学位申請論文

Inter-organizational Network Effects across Organizational Field Boundaries

組織フィールドの境界を越えた組織間ネットワークの効果

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INTER-ORGANIZATIONAL NETWORK EFFECTS ACROSS ORGANIZATIONAL FIELD BOUNDARIES

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Doctoral Thesis

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Abstract

This dissertation looks at how organizational field boundaries in inter-firm networks influence network effects (benefits from cohesion and structural holes) and network change. It focuses not simply on organizational fields but on what happens at their boundaries.

In the empirical section, each study focuses on a different aspect. In the first study on the emerging Japanese nanotechnology field, I find some evidence that field boundaries increase structural hole effects while they decrease cohesion effects.

In the second study on the Japanese biotechnology industry, I find that field boundaries can be spaces where influences can filter through from other fields. The degree of filtering can be dictated by network structure.

In the third study on the Japanese pharmaceutical industry, I argue that field boundaries can slowly weaken through M&As, making an outsider firm more central in the target field.

Finally, in the fourth study, I investigate the different fields around Toyota Motor Corporation and theorize that field boundaries can be managed by powerful members. I argue that Toyota can create field boundaries that act as insulators that separate different fields.

These studies are all placed in a systematically drawn up theoretical framework that I present in Part I. I review the main literature on fields and organizational fields, starting with Warren (1967), Martin (2011), Bourdieu (2005), Bourdieu & Wacquant (1992), DiMaggio & Powell (1991), Scott (2013), Wooten & Hoffman (2008), all the way to the more recent Powell et al. (1996), Fligstein & McAdam (2012), Furnari (2014), and Zietsma et al. (2017). I find Fligtein & McAdam's (2012) definition as the most developed and build on Zietsma et al. (2017).

Chapter 4 puts all the material together to describe my field concept. I accept that 1) fields can be multi-level and nested, 2) networks are not equal to fields,

but they are a structural representation of some aspects of fields, 3) roles, hierarchy, and power are important in fields, 4) symbolic systems such as norms, values, frames are inseparable from fields, and 5) different forms of capital and tangible objects can shape the power relationships within the field and thus the networks. Then, in Chapter 5, I define field boundaries based on the field concept explained above and give some reference points for what I mean by field interaction.

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Introduction

The quick pace of innovation and high-technology development create new areas of research, and boundaries keep shifting. Different technological areas come together, and researchers with different backgrounds need to collaborate. Hence, today innovation is conceptualized as open innovation that is carried out in inter-organizational networks of relationships. The theory of open innovation suggests that building networks among researchers or even organizations leads to successful innovation; however, more connection does not necessarily translate to success. In this dissertation, I attempt to show that network theory by itself cannot answer all the questions. Instead, there is a need for a more nuanced view. Networks might temporarily dissolve boundaries, but behind these newly-built network connections often lie more solid institutional barriers and boundaries. Without understanding these, it is difficult to understand the benefits and constraints of networking. These hidden boundaries impact traditional network effects such as the positive benefits of cohesion or the brokerage benefits of structural holes and play an intricate role in network change and evolution.

To find out where these boundaries are, I turn to the concept of the field. The concept has a long history. Bourdieu's original idea of the *field* has slowly become a key theoretical concept in organizational studies, primarily through Scott, DiMaggio, and Fligstein, who applied the term in the context of organizations. Fligstein and McAdam (2012) proposed that a field is a fundamental building block of society. They conceptualize fields as made up of individuals as well as other fields such as organizations giving rise to organizational fields. These fields are not isolated but interact with each other. Their boundaries overlap, their members may influence each other. Not only hierarchical and nested fields but also remote, loosely related fields can influence one another. In the last two decades, a great deal of research has been done on how fields emerge around new technologies or different issues (Zietsma, Groenewegen, & Hinings, 2017).). However, one must recognize that these fields are not merely collections of interrelated organizations or individuals but are made up of smaller subfields. The structure of the different subfields within a larger field has not been studied in detail. In

this dissertation, the focus will be on these subfields and their boundaries and argue that understanding these is key in gaining insight into how fields emerge, work, and interact with other fields. There are wide-ranging implications from understanding the formation of isolated silos to the intricacies of merging fields.

I will mainly look at field boundaries through a network lens and investigate what effects boundaries have on underlying organizational networks. With the work of Granovetter, Burt, Ahuja, Soda, Powell, and others, network theory has been brought in to add a further dimension to research on fields.

Networks and fields are not identical, and the two concepts cannot be equated (Fligstein & McAdam, 2012), but the need is there to combine them. Theoretically and methodologically, this would be challenging, and I do not claim to have achieved a proper synthesis. However, throughout this dissertation, I endeavor to lay down a clear theoretical argument that helps discuss the two concepts within one framework.

This common framework's core idea is that a network is simply a unique, descriptive feature of a field, and networks can often extend over field boundaries. In contrast to the network, the field is a more theoretically-encompassing concept. Networks can and should be used to understand the underlying mechanics of fields, but equating fields and networks can lead to mistaken conclusions.

To render the theoretical framework more readily understandable, it may be useful to explain some of my empirical studies' premises before moving on. First, I start with a network of organizations. In its purest form, this is just a network of relationships unrelated to any fields or subfields. However, what is critical to understand is that a given node within a network is also part of a field. In some cases, the study's nature is such that all the nodes can be easily located within one field, even if smaller lower-level subfields are nested in this larger field. Researchers attempt to set clear boundaries that match fields and networks by research design in studies of organizational fields. However, even in that case, subfields and the potential effects of their boundaries exist.

In this dissertation, the focus will be on networks that span different fields[1]. In these

[1] In the literature, these settings are often analysed through the theoretical lens of boundary work, role of gatekeeper, institutional boundaries, interstitial fields. These concepts will be addressed later on.

settings, the fields might not be completely unrelated, but they are still different[2]. From the perspective of data, what the researcher has is just one network of different organizations. This network is removed from reality, it is an abstraction and only a certain impression of the actual dynamically changing network and due to limitations of my datasets, most likely biased, missing critical nodes and relationships. It is not a perfect representation of any field or a set of fields; neither is it a substitute for them. It just represents certain aspects of it. We must make use of this because, at least for now, we have no better option.

We need to add something more to this skeletal and purely structural framework: the concept of the field. This does not mean that a network is equated to a field, but it is possible to think of the nodes as members of one or more conceptual fields. Each node is then further categorized into field-membership, and this information is added as attribute data[3]. In this work, I mainly focus on field-boundaries, but other field-level information can also be added, such as status within the field or available capital level.

Fields can enable the researchers to conceptualize notions such as the distribution of power (and different forms of capital) within a field and the nature of the organizations' power relationships. Some inferences can be made based on network data alone, but it has its limitations. For example, highly central nodes often correspond to powerful, prestigious membership within the field, but this association does not always hold (e.g., the roles of secretaries within networks).

Another additional dimension that fields may add to network analysis is the internal forces driving the field. These can be summed up as the logics that directs action, the institutional or structural inertia present, and the practices within the organizations and the habitus[4], to use Bourdieu's term, of the individuals comprising the organizations within the network. In this dissertation, I will only focus on one small facet of fields – field boundaries and will leave the rest for future research.

Before investigating the role of field boundaries, it is necessary to build a framework

[2] Later, I will propose a number of types of field interactions that will make this picture clearer.
[3] In future studies, it might be possible to gather network data for all fields and network data for a superstructure that span all these fields.
[4] On top of this, we have to think of evaluation frames and other categories, metaphors, language and myths that can explain micro-level behaviour within the fields.

that spells out the theoretical connections between the concepts introduced above. The reader should understand that some of the concepts might be defined differently on the following pages, as previously defined in the literature, and careful reading is needed to understand the subtle changes in meaning. Nevertheless, precise definitions are necessary, without which misunderstanding will ensue in the present state of the literature. Key terms will be defined or redefined with the help of the literature.

After setting up the framework, I will turn to discuss field interaction and field boundaries. This will be followed by the empirical section, which will introduce four studies of field boundaries. My unit of analysis in each of the studies presented will be the firm, but I will not treat firms as black boxes. I look inside and investigate both theoretically and sometimes empirically what processes go on within the companies. Thus, the firm can be seen as a middle-level unit, where individuals comprise the micro-level. The firm's internal fields are only inferred because not every detail can be measured and spelled out in the internal fields. I consider individuals, but I always do this within the context of a larger organization that they belong to and only in a theoretical manner[5]. These firms then make up the higher-level organizational fields that are under investigation. To this field-level concept, the network of connections between these members of different fields (i.e., organizations) is added on. These relationships are measured with traditional network analytical methods by compiling and analyzing relational matrices. However, as I mentioned above, networks are not equated to fields but only taken as certain structural data related to fields.

The main focus was on organizations and the processes that unfold in them at the boundaries of different organizational fields. My studies are also organization-level network studies, and as such, I was interested in how the structure and the diversity originating from the many different fields interacting impact change and innovative outcomes[6].

The findings of my empirical studies can be briefly summarized. The most important

[5] Though this does not mean that I treat individuals in a strictly structural view. I accept that individuals have agency within these larger structures.

[6] I focus on innovation outcomes because of the focus was on high-technology firms where producing new technologies is a core function. It can be thought of as a performance indicator.

finding is that network analyses need to take field boundaries into account. Field boundaries do not necessarily show up in networks. A structurally cohesive cluster might be located on a field boundary. What looks like a structurally cohesive structure might be a highly fragmented collection of actors that are temporarily brought together. As Vedres & Stark (2010) pointed out, these temporary clusters can lead to future collaboration or disintegration. However, they cannot be interpreted merely as a socially cohesive group full of shared understanding, norms, and trust. This interpretation is too simplistic.

In my first study, I found that typical network effects are influenced by field boundaries. In the context of the newly forming Japanese nanotechnology sector, I found that network structures influence innovation outcomes. Field boundaries enhance firms' performance when the firms occupy structural hole bridging positions, highlighting the fact that there are different types of structural holes. Within-field holes are less beneficial than cross-field structural holes. Another finding was that there is a particular case of cohesive clusters. As I explained above, structural cohesion can exist without social cohesion, especially in newly forming[7] fields, where previously disconnected partners come together to form a structural cluster. This finding is consistent with the findings of Baum, McEvily & Rowley (2012), who found that tie age is an important factor. The benefits of closure increase with age, while the benefits of bridging decrease with age. My findings can offer a proper theoretical explanation for this. Age, in other words, can refer to institutionalization and field formation. As fields develop, clusters become stronger and more socially cohesive, while structural holes offer less practical benefit, bridging occurs within the same field, though the benefits will not disappear.

My second study focuses on one clear field boundary: the boundary between a national industry sector within the life sciences and its international counterpart. The study found that influences filter into the domestic network through bridges, but the influence is more pronounced when the bridging firm's international partners are central within the larger international network. They transfer their pro-diversity logic to the

[7] Cf. Zietsma et al. (2017).

domestic field, where the field gradually diversifies due to these influences. This study highlights the fact that boundaries can serve as filters. Not every boundary-spanning firm is influenced at the same rate. Different relationships can create different influences, which implies that there are many combinations of relationships that can configure the filtering properties of a boundary. This can provide a fertile ground for future research.

The third study looks at how boundaries can be reduced. In this study, in the context of the Japanese life science industry, I show that mergers and acquisitions[8] can reduce the boundary and propel a peripheral firm towards the center of another field. This study shows that fields that began to merge change their structure in intricate ways and, while this is not included in the study, can become contested among the newcomers and incumbents. This study has far-reaching consequences and asks how field boundaries can exist even in the middle of a well-defined field. For example, Powell & Sandholtz (2012) maintain that institutions (in our sense fields) change through members who bring in their idiosyncratic experiences from different fields or institutional settings. My analysis puts all of this into a more rigorous theoretical frame that helps connect disparate theories.

Finally, in an analysis of Toyota, the Japanese automaker, I investigate how a member can manage field boundaries within the fields they can influence. Toyota, being a very influential company, could create different structures of organizations. One that was geared towards open-innovation and was open to different overseas organizations, and another a more traditional domestic network that worked closely with suppliers. Manufacturing was also divided between a more open learning network and another domestic group within the main company that treated new models with secrecy and oversaw the manufacturing of Toyota's new fuel-cell-powered car, the 'Mirai'. This study showed that boundaries could be consciously created and managed, though further investigations are needed to clarify how boundaries can be managed and under what conditions boundaries become difficult or unmanageable. It seems evident that fields and social structures having an evolving, informal nature can be challenging to manage by members on the inside.

[8] Just as marriage in the age of the Medici (see Pagett & Ansell, 1993).

The dissertation is organized into two parts. Part I lays out the theoretical framework, while Part II describes the empirical studies in detail. Not every part of the theory can be tested and included in the empirical studies, and there is an apparent disconnect between the complexity of the theoretical section and the more simplified concepts in the empirical section. The empirical section is mainly interested in how field boundaries influence traditional networks and what roles field boundaries can play in organizational success, while the theoretical section builds up a complex framework of field elements. With this stipulation, I now turn to the discussion of the theoretical framework.

Part I – Theory

1. Introduction to the theoretical section

Network theory is a crucial tool purported to enable the analysis of social structure. Initially, in the 1870s and 1980s, and even at the beginning of the 1990s, there was an expectation that network theory will prove that structure is more explanatory than nodal context. For example, the traces of these purely structuralist ideas[9] can still be found in Nohria & Eccles (1992). However, due to persistent problems such as endogeneity and measurement error inherent in network analysis, it has become clear that purely structuralist methods are not adequate. Moreover, many findings are interesting from a purely scientific point but fail to offer practical solutions readily applicable to management practice. One has to only think about the famous centrality and endogeneity problem or the debate around structural holes[10]. This is why, beginning in the 1990s, nodal context, or what attributes distinct nodes have[11], began to be brought back in and gained prominence as papers diversified in the organization science field. In this paper, I argue that while nodal attributes are essential, they are not enough. The focus needs to be on a much broader context: the field that these nodes are embedded in.

In the following part, I outline my theory[12] and describe the relationships among my

[9] The above-mentioned network studies were germinated within a structuralist functionalist framework. Positivist in nature, they acknowledge the usefulness of a purely quantitative method that rely on empirical data. However, they also incorporate elements of anti-positivist thought and underlying the structuralist framework are ideas of methodological individualism. Included in these studies are for example block modelling, structural equivalence studies, strong and weak ties, Simmelian ties, cohesive clusters and closure, bridging and brokering, and structural holes.

[10] For more details on the problem of Non-Redundancy/Redundancy trade-off cf. Burt (1992, 2005, 2008, 2010), Podolny (2008), van de Rijt, Ban, Sharkar (2008), Reagans & Zukcerman (2001, 2008). Here only one important issue suffices to be mentioned – the one raised by van de Rijt et al. (2008), namely whether actors within a network can see the overall network and structural holes within it.

[11] Network effects began to be moderated with different types of nodal context.

[12] First, it is necessary to mention where the framework fits within the social sciences. The research was conducted at the University of Kyoto from the early 2010s and was influenced by a number of different research strands. The most important school is without doubt the Stanford School, network theory in organizations (Pagett, Burt, Granovetter, Powell, Borgatti, Everett, & Freeman), social constructivism (Berger & Luckman), Stinchcombe (1987), institutional theory (DiMaggio, Scott, Wooten & Hoffman, Thornton & Ocasio, Lounsbury and the newest generation of researchers), and field theory (Bourdieu, DiMaggio, Fligstein, Zietsma, Hinings). While my theory was mainly informed by organization theory, the context of the empirical research was closer to business strategy, management of technology, and innovation theory. It is important to keep in mind that there are multiple strands running through the research, but the theory is built on a solid foundation at the intersection of field theory, network theory, institutional theory, and strategy. While the reader might think that the context is too wide, I argue that it is not so. In fact, in the age of fragmented mid-level theories and pluralism of ideas, it is difficult to attach a framework to only one specific strand of research.

concepts. As stated previously, some of the concepts might change in definition to the degree that might even conflict with the usual understanding of the specific concept in the literature.

A purely structuralist view of networks has many flaws. The nodes' characteristics or attributes play an important part in how social networks form, change, and maintain themselves. The type of ties has to be considered as well. All kinds of social knowledge and nuances are missing from the purely structuralist view. These are concepts described in neo-institutionalist literature in organizations theory, such as norms, practices, symbolic meanings, frames, institutional knowledge, and logics. Devoid of these essential social contents, networks are unable to explain many of the more complex questions.

Apart from these apparent shortcomings, one additional problem is that unconnected nodes can also influence each other in a real societal context. These influences might be traced through additional network data, but at some point, connections might get too complicated to analyze. For example, a book written by a single person (a node) can influence many who read it. How can we explain this kind of influence in network terms? Or, how can we conceptualize a pure glance at someone across the factory floor that propels some other actor to action?

All of these influences are untraceable in traditional network studies. While network theory does not attempt to deal with these problems, other social research fields have studied them. The concept of a community, a group, or a field is better suited to answer these more complex questions. However, these theories lack the rigorous structural underpinnings that network theory can offer. In this dissertation, I attempt to bring the two concepts together. It is impossible to achieve a proper synthesis of the two terms, and to date, there were no attempts made towards this goal (see Fligstein & McAdam, 2012). However, the present dissertation aims to look into the problem and offer a few necessary observations about how these two concepts can be used together.

1. Field boundaries need to be taken into account when conducting network studies.

2. Nodes can be fields themselves, and therefore internal nodal structure and context need to be considered when thinking about how a network behaves.
3. Unconnected nodes can impact each other.

In the following, I will only focus on the first, but 2 and 3 have far-reaching implications. Uncovering nodal function within networks can lead to exciting concepts and new building blocks of networks (e.g., network insulators, network propagators, network walls, dampeners, connectors, facilitators, reconnectors.)

Another important aim is to enrich my theory from network theory and institutional theory following Water W. Powell. Institutionalist theorists are also working on this synthesis. Thornton, Ocasio & Lounsbury (2012: 50) proposed that "any theory of institutions needs a way to 1) integrate, yet illustrate the partial autonomy of social structure and action, 2) understand how institutions operate at multiple levels of analysis, 3) integrate the symbolic and material aspects of institutions, and 4) explain institutions as historically contingent."

I posit that with the proper theory of field, all of these issues are solved with one stroke[13]. Fields have structure, and its members are both capable of action and capable of being influenced by the field in line with Giddens' structuration theory. As fields are nested, different groups, organizations, fields of organizations, and society can be considered fields. All micro-foundational elements can be located within the individuals themselves with additional help from material objects and the symbolic meaning associated with them. Symbolic and material aspects are thus inherent in the definition. As a matter of course, fields have a history and are historically contingent. However, these elements and the relationships between the elements need to be investigated and a solid framework built. This will be accomplished in the next chapters.

[13] This is not a new idea. Fligstein & McAdam (2012) have already proposed that fields can be the most important theoretical element in solving the problems above.

2. Fields theory: a review of the literature

I will review here the concept of the field. In the table below, I have briefly summarized the key terms related to fields and some of the key scholars reviewed.

Field theory: a review of the literature
Overview of the Field Concept: Martin (review)
Field: Bourdieu
Strategic Action Fields: Fligstein & McAdam
Organizational Fields: Warren, DiMaggio & Powell, Scott, Wooten & Hoffman, Powell
Institutional Fields: Zietsma et al., Hoffman, Furnari

2.1. The history of the concept: Precursors

The concept of the field has become central in organizational and especially in institutional theory (DiMaggio & Powell, 1983; Scott, 1995; Zietsma et al., 2017), but its definition remains vague despite efforts of clarification. In my view, the best definition is provided by Bourdieu (2005) and Fligstein & McAdam (2012), and my concept of fields will be developed from these with a few minor modifications. Modifications are necessary for several reasons. First, definitions were given in varying contexts. Second, some key elements, such as networks, were not integrated within the original field concepts (only in a metaphoric sense were networks mentioned). Before such modifications are possible, it is necessary to review what has been written about fields, so in the following, I outline the history of the concept and point out how its meaning has changed.

In a fairly recent interdisciplinary review, Martin (2011) reviews theories of fields[14]. Martin traces the concept to the physical sciences in the form of the electromagnetic field[15]. While the notion of a field in sociology is unrelated to this physics-originated concept, it sometimes resurfaces as a metaphor (for example, in Bourdieu[16]). Scott

[14] A short review is available in Martin (2003).

[15] Scott (2013) in his chapter on organizational fields builds on Martin as well. Also cf. Hilgers & Mangez (2015: 2) who traces the development of the concept through its original meanings in physics.

[16] Footnote 52 in Bourdieu & Wacquant (1992:101) calls attention to this delineation: "Bourdieu takes pains to emphasize the discontinuity between a social field and a magnetic field, and therefore between sociology and a reductionistic 'social physics'." The biggest difference between a social and a physical field is that

observes that "[w]hat was common to these and related approaches is that the behavior of the objects under study is explained not by their internal attributes but by their location in some physically or socially defined space. The objects, or actors, are subject to varying vectors of force (influences) depending on their location in the field and their relation with other actors as well as the larger structure within which these relations are embedded" (Scott, 2013: 220).[17] In this sense, fields seem to be a purely structuralist construct in which there is little room for agency. In the following sections, I will show how other authors modified the concept to allow for agency.

Martin then reviews how this concept from physics was extended to social psychology (Lewin, 1951), organizational theory (Fürstenberg, 1969; Bourdieu, 1985), and institutional theory (Mannheim, 1940; Warren, 1967; DiMaggio & Powell, 1983;). Scott (2013), in his review on organizational fields, also mentions German Gestalt theory pointing out that these concepts found their way into urban ecology (Park & Burgess, 1921) and social psychology (Kurt Lewin, 1951)[18]. The focus was often on interrelationships and embeddedness in larger structures such as the environment or institutions.

Martin's review was not restricted to organizational theory, and he gives an overview of the larger social science fields. He found that the concept of a field is used in three distinct senses: 1) "as an analytic area of simplified dimensions in which we position persons or institutions," 2) "a field as an organization of forces," and 3) "as a field of contestation, a battlefield." All three meanings are incorporated in the first well-thought-

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"social agents are not 'particles' that are mechanically pushed and pulled about by external forces. They are, rather, bearers of capitals and, depending on their trajectory and on the position they occupy in the field by virtue of their endowment (volume and structure) in capital, they have a propensity to orient themselves actively either toward the preservation of the distribution of capital or toward the subversion of this distribution" (Bourdieu & Wacquant, 1992: 109).

[17] Here too we can observe how the micro-macro duality plays out in evolving research contexts. The individualist claims are transformed into structurally defined forces, just to be relaxed later. Like a pendulum, scholars swing to one and then to the other. For us the important thing is that this structuralist field concept coincides with the purely structuralist standpoint of early network theory.

[18] Cf. Hilgers & Mangez (2014: 3): "Jean-Claude Passeron points out that Bourdieu and he took over the concept of the field from Gestalt theory, in particular the work of Kurt Lewin (Passeron 2003: 42-43). The concept of the psychological field developed by Lewin (1935) shares only the background of a relational epistemology with the concept of the 'physical field'. Knowing the individual from 'observation of his behaviour, one can deduce the properties of the field around him, and, conversely, knowing the properties of the field around the individual, one can deduce his properties from observation of his behaviour' (Faucheux 1959: 7)."

out theory of fields attributed to Bourdieu, whose discussion I turn to in the next section.

2.2. Bourdieu's field

A straightforward definition of Bourdieu's field term[19] applied in an economic sense can be found in Bourdieu (2005). This definition appears in a later work of his, where the concept's meaning has already crystallized[20]. His field concept sometimes remains vague in other texts due to metaphors and Bourdieu's style, but this later text is much more straightforwardly written. The text is also valuable because it reflects on the latest developments in the American social sciences to which he links his work[21]. The text describes a field of organizations, which is close to the concept of organizational fields. Bourdieu defines a field in the following manner.

> "Agents, that is to say, in this case, firms, create the space, that is to say, the economic field, which exists only through the agents that are found within it and that deform the space in their vicinity, conferring a certain structure on it. In other words, it is in the relationship between the various 'field sources,' that is to say, between the different production firms, that the field and the relations of force that characterize it are engendered. More concretely, it is the agents, that is to say, the firms, defined by the volume of capital and structure of specific capital they possess, that determine the structure of the field that determines them, for example, the state of forces exerted on the whole set of firms engaged in the production of similar goods. These firms, which expert potential effects that are variable in their intensity and direction, control a section of the field ('market share'), the size of

[19] Cf. Hilgers & Mangez (2014: 2): "Bourdieu developed the main arguments of his theory of fields at a very early stage. Three important articles set out the first principles: 'Champ intellectuel et projet créateur' (1966), 'Genèse et structure du champ religieux' (1971a) and 'Une interprétation de la théorie de la religion selon Max Weber' (1971 b)."

[20] Bourdieu analyses a great number of fields. I here only quote a list of studies compiled in Hilgers & Mangez (2014): "*religion* (Bourdieu 1971a, 1971c; Bourdieu and de Saint Martin 1982); *education* (Bourdieu and de Saint Martin 1987a, 1987b; Bourdieu 1989); *science* (Bourdieu 1975a, 1976, 1978, 1984a, 1995, 1997a, 2001b); *symbolic goods* (Bourdieu 1971c, 1972a, 1977a); *culture* (Bourdieu 1979a, 1991a, 1992); *the economy* (Bourdieu 1990a, 1997d, 2000a); *haute couture* (Bourdieu 1975b, with Delsaut); *the state* (Bourdieu 1989, 1990a, 1994, 1997c); *law* (Bourdieu 1986); *politics* (Bourdieu 1981, 1990a, 1996b, 2000c); *journalism* (Bourdieu 1996e); *power* (Bourdieu 1990a, 1994), etc. [author's highlights]" For the exact references please see Hilgers and Mangez (2014).

[21] Bourdieu's thought become much more integrated with the more positivist leaning American mainstream after his time at the University of Chicago. The fruit of this collaboration is the book Bourdieu & Wacquant (1992), which gives a good overview of his theories complemented with notes and references added by Loic Wacquant.

which increases with the size of their capital." -- Bourdieu (2005: 193)

A few observations can be made. Bourdieu is using a physics metaphor in his explanation of the field. In his work, this metaphor returns from time to time, but it seems to be only a literary embellishment[22]. He says that a field deforms space in their vicinity, but this cannot be understood in a concrete non-metaphorical sense as 'space' here is quite vague. However, this implies that the agents have a disproportionate role in creating and re-enacting the field itself. The agents are the central architects as well as building blocks of fields.

