B, and how this interaction, in turn, impacted on the solutions developed in interaction with firm A's proceeding customers. This points to the impact of the sequence of interaction. Returning to the case, this means that the customers can benefit from features built into the products, but also that their possibilities to influence the features of the particular product may be limited owing to that its current features have become embedded in other interfaces.

The two forms of embeddedness have consequences for the conceptualisation of connected relationships. Arguably, neither their content nor function can be understood if only focusing on the relationships per se since the connections are always partial and thus fragmented and related to specific resource items and their specific interfaces.

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# Appendix

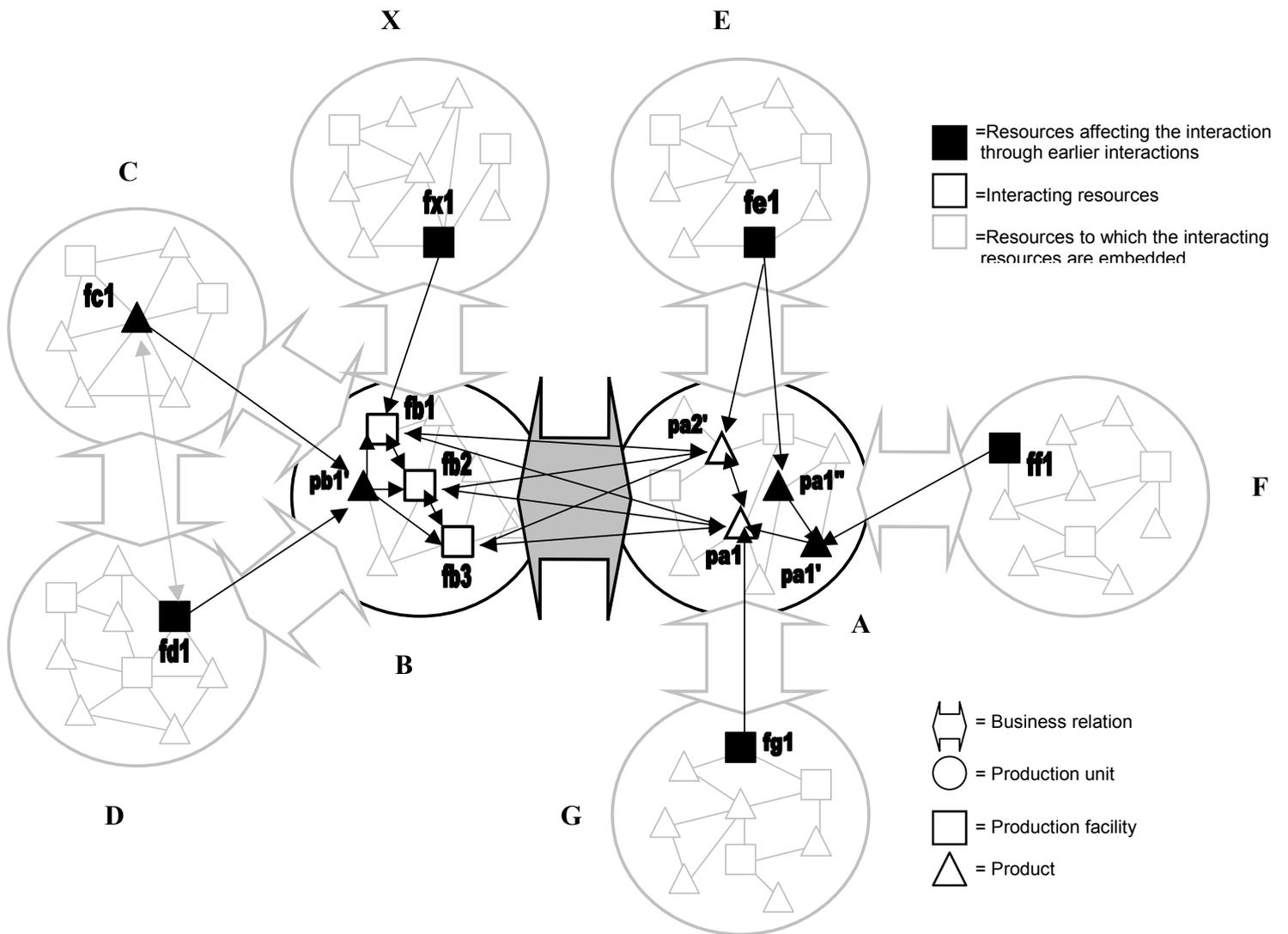


Figure A-1. Illustration of how the adaptations, made in interaction between firm A and firm B, were affected by earlier interactions.

