ACTION AND REACTION IN INTERACTION

-ACTIVITY ADJUSTMENTS AND BUSINESS RELATIONSHIP CHANGE

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Abstract

Change and business network dynamics is considered inherent to industrial networks. In this paper, we approach the notion of change through the specification of interaction. To enable the exploration of interaction between network counterparts, the concepts of activity interdependencies and adjustments are first related to each other and then expanded to include both time- and space-related dimensions. With the resulting conceptual building blocks, the paper explores upon the continuous change of industrial networks. The paper ends by discussing managerial action and reaction in interaction, specifying various ways in which an actor can act and react in the industrial network of which it is part. It is argued that an actor can influence the dynamics of the industrial network and subsequently through interaction is able to change its current position in the network in a desirable way.

Keywords: Activities, Adjustments, Action, Reaction, Interaction

Competitive paper

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INTRODUCTION

Change and business network dynamics is considered inherent to industrial networks. As a consequence, it has been the focus of much research attention within the Industrial Marketing and Purchasing (IMP) tradition (see e.g. Håkansson and Henders, 1995; Halinen et al., 1999; Håkansson and Ford, 2002). Often, it is treated in relation to individual business relationships, acknowledging the practical and theoretical importance of inter-organizational interaction for developing individual firms as well as entire business networks.

In this paper, we approach the notion of change by specifying the concept of interaction. Although the conceptual interpretation and the relevance of interaction are two of the cornerstones of the Industrial Network Approach (INA), it is rarely defined in specific terms (Medlin, 2002). One explanation to this conceptual uncertainty is that the multiple definitions of actors mean that the specific interpretation of interaction changes with context (ibid.). Nevertheless, interaction has a key role in the life of an actor and is directed towards its counterparts (Håkansson and Waluszewski, 2002). According to Håkansson et al. (2009), interaction is: *"a process that occurs between companies and which changes and transforms aspects of the resources and activities of the companies involved in it and the companies themselves"* (p. 27). The actors, activities and resources of business are thus defined in terms of interaction (ibid.).

In order to allow the specification and analysis of interaction between network counterparts, the concept of activity adjustments is drawn upon. The identification of activity adjustments enables the distinction between principally different actions and reactions of an actor (Håkansson et al., 2009). These actions and reactions are in turn recognized as the elements of interaction and as such enable the exploration of change in relation to individual firms, business relationships, as well as entire networks.

To approach these activity adjustments, we use the concept of activity interdependencies. This concept is structural in nature and targets the relatedness of industrial activities. It has concerned many researchers in various research traditions. For example, Thompson (1967) stated that; "*if we wish to understand organization structure, we must consider what is meant by interdependence*" (p. 54). Other scholars, such as March and Simon (1958), Penrose (1959), and Van de Ven at al. (1976) have also explored the relatedness between the activities of a firm. March and Simon (1958) spoke of synchronization of activities and recognize the complex economic processes in which a firm is involved. Penrose (1959) highlighted the need for coordination through plans and arrangements, and assigned such coordinative actions to the management of a firm. In comparison, Van de Ven et al. (1976) argued the need *"to integrate or link together different parts of an organization to accomplish a collective set of tasks"* (p. 322). Whereas these scholars approach the exploration of interdependencies primarily from an intra-organizational perspective, there are several examples of research initiatives, among other within the IMP tradition, highlighting the importance inter-firm relationships and the need to develop conceptual frameworks appropriate to describe and explain them (e.g. Axelsson and Easton, 1992; Håkansson and Snehota, 1995). Such models of industrial networks allow for the identification of extended patterns of interdependent activities (Håkansson et al., 2009).

Purpose

This paper aims to explore and specify the continuous change of industrial networks. It draws upon the structural notion of activity interdependencies to identify separate activity adjustments. These are then used to identify and analyze the actions and reactions of individual actors, enabling the specification of interaction in relation to individual business relationships.

In addition, the paper uses the developed conceptualizations of network change in order to reflect upon the activity undertakings of individual actors (e.g. firms). The actor perspective holds relevance when considering how the actions and reactions of individual actors shape the dynamic features of the network, why this paper ends with a discussion on managerial action and reaction in interaction.

The paper is conceptual in nature, building upon the works of previous researchers, and the conceptual cornerstones of the INA. Furthermore, it summarizes and contextualizes some of the key points in the PhD thesis by Bankvall (2011), why the conceptual definitions and developments are represented also in that thesis. This paper attempts to both condense the main arguments related to the thesis, but also relate these explicitly to the notion of business relationship change. The figures in the paper are as a consequence also represented in Bankvall (2011). The reader is therefore advised to consult that reference when interested in empirical exemplifications related to the developed concepts.

INTERRELATEDNESS OF ACTIVITY INTERDEPENDENCIES AND ADJUSTMENTS

In the analysis of industrial networks, structural and process characteristics can be distinguished between. Whereas 'structural' characteristics can be identified at a certain point, 'process' characteristics must be traced over a period of time (Holmen, 2001). Håkansson el al. (2009) suggest a descriptive model of business interaction which offers concepts related to time and space with regard to the analysis of activity patterns, resource constellations and actors webs. This model is presented in Figure 1.

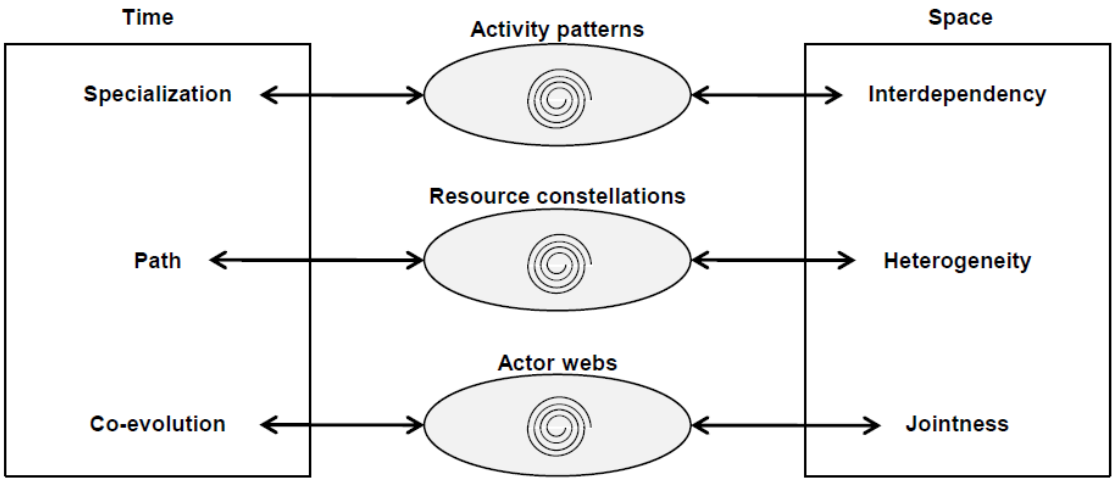

Figure 1. A model of business interaction (Håkansson et al., 2009, p. 41).