Bourdieu holds that the field exists only through the agents found within it and that the field itself has a certain structure defined by the relationship between these actors. He also mentions forces acting within the fields, but these are also vague. Can these forces be defined in more concrete terms? Readers of Bourdieu can imagine these forces from the cases given in his books, but they are not defined in a precise manner. The nature of internal forces within a field is, in itself, an interesting topic of inquiry. It also needs to be questioned whether the agents are the only constitutive elements of a field or whether material objects are also part of the field.

The key point that one can take from this definition is that agents have different amounts of capital available to them, which creates power-imbalances that, in turn, defines the structure of the field. In our further discussion, this element of 'capital' will play a prominent role. Capital can also account for material objects.

Bourdieu's field concept, however, has other dimensions as well. Bourdieu, in his book on France's elite education system, *The State Nobility*, emphasizes the field of power[23]. In Bourdieu (1996:264), he defines fields of power as "a field of forces

[22] Cf. previous section on precursors. This metaphor is also referred to in Fligstein & McAdam (2012) and goes back to the field concept in physics and Gestalt theory in Germany (Scott, 2013; Martin 2011). Scott writes: "What was common to these and related approaches is that the behavior of the objects under study is explained not by their internal attributes but by their location in some physically or socially defined space. The objects, or actors, are subject to varying vectors of force (influences) depending on their location in the field and their relation with other actors as well as the larger structure within which these relations are embedded." (Scott, 2013: 220). He mentions Park & Burgess (1921) in urban ecology, Lewin (1951) in social psychology. For a more detailed review see Martin (2011).

[23] Bourdieu seems to use this term interchangeably with other types of field. It seems that fields have their own power structures and fields are also embedded in larger fields of power. Nevertheless, note that Loic Wacquant thinks of the field of power as something that is "not situated on the same level as other fields (the literary, economic, scientific, state, bureaucratic, etc.) since it encompasses them in part. It should be thought of more as a kind of "meta-field" with a number of emergent and specific properties." (Bourdieu & Wacquant,

structurally determined by the state of the relations of power among forms of power, or different forms of capital. It is also, and inseparably, a field of power struggles[24] among the holders of different forms of power, a gaming space[25] in which those agents and institutions possessing enough specific capital (economic or cultural capital in particular) to be able to occupy the dominant positions within their respective fields confront each other using strategies aimed at preserving or transforming these relations of power." Then he goes on to point out that powerful agents are not aiming at simply the accumulation of or monopoly on different forms of capital, but "rather the determination of the relative value and magnitude of the different forms of power." In other words, capital transforming or with Bourdieu's words "capital granting" power. The struggle is for the "power to dictate the dominant principle of domination." Power needs to be legitimized so that others accept it. Arbitrary violence cannot exist long without justification. Therefore, symbolic strategies to sustain or better the incumbents' positions are pivotal.

Similarly, the power to decide who belongs to a field is also important. Bourdieu (1996) investigates the field of art. There he points out the importance of the power to

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1992: 18).

[24] No doubt Bourdieu was influenced by the then prevailing ideas of the Marxists and theorists of power like Foucault.

[25] In this section, I intentionally leave out the discussion of the game metaphor often used by Bourdieu because it distracts from the structural aspects of the fields. In Bourdieu and Wacquant (1992: 98), Bourdieu explains this metaphor as: "[w]e can indeed, with caution, compare a field to a game (jeu) although, unlike the latter, a field is not the product of a deliberate act of creation, and it follows rules or, better, regularities, that are not explicit and codified. Thus, we have stakes (enjeux) which are for the most part the product of the competition between players. We have an investment in the game, illusio (from ludus, the game): players are taken in by the game, they oppose one another, sometimes with ferocity, only to the extent that they concur in their belief (doxa) in the game and its stakes; they grant these a recognition that escapes questioning. [..] We also have trump cards, that is, master cards whose force varies depending on the game: just as the relative value of cards changes with each game, the hierarchy of the different species of capital (economic, social, cultural, symbolic) varies across the various fields. In other words, there are cards that are valid, efficacious in all fields— these are the fundamental species of capital— but their relative value as trump cards is determined by each field and even by the successive states of the same field.[..] At each moment, it is the state of the relations of force between players that defines the structure of the field. We can picture each player as having in front of her a pile of tokens of different colors, each color corresponding to a given species of capital she holds, so that her relative force in the game, her position in the space of play, and also her strategic orientation toward the game, […] the moves that she makes, more or less risky or cautious, subversive or conservative, depend both on the total number of tokens and on the composition of the piles of tokens she retains, that is, on the volume and structure of her capital. Two individuals endowed with an equivalent overall capital can differ, in their position as well as in their stances ("position-takings"), in that one holds a lot of economic capital and little cultural capital while the other has little economic capital and large cultural assets. […] But this is not all: […] they can also get in it to transform, partially or completely, the immanent rules of the game. They can, for instance, work to change the relative value of tokens of different colors, the exchange rate between various species of capital, through strategies aimed at discrediting the form of capital upon which the force of their opponents rests (e.g., economic capital) and to valorize the species of capital they preferentially possess (e.g., juridical capital)."

define boundaries or the power to define who is included and not included in the field. "One of the central stakes in literary rivalries (etc.) is the monopoly of literary legitimacy (etc.)[..], the monopoly of the power to say with authority who is authorized to call himself a writer or even to say who is a writer and who has the authority to say who is a writer." He calls this the monopoly of the consecration of producers and products. These boundaries then create the entry requirements to the higher reaches of the field and create a hierarchy, which is important for understanding how field boundaries form. Boundaries can be quite porous, dynamic, and changing.

For example, in another work, Bourdieu explains that fields can constitute "a potentially open space of play whose boundaries are dynamic borders which are the stake of struggles within the field itself. A field is a game devoid of inventor and much more fluid and complex than any game that one might ever design."[26]

How can one methodologically approach a field? In Bourdieu & Wacquant (1992: 104), Bourdieu explains that every field must be first analyzed in relation to a larger field of power, then "one must map out the objective structure of the relations between the positions occupied by the agents or institutions who compete for the legitimate form of specific authority," thirdly "one must analyze the habitus of agents, the different systems of dispositions they have acquired by internalizing a determinate type of social and economic condition." As for a methodological tool, Bourdieu (1984), in *Distinction,* used correspondence analysis[27] to place the type of agents within a field based on their different kinds of capital (cultural vs. economical). Tools such as correspondence analysis can give a schematic overview of elite status versus non-elite status within a field.

Bourdieu's field concept is challenging to grasp because he formulated his concepts against positivist understandings of structuralism[28], the opposite of what the aim of this

[26] Bourdieu & Waquant (1992: 104).

[27] Bourdieu & Wacquant (1992: 96) explains his choice of the method in the following way: "Similarly, if I make extensive use of correspondence analysis, in preference to multivariate regression for instance, it is because correspondence analysis is a relational technique of data analysis whose philosophy corresponds exactly to what, in my view, the reality of the social world is. It is a technique which "thinks" in terms of relation, as I try to do precisely with the notion of field."

[28] Bourdieu & Wacquant (1992: 97) expresses this in the following manner: "To think in terms of field is to think relationally. The relational (rather than more narrowly "structuralist") mode of thinking is, as Cassirer (1923) demonstrated in Substanzbegriff und Funktionsbegriff, the hallmark of modem science, and one could

dissertation is. However, he does address methodology about which he suggests that in "analytic terms, a field may be defined as a network, or a configuration, of objective relations between positions. These positions are objectively defined, in their existence and in the determinations they impose upon their occupants, agents or institutions, by their present and potential situation (situs) in the structure of the distribution of species of power (or capital) whose possession commands access to the specific profits that are at stake in the field, as well as by their objective relation to other positions (domination, subordination, homology, etc.)."[29] In this passage, he calls attention to the duality of the underlying network structure. While he does not say this explicitly, we know that a network can be a network of general relationships between members, Bourdieu, however, does not refer to this as a network, but rather a more abstract kind of network, "a network, or configurations of objective relations between positions." I will address this issue later in the framework, but it is important to understand the distinction. A network can also be conceptualized as a collection of abstract forces between different positions as well as a collection of actual relationships between actual agents. In the former, the nodes are not agents but abstract positions within a quasi-hierarchy.

On the same page, he goes on to state that "[i]n highly differentiated societies, the social cosmos is made up of a number of such relatively autonomous social microcosms, i.e., spaces of objective relations [or fields] that are the site of a logic and a necessity that are specific and irreducible to those that regulate other fields. For instance, the artistic field, or the religious field, or the economic field all follow specific logics".[30] With this, he foreshadows the idea of institutional logics. However, in this sense, it is more of a field-specific logic of classification and capital-transformational mental representations that tells members how to orient themselves and what forms of capital to accept as

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show that it lies behind scientific enterprises apparently as different as those of the Russian formalist Tynianov, of the social psychologist Kurt Lewin, of Norbert Elias, and of the pioneers of structuralism in anthropology, linguistics and history, from Sapir and Jakobson to Dumezil and Levi Strauss. […] I could twist Hegel's famous formula and say that the real is the relational: what exist in the social world are relations— not interactions between agents or intersubjective ties between individuals, but objective relations which exist "independently of individual consciousness and will," as Marx said."

[29] Bourdieu & Wacquant (1992: 97).

[30] He explains what he means by field-specific logic in these terms: "while the artistic field has constituted itself by rejecting or reversing the law of material profit (Bourdieu 1983d), the economic field has emerged, historically, through the creation of a universe within which, as we commonly say, "business is business," where the enchanted relations of friendship and love are in principle excluded." (Bourdieu, 1992: 97-98)

legitimate.

The field concept is further complicated because the boundaries might be porous, not immutable, and therefore difficult to pin down. He, in Bourdieu & Wacquant (1992: 100), thinks this a central feature of fields and holds that actors are in a constant struggle to define boundaries: "[t]he question of the limits of the field is a very difficult one, if only because it is always at stake in the field itself and therefore admits of no a priori answer. Participants in a field, say, economic firms, high fashion designers, or novelists, constantly work to differentiate themselves from their closest rivals in order to reduce competition and to establish a monopoly over a particular subsector of the field. […] Their efforts to impose this or that criterion of competency, of membership, may be more or less successful in various conjunctures. Thus, the boundaries of the field can only be determined by an empirical investigation. Only rarely do they take the form of juridical frontiers (e.g., numerus clausus), even though they are always marked by more or less institutionalized 'barriers to entry.'" As this dissertation deals with field boundaries' very nature, this idea will be further elaborated in the following sections.

In more precise terms, Bourdieu defines the "limits of the field" as "situated at the point where the effects of the field cease. Therefore, you must try by various means to measure in each case the point at which these statistically detectable effects decline. […] Michael Schudson (1978) shows that you cannot understand the emergence of the modern idea of "objectivity" in journalism if you do not see that it arose in newspapers concerned with standards of respectability, as that which distinguishes "news" from the mere "stories" of tabloids. It is only by studying each of these universes that you can assess how concretely they are constituted, where they stop, who gets in and who does not, and whether at all they form a field."[31] Bourdieu places an important emphasis on these barriers of entry that truly delineate the boundaries. In Bourdieu (1996), exploring the field of elite education, he investigates the most elaborate form of this entry

[31] Bourdieu & Wacquant (1992: 100-101) on field boundaries adds this: "[i]n the work of empirical research the construction of a field is not effected by an act of imposition. For instance, I seriously doubt that the ensemble of cultural associations (choirs, theater groups, reading clubs, etc.) of a given American state or of a French region form a field. By contrast, the work of Jerry Karabel (1984) suggests that major American universities are linked by objective relations such that the structure of these (material and symbolic) relations has effects within each of them."

mechanism that he calls consecration. He advises us to identify these entry criteria in the form of personal characteristics or ownership of specific forms of capital. The difference between agents needs to be traced back to their roots. Investigators need to find out where these differences have come from.[32]

The boundary issue can be solved in another way. In this dissertation, we argue that many groups can be conceptualized as fields, and therefore the problem of whether newspapers and tabloids belong to one field or two becomes unimportant. They can be conceptualized as two fields with some overlap[33] constituting another larger field. This way, we can easily identify subfields, and parts of a field can be dynamically recategorized as necessary. Agents within fields also reconstitute their views under different circumstances, in which case no definite boundaries need to be drawn up.

Finally, Bourdieu also has something to say about field interaction. As mentioned already, he holds it essential to find how the broader field of power relates to the field under investigation. He reasons that 1) external forces work only indirectly inside fields[34], 2) fields have similarities, but they also have distinct forms that make them different[35], 3) fields are systems of relations independent of the population of individuals inside them where the field defines the individual and gives them identity[36]. Bourdieu thinks that field

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[32] See Bourdieu & Wacquant (1992: 107-108): "People are at once founded and legitimized to enter the field by their possessing a definite configuration of properties. One of the goals of research is to identify these active properties, these efficient characteristics, that is, these forms of specific capital."

[33] Regarding Schudson's study I would argue that the case is not of one field, but two overlapping fields influencing each other.

[34] See Bourdieu & Wacquant (1992: 106):"the external determinations that bear on agents situated in a given field (intellectuals, artists, politicians, or construction companies) never apply to them directly, but affect them only through the specific mediation of the specific forms and forces of the field, after having undergone a re-structuring that is all the more important the more autonomous the field, that is, the more it is capable of imposing its specific logic, the cumulative product of its particular history."

[35] See Bourdieu & Wacquant (1992: 106): "Second, we can observe a whole range of structural and functional homologies between the field of philosophy, the political field, the literary field, etc., and the structure of social space (or class structure): each has its dominant and its dominated, its struggles for usurpation and exclusion, its mechanisms of reproduction, and so on. But every one of these characteristics takes a specific, irreducible form in each field (a homology may be defined as a resemblance within a difference). Thus, being contained within the field of power, the struggles that go on in the philosophical field, for instance, are always overdetermined, and tend to function in a double logic. They have political effects and fulfill political functions by virtue of the homology of position that obtains between such and such a philosophical contender and such and such a political or social group in the totality of the social field."

[36] See Bourdieu & Wacquant (1992: 106-107): "A third general property of fields is that they are systems of relations that are independent of the populations which these relations define. When I talk of the intellectual field, I know very well that in this field I will find "particles" [..] are under the sway of forces of attraction, of repulsion, and so on, as in a magnetic field. Having said this, as soon as I speak of a field, my attention fastens on the primacy of this system of objective relations over the particles themselves. And we could say[..]: he or she is in a sense an emanation of the field. This or that particular intellectual, this or that artist, exists as such only because there is an intellectual or an artistic field."

interaction is a subject that is too complex, but he believes that "there are no transhistoric laws of the relation, between fields, that we must investigate each historical case separately." With network theory in hand, we can attempt to isolate some simple problems to see how complex field interaction works.

An extensive literature treats Bourdieu's theory[37], but here I only mention Fligstein & McAdam's (2012: 24) critique of Bourdieu's particular type of field theory. Bourdieu is mainly concerned with individual constituent members instead of collective actors. They point out that Bourdieu has little to say about how collective actors work, cooperate, and compete. They find that there is not enough detail about the architecture of fields and the relationships between fields. For this, we have to turn to the work of American organizational theorists.

2.3. Scott, Warren, DiMaggio & Powell, Wooten & Hoffman

Bourdieu initially was not widely read in the United States, but he had some promoters[38] within organizational theory, Paul DiMaggio, who along with Walter Powell was a central figure in new institutionalism in organizational theory[39], a term they coined. DiMaggio, building on Meyer and Rowan (1977), defined a field as a "recognized area of institutional life." Scott (2013: 222) writes that "the concept of organization field was crafted by DiMaggio and Powell (1983) to refer to 'those organizations that, in the aggregate, constitute a recognized area of institutional life: key suppliers, resource and product consumers, regulatory agencies, and other organizations that produce similar

[37] See Bourdieu and Wacquant (1992) for an early overview of criticism related to Bourdieu's ideas and Hilgers and Mangez (2014) for specifics on fields.

[38] DiMaggio is of course only one of the proponents. The University of Chicago served an even bigger role. See Bourdieu & Wacquant (1992). Also, it is important to note that DiMaggio did not take the whole framework of Bourdieu, just a few useful concepts. See Emirbayer & Johnson (2008) who discuss the partial takeover of the theory.

[39] Hirsch (1997: 1706) distinguishes three periods of institutionalism: 1) what he calls early institutionalists including Wilson, Weber, Durkheim, Cooley, Dewey, Hughes. This is followed by 2) Hirsch' contemporaries that the newer generation of DiMaggio called 'old institutional theorists' referring to both the neo-institutionalists in economics and political theory, then 3) what DiMaggio & Powell called the new institutionalists a group that was supported by Scott and is active today. This is the group I focus on in this section. It is important to note however another older group, the Columbia-originated Mertonian school: "[t]hese include the large group of now-classic studies by, among others, Selznick, Gouldner, Gusfield, Stinchcombe, Lipset, Coleman, Zald, Clark, and Perrow. Other Columbia faculty, notably Amitai Etzioni and C. Wright Mills, added additional and important perspectives on organizations and their increasingly critical role in American society." (Hirsch, 1997). Also, see Abbott (1992) for a review on DiMaggio & Powell; Stinchcombe (1997) for a description of the old institutionalists.

services and products' (p. 148). It thus incorporates both the organization set and organization population frameworks, while adding oversight units. Although based on Bourdieu's work of fields, DiMaggio and Powell gave primary attention to social relational and network components". Bourdieu's more social context (tribal communities, education, art, academics, taste) was replaced with a more economic context, and the focus shifted to organizational structures and processes. The level has also moved from the individual to industry-wide sectors. In their theory, the focus is on collective actors – organizations. DiMaggio and Powell (1983) observed that the "process of institutional definition, or 'structuration,' consists of four elements[...]: [1] an increase in the extent of interaction among organizations in the field, implying a network and a boundary; [2] the emergence of sharply defined inter-organizational patterns of domination and coalition, implying status hierarchies among actors; [3] an increase in the information load with which organizations in a field must contend, implying shared meanings and practices among field members; and [4] the development of a mutual awareness among participants in a set of organizations that they are involved in a common enterprise, implying shared identity."[40]

Thornton, Ocasio, Lounsbury (2012: 24) point out that "[a]ccording to DiMaggio and Powell (1983: 148), fields are institutionally defined and can only be identified on the basis of empirical investigation. This suggests that a field's boundary is expected to vary by study, empirical investigator, and method of analysis. In this sense an organizational field differs from the typical levels of analysis such as individuals, organizations, and societies and from the commonly measurable cases of a product market, industry, population of organizational forms, and a world system of nation state." This is an important observation that we also hold; nevertheless, it must be mentioned that some field boundaries are quite easily discernible while others are more porous and difficult to define. Some might coincide with more well-defined structures, while others are vague and shifting.

DiMaggio & Powell's theory has centered around the question of why organizations

[40] From Zietsma (2017).

are similar to each other. Their core idea was isomorphism[41]. According to the authors, isomorphism partly stems from the imitation of other field actors, though in Powell's later work, he turned away from the idea of isomorphism and placed much more emphasis on agency[42] and institutional heterogeneity within organizational fields. His work will be discussed in more detail later on.

DiMaggio and Powell's concept was also informed by Warren (1967), who focused on inter-organizational fields[43] in an early study. His field context was also industrial and incorporated different kinds of actors. In this, DiMaggio and Powell's field concept is not that far from Bourdieu, but the bases are different. They likewise did not explicitly address capital beyond the idea that resources are embedded in the network, neither did they focus much on the idea of struggle in early their works apart from the fact that they had analyzed corporations in a capitalistic economy.

DiMaggio & Powell did not craft their framework in a vacuum. There had been a number of significant developments around them. Parts of this, I have already referred to in discussing precursors of the concept of the field through Martin (2011) and Scott (2013), who devotes a whole chapter on organizational fields[44]. Scott's field concept is weaved together from ideas located in various parts of the literature, making his framework somewhat incoherent. Nevertheless, it is essential to review some of its key features. Zietsma et al. (2017) point out that "Scott uses a broader definition, capable of encompassing a broader array of field types, which emphasizes common culture and networks." He defines the field as "a collection of diverse, interdependent organizations

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[41] Cf. Zietsma et al. (2017) who contrast this view with the more dynamic view of struggle: "In contrast to the sense of similarity among actors emphasized by Scott's definition and implied by DiMaggio and Powell's notion of structuration, other actors emphasize conflict and struggle within fields. Bourdieu, for example, viewed the field as "networks of social relations, structured systems of social positions within which struggles or manoeuvres take place over resources, stakes and access" (Oakes, Townley, & Cooper, 1998: 260). Bourdieu's field concept is applied to the societal level and attempts to explain individual action. For his society-level domains such as scientific field, he emphasizes four types of capital (social, economic, symbolic, cultural) that determine actors' power within a specific field and their possibilities for action (Wacquant, 1989; Bourdieu, 1985)."

[42] Working in Stanford University, Powell was influenced by the Bay Area entrepreneurial culture. His theories added more and more elements of agency and entrepreneurial action.

[43] See Wooten & Hoffman (2008: 56): "Warren used the example of community organizations such as banks, welfare organizations, churches, businesses, and boards of education, working in conjunction with one another to elucidate the importance of taking the 'inter-organizational' field as a unit of analysis."

[44] How fields relate to the concept of an institution is not clear, but Scott devotes considerable space discussing organizational fields. I have already touched upon the work of other scholars reviewed by Scott in previous sections and my attempt in this section is to look at how Scott (2013) sees organizational fields.

that participate in a common meaning system"[45] In the center, just as with DiMaggio and Powell, are organizations. Scott argues that "[o]rganizations are themselves major actors in modern society, but to understand their broader significance, it is necessary to see their role as players in larger networks and systems. As I have argued, most organizations engage with not one, but multiple fields and are subject to multiple institutional logics."[46] Scott states that the following components need to be understood when studying organizational fields[47]: institutional logics, actors, relational systems, and organizational field boundaries.

I refrain from discussing these here as each will be discussed later on in more detail, but it is perhaps worth pointing out that Scott defines institutional logics as "shared conceptual frameworks that provide guidelines for the behaviour of field participants."[48]

In his understanding, logics and frames come together and have a significant role in fields. For example, Greenwood & Suddaby (2006: 28) define their organizational field as "clusters of organizations and occupations whose boundaries, identities and interactions are defined and stabilized by shared institutional logics." Zietsma et al. (2017) observe that "[M]any studies assume common logics that exist at the field level and guide behavior." Thornton et al. (2012) go as far as to place institutional logics in the center of organizational theory. In the following, I will argue against this overemphasis on institutional logics.

It is also important to point out that Scott sees fields as being populated by actors[49] with agency. They are not purely structural entities. The focus on agency has become more prominent since the early concepts of social fields. Scott even discusses structuration processes, defined by DiMaggio & Powell (1983)[50], and provides detailed

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[45] Scott (2013: 106), Zietsma et al. (2017).
[46] Scott (2013: 224). This idea is very close to the population theory of Hannan & Freeman (1977).
[47] Scott took the components of his description from the literature and, thus it is not a coherent theoretical framework.
[48] Scott's definition (2013: 225) is based on Friedland & Alford (1991) and Thornton, Ocasio & Lounsbury (2012).
[49] Scott (2013: 228) gives the list of the following types of actors: "(1) individuals (e.g., in the health care sector, a specific doctor), (2) associations of individuals (e.g., the American Medical Association), (3) populations of individuals (e.g., patients, physicians, nurses), (4) organizations (e.g., the Stanford University hospital), (5) associations of organizations (e.g., multihospital systems), and (6) populations of organizations". This is somewhat strange because the term, organizational field, should contain organizations. It is of course true that these organizations are made up of these other actors.
[50] The concept of structuration is of course from Giddens: "Giddens (1979; 1984) defines the concept of

examples[51]. This process refers to "the extent of interaction and the nature of the interorganizational structure that arises at the field level." Both DiMaggio and Powell, and Scott build on Berger & Luckmann's (1966) social constructivism and accept Giddens's core ideas.

It is also important to see how Scott treats the concept of field boundaries. Boundaries are discussed in the following way: "[F]ield boundaries must be empirically determined, but because social systems comprise many ingredients, analysts must choose from among a variety of indicators (Scott and Davis 2007: 152–155). These include a focus on actors (e.g., membership boundaries), on activities (e.g., identifying common repertories), on relations (e.g., interaction networks), or on cultural markers (e.g., shared normative frameworks, cultural beliefs, contentious issues). Laumann, Marsden, and Prensky (1983: 21) also identify two approaches to boundary construction: a 'realist' approach that adopts the 'vantage point of the actors themselves in defining the boundaries' of the system versus a 'nominalist' approach in which the investigator 'imposes a conceptual framework constructed to serve his own analytic purposes.' Moreover, in addition, both spatial and temporal boundaries must be established."[52]

Scott's overview is one of the most developed and encompasses many different methodological approaches. In my network theoretical approach, several of these can be accounted for. Actors and their relationships will be identified along with main activities. However, with network methodology, the cultural markers or the value aspect cannot be easily measured. Qualitative methodology is needed to add this dimension to the analysis. Most of the network theoretical studies have a temporal dimension as well as spatial considerations, and they mainly take the nominalist approach.

The review chapter on organizational fields from Wooten & Hoffman (2008) is another important work within the new institutionalist strand due to their influence. They

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structuration quite broadly to refer to the recursive interdependence or social structures and activities. The verb form is intended to remind us that structures exist only to the extent that actors engage in ongoing activities to produce and reproduce, or change them." (Scott, 2013: 235). Nevertheless, it is applied in a very liberal fashion: "DiMaggio and Powell (1983; DiMaggio 1983) employ the term field structuration more narrowly to refer to the extent of interaction and the nature of the interorganizational structure that arises at the field level."

[51] Scott (2013: 240) calls attention to "Neil Fligstein's study (1990; 1991) of changes in the structure of large U.S. corporations during the 20th century".

[52] Scott (2013: 231-232).

mostly review the American roots of the term, mentioning Bourdieu only in passing. Their starting point is not field theory, but what they call new institutional theory[53]. In the review, they rely on Scott's (2001) definition of "a community of organizations that partake in a common meaning system and whose participants interact more frequently and fatefully with one another than with actors outside the field."[54]

Wooten & Hoffman (2008) emphasize that fields are relational spaces, where different organizations can interact and work out understandings on different matters. This is an interesting development, which takes the field concept in a different direction. In Bourdieu, the focus was on struggle and power fights; here, the importance is on cooperation, coalition building, and negotiation. In a later section, Hoffman's contribution will be further discussed relating to this idea.