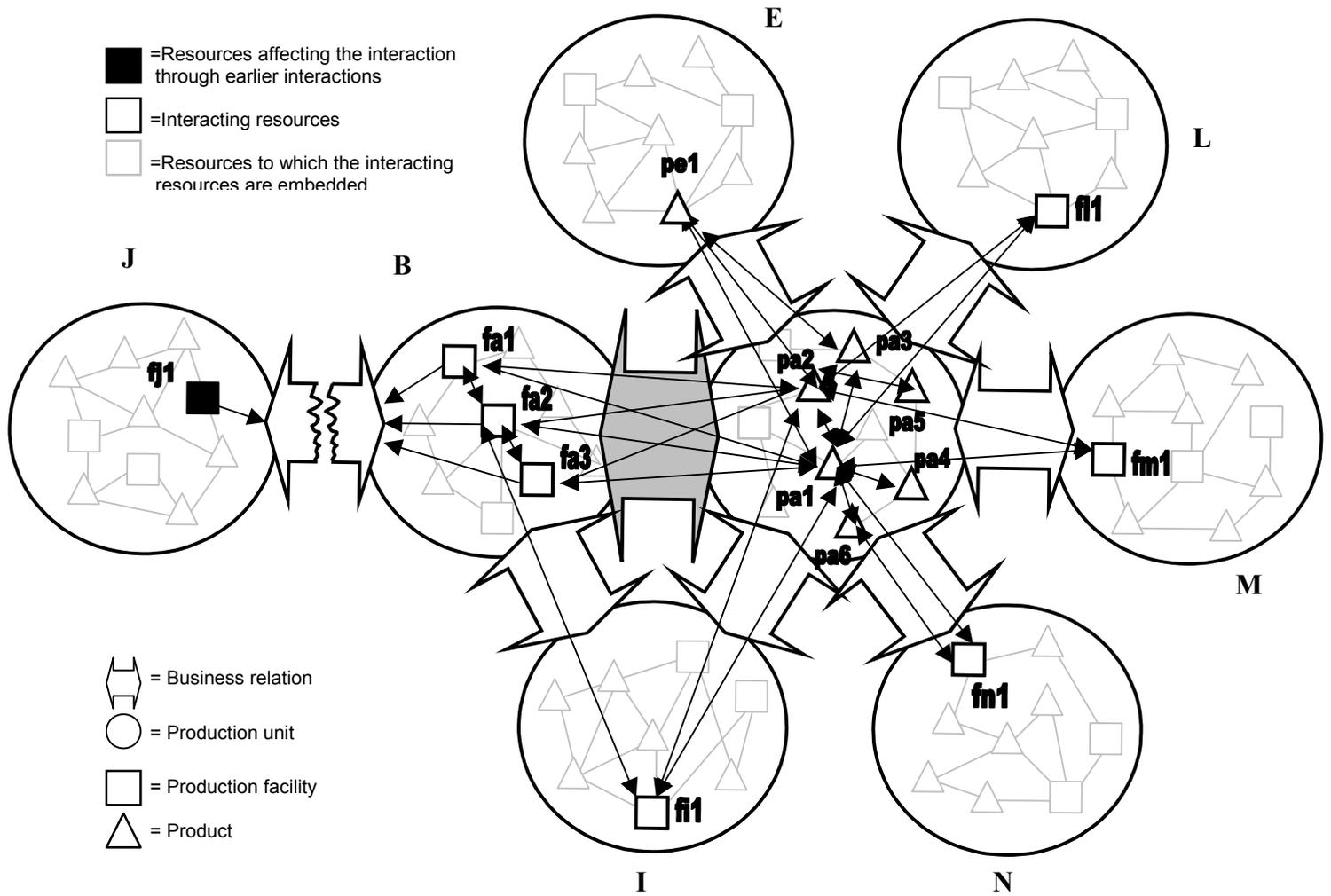


Figure A-2. Illustration of the interaction between firm A and firm B and how it affected and resulted in other interactions.