Focusing on the activity dimension, the model suggests two concepts for the analysis of activities in space and time. All activities in business life are interdependent and *"even if*

some of these activities may appear to be independent, they are always connected to others in a variety of ways" (ibid., p. 42). Interdependency is thus a special dimension of activity patterns. In addition, each activity and the activity pattern of which it forms part evolve over time. This evolution is referred to by Håkansson et al. (2009) as a process of specialization. This process, *"involves making activity adjustments, many of which are step-wise changes in order to successively reduce costs in daily business"* (ibid., p. 43). Activity adjustments are thus identified as the means by which specialization is achieved. They therefore constitute the building blocks of change in activity patterns.

Space represents a structural activity dimension with extended interdependencies among activities (Håkansson et al., 2009). These interdependencies exist between all activities that are part of an activity pattern. This means that not only activities directly linked with each other are interdependent. Extended interdependencies also link activities undertaken seemingly far from each other, for example undertaken by actors that have no direct contact or even knowledge of each other. Such, to some extent 'hidden' activity interdependencies emphasize the potentially far-reaching network effects of interdependencies among individual activities.

Time targets how these structural relationships develop as business prerequisites change. The analysis of activity adjustments allows for the identification of such developments (Håkansson et al., 2009). In principle, adjustments are made to improve the joint performance of activities (ibid.), so activity links are established and developed through adjustments. Activity links are here identified between all directly connected activities, regardless of whether these are undertaken by the same actor or by different actors. This notion is in line with Håkansson et al. (2009). Furthermore, the interest in structural change does not imply an interest to describe actual change processes, but to find representations of change which can be used to analyze the continuous change of structural relationships among activities.

Just as adjustments are made in response to existing activity interdependencies, adjustments of activities also create interdependencies (ibid.). The interdependencies among activities therefore both come from and result in activity adjustments. This dual cause-and-effect relationship between interdependencies and adjustments is one of the conceptual cornerstones of this paper.

REPRESENTATION OF SPACE WITH ACTIVITY INTERDEPENDENCY TYPES

According to the INA, industrial activities are undertaken in a context of resources. Activities and resources are thus related. This relatedness can be depicted in different ways. According to Håkansson (1987), activities *"change or exchange resources through the use of other resources"* (p. 17). This specific relatedness between activities and resources allows for the identification of two principal types of resources. Here, these two resource types are recognized as so-called enabling and object resources, illustrated in figure 2.

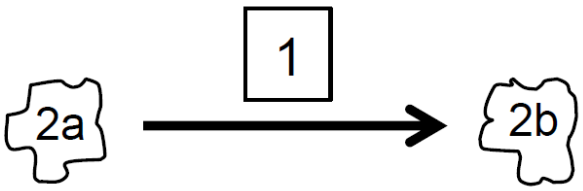

Figure 2. An activity connected with enabling (1) and object (2a-b) resources.

An enabling resource (1) is activated for the actual activity undertaking. This corresponds to what Richardson (1972) identifies as capabilities. These can be machines, equipment or personnel, while object resources (2) are activated in the activity undertaking, and are the objects of it. Such object resources are primarily raw materials, components and end products, refined through the activity undertaking. In addition, with regard to the individual activity, a further distinction of object resources is made. The object resource input for the activity (2a) is distinguished from the object resource output from the activity (2b). The output is a refined version of the input. This notion relates to Hulthén (2002), who says that inputs *"come out of the transformations with new features, as transformation outputs"* (p. 33). Most object resources are labeled as both an input and an output, depending on the specific activity to which they are related.

Here, each 'individual activity undertaking' (consider for example a machine which cuts steel bars into specific lengths, each cutting motion is then identified as an individual activity undertaking) is related to only one input, one output and one enabling resource. However, the resources related to an individual activity undertaking can consist of several resource elements: from the perspective of the activity, its input might be separable into several input elements. The same holds true for its output and enabling resource. Resource elements are thus the distinguishable parts of which an individual resource consists. For example, an enabling resource often consists of several distinguishable parts such as the machines and personnel required for undertaking the individual activities.

An analytical expansion of Figure 2 can be used to describe the continuous nature of most activity undertakings. Activities are ordinarily undertaken more than once (that is, the cutting machine mentioned above is possibly continuously cutting multiple steel bars). When considering the continuous undertakings of an activity, a certain variety is identifiable. This is derived from the resources with which an activity is associated and the fact that what is understood as the same principle resource type, from the perspective of the individual activity, might display some variety. Here, variety is the change of a resource within an existing range (this does not imply changing the resource itself, which is the case when making activity adjustments). In principle, variety could result from changes within the range of one or only a few of the resource elements of which a resource consists.

The variety related to the resources of an activity represents the 'flexibility' of the undertakings of that activity. An activity might, for example, use a variety of inputs, while it still delivers the same output(s), or vice versa. This 'flexibility' is termed as the adjustability of an activity. Here, adjustability represents the flexibility of an activity's undertakings, derived from the variety related to its resources.

With this analytical expansion, not only individual activity undertakings are captured, but the whole range of potential undertakings of an activity. The adjustability is different for different activities.

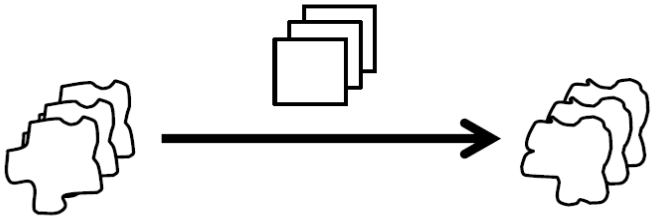

Figure 3. The adjustability of an activity.