It is clear, though, that from Scott, DiMaggio & Powell, and Wooten & Hoffman onwards, the concept of a 'field' is transformed into the concept of an 'organizational field.' This is a significant development, but one that brings potentially problematic theoretical depth to the concept. In Bourdieu, a field was not limited to organizations, it was instead a field of individual actors, but he also used it for a field of organizations[55].

In this dissertation, the context will be capitalistic organizations[56] and the industries they make up. Therefore, the discussions will be limited to treating the world of business, and many of the other types of fields analyzed by Bourdieu will be excluded.

Before moving on, it is necessary to point out that the relationship of fields with the state is a major unexplored issue in the works mentioned above. Many put the state at the highest level, which includes all other fields. We do not adopt this model as it can be shown that the state is just an amalgamation of different fields, and while they often sit on top of field hierarchies, it should not be seen as an ultimate level of nested fields, something that is different in nature. The highest level, perhaps, is society.

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[53] In fact, this clouds the meaning and brings in associations of ill-defined terms that abound in institutional theory, starting with the vaguely defined term, institution.
[54] Wooten & Hoofman (2008: 138).
[55] Higher educational institutions, firms that engage in housing development, etc.
[56] The studies will focus on the biotechnology, nanotechnology, fuel cell automotive industries.

2.4. Fligstein's strategic action fields

As mentioned before, my concept is probably closest to Fligstein & McAdam (2012). However, there are some points of difference. In the following, I review in a nutshell how they think of fields and point out where my concept differs.

Fligstein and McAdam call fields 'strategic action fields' – a label I find unnecessary – and describe them in a social constructionist light, saying that membership in a field is subjective and is not based on objective criteria with boundaries. For them, boundaries are not defined and can shift depending on interpretation and the members' needs. They claim that these "fields are constructed in a sense that they turn on a set of understandings fashioned over time by the members."[57]

They find that "[t]hese understandings are made up of four things: 1) what is happening in the field and what is at stake, 2) what positions are there in the field with what level of power, 3) what are the rules, 3) how to make sense of the field and the surrounding world (interpretative frames)."[58] These define the domain of a field very succinctly. It is clear that these critical understandings cannot be accounted for with a pure network theoretical method and need to be approached with the hybrid method of Powell, where fields are investigated with both qualitative and quantitative studies.

Fligstein and McAdam (2012) build their theory around the core question of how social order and social change take place in delimited social arenas.

Fligstein's definition is more elaborate than previous conceptualizations except

[57] I partly agree with this, but I do not dismiss the possibility of objective criteria from a nominalist methodological standpoint. See Scott on methodology above.

[58] Fligstein & McAdam (2012: 10-11) propose these instead of the more conventional 'institutional logics concept'. They find that these aspects "are lumped together" in institutional logics. This is a valuable observation and there is much value in discussing them in this different manner. Institutional logics tends to shift in meaning and is vaguely defined. Note that Scott (2013) also refer to frames as an important element of organizational fields in a way adding it to institutional logics. This can be described as institutional knowledge or a kind of evaluation frame. Here is Fligstein & McAdam's more detailed description: "First, there is a general, shared understanding of what is going on in the field, that is, what is at stake (Bourdieu and Wacquant 1992).[..] Second, there is a set of actors in the field who can be generally viewed as possessing more or less power. [..]Third, there is a set of shared understandings about the nature of the "rules" in the field. By this, we mean that actors understand what tactics are possible, legitimate, and interpretable for each of the roles in the field. [..] Finally, there is the broad interpretive frame that individual and collective strategic actors bring to make sense of what others within the strategic action field are doing." Note again that this last sense of interpretive frame is narrow. It limits its meaning to interpretation of other actors. In this dissertation, I do not hold this position and define frames in a broader sense. Frames are often used to evaluate what actions to take, appraise the actions of others, and make sense of all kind of data in light of the logic of the field.

perhaps that of Bourdieu: "[S]trategic action fields are the fundamental units of collective action in society. A strategic action field is a constructed mesolevel social order in which actors (who can be individual or collective) are attuned to and interact with one another on the basis of shared (which is not to say consensual) understandings about the purposes of the field, relationships to others in the fields (including who has power and why), and the rules governing legitimate action in the field. A stable field is one in which the main actors are able to reproduce themselves and the field over a fairly long period of time."[59]

Fligstein & McAdam (2012) distinguishes between two types of main actors within fields: incumbents and newcomers. They highlight the importance of internal governance units, claiming to be a novel contribution (though the concept is not new, cf. Bourdieu, 2005).

They assign a vital place to frames, but they accept multiple, possibly contending frames to exist within fields: "rather than positing a consensual frame that holds for all actors, which is implied by the idea of "logics," we expect instead to see different interpretative frames reflecting the relative positions of actors within the strategic action field."[60]

The most salient feature of their framework is that fields can contain other sub-fields. They also distinguish between individual actors and collective actors, which Scott did not. "All collective actors (e.g., organizations, clans, supply chains, social movements, and governmental systems) are themselves made up of strategic action fields. When these fields are organized in a formal bureaucratic hierarchy, with fields essentially embedded within other fields, the resulting vertical system looks a lot like a traditional Russian doll: with any number of smaller fields nested inside larger ones."[61] In fact, Fligstein & McAdam (2012: 3) states that "any given field is embedded in a broader environment consisting of countless proximate or distal fields as well as states, which are themselves organized as intricate systems of strategic action fields. [..]" This idea was already spelled out in Bourdieu. However, they emphasize nested field structures that interact in intricate ways: "[T]he opportunities and challenges a given field faces stems from its relations

[59] Fligstein & McAdam (2012: 9).
[60] Fligstein & McAdam (2012: 11).
[61] Fligstein & McAdam (2019: 9).

with this broader environment. Crises and opportunities for the construction of new fields or the transformation of existing strategic action fields normally arise as a result of destabilizing change processes that develop within proximate state or nonstate fields." They go on to propose that "[o]ne of the central insights of our theory is that the basic structure of any given strategic action field is the same as any other field regardless of whether or not the field is made up of individual people, groups, organizations, or nation-states."[62] In this conceptualization, fields interact with each other and are themselves form a structure of relationships[63]. Whether fields made up of individuals and fields consisting of organizations are identical is a question that cannot be adequately answered empirically. However, there are indications uncovered in this dissertation that suggests that the two levels are not identical and should not be treated thus.

Another key achievement of Fligstein & McAdam is that they identify formal organizations as fields[64]. They acknowledge that organizations are a particular case of fields. They find that organizations have delimited boundaries, a defined structure, formal rules, and authority and obligations linked to specific roles. However, their theory also allows for internal contestation and political struggle. This fits perfectly well with my theoretical framework and will be taken up.

Fligstein and McAdam find the concept of social skill[65] to be another important contribution; however, this can be contrasted with Bourdieu's original concept of habitus. In a later chapter, I discuss how these microfoundations can be integrated with Bourdieu's capital concepts. However, this dimension will not be emphasized in this dissertation and will not be taken up in the empirical section.

2.5. Hoffman, Furnari, and Zietsma's field typology

In a recent paper, Zietsma, Groenewegen, Logue, & Hinings (2017), reviewing the

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[62] Fligstein & McAdam (2012: 59).

[63] Fligstein & McAdam (2012: 9) on this point again:"In general, the ties between fields highlight the interdependence of strategic action fields and their very real potential to effect change in one another. Indeed, we argue that these links constitute one of the main sources of change and stability in all fields."

[64] Flistein & McAdam (2012) also identifies states as fields and a large part of their chapter on macroconsiderations deals with how state and non-state actors interact. Discussing the state in depth, however, is beyond the scope of the present work.

[65] See Fligstein (1997).

organizational field literature, defined institutional fields instead of organizational fields[66]. These institutional fields are explained in the following terms: an institutional field "is the bounded area within which meanings are shared (Glynn & Abzug, 2002) and specific institutions operate. Institutional fields are presumed to be the predominant source of pressures for institutional conformity and the site of institutional embeddedness, which we argue is the core idea of institutional theory. They are also enabling: the institutional infrastructure of organizational fields comprise the mechanisms of social coordination by which embedded actors interact with one another in predictable ways."[67] There is considerable overlap between their institutional fields and other definitions of fields, but their focus is on institutions. Perhaps, the key difference is that, according to the authors, institutions operate within organizational fields, and the fields possess an institutional infrastructure. These institutional concepts are vaguely defined in the literature, but I will treat them in the following sections.

Their work's key contribution is that they have identified two main types of institutional fields: exchange fields and issue fields. They show that some think of fields as populations of similar organizations consistent with organizational ecology. They look at exchange fields as fields where members are subject to the same forces and needs.

They identify three distinct types of exchange fields: 1) industry exchange fields, including museums, hospitals, orchestras, 2) professional exchange fields, and 3) social movement exchange fields. These are the more traditional forms of nominally delimited fields with a more established, more defined form.

Following Hoffman (1999), they also define issue fields[68]. Quoting Evans & Kay (2008: 973), they point out that fields are "characterized by an orienting principle or goal." Fields often form around certain issues, and the participants come from different fields,

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[66] They start by saying that"[T]here is a basic degree of commonality in the approaches of DiMaggio and Powell, Scott, Fligstein and McAdam, and Bourdieu." Cf. also Zietsma et a. (2017): "Some authors either define or operationalize the field more narrowly as the set of "organizations that produce related outputs, use related resources, and rely on similar technologies", occupying the same or similar niches (Gibbons, 2004: 938), without reference to interaction partners."

[67] Zietsma et al. (2017).

[68] Hoffman (1999: 351): a field "forms around a central issue—such as the protection of the natural environment—rather than a central technology or market […] fields become centers of debates in which competing interests negotiate over issue interpretation. As a result, competing institutions may lie within individual populations (or classes of constituencies) that inhabit a field". From Zietsma et al. (2017). Also cf. Meyer and Höllerer (2010).

which leads to contestation within the issue field, but it can also lead to cooperation[69]. They identify three types: 1) competitive issue fields, 2) interstitial issue fields and 3) bridging issue fields. All of these types are fields that are less established, more vaguely defined, and more contested. Some of the cases discussed in this dissertation can be conceptualized as issue fields and interstitial or bridging fields. The concept of interstitial fields is especially important here. These are the fields that form across boundaries of other fields and are the key domains of inter-field interaction and boundary effects that are the topic of this paper.

Zietsma et al. (2017) further observe that fields, in general, have five main features, not unlike those defined by DiMaggio & Powell: a network of actors, common meanings and interests, boundaries, hierarchies of status and influence, and contestation[70]. These will be important building blocks in my later chapters, and thus I do not discuss them here in detail.

After describing the different types of fields, the authors discuss the degree of institutionalization of fields, agency, and pathways of change. They find that more institutionalized fields are more defined and resemble exchange fields more[71].

Their paper is undoubtedly one of the most important theoretical work after Fligstein.

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[69] Zietsma et al. (2017) argue that"in issue-based fields, as Hoffman identified, one would not expect a common logic to operate at the field level, but instead to operate at the level of a specific sub-population within the field, such as an industry or a profession or a social movement."

[70] A direct quote from Zietsma et al. (2017): "First, there is the idea that fields are made up of actors who are in relationship with each other and that those relationships are structured around common meanings and common interests. Thus, there is an emphasis on a common culture and shared networks. Second, there is the idea that fields have boundaries that are established both through common meaning systems and the intensity of relationships within a field compared to outside of it. Third, a very important element in Bourdieu, and also contained in DiMaggio and Powell, is the notion that fields have hierarchies of status and influence; all actors are not equal. Fourth, the existence of differential power, influence and status, means that there is contestation, competition and struggle, something that is emphasized by Bourdieu but has also become more important in studies of change in fields (Greenwood, Oliver, Sahlin & Suddaby, 2008; Wooten & Hoffman, 2008)."

[71] Also cf. the following quote from Zietsma:"All of these elements can be part of, and utilized in an approach to, understanding fields in both (relative) stasis and change. Hoffman's conceptualization of fields as forming around issues rather than technologies or markets suggests a more fluid idea, with fields including new and often competing members and subgroups, connecting with Bourdieu's notion of struggles, politics, vested interests and agency. His definition accords with a change in theoretical emphasis from stability to change in institutional theory in the late 1990s and following, and it may better reflect social changes brought about in part by the internet, as Powell, Oberg, Korff, Oelberger and Kloos (forthcoming) note: "organizational fields … are more dynamic, boundaries are more porous, different organizations have come to populate them and the power differentials among members have been altered". Yet Hoffman's view of fields as issue arenas brings together in one field sets of actors who have commitments to, and embeddedness within, very different institutional logics and structures, suggesting a field that is by no means settled or uniformly constraining." Zietsma et al. (2017)

However, the framework has some severe drawbacks. Even though they identify relationship structure as a critical feature of fields, networks are left out. Again, though the authors claim that hierarchies and power are essential within fields, their positional structure is not explored further. The theory only talks about powerful actors. Again, field interaction is only mentioned in the paper's final part as a possible future research avenue. Boundaries are not conceptualized beyond the interstitial and bridging concepts. All of this work will need to be taken up in the following sections.

Zietsma et al. (2017) is, in fact, a theoretical paper and a review of the organizational field literature. They reviewed 110 papers found in top management journals[72]. A few observations can be made about their approach. Many of these studies use the concept of 'field' loosely, referring to 1) institutional settings, 2) fields in the general sense (field of medicine, for example), 2) a group of organizations, 3) organizations, or 4) institutions. This brings in a number of inconsistencies and vague definitions, which renders their institutional field concept difficult to use. In the next chapter, I try to avoid building a theory based on the aggregate of disparate research papers and instead, work on a more theoretically consistent framework.

Zietsma et al. (2017) found that fields have been operationalized in different ways. They found that the most common ways to find a field are through focusing on industries, social movements, alliances networks, geographic collocation, or similar identity characteristics (for which they give the example of Fortune 500 companies from Brisco & Safford, 2008).[73]

They find that the major differences lie in: "1) the purposes of fields; 2) the boundaries around them; 2) the homogeneity or heterogeneity of actors within them; 3)

[72] The authors reviewed papers published between 1983 and 2015 in Academy of Management Journal, Academy of Management Review, Organization Science, Organization Studies, Journal of Management Studies, and Administrative Science Quarterly.

[73] In their own words: "[f]ields have been empirically operationalized by analysts in different ways, involving different configurations of membership. Some researchers include members from specific industries or sectors (Tolbert & Zucker, 1983), others focus on members of social movements (Barley, 2010; Diani, 2013; van Bommel & Spicer, 2011) and many others analyze industry members and their interaction partners including producers, users, regulators, publics, etc. (Farjoun, 2002; Reay & Hinings, 2009). Some examine institutional processes among those who share some point of commonality even across sectors, such as geography (Glynn, 2008; Lounsbury, 2007; Marquis, Glynn & Davis, 2007), or identity characteristics, such as being major multinationals (Kostova, Roth, & Dacin, 2008), Fortune 500 members (Briscoe & Safford, 2008), or major U.S. employers (Briscoe & Murphy, 2012). These differences are likely to result in analysis showing different effects on field processes." For references see Zietsma et al. (2017).

the structure of relational networks between members; 4) the number, complementarity, and compartmentalization of logics in the fields; 5) and in the nature of the collective identity in the field [numbering added]". While these observations are partially contained within previous theories, the focus was no on the differences between fields. Zietsma et al. (2017) is a major contribution because they move on to typification and comparison of fields by putting emphasis on field purposes, actor heterogeneity, and compartmentalization of logics.

2.6. Powell's organizational fields as networks

In later works of Powell (1996, 2005, 2012), the idea of an organizational field takes center stage. Scott (2013: 214) mentions that DiMaggio was the first to propose block modeling as a viable method to measure fields and that this idea was picked up by Powell, who brought in network theory. Powell's concept builds on DiMaggio's and later Fligstein's field concept, but, while he is aware of the distinction, he still uses networks and fields more or less interchangeably in a less rigorous way[74], sometimes equating fields with networks of alliances between organizations, other times with geographical industry clusters.

Some criticism has been leveled at his work in this respect. Fligstein & McAdam points out that: "For all of its virtues, however, network analysis is not a theory of fields. It is principally a methodological technique for modeling various aspects of the relationships between actors within a field. Moreover, while it can be a powerful tool to help map fields and especially to monitor changes in the composition of strategic action fields, it is mute on the dynamics that shape fields. There are, to be sure, network researchers who have sought to theorize the role that social ties, or other properties of networks, play in shaping social dynamics (Burt 1992; Gould 1993; Granovetter 1973), but no one, to our knowledge, has fashioned anything close to a network-based theory of

[74] Powell's study on the Bay Area biotechnology firms garnered much interest from different fields. His organization field concept was then equated to sectors, industries, local industry clusters, innovational parks, networks. In this dissertation, it is very important to distinguish between these and the concept of a field. While all of these terms can be conceptualized through the field concept these are not equal to the field under discussion here.

fields."[75] They further elaborate on this by saying that a "structural mapping of field relations, however sophisticated, will never substitute for a deeper analysis into the shared (or contested) understandings that inform and necessarily shape strategic action within a strategic action field. In short, the analyst always has to provide the theoretical underpinning for what is important about the relationships (i.e., networks) being studied for any given outcome. If a field is really an arena in which individuals, groups, or organizations face off to capture some gain, as our view suggests, then the underlying logic of fields is not encoded in the structure of the network but in the cultural conceptions of power, privilege, resources, rules, and so on that shape action within the strategic action field."[76]

I agree with the analysis from Fligstein. Network theory cannot by itself become a core theory; field theory is needed to inform what happens in the field. This dissertation, however, argues for the central role of network theory in field analysis. Networks and relational structures are inherent features of any field, and many of the forces active in fields are exerted through network ties. Without a firm grasp of the field's structure, it is difficult to explain how the field works in concrete terms; this becomes even more important when analyzing inter-field interaction.

2.7. Other concepts related to fields

Unfortunately, as the reader could see in the above review, the field concept is incompletely defined. An important task would be to relate it systematically to other related concepts such as society[77], social systems[78], community, groups, teams,

[75] Fligstein & McAdam (2012: 29).
[76] Fligstein & McAdam (2012: 29).
[77] Cf. "In common with Philip Abrams, Michael Mann, and Charles Tilly, Bourdieu explodes the vacuous notion of "society" and replaces it with those of field and social space." (Bourdieu & Wacquant, 1992: 17)
[78] In Bourdieu & Wacquant (1992: 103), Bourdieu's field concept is defined related to Luhmann's concept of systems. While he seems some surface similarities, he considers struggle the organizing principle of fields: "[a]s for systems theory [..] the differences between the two theories are nonetheless radical. For one thing, the notion of field excludes functionalism and organicism: the products of a given field may be systematic without being products of a system, and especially of a system characterized by common functions, internal cohesion, and self-regulation— so many postulates of systems theory that must be rejected. If it is true that, in the literary or artistic field, for instance, one may treat the stances constitutive of a space of possibles as a system, they form a system of differences, of distinctive and antagonistic properties which do not develop out of their own internal motion (as the principle of self-referentiality implies) but via conflicts internal to the field of production. The field is the locus of relations of force— and not only of meaning— and of struggles aimed at transforming it, and therefore of endless change. The coherence that may be observed in

systems of cooperation[79], clusters[80], hierarchies, bureaucracies, institutions, social movements, and formal and informal organizations[81]. Fligstein and McAdam find that several related concepts are used in the literature: "sectors (Scott and Meyer 1983), organizational fields (DiMaggio and Powell 1983), games (Scharpf 1997), fields (Bourdieu and Wacquant 1992), networks (Powell et al. 2005), and, in the case of government, policy domains (Laumann and Knoke 1987) and policy systems/subsystems (Sabatier 2007)."[82] Wooten & Hoffmann (2008) refers to terms related to institutional theory: "For early neo-institutional theory, the central unit of analysis was variously referred to as the institutional sphere (Fligstein, 1990), institutional field (Meyer and Rowan, 1977; DiMaggio and Powell, 1991), societal sector (Scott and Meyer, 1992), and institutional environment (Orru et al., 1991; DiMaggio and Powell, 1991).[83] It is also interesting to mention that Loic Wacquant compares fields to Weber's life-order concept[84].

These concepts can be conceptualized as fields and thus could give us vital knowledge about what fields are and what they are not. However, such an undertaking is not possible within the scope of this work, and I will just cursorily give some important points of comparison in later sections.

Another far-reaching question is how field theory relates to other strands of research. Two contexts need to be discussed here because of the nature of the present study: the contribution of Japanese researchers and the relationship of field theory with strategic management research. The studies were undertaken within these two contexts, and they cannot be clearly understood without discussing them. The latter and some of the former

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a given state of the field, its apparent orientation toward a common function (in the case of the French Grandes ecoles, to reproduce the structure of the field of power) are born of conflict and competition, not of some kind of immanent self-development of the structure."

[79] Chester Barnard's term (cf Barnard, 1938)

[80] In the sense of industry clusters or innovative clusters (Saxenian, 1994; Bresnahan & Gambardella, 2004; Powell, Packalen, Whittington, 2009), but also in the sense of a cohesive structural element, such as a small group.

[81] The concept can be traced back to Weber, Barnard (1938), and for example, Blau & Scott (1962), but it has been an ubiquitous concept in management theory.

[82] Fligstein & McAdam (2012: 9).

[83] Wooten & Hoffman (2008: 138).

[84] "Much like Weber's *Lebensordnungen*, the economic, political, aesthetic, and intellectual 'life-orders' into which social life partitions itself under modern capitalism (Gerth and Mills 1946:331-59), each field prescribes its particular values and possesses its own regulative principles." (Bourdieu & Wacquant, 1992: 17)

will be discussed in the individual studies in the empirical sections. Here, I will highlight a few crucial concepts from the Japanese context in which most of the work has been down within strategic management.

Sugiyama and Takao (2011) focus on business ecosystems[85], a concept that is larger than a field or an industry, but which designates the domain that is necessary to understand the factors that influence the firm's performance. Business ecosystems include financial institutions, complementary goods producers, suppliers, governmental organizations. The list reminds us of Warren (1967), and it can be argued that Powell, for example, calls the same set of actors organizational fields. Thus, the question remains. How close is the concept of an ecosystem to the concept of an organizational field? Clearly, the former's analytic scope is different and perhaps better suited to answer strategic management questions. However, it is also not incompatible with the idea of fields. The most important point his study highlights is whether the field concept can be readily used for strategic management questions such as complementary products, modularization, outsourcing, long-term relationships with suppliers. Indeed, some of these specific questions of management remain unanswered in the sociology-originated concept of the field. However, in future studies, perhaps it would be interesting to review each question with a field lens. Na (2012) describes three cases of ecosystem formation. She finds that a strong focal firm and a group of secondary members take center-stage in all three cases. Her description is very similar to a field concept, but the roles of the firms need to be clearly defined. A platform firm and the others that rely on this platform create a specific role-relationship. It is possible that the ecosystem can be mapped through a role-network within the field framework, but in the present dissertation, I will not attempt to theorize how this could be done.

Takeishi has devoted a considerable amount of time to analyzing firm boundaries from a strategic management lens, investigating the question of outsourcing between firms, asking what a firm should produce within the firm and what it should outsource to suppliers. In his studies, there are no fields or ecosystems discussed. His realm is the firm,

[85] Based on work by Adner & Kapoor (2010), Gawer & Cusumano (2002), Iansiti & Levien (2004), and Moore (1993).

and his focus is on the firm boundary. His main finding is that to collaborate successfully and gain advantages from the supplier, a long-term relationship is necessary. The buyer shares knowledge with the supplier and enables it in some ways. A trust relationship forms, technical knowledge is shared, and deepening-levels of cooperation develop. However, from another perspective, it is also possible that the buyer subsumes the supplier under its control and its competitive advantage stems from the fact that it can greatly influence the actions of the supplier while other buyers who have only short-term relationships with the firm cannot. This can be understood from a field perspective and illustrates how fields can exert control over other fields through mutually beneficial cooperative activities. Takeishi (2002) finds that firms should keep relevant knowledge in-house related to outsourced parts. The long-term relationship allows the buyer to see into the supplier's operations and keep relevant component-specific information for themselves.

Nishiguchi, Wakabayashi, and Nakano focus mainly on networks instead of fields. Wakabayashi actively uses the concept of organizational fields and networks. His network concept is probably closest to Powell's organizational field networks and has indeed produced similar research in the Japanese context. Some of the data used in this dissertation are the result of the work of his research group to which the author belonged. Wakabayashi (2013) investigates the Japanese biotechnology organizational field around the Kansai region in detail, documenting network structure, network effects, and structural evolution.

Nishiguchi and Tsujita (2017) have been proponents of the concept of community capital that enables members of some field to have trust towards each other even when there are no established prior ties. It can also be analyzed with a field logic. I will get back to these observations in the empirical section.

In the following, I move on to the analysis of field boundaries and skip discussing strategic management concepts. These will be dealt with in later sections. Here, I will only note that fields can be in the center of strategic management research and should not be treated as a mere abstract sociological concept.

2.8. Boundaries

The problem with discussing field boundaries is that there are multiple but disparate strands of research focusing on the problem[86]. The difficulty starts because all alliances, mergers, collaborations, and joint-ventures can be expressed in terms of something that is happening at a boundary. A number of papers, therefore, are presented as cases of boundary work. However, the theory and the use of concepts are haphazard, making generalizations problematic. I will not attempt to review these concepts here systematically but will return to the question of boundaries in a later section.

Here, I will mention only one aspect. It is evident from the previous sections that boundaries are difficult to define as everything is ultimately embedded in the broader societal system. However, it is not impossible to nominally identify some boundaries between fields. Some boundaries are quite clear. In the empirical section, not all boundaries will be clearly defined, but some empirical tools can be used to find the degree of boundary abruptness.

There is another crucial question. What happens at the boundary? According to Zietsma et al. (2017), there is a great deal of contestation and struggle, as well as potential cooperation and negotiation. Frames clash and understandings break down. Misunderstandings happen. New coalitions might form, and existing structures might erode. All of these theoretical underpinnings are in the process of discovery, and more work is needed. In the present dissertation, the focus will not be on these actual processes but rather on the effects that the mere existence of a field boundary can have on traditional network structures.

[86] It is impossible to review every relevant strand here as there is probably literally tens of thousands of papers dealing with the issue in very different fields from political science to psychology. Focusing only on organization theory, we can easily identify important theoretical work dealing with boundaries such as boundary spanners, gatekeepers, brokers, boundary work, interstitial fields, field-configuring events, institutional heterogeneity, institutional logics, alliance management, post-merger integration, inter-cultural studies of management. The number of papers in these fields probably number in the thousands.

3. The building blocks of fields: theoretical framework

In the following, I look at the building blocks and related concepts of fields. This is necessary to see what are inside fields and how do fields function through these building blocks. A brief summary of the concepts is given in the table below.

The building blocks of fields: theoretical framework	
1. Capital and resources in fields	**3.1.**
2. The individual in fields	
3. Roles, hierarchy, authority, power in fields	
4. Organizations and fields	
5. Institutions and institutionalization	
6. Logics, interpretative frames, symbolic systems, understandings	
7. Networks as field structure	

Capital and resources in fields

As we have seen in the previous chapter, in Bourdieu's field theory, the concept of capital plays a vital role. Capital is not only something abstract, but in some of its forms, it includes material objects. This material nature[87] of fields must be accounted for. Objects by themselves are not members of the fields in most conceptualizations but are a necessary part of any field analysis. It is also important to note that later theories[88] did not place as much importance on capital as Bourdieu had done. In fact, in more recent theories of fields, structures (for example, networks in the case of Burt or Powell) or institutions (DiMaggio, Zietsma) is in the center, and capital has been relegated to a secondary position even though most researchers acknowledge its importance in a taken for granted manner.

Therefore, it is necessary to look into what Bourdieu means by capital in more detail and then review the concept and its relationship to fields. Bourdieu (2005: 194) describes different types of capital related to economic fields. The following types of capital are

[87] Orlikowsky & Scott (2015), in their theory of materiality, talk of material-discursive processes.
[88] Scott (2013, DiMaggio & Powell (1983), Powell et al. (2005), Fligstein & McAdam (2012) for example put no emphasis on capital or resources possessed by the firms. In their analysis, organizations include material objects and thus their role is simply assumed. In empirical studies organizations size or capital reserves are used as a proxy for accounting for power originating in material objects.

proposed[89]: 1) financial capital (actual or potential), 2) cultural capital (not to be confused with 'human capital'), 3) technological capital, 4) juridical capital, 5) organizational capital (including the capital of information about the field), 6) commercial capital, 7) social capital, and 8) symbolic capital. In the following, I quote Bourdieu's simple descriptions for each type and then discuss them.

For Bourdieu, financial capital is "the direct or indirect mastery (through access to banks) of financial resources, which are the main condition (together with time) for the accumulation and conservation of all other kinds of capital."

Technological capital is "the portfolio of scientific resources (research potential) or technical resources (procedures, aptitudes, routines and unique and coherent know-how, capable of reducing expenditure in labor or capital or increasing its yield) that can be deployed in the design and manufacture of products."

Commercial capital "(sales power) relates to the mastery of distribution networks (warehousing and transport), and marketing and after-sales."

Social capital is "the totality of resources (financial capital and also information, etc.) activated through a more or less extended, more or less mobilizable network of relations which procures a competitive advantage by providing higher returns on investment.

Symbolic capital "resides in the mastery of symbolic resources based on knowledge and recognition, such as 'goodwill investment,' 'brand loyalty', etc.; as a power which functions as a form of credit, it presupposes the trust or belief of those upon whom it bears because they are disposed to grant it credence."

As mentioned previously, in every field, different types of capital have different weights. Some forms can be valuable in multiple fields.[90] Bourdieu posits that translation can occur between the respective types of capital, in which one type of capital

[89] While he gives this list in his analysis on economic fields, it can be assumed that these are his general concepts of capital, especially because it is one of his later, more mature studies.

[90] Bourdieu and Wacquant (1992: 99): "This is so because, at bottom, the value of a species of capital (e.g., knowledge of Greek or of integral calculus) hinges on the existence of a game, of a field in which this competency can be employed: a species of capital is what is efficacious in a given field, both as a weapon and as a stake of struggle, that which allows its possessors to wield a power, an influence, and thus to exist, in the field under consideration, instead of being considered a negligible quantity. In empirical work, it is one and the same thing to determine what the field is, where its limits lie, etc., and to determine what species of capital are active in it, within what limits, and so on."

can be exchanged into another. For example, cultural knowledge can lead to employment that will translate into a higher salary.

The problem with Bourdieu's different types of capitals is that they theoretically overlap. For example, social capital is, in its original form, the leverageable connection an agent has. However, the actual form of 'translated' capital is more likely to be financial, technical, or commercial and cannot work without translation, while some other forms of capital like a piece of simple machinery can instantly be put in use without translation. This gives rise to some complications in theoretical logic and comparability.

For example, financial capital was defined as mastery over resources, which again implies not only social capital but other forms of power. The potential source of financial capital is not simply something that resides in a thing called 'money' but is built up of different types of capital. It is the capacity to borrow money or receive some source of funding from a government or other private sources. It requires some amount of social capital, symbolic capital, and, in a non-capital term, trust and thus cannot be easily handled as a separate entity.

Another problem with Bourdieu from a methodological standpoint is that the location of certain types of capital cannot be defined. Money can be someone's physical property, but financial capital cannot. Similarly, technical capital is more amorphous, including routines and procedures, suggesting that organizations themselves are a form of capital. And this might be so. The locus of capital, however, remains vague. Nevertheless, it is exactly this locus that we need to find if we want to know how power relationships play out within fields.

Bourdieu's concepts are not the only types of capital that can exist. Tilly (2005) calls his forms of capital *value-producing resources* and argues that these are the key forces that solidify social boundaries and create inequality through the mechanisms of exploitation and opportunity hoarding. He gives the following resources: coercive means, labor, animals, land, commitment-maintaining institutions, machines, financial capital, information, media, and scientific-technological knowledge. These are perhaps better suited for field studies; however, the terms multiply, and the concept of capital becomes more elusive.

It is necessary, therefore, to look at the concept of capital in a more precise manner. The first thing to do in this theoretical search is to go back to the origins of the term of capital[91]. Adam Smith defines capital as "[t]hat part of men's stock which he expects to afford him revenue."[92] Hodgson (2014) points out that Smith's concept of capital is mostly physical. It is not monetary. Smith defined four types of fixed capital, machines and tools, buildings as the means of procuring revenue, improvements of land, and the acquired and useful habits of members of the society[93], "which affords a revenue or profit without circulating or changing masters."

I build on Smith's material-based conception of capital to develop further the ideas of Bourdieu. It seems that the label of capital (in such theoretical concepts as cultural, symbolic, or social capital, etc.) has become fashionable and has been applied to many different things[94], both material and immaterial, that help production (Hodgson, 2011). Hodgson (2011: 13) expresses it best when he says that everything has become capital. He also provides two viable ways forward. We either return to the original conception of capital as money to be invested in an enterprise or go with the post-Smithian idea of capital as a physical thing. In my sociological context, I choose the latter with some additions to accommodate non-physical types of capital. There are a number of reasons

[91] As I have no capacity to review the whole development of the term, I turn to Adam Smith, but this does not mean that the term starts with him. For a deeper insight consult Hodgson's (2014) theoretical paper on the derived meanings of capital.

[92] In a way it is quite similar to Tilly's concept.

[93] It is important to point out that his fourth type of fixed capital is a kind of 'human capital' that he discusses in detail: "of the acquired and useful abilities of all the inhabitants or members of the society. The acquisition of such talents, by the maintenance of the acquirer during his education, study, or apprenticeship, always costs a real expense, which is a capital fixed and realized, as it were, in his person. Those talents, as they make a part of his fortune, so do they likewise that of the society to which he belongs. The improved dexterity of a workman may be considered in the same light as a machine or instrument of trade which facilitates and abridges labor, and which, though it costs a certain expense, repays that expense with a profit." Compare this to Becker (1964).

[94] According to Hodgson (2011), the following theories of capital has been proposed: 'natural capital' (Johnson 1909), 'health capital' (Grossman 1972), 'religious capital' (Azzi and Ehrenberg 1975), 'linguistic and cultural capital' and 'symbolic capital' (Bourdieu 1977), 'reputational capital' (Veljanovski and Whelan 1983), 'social capital' (Bourdieu 1986, Coleman 1988, 1990, Putnam 1995), 'organizational capital' (Tomer 1987, Klein 1988), 'academic capital' (Bourdieu 1988), 'cultural or consumption capital' (Becker and Murphy 1988), 'cognitive capital' (Rescher 1989), 'symbolic capital' (Bourdieu 1990), 'environmental capital' (Hartwick 1991), 'self-command capital' (Lindenberg 1993), 'network capital' (Sik 1994), 'personal capital' (Dei Ottati 1994, Becker 1996), 'political, social and cultural capital' (Mouzelis 1995), 'intellectual capital' (Edvinsson and Malone 1997), 'resource capital and institutional capital' (Oliver 1997), 'spiritual capital' (Verter 2003), 'individual trust capital (relational capital)' (Castelfranchi et al. 2006), 'collective trust capital' (Castelfranchi et al. 2006), 'street capital' (Sandberg and Pedersen 2009) and even 'erotic capital' (Hakim 2011). For references see Hodgson (2011).

for this. First, money itself is a derived concept; it is just an intermediary. Not all societies had money, and money itself can obstruct a more practical view of fields.

There are different kinds of material 'capital', yet in its most general conception, a piece of capital is just a material object or a thing[95]. It by itself will not produce wealth; it is just a resource with some potentiality.

The important question then is this: How can a thing become capital? In its most simple form, a physical object might have some functional utility. Thus, a thing can become a higher-order concept: a tool or, in a more complicated form, a machine.

There is another higher-order concept related to this: the artifact, which is a material object imbued with a socially (or more precisely, field-wide) shared symbolic meaning. This distinction between just a thing and an artifact, as here defined, is pivotal. It calls attention to the fact that certain objects (i.e., ceremonial robe, a banner, old school tie) have more social impact exactly because of these shared symbolic meanings. While not having any association, a rock still has the potential to become an artifact in social historicity. These artifacts can confer authority, power, or status but might not be considered a form of capital. Should a ceremonial robe, for example, be considered as capital? In Bourdieu's theory, it is a form of capital that takes part in consecration or power-struggles. Its value cannot be calculated in monetary terms but can be considered a partial contributor to the final value or revenue produced. In Tilly or Adam Smith, a ceremonial robe does not produce wealth directly as a tool does and such would not be considered capital. Of course, it is impossible to resolve this problem here, but it must be noted that the researcher should treat material objects very carefully.

Another form is a self-reproducing 'thing' or rather a life form. A seed or an animal is the foundation of all capital concepts. In this sense, capital is something that generates more than the original input. This understanding of capital leads to a theoretical disconnect among the many meanings of the word 'capital'. Money, for example, does not multiply as a seed does. True, a seed also needs work and other inputs, but money can never by itself reproduce. It is an abstraction. It is the same with objects. A tool might

[95] We need to remember that it can also be a bundle of things or things coupled with people who can operate the thing, or an organization that can enable needed effects. More on this later.

lead to the production of things, or might not, but it cannot reproduce as a plant does in nature.

The problem, however, starts when we move towards the more abstract conceptualizations of capital. For our theory, it is necessary to conceptualize capital more practically. Thought must be given to three questions, 1) where the actual location of these things called 'capital' is to be found, 2) where do they reside, and 3) how are they divided between different individuals, organizations, or things.

Some forms of capital reside in some exact thing, such as a machine, a vehicle, a piece of land[96], or physical currency. Money would be one of these with its function of storing value. This is, in part, what Bourdieu calls actual financial capital, though liquidity in economic terms is also an important point to consider (or in other words, can the money be readily converted). Money is more liquid than some other form of financial capital, but it is also resting on the notion that there is a social acceptance for its value, and actual practice of exchange is required. Money is also socially constructed in the sense of Berger and Luckman (1966).

Others, however, are located in the interrelationships of people. For example, some machinery cannot be operated by one person. While this piece of machinery has a physical location, collective action is needed to utilize it. Another example is when multiple pieces of machinery are needed. Again, these pieces must be mobilized for anything meaningful to be done. This mobilization is the topic of management and organizational theory, but it can also be conceptualized as a form of capital—a special kind of action-oriented resource. From an organizational point of view, to achieve a specific goal, one needs not only tools, other people, and their labor, but also complex cooperative actions[97].

It is true that these other types of capital can be exchanged for financial capital, which means that we need to take the potential convertibility of financial capital into account. However, there is a fundamental problem, namely that we do not have a clear, calculable rate of exchange, and it is evident that circumstances play a critical role in this exchange.

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[96] Though land is seen as a separate factor of production from capital in traditional economic analysis, here I treat it as a form of capital. Adam Smith refers to improvement to land.

[97] These can be thought of as issue fields or cooperative sub-fields.

Companies that can readily access financial resources might suddenly lose their funding in a financial crisis, where non-liquid assets are difficult to exchange into more liquid ones (i.e., money). Similarly, a change of public opinion might turn against a company quickly depleting its sources of symbolic capital. All these have to be kept in mind. However, there is a marked difference between companies that have a fair chance of gaining access to financial resources under normal circumstances to those with little or none. This distinction is clear enough to have a significant role in field formation and the differentiation of power.

Again, some forms of capital reside in individuals. Polanyi's tacit knowledge concept is an example; habitus from Bourdieu is another. We can also mention Adam Smith and Gerry Becker's human capital. The knowledge of operating a specific machine might be in this category, as well as different kinds of skills that an individual can have. Thus, the capital is linked with a certain individual. In this sense, we can talk about an employee as a human resource.

Finally, it is necessary to treat the most problematic concept of all social capital. This term has become popular with the ascent of network theory, but its usefulness is debatable. A complete review here would be impossible, and it has been done elsewhere[98]. The central problem with social capital is that it means different things for different scholars and that it is a derived term. It is an interesting concept, but it fails as a fundamental building block. Social capital has been used as an umbrella term, and one of its foremost promoters, Lin (2001: 4), defined it as "resources embedded in a social structure which are accessed and/or mobilized in purposive action."[99] This shows the inadequacy of the theory because it is not social capital that is the capital. The capital is the resources embedded in social structure. The emphasis is on access or, in other words, power over these resources. Social capital is nothing more than a possibility or a certain power to exercise one's rights to use a certain productive resource. Therefore it is almost always a

[98] Cf. Lin (2001), Adler & Kwon (2002), Bhandari & Yasunobu (2009), and others.
[99] Keep in mind that this definition is quite different from the one proposed by Coleman (1988), but similar to Bourdieu's original idea of social capital as embedded resources (Bourdieu, 2006). Burt (2010) also considers networks or neighbour networks as potential source of social capital. His concept is a derivation of a derivation, highlighting possible theoretical issues.

compound kind of capital (the social relationship and the actual resource are both necessary for it to be meaningful).

It is important to note, however, that not every definition emphasizes embedded resources. For example, Burt (2000) describes the social capital metaphor as advantages that individuals and groups have in a social structure. He recognizes that peer behavior, peer prominence, closure, and structural holes all contribute to performance outcomes.

It is very important to clarify early that, in this dissertation, I do not accept this definition. I call advantages stemming from a network position 'network effects' and distinguish it from social capital. The reason for this is that Burt's conceptualization is an over-abstraction obscuring the fact that the true benefit comes from resources-access and access to other forms of capital, not from a specific position. While it is true that certain positions have potential advantages on their own (brokerage is the most obvious one, but closure also seem to offer obvious benefits), the real power behind them is the actual embedded resource and the power over access.

Tilly, and relational sociologists in general, argue that the relationship is the more important aspect. Social capital theorists agree. Their argument is on the mobilization aspect. Without the right kind of relationship, nothing can happen; therefore, social capital and trust are considered to be more important. Human relationships enable the use of resources[100]. However, the debate seems to be meaningless as both are needed: the actual embedded resources and the relationships, and most do acknowledge the composite nature of social capital.

Finally, following Bourdieu, it is evident that fields and their powerful members can also define what kind of capital or resources are more important within a field. Some material objects or tools are more important in each respective field, and some relationships are more valuable than others.

From a methodological perspective, mapping all forms of capital within a field and the corresponding network would be challenging. However, some key, general forms of capital within the field can be identified. What is it that counts? Bourdieu suggests that

[100] Cooperation needs to be motivated and sustained through institution-building. Powell and DiMaggio would argue that coercion, normative means, and cognitive means are key to this. Chester Barnard also suggests that sustaining and motivating the people behind the cooperative effort is essential.

the investigator should first determine what kind of capital has currency within the fields and who the elite members who defend this particular form of capital are.

In the high-technology sector, the forms of capital that have currency might change depending on the environment and the emergence of new technologies. Both Powell and Dyer and Singh (1998) called attention to the fact that resources are not always internal to the organization but are often outside, residing in networks, fields, or the broader environment. Therefore, it becomes important to see how firms can stretch their boundaries to reach out for resources that are not within their traditional fields. In the empirical section on M&As, I will explore what kind of key resources are embedded in the larger network and how firms try to access these through coalitions.

Perhaps, instead of capital, it is much more promising to talk about resources, skills, symbolic knowledge (categories, schema, etc.), relationships, and practices (routines, procedures, etc.). In this simple conceptualization, we have a field made up of material objects and individuals with specific skills and symbolic knowledge in front of us. These individuals relate to others within the field dictated by the present rules in the symbolic knowledge they possess and amplified by their skills. In all this, the individual will have a pivotal role.

3.2. The individual in fields

As mentioned earlier, originating from a structural-functionalist perspective, the theory built here acknowledges the duality of structure and builds on Bourdieu's dialectic instead of building on a purely methodological individualist standpoint[101]. In other words, I accept agency but cannot forget about the fact that actors are embedded in a larger social structure. The difference, however, is that I analyze structure through the concept of fields. The enabling and constraining function of structure is conceptualized in the field.

My task is to clarify how the later chapters use the concept of an individual[102]. I avoid

[101] Here I quote a concise explanation given by Loic Wacquant: "[m]ethodological individualism (a term coined by the economist Joseph Schumpeter) holds that all social phenomena are in principle explicable strictly in terms of the goals, beliefs and actions of individuals. Holism, in contrast, contends that social systems have emergent properties that cannot be derived from the properties of their component parts and that social explanation must start from the systemic level." (Bourdieu & Wacquant, 1992: 16)

[102] In my specific empirical research context, I define an *individual* as a member of an organization, often a person who is part of a cross-boundary team between alliance partners, either in a management, or a lower

the term actor[103] here because I wish to focus on a human individual as a key building block of any field[104]. This does not mean, however, that I would only treat micro-level fields. On the contrary, the empirical section will focus on organizational fields. However, it is important to remember that fields are still made up of individuals on the lower levels, and an organization is formed with smaller and smaller subfields. At the micro-level, the individuals reappear. In the following, this fact will become pivotal. The underlying theory focuses on the individuals within the organizations. It is not the organizations themselves that are the agents, but the individuals occupying them.

What do individuals bring to fields? In Bourdieu's conceptualizations, individuals are often the field. However, we have seen that resources and physical objects are also necessary to make up a field, and they need to be considered. Nevertheless, it is important to look at the individual. An individual brings not only a pre-learned meaning system with himself, but also a set of tacit skills as defined by Polanyi, or the habitus of Bourdieu. These skills can also include skills enabled by personal attributes (for example, a certain physical appearance that can help foster trust). Other forms of capital, such as cultural capital, can also attach to a person and can have far-reaching consequences in the field's operation, as we have seen in the previous section. Other forms of capital, however, might be indirectly attached to the person. While it is true that social capital is linked to the individual, the actual resources are found outside of the individual.

Nevertheless, access to these resources might be granted only through this individual, in which case, from the field's perspective, and especially from a methodological standpoint, the specific forms of resources can be thought of as attached to the individual. If the individual stops being a member of the field, the access will most likely be denied to the rest of the field or organization unless a new relationship is negotiated. This can be costly, however.

The individual has another important role in fields because they are the sources of

position. In the studies that follow, most of these teams can be found in R&D and the top level of the company, so the reader can keep these individuals in mind, and think of mainly research scientists, managers and other people involved in collaboration and collaborative strategy planning and execution.

[103] Cf. Meyer & Jepperson (2000) on the meaning of actors.

[104] I sometimes use the expression, 'a member of a field' , which can stand for either an individual or another field (in my context, usually an organization).

agency. Much has been written about the role of the individual in the evolution of institutions. Hardy & Maguire (2008), Lawrence, Suddaby, and Leca (2009), for example, describe how individuals can either through institutional entrepreneurship or institutional work have an impact on larger structures and institutions.[105] In a similar vein, individuals have a pivotal role in creating, maintaining, and influencing field structure. Through contestation or cooperation, they are recreating and modifying the field. Much of what drives individual agency can be described through frames and logics that guide the individuals. I will discuss these important concepts in a later section.

My theory of fields, therefore, gives an important role to the individual. Even if the unit of analysis is not the individual, his existence must be theoretically drawn up and accounted for. In more precise terms, every causal relationship proposed to take place between organizations or within inter-organizational networks must also have a micro-level theoretical explanation (even if it is not tested statistically). The empirical section will contain such theorizing.

3.3. Roles, hierarchy, authority, power in fields

With our concept of field capital and individuals, it is now easy to conceptualize roles and power. Roles are positions within a field that provide access to certain resources. They often come with predetermined links to others within the field or at least orients other members, and they derive their power from the fact that they are also within the hierarchy. Those outside the field or the hierarchy, in most cases, cannot access the resources or make the members act in certain ways unless they bring other institutional pressures or some form of coercion.

A role in itself, however, is meaningless. It becomes a role when an individual[106] occupies it. The key idea behind roles in any analysis is that, in a way, it becomes inseparable from the individual that is temporarily occupying it[107]. They blend, and the individual's ‘capital’ is added to or subtracted from the endowments that a role might

[105] The relationship of institutions and fields will be discussed later.
[106] For now, this actor is an individual, but it could also be an organization or a group, in other words a field.
[107] This gives rise to the problem of identity. In this work, for the author, identity seems to be a derived term and thus are not dealt with in the theoretical framework. Cf. Hatch, M. J. & Schultz M. (2004) Organizational Identity: A reader. OUP: Oxford.

provide. A prestigious position occupied by an unqualified person, for example, can trivialize and weaken the role.

Berger & Luckmann (1966)[108] give much importance to roles in their theory, though they are interested in roles as far as they concern the individual. However, they posit that action performed conforming to roles enact institutions and can be considered key to understanding how fields function.

In certain settings, roles can be specific and easy to observe, such as in hierarchies of a division of labor within rationalistic organizations. The roles there are defined as the formal organization and are often expressed in charts and job descriptions.

Not every field has this clearly discernible system of roles. Stark (2011) uses the concept of heterarchy in contrast to a more traditional hierarchy to describe the more complex structure of many organizations. This concept can also describe the complexity within fields. A simpler categorization could be achieved by utilizing a newcomer-incumbent dichotomy in which the focus is on the struggle between the two groups of actors. Whether roles are explicit or vaguely expressed, they do exist within fields.

The other key element to understanding roles is that they are seldom by themselves. They create an intricate system within fields. From a sociological point of view, these systems are understudied at the moment, but organizational theory and management have long been investigating this issue.

For Berger and Luckmann, the roles represent the institutional order. In fact, they go as far as to define institutions in the following way "[i]nstitutionalization occurs whenever there is a reciprocal typification of habitualized actions by types of actors. Put differently, any such typification is an institution." Following this, they explain that: "The typifications of habitualized actions that constitute

[108] "In sum, the actor identifies with the socially objectivated typifications of conduct in actu, but re-establishes distance from them as he reflects about his conduct afterwards. This distance between the actor and his action can be retained in consciousness and projected to future repetitions of the actions. In this way both acting self and acting others are apprehended not as unique individuals, but as types. By definition, these types are interchangeable. We can properly begin to speak of roles when this kind of typification occurs in the context of an objectified stock of knowledge common to a collectivity of actors. Roles are types of actors in such a context. It can readily be seen that the construction of role typologies is a necessary correlate of the institutionalization of conduct. Institutions are embodied in individual experience by means of roles. The roles, objectified linguistically, are an essential ingredient of the objectively available world of any society. By playing roles, the individual participates in a social world. By internalizing these roles, the same world becomes subjectively real to him." (Berger & Luckmann, 1966: 91)

institutions are always shared ones. They are available to all members of the particular social group in question, and the institution itself typifies individual actors as well as individual actions. The institution posits that actions of type X will be performed by actors of type X" (Berger & Luckmann, 1967: 72).

Actors of type X is what we can call a position within a field. In this simplistic definition, roles are linked to specific actions, and the knowledge of these is shared within the field. Their definition of an institution is mainly a definition of a role-action nexus or network: "This representation takes place on two levels. [1] First, performance of the role represents itself. For instance, to engage in judging is to represent the role of judge. The judging individual is not acting 'on his own', but qua judge. [2] Second, the role represents an entire institutional nexus of conduct. The role of judge stands in relationship to other roles, the totality of which comprises the institution of law. The judge acts as the representative of this institution. Only through such representation in performed roles can the institution manifest itself in actual experience. The institution, with its assemblage of' programmed' actions, is like the unwritten libretto of a drama."[109] They define institutions, but the definition can be relevant to fields as well. Nevertheless, a field might be different in some aspects (for example, in the case of organizational fields, roles might not be this clearly defined). More will be added to this later on.

Roles and routines are linked together in their theory, and people work in a network of interlinked-action. Similarly, fields have an internal dynamism that needs to be understood apart from a visible structure of relationships at any one moment. One way to understand it is to think of it as a formal organization, a hierarchy, or a bureaucracy[110].

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[109] Berger & Luckman (1967: 92).

[110] Hierarchy seems to be a well-defined term, but it is in fact quite complex. The metaphor of a pyramid is often used, which, if we look into, is quite vague in a number of ways. In this metaphor, the top controls the lower layers and there is an emphasis on top-down control and different levels of power in descending order. It is easy to realize that this structure is an ideal type, but problems still remain. What the concept is often translated to is a hierarchical tree with each member or role occupying a proper position within the tree. To be sure, this mathematically describable structure can be sometimes complicated with cross-cutting links between levels, but by and large the tree structure is implied. If we expand the meaning further however another meaning comes to focus. Hierarchy implies different levels of power and a structure that underlies this power. In the management literature, hierarchy is often contrasted with the concept of equality, democracy, and in organizational terms: flat organizations. A picture is painted where equality is against elitism. This overly simplistic dualism, however, can be quite misleading. In our conceptualization, fields do have hierarchies, but these hierarchies are not necessary pyramids. Rather there is a clear distinction between

In its most typical form, it resembles a Weberian bureaucracy or what Chester Barnard calls a system of cooperation. In these kinds of systems, the role-network is overt and often codified, though an informal structure is also present in every case.