The illustration in Figure 3 shows an activity and its resources. Each resource displays a variety that allows it to be changed in three different ways ("the range") with regard to the undertakings of the activity. The change of an individual resource might involve the change of only one or a few of its constituent resource elements. In relation to the principal argumentation, it is nonetheless identified as a changed resource.

As illustrated in Figure 3, the adjustability of an activity is represented in the variety of its resources. The identification of the adjustability of an individual activity can thus be approached by analyzing of its resources. With this basic relatedness of activities and resources, the issue of connected activities is approached. The specific relatedness between activities and resources means that activities intersect resource ties, and resources intersect activity links. One dimension thus "bridges" the connection of the other and an activity links with other activities through its resources. Activity links are made specific with activity interdependencies. For the purpose of this paper, we draw upon the four interdependency types suggested by Bankvall (2011). These are here briefly recapitulated and specified in light of the activity-resource relatedness discussed above.

Input-output related interdependence is illustrated in Figure 4. This figure also highlights an important notion presented above. An individual object resource is often labeled as both an input and an output, depending on the activity to which it is related. Furthermore, this interdependency type represents a kind of structural backbone for activity analysis. All activities are exposed to it and two of the interdependency types presented below derive from this input-output related interdependence between activities.

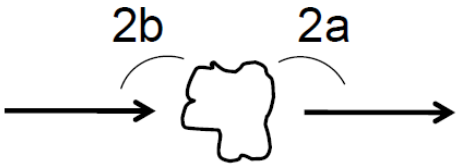

Figure 4. An activity link subject to input-output related interdependence. Distinguishing between inputs and outputs in accordance with Figure 2, the bridging resource is an output in relation to the first activity (2b), and an input in relation to the second (2a).

The definition of joint interdependence given by Håkansson et al. (2009) aids the specification of the second and third activity interdependency types. These acknowledge interdependence between activities which have *joint direction of outputs* and *joint origin of inputs*, respectively. Joint direction of outputs exists when two activities (individually) deliver outputs required as inputs for a common third activity. In contrast, joint origin of inputs exists when two activities require inputs which are delivered as outputs from a common third activity. These types of interdependency are illustrated in Figures 5 and 6. With regard to the illustration of joint direction of outputs, the two resource elements of the bridging resource are clearly identifiable (illustrated as a puzzle with two pieces) as they are separate outputs from two different activities.

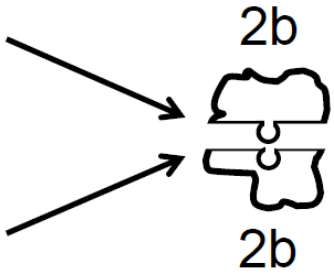

Figure 5. Joint direction of outputs (in accordance with Figure 2, both elements of the bridging resource are outputs in relation to the two activities (2b)).

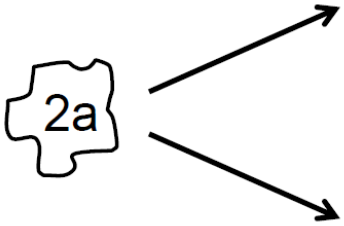

Figure 6. Joint origin of inputs (in accordance with Figure 2, the bridging resource is an input in relation to both activities (2a)).

In relation to all three types of activity interdependency the intermediate resource is an object resource, but an enabling resource can also connect two activities when they require the same enabling resource for their undertaking. Here, they are identified in *the shared activation of an enabling resource*. This type of activity interdependency corresponds to what Richardson (1972) targeted with his analysis of similarities among activities, and it was also indicated in the specification of pooled interdependence by Thompson (1967). The shared activation of an enabling resource is illustrated in Figure 7.

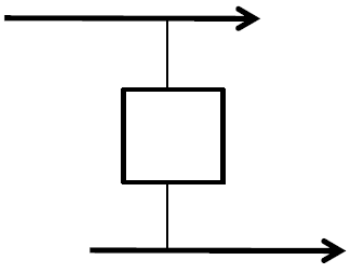

Figure 7. Shared activation of an enabling resource.

These four types of activity interdependency represent distinct ways in which activities link. Two activities might link in a way involving several of the interdependency types specified above. If so, they are separated into several individual activity links. An activity can thus have several links to another given activity. In addition, indirect activity interdependencies are also identifiable among activities, following the basic interdependency logic of industrial networks. With this typology, such indirect interdependencies can be separated into any combination of the four suggested activity interdependency types, making indirect interdependencies specific and traceable.

Activity interdependencies specify the type of link(s) between two activities. However, they say little about the characteristics of the link(s). To target one aspect of such suggested characteristics, the concept of activity adjustability is related to the activity link. An activity link is facilitated by a bridging resource. There is variety related to this bridging resource, just as there is variety related to the resources of an activity. With regard to the activity link, the bridging resource can be changed in a number of ways without compromising the integrity of the link. In a way, this variety of the bridging resource indicates how 'flexible' the activity undertakings of the individual activities are vis-à-vis each other, i.e. how they condition each other's undertakings. The flexibility of the undertakings of an activity link, derived from the variety related to its bridging resource, is represented with the concept of "linked adjustability". Such linked adjustability is illustrated in Figure 8, where an activity link subject to input-output related interdependence is depicted.

Figure 8. The linked adjustability of an activity link.

Linked adjustability indicates the reciprocal nature of the undertakings of the two activities - that is, how the output of activity *a* is changed without compromising the integrity of the link. Activity *b* must then also be able to receive inputs which are changed in accordance with the outputs of activity *a*. By definition, linked adjustability is the flexibility of an activity link, derived from the variety related to its bridging resource.

The concept of linked adjustability is related to that of adjustability, but whereas adjustability is an activity concept, linked adjustability is related to the activity link. Any given activity is part of several activity links. These links display linked adjustability. Thus, the adjustability of an activity is the combined result of the linked adjustability of each of the activity links of which it is a part. To specify individual activity links, the concept of activity interdependencies is thus supplemented with the notion of linked adjustability.