Owen-Smith & Powell (2008) observed the same thing through March and Olsen that: "[O]rganizational action is routine-based, rule-governed, and triggered by conventions that match concrete situations and actions to the needs of particular positions (Cohen, March, and Olsen, 1972; March and Olsen, 1989). These logics of appropriateness do more than simply set the grounds for concrete action in particular situations. When strung together across roles, they represent the authority structure of an organization by 'defining the relationships among roles in terms of what the incumbent of one role owes to the incumbents of other roles'" (March and Olsen, 1989: 23).

Not all fields are like this, however. Some fields have members that rarely interact and carry out their business on their own. They perhaps compete with each other but do not cooperate in an ensemble (one can think of a collection of universities that compete for students and employment prospects but do not intricately need each other to carry out their daily business).[111]

However, even in these types of networks, the actors will have different weights within the fields. Some will have a defining presence and will be able to set the rules of the field and the forms of capital most valued. These different weights can be thought of as the relative power[112] of actors.

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the amount of power between agents. Probably the idea of Stark's heterarchy is closer to reality than a clearly defined hierarchy. One question then is whether a hierarchical structure appears naturally or is it artificial. It is not possible to answer this question here, but there is evidence that to some degree hierarchies form in a natural manner as it reappears through history, on different levels, and in different societies. Heterarchy has a tendency to crystallize in more humanly-relatable hierarchies.

[111] Understanding roles within fields would necessitate a better understanding of the different type of fields. Therefore, I will not focus on roles in the empirical section.

[112] Perhaps it is useful to call attention to the difference in meaning between the different concepts of power. The discussion of the vast literature on power is not possible here, but a simple observation must be made. Both Barnard (1983, 1968) and Stinchcombe (1997) are clear about the distinction between authority and power. Authority is prescribed by the rational individual in his formal plan for an organization, while power needs a basis in actual social realities. Access to certain resources or collective procedures can be thought of as sources of power as Bourdieu held. Blau and Scott (1962) are even clearer. They distinguish between authority, power, and persuasion, in which the latter is linked with the idea of legitimacy. In my conceptualization, power is not simply socially constructed but is based in material realities and resource access.

This leads to Fligstein & McAdam (2012), who talk of incumbents and internal governance units. These are central, possessing key roles and resources within the field, and thus power. They also talk of challengers, which also implies some form of power, which perhaps originates in another field.

Another metaphor to describe this incumbent-challenger power structure is a core-periphery picture. In either case, the emphasis is on competition between incumbents and others. Scott (2013) mentions that "Fligstein and McAdam (2011: 13) emphasize this conception of fields as competitive arenas, insisting that the most important distinction involving actors to be made by field analysts is that between incumbents—those actors in control of the most important types of capital—and challengers—those actors with relatively little influence but 'awaiting new opportunities to challenge the structure and logic of the system.' This conception emphasizes the need to take into account the role of peripheral, subjugated actors who may come together in coalitions, as well as less inchoate social movements struggling to mobilize around a collective action project."[113]

Scott (2013) focuses not only on incumbents and challengers (those with some degree of power) but also on the peripheral, subjugated actors and hints at the potential power of social movements.

Instead of the idea of powerful actors maneuvering behind the scenes, Zietsma et al. (2017) highlight the importance of institutionalization and the degree to which a field is institutionalized. In emerging fields, hierarchy and forms have not solidified, and there is a great deal of competition and struggle. More mature fields, however, have a much clearer structure: "[f]ields with a highly elaborated institutional infrastructure, consisting of meanings, practices, identities, power structures, subject positions, and governance mechanisms, will feature relatively clear conceptions about what is appropriate or allowed in most situations[114]" (Zietsma et al., 2017).

It is clear that a field is not simply an arena of constant power struggle, but as it becomes more established, many power structures become unquestioned and, therefore,

[113] Scott (2013: 229).
[114] In quote reference: Hinings, C.R., Logue, D. & Zietsma, C. (2017). Fields, governance and institutional infrastructure. In R. Greenwood, T. B. Lawrence, R. Meyer & C. Oliver (Eds.), Handbook of organizational institutionalism (2nd ed.). Sage.

less contested. Nevertheless, the power structure is intact, and there will be more powerful, elite actors and less powerful non-elite actors.

Elite theory can be of help here. Definitions of the elite vary, but they do define what I have been describing within fields. Both Mosca and Michels describe with great precision how fields (organizations or societies) can be ruled through minor elite fields, or in Fligstein's term, internal governance units and powerful actors within these larger groups. Here we refer to a definition from Pareto quoted by Bottomore (1964): "For the particular investigation with which we are engaged, a study of social equilibrium, it will help if we further divide that class into two classes: a governing elite, comprising individuals who directly or indirectly play some considerable part in government, and a non-governing elite, comprising the rest. So we get two strata in a population: (1) A lower stratum, the non-elite, with whose possible influence on government we are no just here concerned; then (2) a higher stratum, the elite, which is divided into two: (a) a governing elite, (b) a non-governing elite."[115]

These concepts can be used in my theory without any difficulty by changing the word government to field government. As an abstract entity, the overall field with all its constituents can never be the same, just as the proverbial river under the bridge, especially when we consider the unique actions of the subjugated. The field never stops morphing, but its more salient features can stay the same. Changing these salient features can only be undertaken by elites, some special individuals, or social movements. Finally, we need to address the question of the democratic nature of the fields. I tend towards Michels' position and his law of oligarchy: "Organization implies the tendency to oligarchy. In every organization, whether it be a political party, a professional union, or any other association of the kind, the aristocratic tendency manifests itself very clearly. The mechanism of the organization, while conferring a solidity of structure, induces serious changes in the organized mass, completely inverting the respective position of the leaders and the led. As a result of organization, every party or professional union becomes divided into a minority of directors and a majority of directed."[116]

[115] The quote is from Bottomore (1964).
[116] Michels (1999: 70).

Network theoretical reasons for the law of oligarchy can be proposed[117]. In recent decades with the advent of computational power and the development of network theory, small-word theory discovered the power-law nature of social networks (Watts & Strogatz, 1998; Watts, 1999; Barabasi, 2016). Some nodes have a disproportional number of ties, while most have low connectivity due to preferential attachment (Barabasi, 2016). Why would this happen? I claim that it is mathematical in origin and stems from the bounded capabilities of the human mind. Human scale necessitates that a limited number of nodes be given meaning within large systems to help rational sense-making. This limitation in humans gives rise not only to specific social structures but also to power-law like networks and oligarchical tendencies in fields.

Nevertheless, my aim here is not to investigate the power structure of fields, but from the above, it becomes evident that any analysis of fields must consider the different status and power that members have within the fields.

3.4. Organizations

My field concept now has individuals with a certain amount of capital, which confers certain powers to different defined or informal roles that the fields have. I have discussed Weber and Barnard and has discussed formal organizations in the previous section. I have also accepted Fligstein's conceptualization of a field as having a nested structure and identical basic features at different levels. This means that an organization is a field.

However, it becomes important to ask how organizations can make up fields; in other terms, it is necessary to define organizational fields[118]. This has partly been done by DiMaggio and Powell, Warren, and Scott. However, two important things need to be addressed. Burt, for example, often treats organizations and individuals as interchangeable within the networks. He holds that network effects work similarly in

[117] Mosca, Michels, Pareto, and Machiavelli has been viewed as overly pessimistic about human nature. Their works has been read as a testament to the evil character and the corrupting nature of power. Here, however, my observation is that this oligarchical tendency does not necessarily arise because humans are evil. While I acknowledge the fact that power can be intoxicating and difficult to hand over, I also approach the problem from a mathematical theoretical ground.

[118] I argue that organizational fields are a more complex than individual fields and are more difficult to analyse, because the actors are themselves fields. Also, most empirical analyses will have serious limitations due to difficulties in gathering sufficient data and getting access to organizations.

individual and organizational networks. This seems to be untenable if we consider that organizations are themselves fields, and they too have their underlying network structure. They might behave fundamentally differently from individuals. Their roles within the network are likewise different; while different forces act on them, they behave differently. It is also important to understand that organizational links are often formed between individuals within the linking organizations and can have entirely different dynamics. Treating individuals and organizations identically in network studies is overly simplistic. From a methodological standpoint, any causal relationship between organizations must also have an underlying individual-level theory. While this part of the theory is often untestable with large sample inter-firm data, it is still necessary to conceptualize the causal relationship. The problem is that multiple explanations are often possible. Structural hole effects, for example, can work for multiple reasons.

In the empirical section, my main focus will be on organizational networks, and the network effects will be mainly tested on samples of organizations and their networks.

3.5. Institutions and institutionalization

So far, I have tried to avoid the concept of an institution, but it needs to be discussed. I avoided the term because it is vaguely defined in the literature[119].

First, it is important to distinguish the terms 'institutions' and 'institutionalization' from institutional theory. Institutional theory, especially the new institutionalism in organization theory[120], contrary to its name, is not primarily a theory of institutions. Its aims and goals are broader. The starting point of neo-institutional theory is in the opposition to an economic interpretation of organizations[121]. Friedland & Alford (1991), for example, argues that efficiency is not the key criteria in how organizational practices and forms are formed[122]. The main focus of institutional theorists is to locate why specific

[119] See Hirsch (1997) for a critical review of Scott's research programme.

[120] For a review of the research program see DiMaggio & Powell (1991). They state in their introduction that the main object of the new institutionalists is "organizational structures and processes that are industrywide, national or international scope".

[121] See Dobbin (2004) who in his economic sociology reader calls attention to four concepts: institutions, networks, power, and cognition. Also see DiMaggio & Powell (1983) on isomorphism, Granovetter (1985) on the concept of embeddedness.

[122] "[O]rganizational structures appear to be institutionally patterned in ways which cannot be explained by competitive interaction between organizations, technology, or organization-specific environmental

forms arise. They look at social movements, the professions, non-economic rationales, and mimicry that shape actual organizations.

Friedland & Alford and many early neo-institutionalist studies[123] equate institutions with certain practices and patterns of organization[124]. Dobbin (2004:5) holds that sociologists use the term 'institution' "when talking about particular conventions, some defined by law, some by tradition." He equates institutions with conventions and routines. This idea of institution as certain practices exists in earlier works. Berger & Luckmann (1967: 71) define institutionalization by first discussing habitual action and habitualization. They assert that habitualization precedes any institutionalization: "Habitualized actions, of course, retain their meaningful character for the individual although the meanings involved become embedded as routines in his general stock of knowledge, taken for granted by him and at hand for his projects into the future. Habitualization carries with it the important psychological gain that choices are narrowed."

As mentioned previously, they define an 'institution' in broad terms: "Institutionalization occurs whenever there is a reciprocal typification of habitualized actions by types of actors. Put differently, any such typification is an institution." Then they define these actions in terms of types of actors or positions: "The institution posits that actions of type X will be performed by actors of type X. […] Reciprocal typifications of actions are built up in the course of a shared history. They cannot be created instantaneously. Institutions always have a history, of which they are the products. [...] Institutions also, by the very fact of their existence, control human conduct by setting up predefined patterns of conduct, which channel it in one direction as against the many

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conditions. The new institutionalists in organizational theory argue that the processes by which organizational forms tend toward homogenization cannot be explained by their contributions to efficiency, particularly as an organizational field evolves (DiMaggio and Powell 1983; Meyer 1981). Institutional analysts have specified the mechanisms—professionalization, state regulation, requirements for trust, mimicry under conditions of uncertain technology—by which institutionalization takes place. From an institutionalist perspective, organizations which adopt the appropriate forms perform well not because they are most efficient, but because these forms are most effective at eliciting resources from other organizations which take them to be legitimate." (Friedland & Alford, 1991: 243)

[123] Studies such as Tolbert & Zucker (1983), Fligstein (1990), DiMaggio (1991), Edelman (1992), Dobbin, Sutton, Meyer & Scott (1993), Davis, Diekmann & Tinsley, (1994), Sutton & Dobbin, (1996), Davis & Greve (1997), Lounsbury (2001). See Wooten & Hoffman (2008).

[124] In a sense, these could be called organizational innovations, though innovation hints at that something is fundamentally created instead of copied.

other directions that would theoretically be possible. […] To say that a segment of human activity has been institutionalized is already to say that this segment of human activity has been subsumed under social control. Additional control mechanisms are required only in so far as the processes of institutionalization are less than completely successful. [..] The institutions, as historical and objective facticities, confront the individual as undeniable facts. The institutions are there, external to him, persistent in their reality, whether he likes it or not. […] It is important to keep in mind that the objectivity of the institutional world, however massive it may appear to the individual, is a humanly produced, constructed objectivity. [..] At the same point, the institutional world requires legitimation, that is, ways by which it can be 'explained' and justified."[125] This process is spelled out in a simple example of two people interacting. The key step in institutionalization comes when the habitualized actions and typifications of two hypothetical initial persons become fact-like to a third person.[126] For Berger & Luckmann (1966), institutions are represented by 1) roles and the enactment of these roles in the context of other roles, 2) linguistic objectivation and symbolic meaning, 3) symbolic objects (natural or artificial).

Nevertheless, the fact remains. Institutions in this micro-level definition are conventions and practices. This definition, however, is not consistently used. As institutions become more complex, they become intertwined with organizations and then with organizational fields. Dobbin (2004: 5) expresses this well in his introduction: "[in] common parlance people use institution to refer to sectors of society – the institution of organized religion." It seems that this meaning from common parlance is so firmly rooted in the word that it influences thinking about the concept. It is evident that 'institution as an organization and organizational field' needs to be clarified.

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[125] Berger & Luckmann, 1966: 72-80.

[126] See Berger & Luckmann (1966: 76): "The institutional world, which existed in statu nascendi in the original situation of A and B, is now passed on to others. In this process institutionalization perfects itself. The habitualizations and typifications undertaken in the common life of A and B, formations that until this point still had the quality of ad hoc conceptions of two individuals, now become historical institutions. With the acquisition of historicity, these formations also acquire another crucial quality, or, more accurately, perfect a quality that was incipient as soon as A and B began the reciprocal typification of their conduct: this quality is objectivity. This means that the institutions that have now been crystallized (for instance, the institution of paternity as it is encountered by the children) are experienced as existing over and beyond the individuals who 'happen to' embody them at the moment. In other words, the institutions are now experienced as possessing a reality of their own, a reality that confronts the individual as an external and coercive fact."

Other definitions further complicate the definition of institutions as practice. Stinchcombe (1997) proposes a definition of an institution as those values or norms that correlate with power; in other words, "a structure in which powerful people are committed to some value or interest" (Stinchcombe, 1997: 107). While he refers to norms and values, he also brings in the concept of 'structure'. It is clear that practices are enacted in a social context, and this necessitates some form of structure or hierarchical relationship. However, the concept of structure overlaps with fields and organizations. Where is the boundary, then? Scott (2013: 57) also refers to 'structure': "institutions are multifaceted, durable social structures, made up of symbolic elements, social activities, and material resources." This makes the definition even more complex. In this definition, institutions are social structures in which material resources are also included. They are not only conventions but also social structures populated with people, material objects, symbolic meaning, and practices. In this conceptualization, institutions are fields.

These definitions become more encompassing as they evolve and, at the same time, more confusing. As organizations, we can think of institutions as shared symbolic systems, as practices and routines, reenactable schemas, rules, and templates, as established order, as supra-organizational patterns, as a state. Which one is it then? Furthermore, how can we integrate institutions with other concepts such as the organization and fields? The usefulness of the concept is evidently limited.

From a field perspective, another important term that needs clarification is 'institutional environment'. This vaguely defined term is widely used. For example, Wooten & Hoffman (2008: 131) states that "[I]nstitutional theory asks questions about how social choices are shaped, mediated and channelled by the institutional environment." This idea was already present in Friedland & Alford (1991: 232), who think that "[i]nstitutions are supra-organizational patterns of human activity by which individuals and organizations produce and reproduce their material subsistence and organize time and space." There lies the contradiction in the definition of Friedland and Alford. They insist on supra-organizational patterns, but then later, they talk about practices[127]. They

[127] Later researchers simply state that they operate in multiple levels. For example, Thornton, Ocasio, Lounsbury (2012: 13): "The institutional logics perspective assumes that institutions operate at multiple levels of analysis and that actors are nested in higher order levels - individual, organizational, field, and

even call for reconstruction: "[t]o sustain heavy intellectual traffic, the notion of institution requires reconstruction, and particularly a rethinking of the relationship between symbol and practice. We would argue that institutions must be reconstructed as simultaneously material and ideal, systems of things and symbols, rational and transrational". To date, this reconstruction has not been achieved, and I argue that it is better to do away with the concept of institutions, though I will occasionally use them when the meaning is clear for accepted social practices and other social institutions such as the legal system.

Therefore, while the concept of institution is important, it cannot be central to my theory. It is clearly a derived concept from other building blocks of the social, and while it is worthwhile to study it, it is better left out. This dissertation proposes that the field should take center stage, along with that of the organization. An organization can be thought of as a special kind of cognitively delimited field, and institutionalization occurs within the fields while acknowledging the fact that certain institutional settings permeate the societal level fields and thus some forms of practices are universally available to all kinds of fields (this can account for the supraorganizational nature).

In this dissertation, the definition of 'an institution' is the following: an institution is a solution for a human problem[128], which, in its simplest form, is just a mental representation of how to solve the problem and what is required to solve the problem. Enactment of the form stems not from coercion or normative pressures but from the simple fact that the actors know no better solution. They choose a special institutional form because that is what they know. Isomorphism can easily be explained from this standpoint as well. The solutions can evolve into a complex set of organizations with their own fields, complete with necessary norms, coercive sanctions, symbolic meanings, practices and routines, position structures, and material forms of capital that makes its functioning possible. For example, property violation is a human problem. Punishing property violations can become institutionalized as specific solutions are widely

societal".

[128] In fact this definition can already be found in Berger & Luckmann (1967: 87): "The transmission of the meaning of an institution is based on the social recognition of that institution as a 'permanent' solution to a 'permanent' problem of the given collectivity."

dispersed in society. There can be several related solutions and, thus, institutions for this problem. Folkways and social ostracism, on the one hand, can evolve into the very complex legal system of the modern state.

The strength of this definition lies in the fact that the concept of the institution becomes compatible with all the other elements. It is just a solution. How it is actually realized can be different. However, each institution can then be decomposed into its constitutive elements. It is no longer an elusive term but a descriptive, delimiting concept that can be retranslated into other concepts that lend themselves to a ready investigation. The solution, the mental image, is then manifested in symbolic, material, and social structural form. In this more materialized form, it can be conceptualized with the field concept. However, a field can also contain different smaller level institutions in the form of practices. Thus, they can also serve as building blocks for fields. Nevertheless, in the following, I mention the word institution with caution and make an effort to avoid its use.

3.6. Logics, interpretative frames, symbolic systems, understandings

In this section, I attempt to give a brief review of concepts related to the micro-foundations of institutional theory. It is not a very well-developed, coherent theory, and here I do not attempt to give a comprehensive overview. The main goal is to find out what key concepts need to be considered. Microfoundations traditionally look at the individual or psychological level and ask how individuals orient themselves within social worlds. In many cases, the analytical focus is often on interaction with others or simply on making sense of social realities.

A number of useful theoretical concepts have been proposed: group climate, norms, values, frames, cognitive frames or evaluative frames, schemas, categories, and other forms of classification such as rankings and classes, knowledge of institutions, symbolic meanings, vocabularies, metaphors, language, and institutional logics.

The problem with all of these concepts is that they are not well-integrated into one theoretical framework. Frames, for example, overlap with most of the others. Berger &

Luckmann simply uses the word 'knowledge'.[129] Goffman goes further in defining frames as "schemata of interpretation"[130] that enable individuals "to locate, perceive, identify, and label" (Scott, 2014).

The institutional logics perspective attempts to integrate these disparate theoretical concepts and place them in the center of institutionalist theory. Institutional logics is defined here as "the socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality (Thornton & Ocasio, 2008). Owen-Smith & Powell (2008) explains this in more succinct terms, "[l]ogics constitute the rules and conventions of a particular organizational field," already highlighting one key difference. Is institutional logic part of the field? Or is it merely internalized by the individuals themselves?

The problem with the concept starts with the term 'logic'. This word can simply mean a rational argument for doing a particular action. Organizing logic can, therefore, mean arguments for doing things, making specific organizational arrangements. In this sense, there can be a great number of such logics. However, Thornton & Ocasio (2008) and Thornton, Ocasio & Lounsbury (2012) use it in a very specific way. Their usage goes back to Friedland & Alford (1991: 248-249), who observe that each "of the most important institutional orders of contemporary Western societies has a central logic—a set of material practices and symbolic constructions—which constitutes its organizing principles and which is available to organizations and individuals to elaborate."[131]. The authors enumerate the different types of logic in society: capitalism, state, democracy,

[129] "The primary knowledge about the institutional order is knowledge on the pre-theoretical level. It is the sum total of 'what everybody knows' about a social world, an assemblage of maxims, morals, proverbial nuggets of wisdom, values and beliefs, myths, and so forth, the theoretical integration of which requires considerable intellectual fortitude in itself […] On the pre-theoretical level, however, every institution has a body of transmitted recipe knowledge, that is, knowledge that supplies the institutionally appropriate rules of conduct." (Berger & Luckmann 1966: 83)

[130] Gadamer in his hermeneutics is doing something very similar. It would be interesting to compare his concepts of prejudice, tradition, horizon with frames, etc. For lack of space, I refrain from this excursion.

[131] Friedland and Alford (1991: 248) specify the different types of logic: "The institutional logic of capitalism is accumulation and the commodification of human activity. That of the state is rationalization and the regulation of human activity by legal and bureaucratic hierarchies. That of democracy is participation and the extension of popular control over human activity. That of the family is community and the motivation of human activity by unconditional loyalty to its members and their reproductive needs. That of religion, or science for that matter, is truth, whether mundane or transcendental, and the symbolic construction of reality within which all human activity takes place."

family, religion (and as a subset, science). They add that "[t]hese institutional logics are symbolically grounded, organizationally structured, politically defended, and technically and materially constrained, and hence have specific historical limits." Very similar categories are retained by Thornton et al. (2012). They define "interinstitutional system"[132] ideal types: family, religion, state, market, profession, corporation.

I do not accept this framework and return to the original meaning of a logic that drives action. This logics concept is intricately linked with cognitive frames, categories (Goffman, 1972; Bowker & Star, 1999; Cornelissen & Werner, 2014), and language and metaphors (Colyvas, 2008). The logic for action is expressed in language, and metaphors are often used to add weight[133]. Rhetoric plays a prominent role in fields. Once the logic is established and a meaning system is shared, categories form, which then becomes the basis for evaluative frames[134]: "[i]n ethnomethodological studies, categories, and classifications become interpretive schema that members of organizations draw on. Over time, these schemas become a repository of organizational knowledge. As particular schemas become routinized through repeated application and use, they develop a habitual, taken-for-granted character".[135] Kuypers (2009) observes that frames "induce us to filter our perceptions of the world in particular ways, essentially making some aspects of our multi-dimensional reality more noticeable than other aspects. They operate by making

[132] Here I do not discuss the concept of inter-institutional system. This is an insufficiently defined concept and will be avoided in further discussion to avoid confusion.

[133] Consider Berger & Luckmann (1966: 82): "Language provides the fundamental superimposition of logic on the objectivated social world. The edifice of legitimations is built upon language and uses language as its principal instrumentality. The 'logic' thus attributed to the institutional order is part of the socially available stock of knowledge and taken for granted as such. Since the well-socialized individual 'knows' that his social world is a consistent whole, he will be constrained to explain both its functioning and malfunctioning in terms of this 'knowledge'. It is very easy, as a result, for the observer of any society to assume that its institutions do indeed function and integrate as they are 'supposed to'. De facto, then, institutions are integrated. But their integration is not a functional imperative for the social processes that produce them; it is rather brought about in a derivative fashion. Individuals perform discrete institutionalized actions within the context of their biography. This biography is a reflected-upon whole in which the discrete actions are thought of, not as isolated events, but as related parts in a subjectively meaningful universe whose meanings are not specific to the individual, but socially articulated and shared. Only by way of this detour of socially shared universes of meaning do we arrive at the need for institutional integration. This has far-reaching implications for any analysis of social phenomena. If the integration of an institutional order can be understood only in terms of the 'knowledge' that its members have of it, it follows that the analysis of such 'knowledge' will be essential for an analysis of the institutional order in question."

[134] Kuypers (2009) defines framing as "a process whereby communicators, consciously or unconsciously, act to construct a point of view that encourages the facts of a given situation to be interpreted by others in a particular manner. Frames operate in four key ways: they define problems, diagnose causes, make moral judgments, and suggest remedies. Frames are often found within a narrative account of an issue or event, and are generally the central organizing idea."

[135] Powell & Colyvas (2008: 280).

some information more salient than other information. ..."

I adopt the concept of frames and logic in the above-defined sense (not in the sense of institutional logics theory) because they are the driving force behind field-level action and often serve as the legitimating reasoning behind power relationships. In a way, they are the symbolic glue that holds fields together. Frames and logic cannot exist without categories and differences that form the basis of comparison[136].

It is perhaps important to highlight the non-capital interpretation of material objects. What kind of role do Berger and Luckmann (1966) attribute to artifacts? They, for one, think that these objects serve as mnemotechnic aids in the transmission of institutional and other social meanings[137]: "[T]he 'knowledge' may have to be reaffirmed through symbolic objects (such as fetishes and military emblems), and/or symbolic actions (such as religious or military ritual). In other words, physical objects and actions may be called upon as mnemotechnic aids. All transmission of institutional meanings obviously implies control and legitimation procedures."[138]

3.7. Networks and their roles in fields

Now that I have laid out the theoretical underpinnings of fields, I turn to the discussion of networks. Networks are an integral part of fields, in a way, inseparable. The way I treat networks in this dissertation is to look at network theory as a methodological tool to describe a particular feature of the field. The particular feature is a relational structure. In many of Bourdieu's studies, fields were drawn up by identifying the most powerful or prestigious agents. As network theory matured, more and more tools were developed to analyze structure.

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[136] See Bowker & Star (1999). Also, consider Bourdieu (1996): "It is undoubtedly through the successive classifications that have made them what they are from the point of view of the academic taxonomy that the classified products of the educational system, both students and teachers, have acquired – to differing degrees according to their position in these structure – the practical mastery of principles of classification circumstantially adjusted to the objective classifications enabling them to classify all things (starting with themselves) according to academic taxonomies, and functioning within each of them, in all good faith, like a machine for transforming social classifications into academic classifications, that is, into recognized-misrecognized social classifications."

[137] See Berger & Luckmann (1966: 87): "This process underlines all objectivated sedimentations, not only institutionalized actions. It may refer, for instance, to the transmission of typifications of others not directly relevant to specific institutions. For example, others are typified as 'tall' or 'short', 'fat' or 'thin', 'bright' or 'dull', without any particular institutional implications being attached to these typifications".

[138] Berger & Luckmann (1966: 88).

Theoretically, however, there are certain problems when one tries to bring the concept of fields together with networks. In a previous section, I have introduced Fligstein's criticism on network-based studies that holds that "the underlying logic of fields is not encoded in the structure of the network but in the cultural conceptions of power, privilege, resources, rules, and so on that shape action within the strategic action field."[139]

Contrary to this, quantitatively measured networks are much simpler, containing less information. Networks are made up of nodes (or the actors) and ties (the relationship between nodes). The ties are often conceptualized as conduits that can transmit some symbolic meaning, but they can also have signaling effects or signify collective action or co-membership. However, this dimension is not encoded in the network, and it is necessary to know the details of how networks are measured.

Networks are dynamic, and their continually changing realities are also difficult to map. There are many ways to measure network ties[140], and care must be taken to identify what exactly flows in the ties. All this complicates matters. Networks cannot account for many inherent features of fields, as pointed out by Fligstein and in my analysis.

While early structuralists thought that network analysis could make unnecessary the analysis of nodal attributes[141], the theoretical position in this paper is that nodal attributes are crucial, and structural analysis is not enough to describe complex social realities. Galaskiewicz and Burt (1991), for example, show that it is not always a connection that leads to similarities in action[142]. The authors showed that unconnected[143] but structurally equivalent[144] (similar structural positions in networks) actors behaved similarly. In other

[139] Fligstein & McAdam (2012: 29).

[140] Ties between individuals can be varied. Communication, advice, friendship, co-membership, face-to-face meetings are the more common ways to map ties. Ties between organizations can be even more challenging, especially when we think of the possibility of some ties being limited to some part of the organization. There most common way to measure ties is to look at corporate alliances.

[141] Marquis & Tilcsik (2016) discusses the idea of 'organizational filters' and cite Martin (2003) who emphasized that "actors have different attributes that make them more or less susceptible to the effects of different fields, and the influence of the environment is a function of both the environment and the characteristics of the actors themselves". (p. 1331)

[142] See also Galaskiewicz (1985), Galaskiewicz (1997) for the study of the urban grants economy.

[143] According to Greve (2005: 1032): "even when no social tie is present, actors may watch and imitate each other because they view the other as being in a similar environment."

[144] Structural equivalence happens when two nodes in a network occupy similar structural positions. In the words of Burt (1987) "[s]tructurally equivalent people occupy the same position in the social structure and so are proximate to the extent that they have the same pattern of relations with occupants of other positions. More specifically, two people are structurally equivalent to the extent that they have identical relations with all other individuals in the study population."

words, their behavior was influenced by how other actors behaved in similar positions. The question is whether this can be counted as an influence of structure or simply the coincidence of categories with structure and structurally equivalent positions[145], in other words, positions within a field.

The above shows that networks cannot be equated with fields and that fields contain more information. The key issue is how networks can help in the analysis of a field. Fields have structure, but many networks can be drawn from a field, and many different tie mappings can be used. And here lies the problem.

In the case of organizational fields, this problem is practically simpler because, in some research settings, the interaction between organizations can happen formally as in alliances, joint-ventures, and other forms of cooperation.

There is another way to think about field structure. In the section on roles, I have argued that roles form a structure and that there are logical interrelationships between roles. It can be thought of as a cooperation network. A cross-sectional network based on friendship relationships, for example, might not give much information about this inter-role structure. In formal organizations, this inter-role structure can take very specific forms and, in some cases, might be made explicit. The organization chart of a formal organization would be a good example.

A further difficulty is that the institutionally defined structure of roles is not always enacted, and sometimes some relationships remain templates in symbolic form until they are activated. In addition to this, it is also possible that role relationship patterns might be enacted with slight alterations in different situations. For example, when a superior is on a business trip, his peers have to do without him.

All this leads to the conclusion that networks, especially cross-sectional networks, might not reveal much about the field's actual underlying structure. Unnecessary connections (e.g., between janitors and judges) and too many connections (e.g., friends

[145] An intriguing concept is 'institutional equivalence' proposed by Marquis and Tilcsik (2016). Their study analyses a longitudinal sample of Fortune 1000 firms and the philanthropic contributions they made. For them, "two firms are institutional equivalents if they operate in the same industry and are headquartered in the same geographic community—that is, if they are industry peers that are also local geographic peers." (Marquis and Tilcsik, 2016: 1327) They argue that institutional equivalents serve as a reference category of imitable peers, while other peers outside these equivalents will receive relatively little attention.

who do not work together and have little bearing on the actual running of the organization) might make the complicated structure of the organization difficult to discern. This is the main reason while institutional theorists are reluctant to put network theory in the center of their inquiry. Networks can indeed overcomplicate things.

This may be so, but I firmly believe that networks can also have far-reaching effects that researchers need to explore. Some of these network effects might not be obvious and might present special forces that cannot be understood with a methodological individualist approach or only a traditional field analysis. This theory of embeddedness or the influence of structure will form an important part of my empirical investigations.

There is a long literature on networks, and it needs to be reviewed to clarify what these effects may be. Granovetter (1985) calls attention to the fact that both the under-socialized accounts[146] of economic action (a position held by neoclassical economists) and the over-socialized account[147] (a position where the social assumes a key place) are neglecting social structure. Granovetter called attention to the importance of studying social relationships through network structure. The theory of embeddedness suggests that each organization is influenced not merely by its immediate neighbors but also by the whole network (Uzzi, 1996a; Uzzi, 1996b). This idea is in accord with the idea of the field, but only partially. Structure, as it is, not the field, can have its own effects. Structure, in this sense, is not equal to a field or institutional environment.

However, network theory has a sizable overlap with field theory. Owen-Smith & Powell (2008: 596), discussing networks in the context of institutional theory, assign

[146] Granovetter (1985: 483) defines the under-socialized account as: "[c]lassical and neoclassical economics operates, in contrast, with an atomized, undersocialized conception of human action, continuing in the utilitarian tradition. The theoretical arguments disallow by hypothesis any impact of social structure and social relations on production, distribution, or consumption."

[147] Granovetter (1985: 483) defines the over-socialized account in the following way: "I begin by recalling Dennis Wrong's 1961 complaint about an 'over-socialized conception of man in modern sociology'-a conception of people as overwhelmingly sensitive to the opinions of others and hence obedient to the dictates of consensually developed systems of norms and values, internalized through socialization, so that obedience is not perceived as a burden. To the extent that such a conception was prominent in 1961, it resulted in large part from Talcott Parsons's recognition of the problem of order as posed by Hobbes and his own attempt to resolve it by transcending the atomized, undersocialized conception of man in the utilitarian tradition of which Hobbes was part (Parsons 1937, pp. 89-94). Wrong approved the break with atomized utilitarianism and the emphasis on actors' embeddedness in social context-the crucial factor absent from Hobbes's thinking-but warned of exaggerating the degree of this embeddedness and the extent to which it might eliminate conflict." Granovetter (1985: 485) mentions James Duesenberry who summarized these two positions in a simplified manner: "economics is all about how people make choices; sociology is all about how they don't have any choices to make"

networks a very important role. They find that "many institutional studies presume that professional or inter-organizational networks serve as conduits for the diffusion[148] of appropriate practices and ideas." They observe that "[t]he cognitive categories, conventions, rules, expectations, and logics that give institutions their force also conditions the formation of relationships and thus the network structures that function as the skeletons of fields." They state that "networks generate the categories and hierarchies that help define institutions and contribute to their efficacy." This is a substantial claim as it designates networks not only as fields but also as de facto social structure. This idea underpins their statement that "[n]etworks are essential to fields in at least two senses: they are both a circulatory system and a mechanism for sensemaking."[149] Likewise, Greenwood, Oliver, Sahlin & Suddaby (2008) emphasize that Westphal and Zajac (2001) saw network ties as conveyers of institutional pressures and as conduits for knowledge of how to avoid them.

In fact, Owen-Smith & Powell do not firmly delineate between networks and fields. Powell often thinks of networks as organizational fields and uses the terms interchangeably. For example, in their conceptualization, networks serve as signals, but is it the network that is the signal? It can readily be acknowledged that ties and centrality can and indeed signal status. However, more complex network structures might not be easily visible when observing relationships from the inside (see van de Rijt, Ban & Sharkar, 2008). Therefore, influences stemming from the knowledge of the network structure and influences from the network structure itself need to be separated. Knowledge about the network might not even be accurate and might be based on a false perception.[150] Some structural elements might be easier to see by those who are inside the network. Field boundaries, in some cases, can be easy to find. Centrality is often obvious.

Traditional network theory has put a great deal of emphasis on uncovering network

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[148] They mention that much institutional research conflates 'simple' diffusion with 'deep' institutionalization. This is an interesting observation relating to the fact that institutionalization is often regarded as the extent that something is entrenched and diffused in society. It would be interesting to look at it in network terms and see where the limitations of the concept of institutionalization as diffusion are.

[149] Owen-Smith & Powell (2008: 596).

[150] For example, structural holes might be particularly difficult to see within the network as van de Rijt et al. (2008) showed.

effects that are either beneficial or detrimental for members in certain positions. Empirical studies lend support to the claim that specific structural positions within an interfirm network structure provide benefits (Baum et al. 2000; Podolny, 2001; McEvily et al. 2012) and also influence network evolution (Gulati, 1995; Powell et al., 1996; Walker et al., 1997; Ahuja, 2000; Stuart, 1999, 2000).

Apart from Powell et al. (1996), there is additional evidence that central positions within the network enhance performance (Rowley et al. 2000; Baum et al. 2000) and that central actors are more likely to survive (Uzzi, 1996b; Baum et al. 2000; Cattani et al. 2008).

Apart from centrality, other network positions are also theoretically beneficial to focal nodes. The network cohesion view advocates that positions densely embedded in a relatively closed network are beneficial to the focal node (Coleman, 1988; Uzzi, 1997; Walker, Kogut & Shan, 1997; Dyer and Nobeoka, 2000). Cohesive networks are better at enforcing obligations; thus, they foster trust (Buskens, 2000) and often create stronger bonds (Granovetter, 1973), facilitating the transfer of tacit knowledge (Ahuja, 2000). For example, in the case of the Japanese automobile industry, it is a widely held view that close cooperation with suppliers (see Dyer & Nobeoka, 2000) create competitive advantage by aligning the employees of the firms to form a shared community of practice (Brown & Duguid, 1991).

Another empirical finding shows that the existence of non-substitutable partners in an ego network[151] also positively moderates the relationship between the density of the network and performance (Bae & Gargiulo, 2004).

Another theory suggests that positions that bridge holes in the structure and reach into different parts of the network are more advantageous (Burt, 1992; McEvily and Zaheer, 1999; Zaheer & Soda, 2009). Structural holes occur when the structure remains unconnected, for example, between two divisions. The person who bridges these fields by having ties in both are said to be bridging a structural hole. This way, knowledge and resources can flow from originally unconnected networks, and the node bridging the

[151] An ego network is a network around one focal actor. For an overview of network terms see Borgatti, Everett & Johnson (2018).

structural holes can access unique information and may even be able to control the flow. For example, Reagans & Zuckerman (2001) show that brokerage positions are good determinants of innovation rates.

Traditionally, the two theories of brokerage[152] and closure[153] have been presented as two competing theories, but no consistent studies are showing which position is the more beneficial, suggesting that there are many contingencies [154] that determine the effectiveness of structural holes and closure (Tortoriello and Krackhardt, 2010; Vasudeva, Zaheer & Hernandez, 2013).

A more dynamic view suggests that it is much more worthwhile to look at the role of time when considering the benefits network positions bring (Baum, McEvily & Rowley, 2012; McEvily, Jaffee & Tortoriello, 2012). For example, according to Baum et al. (2012), the benefits of closure increase with age, while the benefits of bridging decrease with age.

Other studies try to focus on hybrid positions. Vedres and Stark (2008) argue that the most advantageous position is where an actor participates in multiple cohesive groups and serves as a broker between the groups. This is a structural position that the authors refer to as intercohesion.

While it is evident that there is support for these network effects, it is not clear what these findings mean in the context of 'fields'. Three questions need to be addressed. First, it is important to ask whether the network effects can be countered or strengthened by certain field-specific attributes. This is a far-reaching question that cannot be fully answered here.

Second, it is important to explore whether central nodes can be equated with elite actors. Is centrality the same as resource-rich, powerful roles in a field? We already have an answer to this second question. They are not the same, but they often coincide. For example, studies of employees in companies found that secretaries took a central position in a network (Sozen, 2012), while CEOs and other higher-level executives were relatively

[152] Associated with less cohesive, more open structure rich in structural holes.
[153] Associated with cohesion and a closed structure without structural holes.
[154] For example, Vasudeva, Zaheer & Hernandez (2013) suggest that the national level of corporatism as an institutional factor determines the extent of beneficial effects of structural holes and argue that countries with high levels of corporatism offer more innovative benefits for firms occupying structural hole positions.

isolated, even peripheral (Koput, 2010). This by itself is a serious weakness of network theory and shows that it cannot replace field theory without knowledge of the underlying role of the individuals. In a field, capital, roles, power, and status identifies the elite actors. Networks can only show highly connected ones.

The third question is whether the effects will change if the network goes across field boundaries compared to when the network corresponds to one field only. The studies in this dissertation will focus on this third question. In other words, networks might behave differently when they constitute an interstitial field or a space where field interaction occurs.

Network theory, however, does not only treat position effects but also deals with other phenomena such as network change and evolution, network propagation, and network types. An important subsection of network theory addresses flows, transfers, contagion, and the spread of different innovations or institutions[155]. Some of these studies focused on fields. For example, Davis (1991) describes how the ‘‘poison pill’’ strategy spread through a field in the 1980s. Many studies in institutional theory followed. More technical papers in the social network literature deal with mathematical models of contagion[156].

Fields are often connected through networks. Agents network across fields, and their activities are important in field interaction. Networks, however, are only temporary. Energy and time are necessary to keep the connections between the fields. Some of these temporary connections dissolve with time.

[155] Burt (2010) described network models of contagion identifying key contributions in interpersonal influence (e.g., Lazarsfeld, Berelson, and Gaudet, 1944; Festinger, Schachter, and Back, 1950; Katz and Lazarsfeld, 1955; Rogers, 1962; Coleman, Katz, and Menzel, 1957) and transfer of practices through network ties (e.g., Davis, 1991; Greve, 1995; Davis and Greve, 1997).
[156] See Jackson (2010) for some actual models.

4. A framework of fields, subfields, and boundaries

Putting everything together, I now give a brief outline of my theoretical framework. I hold that the core building blocks of society are the individual and the field[157]. Groups of people can be described as fields. As their interaction becomes more intertwined, these groups create more and more complex fields. Fields are nested, and fields can make up larger fields. The fields are built up with a certain hierarchical role or status structure, and each member has access to different levels of resources (capital) that correspond to their status within the field. They possess certain cognitive frames and logics that guide their actions. All fields have an underlying network structure, which can influence the members, but the members can also influence the structure. Many of the actions they perform are habitualized or institutionalized, and thus the fields are not always places of contestation but also of cooperation.

In this dissertation, each study looks at a slightly different kind of field and subfield. In the first study, the larger overarching fields will be a newly forming issue field, the Japanese nanotechnology industry, made up of collaborating firms. Most firms in this new field are from other established firms as well. Boundaries will emerge where two established fields that had no extensive ties before come together. In the second study, the field under investigation will be two different fields, a Japanese domestic industry and its international counterpart. It can also be understood as a large biotechnology-related R & D field divided into its subfields (domestic and international). The third case will investigate the same. The last case will be slightly different. Here the fields will not correspond to industries or international fields, but the different organizational subfields that Toyota creates around itself.

Every field contains actors (at the lowers order, individuals), shared symbolic systems (including blueprints for institutions), routinized practices, and certain material and immaterial resources (or, in Bourdieu's term, capital). Capital decides power. Power is an ability to influence someone, even in opposition, to give access to certain material or collective capital. We defined field capital as the kind of capital that gives power to

[157] In opposition to those who hold that it would be the transaction or the relationship, institutions, cognitive frames, or institutional logics that should be taken as the prime unit of analysis.

roles in a given field. Material capital is a resource that can be used in certain ways. Collective capital is a resource that needs collective action to perform.

Roles or positions, in turn, create special structures and hierarchies. Some roles and its occupants have a disproportionate amount of access to capital and have far-reaching powers within the field. This happens because of the power-law nature of social networks and human limitations of mind. The actual structure of the field can be grasped through multiple conceptual networks.

However, the role-hierarchy does not equate to centrality-periphery in networks as networks cannot perceive capital, but high-centrality nodes tend to correlate with elite status. In some networks, this is clearly the case. Even in the case where secretaries occupy the central positions, we can think of them as being associated with the executives. Paring secretaries with executives can resolve the problem.

The measurement of ties becomes a key problem. I propose that the best way to measure networks (which I could not achieve in the empirical section) is to measure ties by two-way power relationships or a dual mapping of the formal and informal networks. However, in the studies that follow, I rely on traditional network approaches of mapping alliances and other cross-firm linkages.

It is also important to think about what flows in the ties. In this conceptualization, it is not only information and symbolic matter that flows, but also actual requests. Ties can become activated to provide a gateway to some form of capital. For example, work requested from a subordinate or colleague can be seen as accessing his unique human capital and possibly tools to gain something. His printer will be used, and his human effort to print and distribute pamphlets, for example. It can also be a whole department that is thus mobilized to perform some complicated task. It can also be money that flows through the ties or some other physical resource.

The question is who can request and who cannot. What can and cannot be requested. Routinized, this requesting authority is linked to roles, and as one occupies a certain role, the taken-for-granted, legitimated nature of the role enables them to request certain things from others within the field without enduring obligations to reciprocate or a loss of requesting power. And this is key. A low, non-elite, peripheral actor needs capital to

reciprocate, and thus over-requesting leads to depletion of his capital. Elite actors, while not completely uninfluenced by the problem, can request without fear of depletion of capital. Many requests can have symbolic meanings, and thus, even requesting can become a form of power increasing measure[158].

The above are the main conceptual features of the framework. From a methodological standpoint, much will remain in the level of theory. However, as the theory informs itself from empirical studies in the literature as well as qualitative studies, it is reasonable to expect that most of its parts are useful for analysis.

The next logical question after having clarified my theoretical framework of fields is to look at how fields interact. Field interaction becomes pivotal in understanding a larger system of fields, such as organizations and organizational fields, made up of many nested fields.

[158] This is one reason why the rich get richer.

5. Field boundaries and field interaction

In this chapter, the discussion moves onto field boundaries and the interaction near these boundaries. Cicero, in his work, On the Commonwealth, observed that fields are influenced from the outside: "Maritime cities are also subject to corruption and alteration of character. They are exposed to new languages and practices; not only foreign goods are imported, but foreign customs as well, so that nothing of ancestral institutions can remain unaltered." He identifies maritime cities as places that are on a field boundary. Cicero claims that influences filter in from foreign lands that corrupt the ancestral institution. Whether these influences are bad or good in character, it is difficult to dispute the fact that boundaries serve as important points of connection between fields. Focusing on the field boundary therefore is pivotal in understanding field change and field maintenance.

A number of more recent studies have highlighted the importance of thinking about boundaries and how the fields interrelate (Friedland & Alford, 1991; Scott, 2001; Fligstein & McAdam, 2012; Padgett and Powell, 2012; Thornton et al. 2012; Furnari, 2014; Zietsma et al. 2017). There is also a very large literature that focuses on brokers and gatekeepers who connect disparate clusters and gain influence (see, for example, Aldrich & Herker, 1977; Obstfeld, 2005). While not all of these authors look at fields, they all discuss the importance of one institutional setting influencing another, and they point out that focusing on boundaries is important.

In the previous chapters, I laid out a framework for fields that now extend the discussion to the more refined concept of field boundaries. In this conceptualization, fields are, to some degree, on their own, and while they are connected to larger 'institutional settings', they are also independent of them with their own set of symbolic systems.

Instead of scrutinizing merely the individual broker or institutional entrepreneur, my focus is on the field boundary. Boundaries can form on many levels. In my empirical studies, the focus will solely be on fields of organizations, but fields on all levels have boundaries and what happens at those boundaries are important.

In what follows, I define field boundaries in networks. A network of individuals and

organizations is not a field. As mentioned before, networks can map fields to some degree, but they are not always very successful in identifying field boundaries, especially in cross-sectional studies[159].

In some cases, the field boundaries are clear and easy to identify in networks as they form cohesive clusters, but in other cases, the boundaries are blurred due to cross-boundary ties.

This is especially true when one considers newly emerging issue fields, where members from distinct fields cooperate. Their newly forming field might look like one complete field with rich interrelationships, but many of the cohesive clusters are newly assembled, and the usual benefits of cohesion may not be present.

A similar observation can be made about structural holes. If the members are in one particular field, then, even if holes exist, it is likely that information is available to many of the members. We expect that while structural hole effects will not disappear, they will be somewhat diminished. Burt's theory implies that holes located on field boundaries are more important than holes located within a close-knit field from an information perspective. This hypothesis will be tested in my first study.

Field boundaries, therefore, should be identified in network studies. These boundaries can be identified through careful longitudinal studies (Vedres & Stark, 2010) where cohesive lineages are calculated, or simply by using the investigator's judgment. This latter method is obviously less rigorous. However, in many cases, the fields are more or less discernible. For example, industries, local industrial clusters, corporate groups can be identified as fields of organizations. However, it must be mentioned that there is considerable overlap between fields, and sometimes boundaries are difficult to find.

In the studies that follow, the boundaries are more or less visible. In nanotechnology, disparate fields of different industries come together to work on new technological problems. Universities partner with firms. In these, a field boundary is clearly visible. In the case of biotechnology, the field boundary lies on a larger national level. The boundary between the U.S. life science industry and the Japanese life science industry is clear.

[159] To remedy this problem, researchers has turned to longitudinal studies (e.g. Vedres & Stark, 2010).

There might be overlaps, but these are the exact points of interaction that we are interested in.

Boundaries do not seal off completely separate social spaces. These boundaries are not rigid but always changing and blending, as defined in the previous sections. Fields interact in intricate ways. In this dissertation, it would be too ambitious to build a general theory of field interaction, and I will merely set out a tentative framework. In the empirical section, I will look at field boundaries because boundaries are where fields interact[160], but the interaction will not be the main focus of the empirical studies.

The idea that fields interact is not new. Fligstein & McAdam (2012) put the idea in the center of their book: "Fields do not exist in a vacuum. They have relations with other strategic action fields, and these relations powerfully shape the field's developmental history. It is useful to consider how these relations affect the stability and instability of strategic action fields."[161] Fligstein & McAdam identifies three types of relations between fields: "The relations between strategic action fields are of three types: unconnected, hierarchical (or dependent), and reciprocal (or interdependent). Many factors shape the links between fields: resource dependence, mutually beneficial interactions, sharing of power, information flows, and legitimacy. Where no obvious links exist between fields along any of these dimensions, we can say that fields are unconnected. Hence, we could say that the commercial fishing industry in the United States in the 1950s and 1960s and the civil rights movement in the same period were unconnected fields."[162]

Fligstein & McAdam (2012) then calls attention to the fact that strategic action fields can be decomposed into their unit fields. They give examples of both hierarchical and cooperative relationships between these higher and lower-order fields. They present formal corporations as cases where lower-order offices or divisions are in hierarchical

[160] Nevertheless, it must be mentioned that field interaction can occur in the inner space of the field and not only at field boundaries through learning from codified knowledge (i.e. books, research papers, internet resources etc.). Though even in this case, the books and other codified artefacts are products of different fields and thus are carriers of the field (do not confuse this with Scott's idea of institutional carriers) and can be conceptualized as a special case of field interaction.

[161] Fligstein & McAdam (2012: 59)

[162] Fligstein & McAdam (2012: 59).

relationships with the bigger field (the corporation).

They then give an example of a lower-order field (an influential sports team) that can influence the higher-order field (a central administrative organization that oversees the specific sport). Though this example clearly misses the point as the administrative organization is not the higher-order field, merely another field that plays the role of a governance unit. The higher-order field (to be precise and to be able to present it as an analogy along with the case of the firm) would be the overall field containing all the teams, all related organizations, and the central administrative organization.

Next, they move on to discuss interdependence, where different fields cooperate. They mention Bourdieu's famous case of the interdependence of the French Grandes Ecoles, large French corporations, and the French government.

Finally, they define what they mean by the connection between fields. They observe that in the modern world, indirect linkages without actual geographic proximity are possible.

They are not the only ones that think about interaction between fields. Greenwood & Hinnigs (1996) observe that "fields vary in their insulation from other fields. Some fields lack permeability (i.e., they are relatively closed to or not exposed to ideas from other institutional arenas). Other fields are more open and thus more likely to permit variation and change."[163]

Without calling it field interaction, a great deal of attention is given to boundaries in organizational theory. Countless case studies have looked at the intersection of different organizations and fields. A number of terms are in use, such as boundary spanning[164], gatekeepers[165], cross-boundary linkages, and institutional heterogeneity[166]. The power of my theoretical framework is that by conceptualizing everything as fields, it is possible to analyze all of these through one framework of field interaction.

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[163] Another thread of research that discussed interaction is institutional logics. The aim of Thornton, Ocasio, Lounsbury (2012) was, in their own words, to "analyz[e] the interrelationships among institutions, individuals, and organizations in social systems". However, as I have pointed out in the previous section, theirs is a very problematic theory, because fields are vaguely defined, logic is linked to ideal types, actors are difficult to account for. Instead, we propose to look at the field with all its constituent building blocks.

[164] For more on boundary spanning see Aldrich and Herker, 1977; Adams, 1980.

[165] For a definition see Allen (1977).

[166] For more on institutional heterogeneity see Powell and Sandholtz (2012).