THE REPRESENTATION OF TIME WITH ACTIVITY ADJUSTMENTS

The concepts developed in the previous section can aid the analysis of established activity structures. However, these structures continuously change. The activity structure underlying the production of a specific end product is refined in the light of new technological advances, revised production processes, changed demand patterns, etc. The activity structure of an actor is also changed as activities are developed or perhaps eliminated, and additional activities are introduced. Change is simply an inherent feature of business life.

It has already been suggested that there is an adjustability related to activities. This represents the flexibility of an activity's undertakings, derived from the variety of its resources. However, under certain circumstances resource changes are made which modify this variety. By definition, a modification increases or decreases the variety of a resource. With modifications, the adjustability of an activity is altered. Alterations of the adjustability of an activity, derived from modifications related to its resources, are targeted with the concept of activity "adjustments".

Researchers in the INA have approached the issue of adjustments (and the related concept of adaptations) somewhat differently (see e.g. Håkansson, 1982; Gadde and Håkansson, 1993; Brennan and Turnbull, 1998). Despite its acknowledged importance for the understanding and analysis of industrial networks, there are differences in conceptual approach. Here, the activity dimension of the INA is of main analytical interest. According to the distinction of Håkansson et al. (2009), activities are adjusted, whereas resources are adapted.

Activity adjustments are illustrated in Figure 9. As indicated in this figure, adjustments can involve the expansion and/or limitation of the current adjustability of an activity.

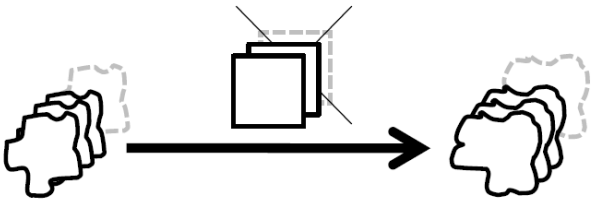

Figure 9. Illustration of activity adjustments.

In Figure 9, all the resources of an activity are modified. As a result of the modifications in this specific example, both the input and output can be changed in four (instead of three as above) different ways with regard to the undertakings of the activity. In contrast, the enabling resource can be changed in two (instead of three) different ways with regard to the undertakings of the activity. Adjustability is analyzed from a given set of resources; adjustment implies the change of this resource set.

Activity adjustments not only derive from modifications of the variety of resources, they also cause such modifications. When an activity is adjusted in response to a resource modification, this has an impact on the other resources of the activity. Thus resource modifications both result in and result from activity adjustments. The notion is illustrated in Figure 10. From the perspective of an individual activity, the variety of any of its three resource types might be modified, in which case this modification alters the adjustability of the activity which, in turn, requires the modification of at least one of the other two resource types.

In line with this argumentation, an activity adjustment can be said to consist of two components: the "incoming" component targets the need to adjust an activity in response to a resource modification, whereas the "outgoing" component targets the need to modify a resource(s) in response to an activity adjustment. In Figure 10, the incoming component is illustrated with unbroken arrows and the outgoing component is illustrated with broken arrows. The figure illustrates the principal directions of such incoming and outgoing components: a specific adjustment might involve any combination of these components.

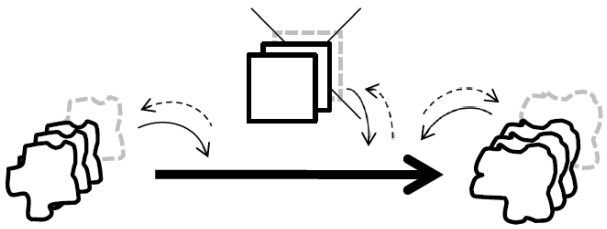

Figure 10. The principal directions of the incoming and outgoing components of an activity adjustment.

The separation of incoming and outgoing components of an activity adjustment is primarily made for analytical reasons. Both concern the same principal adjustment, but they target different aspects of it with regard to the required resource modifications.

Since the alteration of the adjustability of an activity is analyzed using the concept of activity adjustments, such adjustments can also be related to activity links. Activity links are characterized by some linked adjustability. The modification of the variety of a bridging resource involves the alteration of the linked adjustability of an activity link. Figure 11 shows an activity link subject to serial interdependence. The bridging resource that facilitates this link is modified. As a result of this specific modification, the bridging resource can be changed in four (instead of three as previously) different ways without compromising the integrity of the activity link.

Figure 11. Alteration of the linked adjustability of an activity link subject to serial interdependence.

From the perspective of an activity link, "developing activity adjustments" are identified. Developing activity adjustments alter the linked adjustability of an activity link. They do not compromise the integrity of the link, but they change its characteristics. A developing activity adjustment is related to the alteration of the adjustability of both activities of an activity link.

Incoming and outgoing components are identified also in connection with developing activity adjustments, which concern an activity link. When one of the activities of an activity link is adjusted, this requires modification of the bridging resource. This modification in turn requires adjustment of the other activity of the activity link. Figure 12 illustrates the principal directions of incoming and outgoing components with regard to an activity link.

Figure 12. The principal directions of incoming and outgoing components of an activity adjustment, with regard to an activity link subject to serial interdependence.

In accordance with the concepts above, change is connected with activity adjustments which alter the linked adjustability of activity links. Such alterations target the dynamic nature of established activity links. However, under certain circumstances an activity is adjusted so as to compromise the integrity of the activity link and the activity adjustment is then not followed by the subsequent alteration of the linked adjustability of the link and the adjustment of the other activity.

In such situations, whether or not the established activity link is broken, the adjustment of the activity is conditioned by the establishment of a new activity link and from the perspective of an activity, "establishing activity adjustments" are identified. These are activity adjustments which result in the establishment of new activity links. Activity links are established when two previously unrelated (or at least only indirectly related) activities become linked. When

an activity adjustment is not facilitated within an existing activity link, it needs to be directed towards a new activity link or the activity will not be adjusted. This is illustrated in Figure 13.