Regarding organizational fields, the closest we get to our present concept of field interaction is what Zietsma et al. (2017) call interstitial positions: "Interstitial positions are structural positions between or at the overlap of institutional fields (Rao, Morrill, & Zald, 2000), wherein members of different fields interact with one another (Furnari, 2014) because they share a common interest or issue. While they have been described in the literature quite separately, there is a case to be made for considering organizing efforts in interstitial spaces to be issue fields. Interstitial issue fields are fields that arise in these interstitial locations, drawing members from multiple fields and logics, with the purpose of negotiating coordination to respond to emerging issues or opportunities."[167] It is probably better to avoid this new term and instead use the more specific boundary term. Further, confusion arises from the fact that Hoffman's issue fields, interstitial fields and interstitial positions are conflated. Interstitial positions are simply field boundaries or spaces around boundaries. They might or might not form a field. Interstitial fields are fields that form on boundaries of larger fields. Issue fields are fields that form around an issue and might not even be located on a boundary, though it is likely to have members from disparate fields.

Field boundaries have been surveyed from a network perspective. Powell et al. (1996) pointed out that in high technology industries, such as biotechnology, innovation takes place in networks of firms rather than within individual organizations through inter-firm alliances.

Powell and Sandholtz (2012) puts this even closer to our theoretical context and claim that real innovation occurs in the intersection of institutions, even if it merely means that the individuals in a field bring knowledge of other institutions. Powell refers to this as institutional heterogeneity and posits that it is the key driver of innovation[168]: "As further

[167] Zietsma et al. (2017).

[168] Innovation is a problematic term. Schumpeter conceptualized it as recombination of elements, in other contexts it is just a synonym for an invention or a new product. In this paper, different forms of innovation is strictly distinguished in theory and treated as different. The most basic meaning of innovation is just a new product (this does not necessarily need to be completely new, but needs to offer something novel for customers). Innovation of practices, institutions, routines within organizations is the second usage. In this sense, it is not the product that is the target of the innovation, but the organization. New ways of management, quality control, institutional or symbolic meaning can all be called innovation in this sense. A third sense we use innovation in this paper is simply new discoveries in the form of patents, this conceptualization is necessary for operationalizing the concept in the empirical part. Though this have clear drawbacks, it is needed for the statistical analysis. The reader is warned to think about which meaning is referred to in the

illustration of the difference between recombination and transposition, we emphasize that innovation is an interstitial phenomenon (Owen-Smith and Powell, 2004). Recombination occurs between domains where there is cross-traffic and ongoing conversation – that is, across existing interstices. Transposition occurs between domains where traffic is scarce and communication infrequent, thus forging new interstices. As Simon (1982) pointed out, interactions within and between subsystems are of different orders of magnitude. By extension, because they involve interactions between previously distant social systems, transpositions are both less likely to be accepted and more likely to produce radical social novelty than "within-system" recombinations."[169]

In one of my cases, I will describe exactly these kinds of interstitial boundaries in the case of nanotechnology. This can also be described as the transformation of an issue field towards an exchange field, though only the first steps are analyzed. Zietsma et al. (2017) observe that "importantly, though, once institutional infrastructure becomes stabilized within an issue field, there is little to distinguish it from an exchange field, and we could conceive of the issue field as becoming an exchange field over time."[170]

I need to emphasize that my theoretical framework of fields is not based on the "issue and exchange field" distinction, but it is compatible with it. It seems to be too restricting just to create two types of fields. Nevertheless, the idea of issue fields will be used in the section on nanotechnology to link the discussion with Granqvist and Laurila (2011), Furnari (2014), and Zietsma et al. (2017).

The boundaries of fields will have an underlying structure that can be mapped with networks. Fields have structure. I have proposed that the structure is twofold: one is a hiero-heterarchical structure of roles, while the other is many an underlying network of

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text, as I not always distinguish them in writing, but the logic of the context should serve as a clear guide.

[169] Powell & Sandholtz (2012).

[170] Zietsma et al. (2017) adds: "For example, Furnari (2014) described the Homebrew Computer Club as an interstitial space where people from multiple fields interacted on the issue of home computers, planting the seeds for the personal computer industry exchange field of today; Akemu, Whiteman and Kennedy (2016) show how the Fairphone exchange field emerged from social activism and the creation of an issue field; and Granqvist and Laurila (2011) described how industry, science, government and environmentalists organized around the issue of nanotechnology, which eventually became an industry exchange field of its own. While the borrowing and blending that occurs in interstitial positions may resemble that done by hybrid organizations (Battilana & Lee, 2014), on balance this work suggests that organizations in interstitial positions may be part of emerging interstitial fields, which are likely to become exchange fields over time as institutional infrastructure becomes more elaborated."

relationships. In the studies below, I will rely on the latter. However, we need to consider them both here. It is possible to have role-based relationships (buyer-supplier, etc.) that span the two networks. Alternatively, the boundary can have just some linkages without any commitment of divided role-based activity. Considering the interaction between fields, methodologically, we can have one underlying network comprising the members and links between two or more fields.

The question is then this: what are the actual influences flowing through the network ties (Ahuja, Soda & Zaheer, 2011) that might be considered field influence.

In order to answer these questions, we turn back to concepts such as *categories* (Bowker & Star, 1999), *metaphors,* and *language* that form the basis of the micro-foundations of organizational, institutional theory (Colyvas, 2008) and also the concept of institutional logics (Thornton & Ocasio, 2008).

Most traditional network theory studies involving network flow focus on knowledge transfer or adoption of practices, and they emphasized tacit knowledge (Polanyi, 1966) and explicit technological know-how.

In fields, however, there is another type of knowledge, institutionally conditioned knowledge that flows with the specific technical knowledge and influences activity by imposing legitimizing frames on interpretation[171] and have an effect on field evolution. It can be called institutional logics, symbolic systems, rules, or schemas. It can be explicitly expressed or implicitly embedded in the *language*, *metaphors,* and *categories* (Colyvas, 2008) used by members of a given field. Organizations and fields also have their own institutional vocabularies (Suddaby & Greenwood, 2005) and legitimizing rhetoric for their own organizational practices and strategies.

Using an R&D context as an example, it is possible to describe how these concepts work in an everyday context to help decision making. Owen-Smith (2001) and Owen-Smith & Powell (2008) describe how *categories* shape discourse within a lab. The study presented an extract from a conversation between members of a research laboratory about a paper that contradicted their results. The assessment of whether the results had been

[171] It is also likely related to absorptive capacity (Cohen & Levinthal, 1990).

valid was based on *categories* about the research (such as the scientific background of the scientist, her work history, the lab's reputation, etc.).

Recently a more nuanced view of this evaluation process has been described (Perry-Smith & Mannucci, 2017). Here too, the authors emphasized the importance of frames and the way participants need to change these frames according to the phase of the creative process, suggesting that categories and frames play a pivotal role in the process of creating ideas[172].

Evaluation of one's own and others' research output is essential because it influences one's own future research trajectory. However, researchers working together from different fields have different categories, concept hierarchies, and metaphors, which all shape the final assessment and future activity. These *categories* and *assumptions* are also attached to current or prospective organizational practices, and different fields have slightly different preferences to one or the other.

Thus, in a heterogeneous, cross-field relationship, these mostly taken for granted *categories* and *assumptions* are often questioned. This may lead to improved quality by imposing stricter criteria on what is a good methodology and what is worthwhile or bog down the research process by disagreements on what should be down and how it should be done.

The process of evaluation and innovational activity, however, is not the main focus of this dissertation. It must be discussed to have a clear view of the micro-processes that occur on the boundaries, but the target of analysis is the underlying structure at the boundaries.

In the following, therefore, I briefly describe the different underlying structures of field boundaries. These are not necessary interactions per se, but rather the structure of the two fields related to each other that serve the basis of interaction. Once these structures are described, I propose a number of interactions that can take place in fields.

[172] They theorize that there are distinct phases of what they call the idea journey: idea generation, idea elaboration, idea championing, and idea implementation. In order to successfully move down what this journey the idea generators need different kind of frames. In the first phase cognitive flexibility is needed, then support, influence, and shared vision. In each phase, evaluation occurs influenced by the frames of the participants.Cross-field settings can serve benefits and drawbacks in each phase.

This classification is purely theoretical and preliminary. It is quite likely that there are many more constellations and more types of interaction.

1. *Isolated / Unconnected fields*

Fields can be isolated, and no inter-field interaction may occur. Even then, however, some isomorphism can occur due to similarities in human makeup and environmental conditions in the unconnected fields. Similar needs might be answered with similar methods. Today, due to the development of communication, one might argue that nothing is unconnected, and it might be so. However, it is good to distinguish between fields that are unconnected but can have knowledge of other fields and those which are completely unconnected.

2. *Overlap and loose-connection*

Fields overlap with members with links in multiple fields[173]. This is, again, not a new term. In network studies, this phenomenon is studied under 'multiplexity', and a great deal of empirical work incorporates overlaps. Most fields have a high-degree of overlaps, though some of these overlaps are not important, having little influence. I would assume that analytically one can find critical overlaps that can strongly influence field-level outcomes.

3. *Filters*

Fields can be separated with only scattered, intermittent, and sporadic links, whereby some influence might be transmitted. In this case, the boundary closes off two or more relatively separated spaces, but cross-linkages provide entry points through which influence flows. These can be different kinds of influences. Role-based relationships, hierarchical relationships are also conceivable. In the research context of the empirical studies, these cross-boundary linkages will be mostly R&D alliances where cooperation occurs. Material, knowledge, and other influences will flow through the links. One special case of filers can be when members of one field enter and become members in another field, either with links remaining in the original field or links severed. In some

[173] Zietsma et al. (2004) observes:"Evans and Kay (2008) studied the negotiation of the North American Free Trade Agreement and the relative success of the labor and environmental social movement fields in influencing what they term a hostile trade policy field. They claimed that the structure of field overlaps enabled mechanisms of influence including alliance brokerage, rule-making, resource brokerage and frame adaptation."

cases, these members can be important members of multiple fields.

4. *Merged structures*

Fields merge in diverse ways. One is hierarchical nesting, where one field has power over another, but the field remains distinct. Fields can also completely merge. Often during the merging process, conflict and internal restructuring occur. Two distinct hierarchies need to merge into one; categories are redefined. These hierarchies do not completely disappear, creating tension within the field. However, fields can be completely subsumed[174].

5. Interstitial fields and issue fields

A new field might be created by members coming together from different fields. In this case, it is impossible to speak of one boundary, but a jumble of different boundaries that come together. Each member can face multiple field boundaries. In the first study, the focus will be on such an issue or interstitial field.

The concept of issue fields (Hoffmann, 1999; Zietsma et al., 2017) or interstitial fields (Furnari, 2014) is a newly developing research area to conceptualize interaction between fields. While I acknowledge the conceptual usefulness of these terms, I consider them too restrictive. It is more meaningful to establish a theory of field boundaries and interaction that can help in a larger number of cases and give a clearer theoretical image. Issue fields are just a special case of cross-boundary interaction[175]. Unfortunately, in this short dissertation, it is not possible to explore all these theoretical interaction patterns. Instead, the focus will be on field boundaries and their effects on fields and their networks.

In the following, some basic patterns from the empirical studies will be illustrated with simplified diagrams. Overlap can occur in a great number of ways, and the illustrations serve only as simple visual aids and are not based on actual data. However,

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[174] A field might completely destroy another field with members either completely absorbed by the new field in a new structure or the members destroyed. Some remnants with original imprinting might remain (viz. those who escaped, ex-members of organizations, artefacts, books, previously acquired habits routines from the destroyed population etc.)

[175] Another problem with Zietsma and Furnari is their insistence on the use of the ambiguous institutional field concept. I think that this term should be avoided because the definition of institution is murky and the field is not made up of institutions. While its vague connection to 'institutional things' is apparent, it is not a well-chosen term.

they are good enough to illustrate how we can imagine these boundaries mapped onto networks. The first type, seen in the figure below, is from the second study, where the Japanese and the international life science fields overlap. In the middle is an organization that connects the two networks. This is probably the easiest-to-understand type of overlap.

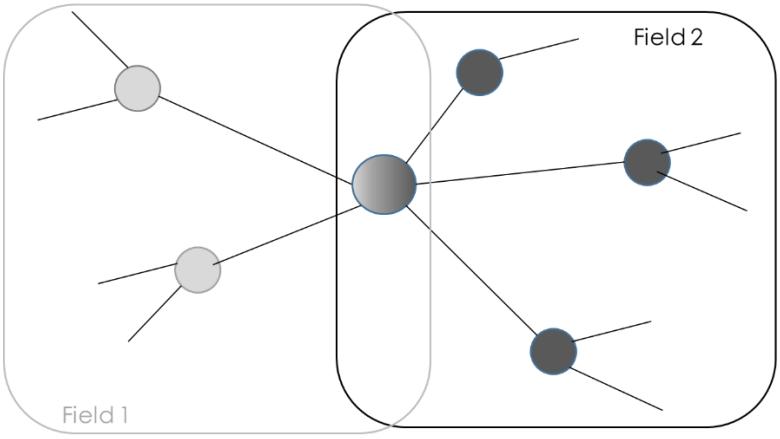

Figure 1 A network spanning a field boundary

A more complicated overlap is shown in the second figure. Here fields intermix. In the case of the nanotechnology industry, firms from different fields intermingle to create a newly emerging field (black). It can also be understood as an interstitial field, where most of the participants are from other fields.

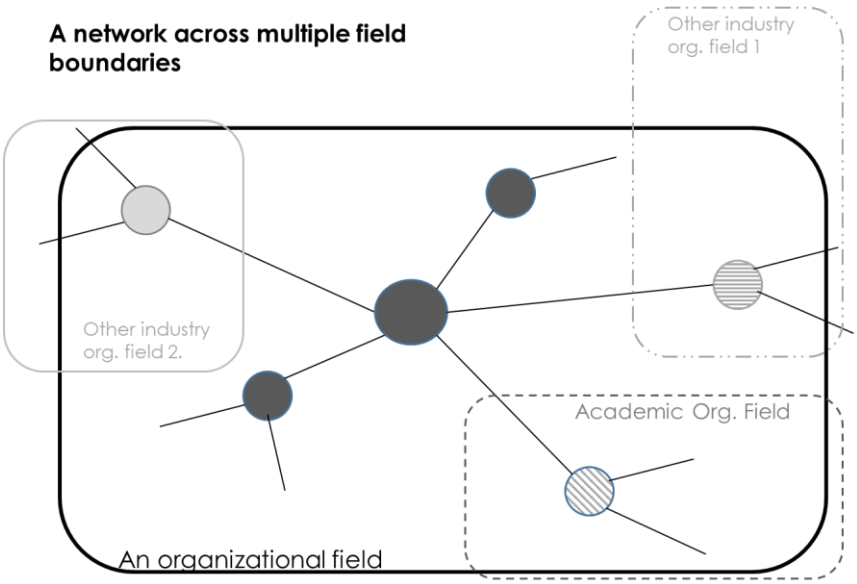

Figure 2 A network across multiple field boundaries

These spaces around the overlaps can be simply conceptualized as boundary spaces, and these boundaries can be described by the networks that span the fields and gives their structure. Networks interconnect across fields, and our focus is now on the field boundaries that are mapped onto the networks.

In our case, these are organizational networks, but the individuals within the organizations are the ones who create the linkages through networking with other individuals and their organizations. This networking is powered by their own frames (logics), strategic intention, and motivation. If these frames change or if the motivation of the members decreases, then these uninstitutionalized network ties can dissolve. Time is needed to create trust relationships or a new emergent field, but time can also work against these cross-boundary network ties. Ties by themselves are not enough.

In this context, it is also important to ask whether network effects work as theorized in the literature across the boundaries. In this dissertation, the following observation can be made based on the theoretical framework and the empirical investigation to be presented in the later chapters. These are the major implications of the invisible institutional boundaries that are present in networks, especially networks that describe newly emerging fields or interstitial boundary spaces.

1) Field boundaries increase structural hole effects: the idea behind brokering non-redundant information presupposes the fact that structural holes in effect signal boundaries and gaps that separate different parts of the network. In empirical data, it is often not the case. Structural holes might be temporary or the product of a given data-selection method. These artificial structural holes can lead to biased results. To mitigate the effects, we can add a variable measuring field boundary spanning. Structural holes combined with field boundary spanning will give better results. We predict that there are significant positive interaction effects. As seen in the figure below, there are two types of structural holes in the network around boundaries: within-field structural holes (shaded diamond) and cross-field structural holes (dark triangle). According to the above reasoning, we can expect different effects from the two types of structural holes. Cross-field structural holes should be more effective.

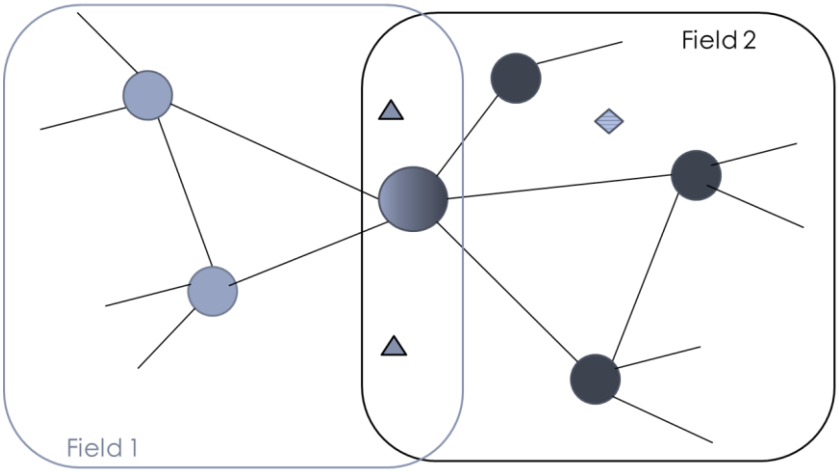

Figure 3 Two types of structural holes: within-field (shaded-diamond) and cross-field (triangles)

2) Field boundaries decrease cohesion effects: Similarly, field boundaries within cohesive clusters might signal that a diverse set of nodes came together, but the social cohesion that provides the benefits to the nodes is not yet established. The cohesive cluster might be a government consortium where a diverse set of firms are brought together by government policy. These newly formed clusters are not yet cohesive in the general sense and are more bound to rupture (see Vedres & Stark, 2010).

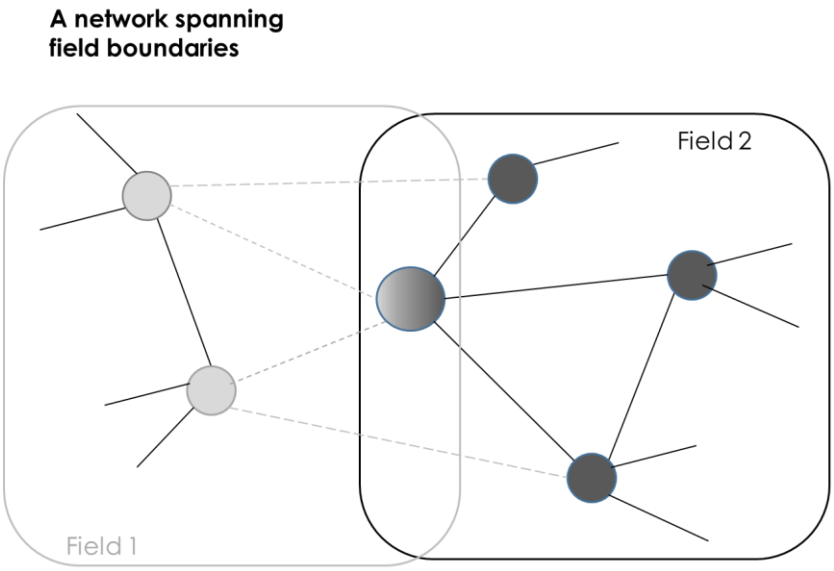

Figure 4 Cross-field cohesion can be temporary without the usual benefits

3) Field boundaries can be filters: the nature of the relationship can filter influences at different rates. Some types of relationships will be more conducive to channel influences from fields than others. Prominent members of a field can channel more influences from a distant, loosely connected field when forming relationships with more central members of that other field. These central members are better suited to translate information and influence partners than highly cohesive partners.

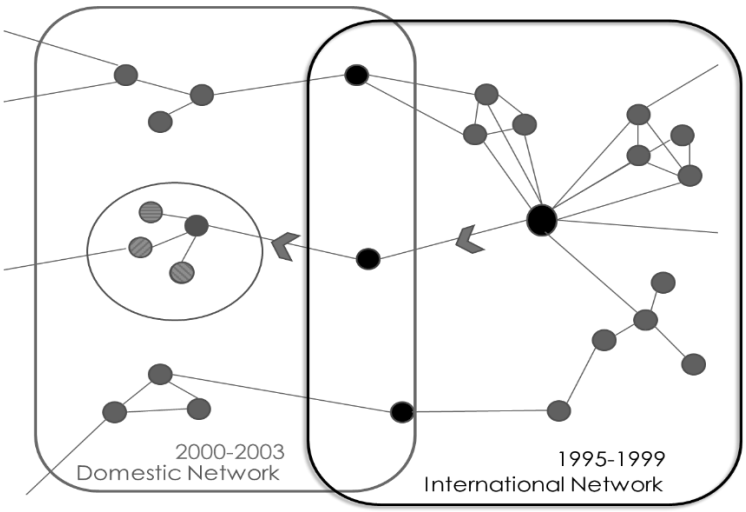

Figure 5 Boundaries can act like filters where some links transmit more influences than others

4) Field boundaries can be weakened through M&As. New entrants in organizational fields can gain status and a better position by joining members in the field. In the case of corporations[176], M&A strategy is the quickest way to assimilate into a field and gain centrality. Through a case study, I show how one company tries to build a better foothold within a higher-status international field.

5) Field boundaries can be managed. In the last study, I turn to the question of how organizations can manage field boundaries. Through the case of Toyota, I argue that field boundaries can be consciously created by managing groups within a firm, which can give considerable influence to the company that succeeds in creating the right kind of boundaries. These boundaries can also help keep out unwanted influence and maintain field traditions.

[176] The assumption here is that the firm is made up of for-profit firms in a capitalistic society.

Part II – Empirical studies

6. Introduction to the empirical section

In Part II, the focus will be on several actual cases of fields and their underlying networks. It is important to understand that the case studies that follow here are intended not as tests for the different parts of my main framework but rather as explorative studies that utilize both the framework and the theoretical tools outlined in the previous part.

The central unifying concept in each study is the field boundary. The first study looks at how traditional network effects, the beneficial influence of structural hole spanning positions and positions in cohesive networks, behave when they operate across field boundaries. The second case looks at how fields and their networks can change by influences filtering through the boundary. The third case looks at how these boundaries can weaken as firms get integrated into another network. Finally, in my last case, I focus on how large, influential firms can manage these field boundaries.

Each study is different in some ways, but there are some similarities. Each study looks at organizations, mainly in Japan, and each study focuses on technology firms and their organizational fields. In the first three studies, networks are analyzed by acknowledging that they are made up of different fields. In the network data, these lines can often be invisible, while in other cases, it might coincide with network structure. Lower-order fields of individuals in these organizational networks are considered, but they are not addressed directly in my analyses. In each case, a theoretical mechanism is proposed to show how microprocesses facilitate the given causal effect, and references will be made to the individuals within the organizations.

The research context is also informed by strategic management, technology management, and theories of innovation. Missing from the theoretical section are reviews of the literature on innovation and alliance management. These were not an integral part of my theoretical framework and, thus, were left out. In the following sections, however, these will be reviewed whenever they become necessary.

7. Case I – Boundaries and network effects: The case of the Japanese nanotechnology industry

7.1. Background

A new organizational field (or issue field in Hoffman's terms[177]) is often made up of a diverse set of actors from different organizational fields with their idiosyncratic backgrounds, logics, and practices. To analyze the role of field boundaries in network effects and in innovation activity in general, this chapter looks at the nascent Japanese nanotechnology industry. Nanotechnology is an emerging interdisciplinary technology influencing multiple industries and scientific fields (Islam & Miyazaki, 2009), and the organizations coming together are from different industries and institutional backgrounds (Rothaermel & Thursby, 2007), making it a particularly interesting case for studying the formative stages of an organizational field and how field boundaries moderate traditional network effects.

The main research question is this: How do alliances with organizations across field boundaries influence the relationship between network position and the focal firm's innovational activities?

Looking across field boundaries is not new. The literature abounds in studies of cross-boundary alliance and other diversity studies. Powell uses the concept of institutional heterogeneity, while strategical management scholars simply look at diversity by introducing such concepts as alliance portfolio diversity (Powell et al. 1996; Phelps, 2010; Faems, De Visser, Andries & Van Looy, 2010). This latter concept measures diversity within the firm's ego network made up of simultaneous alliance partners. It focuses on types of relationships (vertical, horizontal, or competitor), types of organizations (non-industry or industry, domestic or foreign), and types of alliance activities (co-marketing, co-production, distribution, R&D, experiments with hospitals).

In the alliance portfolio diversity literature, there is evidence of high alliance portfolio diversity having positive effects on both firm performance (Baum et al. 2000; Duysters et al. 2012) and innovation (Phelps, 2010). However, cooperation between highly

[177] Zietsma et al. (2017) calls newly forming fields issue fields following Hoffman, as these fields form around an issue. A number of studies have investigated newly forming fields (see Granqvist and Laurila 2011; Furnari, 2014).

heterogeneous partners (cross-boundary partners) may also cause difficulties and reduced performance (Faems et al. 2010) and may even lead to alliance failure (Lokshin et al. 2011). Some studies suggest an inverted u-shape relationship between alliance portfolio diversity and performance (Frankort et al., 2012; Duysters et al., 2012).

It must be noted that some of these measures indicate a field boundary; others might not. Mostly the source of diversity comes from firms cooperating across field boundaries. These cooperating partners have potentially different historical trajectories that can be treated as a form of diversity. Similarly, institutional heterogeneity arises because actors come together from different organizational fields. Not all diverse relationships indicate a strict field boundary, however[178]. Therefore, while alliance portfolio diversity can be useful, it cannot answer my research question. Findings from this existing literature will be explored, but the present study's focus is not on diversity. It merely treats field boundaries.

This dissertation recognizes that there are many different kinds of diversity concepts and that the combination of different kinds of diversities creates methodological complications. Therefore, the concept of diversity will be avoided. We can think of cross-boundary relationships as a form of cross-field relationship made up of heterogeneous partners.