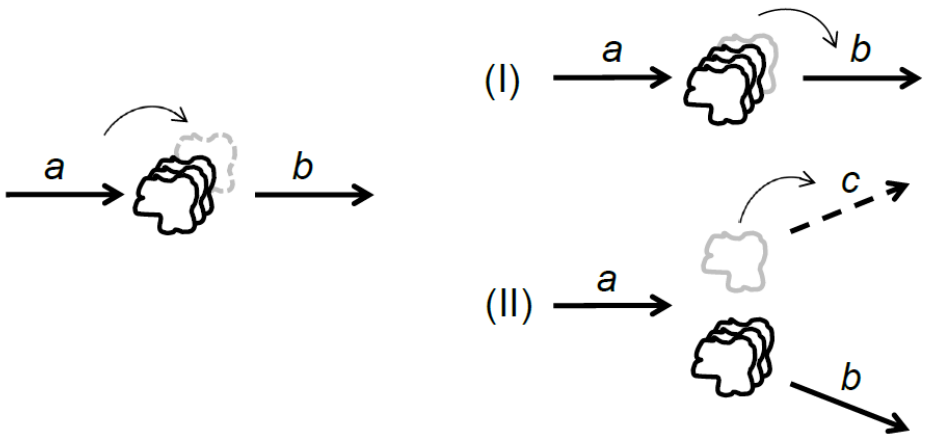

Figure 13. An activity adjustment which results in (I) the alteration of the linked adjustability of an established activity link (a-b), or (II) the establishment of a new activity link (a-c).

Activity *a* is adjusted. This adjustment has an outgoing component which requires modification of the bridging resource between activities *a* and *b*. In situation (I), this adjustment is identified as a developing activity adjustment, as it alters the linked adjustability of the activity link between activities *a* and *b*. As a result of the modification of the bridging resource, the adjustment has an incoming component with regard to activity *b*, which subsequently requires adjustment. In situation (II), the adjustment compromises the integrity of the activity link between activities *a* and *b*. The linked adjustability of this activity link is not altered, but the adjustment is identified as an establishing activity adjustment, which results in the establishment of an activity link between activities *a* and *c*. In this situation, the adjustment has an incoming component with regard to activity *c*. In this latter situation, the activity link between activities *a* and *b* remains intact and unaltered although the inability of activity *b* to adjust in line with the component incoming from activity *a* can also result in the activity link being broken.

An activity adjustment can involve the alteration of the linked adjustability of an established activity link, at the same time as it requires the establishment of a new activity link. Thus developing and establishing activity adjustments can co-exist as aspects of the same principal adjustment. In addition, in line with the argumentation above, an activity adjustment can result in breaking an established activity link.

ACTIONS AND REACTIONS IN INTERACTION

In accordance with the Activity-Resource-Actor (ARA) model, actors undertake activities and activate resources (Håkansson, 1987). Moreover, actors can act. Their possibilities for action, reaction, and interaction are conditioned by the relations between activities, resources and actors. Using the conceptualizations related to interdependencies and adjustments above, it is now possible to specify the acting, reacting and interacting of an individual actor.

As illustrated in Figure 14, an activity is undertaken by a specific actor (the figure indicating the boundaries of the actor). In connection with the undertaking of this activity, the actor also activates related resources.

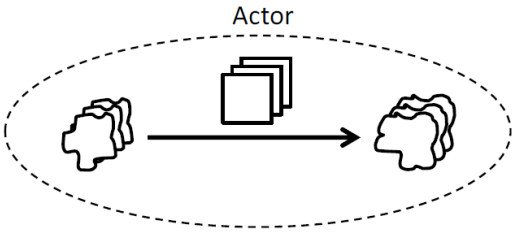

Figure 14. An activity undertaken by a specific actor, who also activates the resources of the activity.

An actor undertakes an activity in accordance with the adjustability of the activity. An actor also makes activity adjustments through modifications of the resources of an activity. An actor is connected to all the space and time-related aspects of activity linking discussed above.

The analytical separation of acting, reacting and interacting is made possible with the notion of incoming and outgoing components of activity adjustments. An actor experiences a need to adjust an activity in response to a resource modification. As the actor makes this adjustment, there will be a need to modify one or several of the other resources of the activity. Both the "action" and "reaction" of actors can thus be related to activity adjustments. The reaction is related to the incoming component of an activity adjustment, whereas the action is related to the outgoing component. Both action and reaction are part of the same activity adjustment; although they represent different aspects of it. Through this analytical separation, the resource modifications related to an activity adjustment are assigned to either the reaction or the action of an actor.

So an activity is undertaken by an actor, and the adjustment of this activity is both a reaction and an action of the actor. With this in mind, the notion of interaction is approached. The exploration is again exemplified with an activity link subject to input-output related interdependence. The two activities which are part of this link can be undertaken either by the same actor or by different actors. These alternatives are represented in Figure 15. In addition, incoming and outgoing components of an activity adjustment are indicated with regard to the specific activity link.

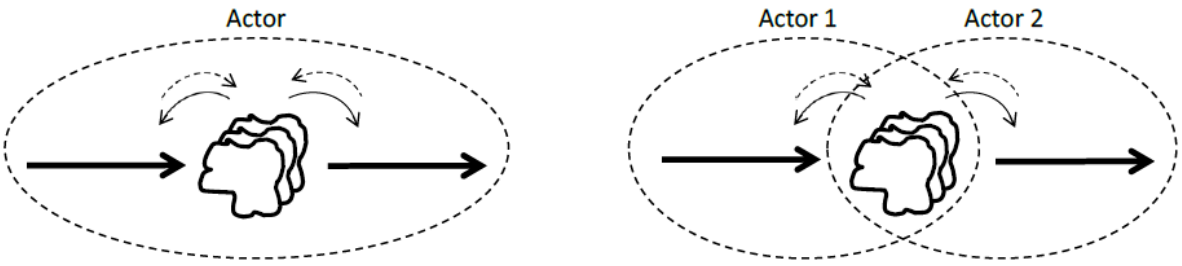

Figure 15. An activity link, subject to input-output related interdependence, residing either within the boundaries of an actor, or crossing the boundaries of two actors.

The activity link either exists within the boundaries of an actor, or crosses the boundaries of two actors. The activity link is bridged by a resource which, in the latter case, is activated by both actors. As illustrated in Figure 156, the adjustment of one activity creates an outgoing component which requires modification of the bridging resource. The other activity will then

need to adjust in response to the resource modification. The separation of action and reaction with regard to the outgoing and incoming components of an activity adjustment thus allows for analysis of interaction from the perspective of an actor. When considering the activity structure of an actor, and the ways in which these activities link with activities undertaken by other actors, the acting and reacting of an actor always relate to its counterparts. Here, boundary-crossing activity links are identified as a special case of activity links. As all actors experience boundary-crossing activity links, these are crucial to the analysis of interaction.

In accordance with the INA, actors are involved in interaction processes with other actors. These interaction processes may be separated into the reactions and actions of two actors who are adjusting activities which are linked across their actor boundaries, illustrated in Figure 16.

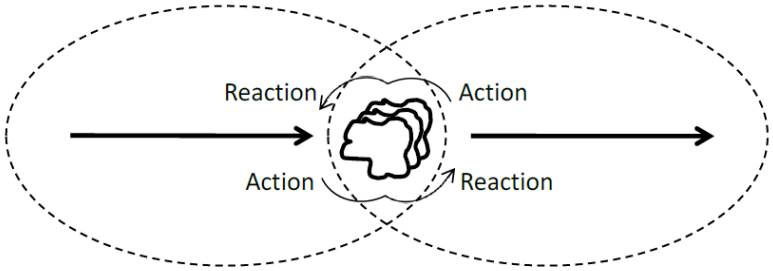

Figure 16. Action and reaction in interaction.

MANAGERIAL ACTIONS AND REACTIONS IN INTERACTION

Actors undertake and adjust activities. Related to these undertakings and adjustments are the activations and modifications of an activity's resources. The exploration in this paper distinguishes between the actions and reactions of an actor, associating them with the incoming and outgoing components of an activity adjustment. In addition, boundary crossing activity links require interaction, as they involve the adjustment of activities undertaken by separate actors. Interaction is thus seen as means of handling such boundary-crossing activity links. The boundaries of an actor separate internal and external activities and thus represent the perimeter of the actor's direct influence. As illustrated in this paper, the bridging resource of a boundary-crossing activity link can be activated by both actors in a business relationship. The boundaries of these actors therefore intersect with this bridging resource. This dual resource activation marks the starting point for an actor's indirect influence. It is also our starting point when adopting a network perspective for discussing the acting and reacting of individual actors.

Adopting a network perspective requires a network. Using the conceptual relatedness presented in this paper, it is possible to expand upon the notion of activity interdependencies and adjustability to depict a larger network of interdependent activities. As made evident in Figure 17, this network illustrates a combination of all four identified activity interdependency types, as well as the enabling and object resources related to individual activities. While not pursuing any details, Figure 17 illustrates the variety of ways in which individual activities link in order to create larger networks of interdependent activities.

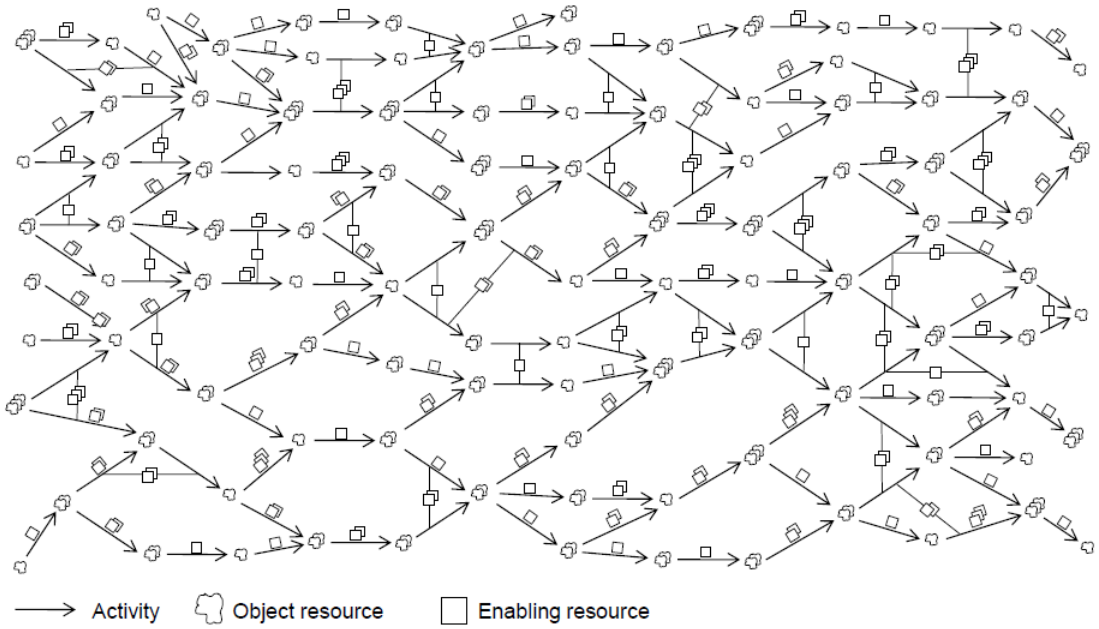

Figure 17. A network of interdependent activities.

In addition to this analytical expansion, this analysis also requires the specification of an additional concept. As previously specified, modified resources cause activity adjustments which, in turn, cause the modification of additional resources. In consequence, activity adjustments propagate from one activity to another and series of adjusted activities can be identified in relation to networks of linked activities. These series of adjusted activities are recognized as propagations. The notion of such propagations relates to Holmen's (2001) identification of a change boundary. Defining the change boundary as the boundary within which something has changed; such changes include new and modified resources, as well as existing resources used in new combinations without being modified (ibid.).

Three propagations are illustrated in Figure 18 (numbered 1-3). The incoming and outgoing components of individual activity adjustments are also illustrated, highlighting the notion that these components are not only associated with the adjustment of individual activities, but also concern different aspects of developing and establishing activity adjustments. Here, activities introduced to the network of linked activities as part of establishing activity adjustments are represented as broken arrows.

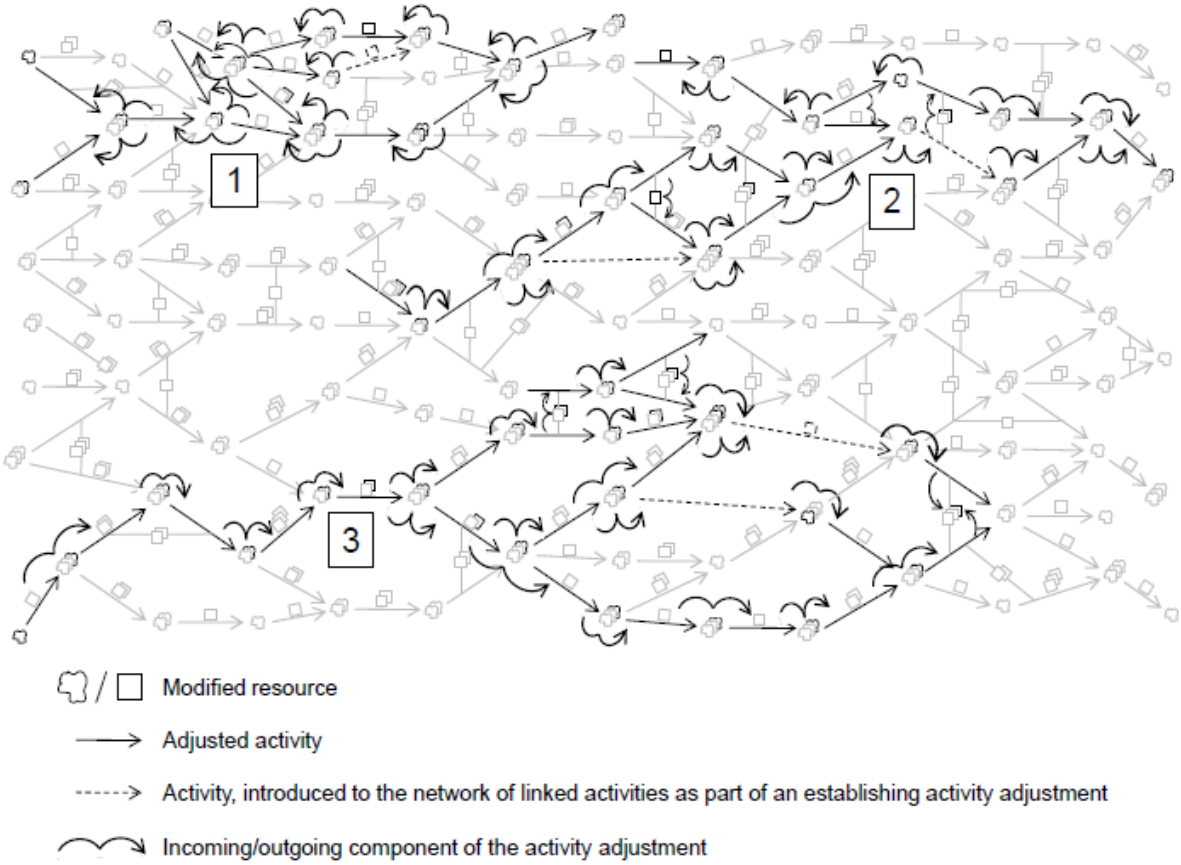

Figure 18. Illustration of three series of adjusted activities, recognized as propagations.

Each propagation has both a start and an end. It starts with a resource modification somewhere in the network. This initial modification may be the indirect result of previous activity adjustments. Whether it is then identified as the start of a new propagation depends on how the modification in question is related to these previous adjustments. Sometimes a separation between individual propagations can be made for analytical reasons, while acknowledging their inherent relatedness. The end of a propagation is also related to resource modifications. Although a specific propagation only has one starting point, it might have several end points. A propagation ends with the modification of a resource which does not bridge any activity links and therefore does not facilitate the further propagation of the adjustments.

To enable the discussion of the actions, reactions and interactions of an actor, Figure 19 considers the boundaries of an actor in the network of interdependent activities and propagations.

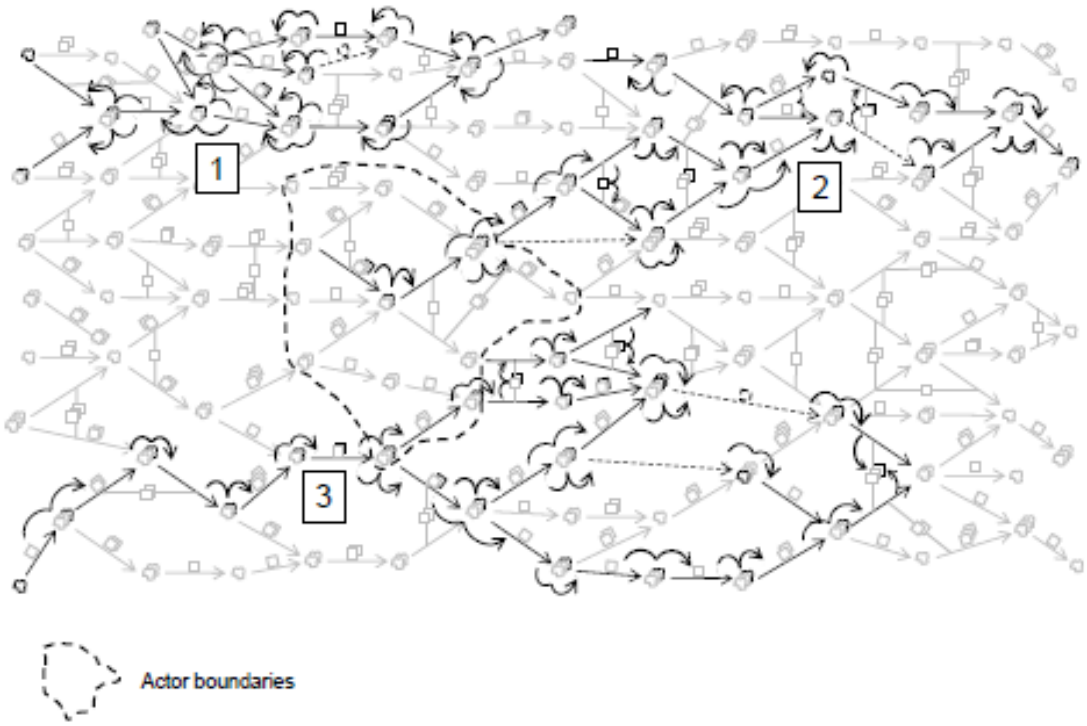

Figure 19. The boundaries of an actor in the network of which it is part.

Each of the three propagations illustrated in Figure 18 is located differently with regard to the boundaries of the actor. From the perspective of the individual actor, the first propagation starts, propagates, and ends outside its boundaries. As such, it does not concern any of the internal activities of the actor, which need not be adjusted in light of these specific adjustments. In contrast, the second propagation starts within the boundaries of the actor. It thus originates with the actor and then propagates to include activities of its counterpart(s). As such, it crosses the boundaries of the actor. In principal, the reverse situation is also conceivable; where a propagation starts outside the boundaries of the actor and ends within its boundaries. The third propagation neither starts nor ends within the boundaries of the actor. It does, however, propagate to include its internal activities. The propagation thus crosses the boundaries of the actor twice. Despite the choice to focus solely on the adjustments of the individual actor, it is recognized that the propagations outside its boundaries are enabled by the activity adjustments of other actors, with many of whom the actor is involved in business relationships.

From the perspective of an actor, individual propagations are separable in accordance with these alternatives. Initially, a distinction is made as to whether the propagation originates within the actor, or outside the actor. In the first case it marks the start of a desired development of the actor. It therefore adjusts the activities of its activity structure accordingly, which might involve developing certain activity links and establishing others. When the adjustments propagate across the boundaries of the actor, which they need not do if they are entirely internal propagations, the actor no longer directly influences the further direction(s) and reach of the propagation. It is up to the counterparts of the actor, who in turn experience the propagation as originating outside.

In this situation, it is crucial for the actor that the propagation, which originated from within the actor, is well received. If propagations are initiated which affect the desired inputs and/or delivered outputs of the actor, they must be absorbed by the counterparts, who deliver the

inputs and receive the outputs. Otherwise, the propagation will not be possible. As interaction is seen as a means of handling boundary-crossing activity links, it is also the vehicle through which these outgoing components of activity adjustments are handled by the actor. Through interaction, the actor is able to influence and receive information about the desired activity undertakings of its counterparts and can make adjustments which are more likely to be absorbed by them. The actor can also influence them to absorb incoming components of activity adjustments which would otherwise be rejected. This is crucial, as the activities under the direct influence of an actor only account for a limited part of the activities that usually need to be adjusted following an initiative of an actor. This notion emphasizes the importance of interaction for influencing the direction and reach of outgoing propagations.

If a propagation originates outside the actor, it will influence the activity undertakings of the actor only if it is directed towards the actor's internal activities. As such, the first propagation in the illustration is of no apparent relevance to the activity undertakings of the actor. However, given the notion of extended networks of linked activities, it is highly likely that propagations initially observed at a distance, and as such of no apparent concern to the actor, eventually also require adjustment of the actor's internal activities.

With regard to an incoming propagation, the actor has a choice of how to react. An actor can decide to absorb it, in which case the current direction of the propagation is elongated and its further reach facilitated. If the propagation is also considered beneficial for the activity undertakings of the actor, the actor might even try to amplify it, either through the development and establishment of internal activity links or by interacting with its counterparts to try to influence the adjustments of their respective activities. If the propagation is not considered beneficial, the actor might try to dampen it. This might also involve activities internal and external to the actor. In case the propagation is not at all in line with the desired activity undertakings of the actor, the actor might decide to reject it. This would mean that the counterpart from whom the propagation originated either had to refrain from making the adjustment(s) or find another counterpart who is willing to absorb it.

Thus, as establishing activity adjustments relate to the introduction of new activities in the network, they also allow for the identification of potentially new actors. When the counterparts of an actor are not willing and/or able to absorb an incoming activity adjustment, it needs to be directed elsewhere. The further propagation is then conditioned by the identification of other actors who absorb the incoming adjustment by adjusting one or several of their internal activities. The activities of these actors are then introduced to the network, which is expanded accordingly. The opposite situation can also hold true if an incoming activity adjustment is rejected by an actor and this rejection results in the breaking of an existing activity link.

With all these alternatives, interaction is crucial. Through interaction, an actor is made aware of potential incoming propagations before they reach the actor's boundaries. The actor might also be able to influence these propagations long before they ever require the adjustment of the actor's internal activities. Knowledge of potential incoming propagations also aids an actor in making decisions about what activities to adjust, either to oppose potential incoming propagations or to support them. Generally, the mere awareness of such propagations enables an actor to make decisions concerning how to react to them once they affect the actor's internal activities. This relates to the notion that individual propagations can both support and oppose each other. With a less interactive approach, fewer propagations that eventually reach the actor's boundaries are anticipated. As argued here, the activity boundary of an actor can thus be expanded through interaction. The activities of the counterparts are influenced and

propagations can be anticipated and prepared for. Propagations which move in potentially conflicting directions and risk opposing each other can be predicted and handled.

Whether a given propagation originates from within or outside the actor, there is a choice of how to act or react to it. The internal activities of an actor can be adjusted in different combinations giving the same final result. Some of the internal activities of an actor can be easier to adjust than others, in which case these are preferred for making such adjustments. Some propagations can require the alteration of the adjustability of specific activities, regardless of whether or not these are exposed to several activity interdependencies and considered difficult to change without compromising other activity links. An actor can thus make choices with regard to acting and/or reacting. The range of choices is conditioned by the activity structure of the actor. With a more adjustable activity structure, an actor is able to assign the adjustments to preferred activities, while avoiding other. An activity can also be adjusted only in the sense that it transfers the resource modifications between inputs and outputs but no modification is made of the enabling resource of the activity.

With all these decisions, the time aspect is vital. Decisions concerning how to act and react with regard to specific propagations and counterparts are influenced by previous experiences both of similar propagations and the counterparts in question. In addition, anticipation of future interactions also influences the decisions of the actor, as certain actions and reactions are made to 'invest' in future opportunities.

In conclusion, actors act, react and interact in a variety of ways to influence the direction(s) and reach of individual propagations. This way they influence the dynamics of the industrial network of which they are part and are able to change their current position in the network in a desirable way. This is in line with general principals associated with industrial network theory, what is however new in this conceptualization is the ability to evaluate the specific effects of managerial actions and reactions, interpreted as propagating activity adjustments. As such, it targets how managers should act and react given the network of interdependent activities of which they are part, and which results they aim to achieve. In that way, the conceptualization creates opportunities for normative decision making, going beyond the more descriptive ambitions associated with most contributions within the industrial network approach.

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