This study will focus on the field boundary and the underlying network that spans that boundary. Network theory has uncovered several network effects that bring benefits or drawbacks to certain positions. This study will explore whether these effects are identical across field boundaries or different.

Based on the literature on inter-firm networks, two network structural positions are theorized to be beneficial. These are the two most studied concepts, and thus it is important to start with their discussion. One is a highly cohesive position (Coleman, 1988), where the focal firm's partners are also connected. The theory posits that this cohesion creates a high-trust relationship where "social capital" can be exploited.[179] In

[178] Both horizontal and vertical relationships often are formed between firms within the same field. Competitors also often are located within one large field. There might be subfield boundaries between the firms, but this might not always hold.

[179] Social capital here is in a general sense, meaning benefits from social cohesion. Hence,

this case, the negative effects of institutional heterogeneity of the participated organizations might be mitigated by cohesion.

The other is a position that bridges structural holes (Burt, 2004). As explained in the theory section, structural holes are holes in the network where nodes are not connected. A bridging node connects otherwise unconnected parts of the network, so it can leverage its position by controlling the flow of knowledge between sub-networks, and it can benefit from the unique knowledge provided by the separated groups. In this case, institutional heterogeneity from different sub-networks offers truly unique influences that can be exploited and used in other alliances. According to Burt's theory, in contrast to a cohesive position, a bridging position might be better because, in a cohesive relationship, everyone is exposed to the same kind of influence

The chapter aims to elucidate the relationship between alliances across field boundaries and outcomes measured as innovation activity and the effects of network positions on this relationship. We will review the literature in Section 2 to clarify the concepts above and the logic behind the theoretical framework in Section 3. In section 4, a brief overview of the nanotechnology industry will describe my research context. Then Section 5 and 6 will turn to the empirical analysis.

7.2. Literature and hypothesis

7.2.1. Organizational fields in context

The chapter looks at a newly forming organizational field made up of firms and institutions from multiple fields[180].

While organizational fields encompass many types of organizations and many forms of relationships, as well as perceptions about others without existing relationships, in this chapter, the focus will only be on a narrow band, R&D alliances, representing field activity. The reason for focusing on R&D activity is because, in the present premature state of nanotechnology, research constitutes the most important dimension for field activity (Lavie & Drori, 2011). Future R&D activity and business strategy are both

the apostrophes.

[180] See Nikulainen & Palmberg (2007) for why the nanotechnology industry fits this description.

influenced by the experience of R&D staff.

Although Wooten & Hoffman (2008) points out that industries or core technologies are not necessarily the best unit of analysis of organization fields, as it was used in traditional studies, it is obvious that each industry can be seen as a slightly different field even though its boundaries might be overlapping and containing many shared stakeholders. For simplicity, these complex stakeholders (consultants, law firms, venture capital, financial institutions, NPOs, etc.) are disregarded here.

The newly forming field is interwoven with different, and in some cases contending, logics, as the field is made up of members with divergent pasts and experiences[181]. As the larger field of nanotechnology is in a state of flux, contending logics can be seen as a constant force behind field evolution (Seo & Creed, 2002; Suddaby & Greenwood, 2005; Wooten & Hoffman, 2008; Furnari, 2014; Zietsma et al., 2017). According to the theory of creative combinations, the different logics and differing backgrounds also influence innovative activity[182].

Powel et al. (2012) focus on the concept of institutional heterogeneity. This concept is clearly actor-based and focuses on each actor's background and the knowledge and experience they gained in various institutional fields. From a methodological standpoint, the actor's experience can be ascertained and described if available[183]. However, when it comes to organizations, we face a problem. How can we ascertain the background of the organization? Because organizations are larger-order fields containing lower-order fields and individuals, it would ultimately be necessary to analyses their relationships and unique backgrounds. Instead, the present study identifies field boundaries first. Organizations collaborating across boundaries can be seen as having heterogeneous backgrounds [184], making the theory compatible with diversity or institutional

[181] See Zietsma et al. (2017) for a description of issue and interstitial fields.

[182] According to the now prevalent theory of creative combination proposed by Schumpeter, innovative creation is based on recombination of existing resources and concepts (Schumpeter, 1942). In a work on emergence of high-tech clusters, Powell, Packalen & Whittington (2012) highlight the importance of institutional heterogeneity in the formation of high-technology industry clusters alongside other factors such as a local anchor tenant and a dense web of relationships. According to this view, one institutional background can be utilized in another to create new routines or structures of organization, which can lead to more innovative products and services (Padgett & Powell, 2012).

[183] CVs and resumes of major founding members for example are in many cases available.

[184] The question then present itself whether this identification is robust enough for making inferences. After all, an alliance partner might be in a different field, but the individuals within the organization might be

heterogeneity studies, but it does not become one. Instead of a heterogeneous relationship, the study focuses on cross-boundary relationships defined as R&D collaborations[185] between members from two distinct organizational fields.

Although some of the logics within the fields are shared (e.g., same industrial or business logics, etc.), it is possible to see each field as having slightly divergent norms, assumptions, core metaphors, practices interpretative and categorical frameworks.

The boundary is an important delimiter of these influences. As mentioned previously, the chapter aims to empirically investigate the possible effects of these boundaries on the underlying inter-firm R & D network and see how these boundaries moderate traditional network effects (i.e., the effects of structural hole spanning and cohesion). The unit of analysis is the firm, and, with it, implicitly the corporate laboratory. Behind this main research question, the study is also concerned with the way heterogeneous institutional micro-level assumptions, categories, and practices influence other labs and then, after some time-lag, firms themselves.

Before going further, the discussion of some previously undiscussed literature is necessary.

7.2.2. Additional theory: Strategic alliances and cooperation in R&D

The first step is to review the literature on strategic alliances and especially technology alliances, as our choice of field is an R&D alliance network. It is also important because alliance networks are often how organizational networks are mapped out empirically. It is clear from the theory that an alliance network is not a field by itself. First, it is a larger-order field made up of other smaller fields (i.e., organizations). Second, they are also made up of larger groups of organizations (group companies, industries, etc.). It simply

coming from the same field or researchers might all come from a similar background rendering different field relationships unimportant. After all, this is the actual case in biotechnology in the US. Academia and industry creates a larger field of biotechnology research, where venture funds, banks, regulatory organizations are just auxiliary organizations.

[185] In our study the focus is on R&D collaborations for multiple reasons. First, there is available data on alliances in patent records. In the nanotechnology industry, research and development is the key activity. In this the most straightforward way of actual mutual influencing is an R&D collaboration. It is also important to note that in Japan, professional R&D personnel are less mobile than in the US. This creates an ideal situation where field boundaries are more pronounced. In the US, field boundaries are more blurred and engineers from diverse backgrounds are much more mixed.

maps the relationships among firms based on nanotechnology R&D activities. It spans multiple fields.

There has been an interest in R&D alliances among management scholars. From the 1980s onward, large corporate laboratories gradually gave way to cooperative forms of research and development (R&D) and partnering because of high uncertainty. Collaboration in R&D became increasingly necessary (Hagedoorn and Schakenraad, 1992; Nohria and Eccles,1992; Gulati, 1995; Powell et al., 1996). There is mounting evidence that alliances in general lead to increased performance and innovation (Hagedoorn and Schakenraad, 1994; Shan, Walker, and Kogut, 1994; Powell et al., 1996) by providing knowledge benefits (Kogut and Zander, 1992), access to other firms' resources, reduced transaction costs (Williamson, 1985), reduced risks, greater adaptability, and creation of competitive advantage through a synergy of complementarities (Bae & Gargiulo, 2004; Lokshin et al. 2011). For example, Shan et al. (1994) showed that alliances between ventures and larger firms in the U.S. pharmaceutical industry had a positive effect on the ventures' innovative output measured in patents issued. Technology and R&D collaborations also lead to improved innovation rates (Hagedoorn, 1993, 2002; Ahuja, 2000; Rowley et al., 2000; Un et al., 2010; Lokshin, 2011; Vasudeva et al. 2013).

Despite the many theoretical benefits, the literature also reports that alliances often result in *failure,* and the failure rates are as high as 30-40% (Lokshin et al., 2011). Lokshin et al. (2011) collected the main causes for unsuccessful partnerships: opportunistic behavior (TCE, Williamson, 1985), inequality in resources resulting in power imbalance (RBV), increased rivalry between partners with overlapping core businesses, failure to attain goals, and unrealistic expectations (access to partners technology or markets, too ambitious goals, etc.).

New studies attempted to look at possible contingencies and moderating effects to address the inconsistency in alliance outcomes. One strand of research focused on the *properties of partner firms*. It is reasonable to think that partners with different resource endowments, performance, and know-how give different benefits (or liabilities) to the focal firms. Stuart (2000) showed that the status, performance, and innovativeness of

partner organizations have a huge impact on the focal firm's performance; in some cases, large companies even providing status benefits for young firms.

Belderbos, Carree, & Lokshin (2004) found that different types of firms (competitors, suppliers, customers, and universities) had positive effects on different performance indicators. The focal firm cooperating with competitors and supplies gained increased productivity performance (incremental innovation) while cooperating with universities, suppliers, and competitors helped it achieve higher growth levels. Un, Cuervo-Cazurra, & Asakawa (2010) tested the effect of different types of R&D collaboration ties (university, supplier, customer, and competitors) on the level of product innovation. They found that suppliers have the strongest positive effect, followed by universities (they could show no significant relationship in the case of customers and only a negative relationship in the case of competitors).

Another research direction shifted the attention from dyadic cooperative relationships towards a whole portfolio of simultaneous alliances. These are called 'alliance portfolios', which are, in essence, ego networks of firms.

There is a whole rich strand of research on alliance portfolio diversity[186] (Powell et al. 1996; Baum et al., 2000; Belderbos et al. 2004; Faems et al. 2005; Faems et al., 2010; Phelps, 2010; Lokshin et al., 2011; Srivastava & Gnyawali, 2011; Duysters et al., 2012; Wassmer, 2010). There is evidence that more diverse alliance portfolios lead to better performance (Baum, Calabrese, & Silverman, 2000; Faems, Van Looy, & Debackere, 2005). Lokshin et al. (2011), for example, found that persistent product innovation strategies and diverse partner portfolios have a positive effect on performance, especially in avoiding future alliance failure.

On the one hand, these findings, combined with the section's arguments about field evolution, suggest that heterogeneity might be beneficial in both field evolution and firm success (measured as increased innovational activity). On the other hand, there is also

[186] There are problems with the concept of alliance portfolio diversity (APD). While there has been a proliferation of papers that use the concept due to the easy availability of all sorts of alliance data, the conceptualizing of the concept has been far from consistent or rigorous. Papers use different constituent measures to compute it and they discount the cases when a homogeneous alliance portfolio might actually be made up of organizations from another field. These problems make the concept untenable for using it for our inquiry.

evidence of an inverted u-shape relationship between portfolio diversity and performance (Frankort et al., 2012; Duysters et al. 2012), suggesting that there is a liability in too many heterogeneous partners. Combining this insight with the arguments for high rates of alliance failure, it seems that heterogeneity might also cause harm. There is some evidence for this. Faems et al. (2010) found that R&D collaboration diversity had negative direct effects on profit margin, although they also found indirect positive effects as well. Duysters et al. 2012 theorized that experience and alliance management capability are moderating the relationship, and they found a strong moderating effect for experience, suggesting that learning processes help deal with highly heterogeneous alliance portfolios. Other contingent factors also seem to be at play. Goerzen & Beamish (2005) found that internationally diverse alliance portfolios are negative to performance.

Instead of looking at the multifaced concept of diversity, I focus on just one special source of diversity: field boundaries. To be sure, not every field boundary is created equal. Some fields are more similar than others. However, the field boundary is the single most important source of diversity of any kind. In the following, I attempt to reduce the complexity of diversity into this one concept.

In this chapter, the emerging nanotechnology field is represented by an inter-organizational network of R&D collaborations, and each firm is, therefore, part of a larger set of relationships that go across field boundaries. Depending on which part of the network a firm is, the effects of partnering with heterogeneous cross-field organizations might differ.

As presented above, heterogeneity (or alliance portfolio diversity) has mostly been investigated in non-network studies. There are only a few papers that use the term in inter-firm networks and network structure. Hagedoorn et al. (2006), for example, found that centrality-based capabilities (measured as high node betweenness centrality[187]) and partner choice strategies (measured as Burt's hierarchy measure) are facilitating the formation of new ties in this context. However, no studies look at both fields and networks together.

[187] See Borgatti, Everett & Freeman (2002) for details on network variables.

Even less attention has been paid to concrete field boundaries. To address this gap, this study focuses on the moderating effects of boundaries on beneficial cohesive position and structural hole bridging positions in the network. The next section sets up the hypotheses.

7.2.3. Hypotheses

Before testing my main hypothesis on the role of field boundaries within networks, I must discuss some of the theory behind the model set up in this chapter.

The first question that has to be asked is whether partnership across firm boundaries provides any benefits or whether it is detrimental. On the one hand, partnering with universities, research institutes, and firms from different industry fields theoretically offers certain benefits to the focal firm. Apart from the reasons provided by the alliance portfolio diversity literature for organizational type heterogeneity, there are certain reasons for a positive relationship between institutional heterogeneity and innovation intensity as well. Experiencing diverse institutional backgrounds prepare actors to utilize their experience in other institutional settings (Powell et al., 2012; Kale & Singh, 2006). Different logics might influence the way of thinking of partners. Exposing oneself to a diversity of fields leads to higher levels of absorptive capacity (Cohen & Levinthal, 1990). Heterogeneous fields potentially serve as sources of unique knowledge (Burt, 1992), and diverse institutional backgrounds provide a wider range of critical views on research, thus further optimizing quality. Recombination is the essence of innovation, according to Schumpeter (1942), and more building blocks in the form of heterogeneity offer more possibilities in the number of potential combinations. Hence,

Hypothesis 1a. Research collaboration with organizations across field boundaries (heterogeneous relationships) has a positive effect on innovation rates.

In contrast to the positive picture above, alliance literature suggests that alliances fail easily (Contractor & Lorange, 1988; Noteboom, 2004; Lokshin, 2011). Apart from the reasons discussed in the previous section, there are some other problems caused by institutional heterogeneity. For one thing, lower trust and large cognitive distance make these alliances more prone to failure (Noteboom, 2004). The large gap between the

assumptions about practices and strategies might also create an incompatible cooperative context, where adjustments consume much time, and real research activities become bogged down, thus,

Hypothesis 1b. Research collaboration with organizations across field boundaries (heterogeneous relationships) has a negative effect on innovation rates.

Organizations across field boundaries might be too broad, encompassing both relationships with universities and cross-industrial relationships. Thus it is necessary to look at specific types of boundaries. First, in the case of industry-industry relationships, some basic assumptions are shared, and *industry logic* is the norm. Therefore, it might be possible that this shared background offers a better platform for sharing useful institutional knowledge that is not based on the main logics of the industry.

Hypothesis 2. Research collaboration with firms operating mainly in other industry fields has a positive effect on innovation rates.

However, the huge gap between industry and academia in institutional backgrounds might imply that there is more to be learned and benefitted from, and academic institutional background might offer special benefits to firms. For example, long-term research trajectories, focusing on disruptive innovation instead of just incremental improvement to existing products, utilize academic routines to identify the really promising new research fields. Hence,

Hypothesis 3. Research collaboration with universities and research institutes has a positive effect on innovation rates.

While heterogeneity seems beneficial, as argued in Hypothesis 1a, highly cohesive networks suggest that knowledge is quite similar between all members making it less useful. Cohesion across field boundaries might also lack trust and real cohesion as the network ties are still new or temporary. The liabilities of heterogeneity in this situation might outweigh the benefits. However, in a structural hole bridging position, firms can access genuinely new knowledge and institutional experience, especially from heterogeneous actors who give access to other fields.

Hypothesis 4a. Research collaboration with organizations across field

boundaries has a much more positive effect on innovation rates when the firm is in a structural hole bridging position.

In contrast to the above, it might be argued that the opposite is more beneficial because a cohesive cluster can perhaps immediately provide benefits that accrue from cohesion (e.g., Simmelian ties, monitoring by peers) and is stronger with many ties that support tacit knowledge transfer, thus enlarging the effects of institutional influences. In this case, a structural hole is less useful as a focal firm has to adjust to many different fields, while a cohesive position is helped by the fact that all participants share the same heterogeneous environment. Thus,

Hypothesis 4b. Research collaboration with organizations across field boundaries has a positive effect on innovation rates when the firm is in a cohesive network position.

7.3. Methods

7.3.1. Research setting: Nanotechnology in Japan

The Japanese nanotechnology field was identified as a newly emerging and relatively vaguely defined field. It failed to materialize as a coherent field and is still in a form of emergence. In fact, in the 2010s, the field was redefined in different categories based on use rather than technology.

To define the field and its vague boundaries, I use the American National Nanotechnology Initiative's definition as used by Rothaermel & Thursby (2007). Scholars and other government initiatives have often adopted this definition: "Nanotechnology is the understanding and control of matter at dimensions of roughly 1 to 100 nanometers, where unique phenomena enable novel applications. The diameter of DNA, our genetic material, is in the 2.5-nanometer range, while red blood cells are approximately 2.5 micrometers. Nanotechnology involves imaging, measuring, modeling, and manipulating matter at this length scale, enabling nanoscale science, engineering, and technology. At the nanoscale, the physical, chemical, and biological properties of materials differ in fundamental and valuable ways from the properties of individual atoms and molecules or bulk matter. Nanotechnology R&D is directed toward

understanding and creating improved materials, devices, and systems that exploit these new properties."

Nanotechnology research started in the 1960s after the famous speech by Richard Feynman, "There's plenty room at the bottom" at Caltech in 1959. Several new tools helped its development, such as the scanning probe microscope and its variants. These new tools made it possible not just to look at the nano-level but also to manipulate single atoms. Breakthroughs like the carbon nanotube, graphene, fullerenes, and nanoparticle technology made basic research closer to actual commercial utilization.

The commercial activities gave rise to emergent nanotechnology fields in various counties around the world. A Japanese nanotechnology industry also started to form around the year 2000, and although in 2007-2008, the initial nanotechnology boom and investment enthusiasm came to an end, the industry is still forming and evolving.

In the following, I review 1) the industries that make up the field, 2) the governmental organizations and policy that influences its development, 3) the alliancing behavior between them, and 4) the special case of a nanotechnology-related company Toray to illustrate the strategy of a relatively successful player.

First, the development of the organizational field of nanotechnology incorporates different kinds of organizations (Meyer, 2007; Schummer, 2004). Similar to the case of biotechnology, nanotechnology also includes multiple sectors of industry, public research institutions, universities, and non-private organizations.

In the case of nanotechnology, the span of sectors and related fields influenced are even greater than in biotechnology (Rothaermel & Thursby, 2007). However, the field is still highly fractured, moving in multiple directions (Islam & Miyazaki, 2009; 2010). Islam & Miyazaki (2010) divided the field into four main areas: *bio-nanotechnology, nanoelectronics, nanomaterials, and nanomanufacturing and tools*. Adopting this framework, it is possible to group the main industries involved in the Japanese nanotechnology field into these four main areas.

The first, *bio-nanotechnology*, is represented in the study by organizations involved in biotechnology (represented by firms such as Beacle), pharmaceuticals (Ono Pharma), cosmetics (Shiseido, JO Cosmetics), and food products (Ajinomoto). The second,

nanoelectronics, consists of firms engaged in electronics (Sharp, Panasonic, Sony), semiconductors (Rohm, Tokyo Electron, Toshiba), laser, and optics. The third main application area is advanced chemicals and *nanomaterials* involving the chemical (Mitsubishi Chemical, Hitachi Chemical), fiber (Teijin, Toray, Toyobo, Gunze), rubber (Bridgestone), glass, ceramics, oil (Nippon Oil), metal (Hitachi Metals), and plastics industries. Lastly, the precision tools industry (SII Nanotechnology, Shimadzu) and the industrial machinery industry specialized in nano-level processing and measurement tools.

Apart from the above categorization, we can identify other industries, such as the environment- and energy-related industries (*Osaka Gas*), the automobile industry (*Toyota, Nissan*), and trading companies (*Sumitomo, Mitsubishi, Mitsui, etc.*). The automobile industry, for example, uses nanotechnology for battery and fuel cell development and nanomaterials for the weight reduction of various parts. Large trading companies found nanotechnology promising and carried out considerable investments, though not always successful.

Finally, purely nanotechnology-oriented venture companies also began to appear mostly in the 2000s. Some are spin-offs or newly formed divisions (*SII Nanotechnology, Frontier Carbon, GSI Creos*) or joint ventures between larger organizations (e.g., *Admatechs*).

Second, after discussing the industries involved, it is important to highlight both universities and state founded research institutes that play a key role in nanotechnology's formative stage. In their study on Israeli research programs, Lavie & Drori (2011) point out that academic basic-research provides the seeds for future growth. Nikulanien & Palmberg (2010) reviewed the Finish nanotechnology research scene and emphasized the importance of university-industry relationships.

To better understand academia's role and government policy in network formation, it is necessary to review Japan's innovation framework and the challenges it has to overcome. Asakawa (2006) identified vital issues faced by the Japanese biotechnology industry and the institutional environment. He showed that the innovational framework in Japan has some rigidities, such as rigidities in government policy (government

priorities are sometimes set too late, vertical integration of ministries), academic context (professors are less motivated to patent because evaluation is based on scientific publications), investment and economic context (no well-developed venture firm investment, more investment for western companies than domestic by Japanese firms), research orientations (in-house R&D preference, focus only on close to product innovation, disregarding disruptive-type innovations because of inherent risks), and lastly rigidities due to cultural norms.

A similar story can be told about the nanotechnology industry; however, lessons learned from biotechnology was in some parts applied to nanotechnology. For example, in nanotechnology, the government did recognize the field's potential, although professionals from the field now claim that the government's emphasis on semiconductor technology was misplaced and led to misguided investments. Patenting by university professors has been more and more encouraged, as the dataset indicates by the high centrality of universities. However, patenting is still seen as similar to scientific publications, and many stops at an application of a patent, not caring whether it will be granted or whether it will result in a successful commercial product. Some of the joint-research with industry is carried out only in order to gain access to funding.

The Japanese government designated nanotechnology as a primary growth sector and allocated substantial funds to support the industry. The leading institutions of research are main government research labs, such as the National Institute of Advanced Industrial Science & Technology (AIST), National Institute for Material Science (NIMS), and Japan Science & Technology Agency (JST). Another agency that helps manage R&D in this field is the New Energy and Industrial Technology Development Organization (NEDO). Other supporting organizations and frameworks for networking and collaboration were set up, such as the Nanotechnology Business Creation Initiative (NBCI) or the Kansai Nanotechnology Initiative by the Osaka Science & Technology Center. Furthermore, international nanotechnology-related conferences and expos were set up, such as the annual NanoTech Japan trade show. NanoTech Japan has been held every year since 2002 and is among the largest nanotechnology-related trade shows in the world. According to their report, in 2012, a total of 649 exhibitors (out of which there

were 185 overseas exhibitors from 21 countries) welcomed about 45,000 visitors during the three-day exhibition period[188]. The organizational field also contains numerous other actors that the present study does not deal with, such as law firms, consultants, domestic venture capital firms, and incubator initiatives.

Third, it is necessary to look at the state of alliancing in Japan to understand the field's dynamics. Based on Lincoln (2009), it can be said that the Japanese inter-firm alliances are far less numerous than that of the US. Most are facilitated by government consortia or university brokerage. Asakawa (2006) highlights that many firms in Japan prefer to work with overseas universities, and they invest more in them. In our nanotechnology network, it can also be seen that most alliances include a university or a research institute, while the number of purely cross-industrial alliances is still low.

Finally, the nanotechnology efforts of one company, Toray Industries Inc., will be introduced here as a sample to show how this industry fits our conceptual framework. Toray's background is in textile and fiber products, but it reached high capabilities in synthetic chemistry, polymer chemistry, and biochemistry through diversification. As one of the leading firms in carbon fiber technologies, it is said to have understood nanotechnology's potential early, so it has a head start compared to other companies. The company is famous for its nanofibers, nano laminated films, and nanoalloy technology.

Toray aims for a diverse R&D alliance portfolio, incorporating government consortia, university alliances, and it collaborates with many different industries, both domestic and foreign. Toray also occupies a position with many heterogeneous alliances across firm boundaries in my nanotechnology alliance network and bridges multiple structural holes.

7.3.2. Data

The relational dataset

The first step was to collect data from patents stored in the Japanese Patent Office's online database and assemble a relational database of research collaborations in

[188] Similar numbers were reported in 2020. There were 648 booths from organizations from 22 countries and 47,692 visitors.

nanotechnology-based on joint patents[189]. I included Japanese domestic companies, universities, and research institutes in the period 2005-2010. Our cut-off point of 2005 was selected because legislation in the previous year made public universities legal entities. This legislative step had two effects: 1) names of universities have appeared on patents instead of names of individuals, and 2) increased university patenting. This made data collection more straightforward and reduced the chance of bias caused by undisclosed collaborative relationships (university professors gave patent rights to companies in exchange for funding).

As nanotechnology used to have no definite IPC code for patents, the search was conducted using keywords. These keywords were determined by the help of the literature and included words such as *nano, nanotechnology, nanoparticle, nanotube, carbon nanotube, fullerene, nanofiber, nanocrystal,* and words related to *atomic force microscopy and scanning probing microscopy.*

Approximately five thousand patents were obtained this way from the database, out of which 958 were joint patents. However, it is likely that this does not entail the full population of joint nanotechnology patents because some related patents might not contain the above keywords. Also, this method excluded alliances that did not result in a patent application.

The second step was to create an actor-actor matrix containing 1784 ties between 604 nodes (of which there are 464 firms, 85 universities, and 55 public research institutes and government institutions) based on the patent data between 2005 to 2010. Then, another three networks were created for each consecutive two-year period[190]. Due to limitations

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189 Joint-patent holders were assumed to have collaborated in a research alliance. This also means that the periods given are actually off-set by some time and the alliance had happened before the patenting. Final, outcome variables were adjusted to this to assume a large enough span to let the effects unfold. See explanation later in the text on the 5-year period for effect times. Some obvious cases of non-alliance patents were excluded.

190 The two-year period was set because due to the nature of the data more robust networks could be drawn up compared to one-year periods. Networks for each one-year period would have left the network relatively sparsely connected due to the nature of patent data. However, alliances are often longer-term and a two-year period should not create a theoretical distortion. Many of the relationships can be assumed to be continuous and not happening only for a very short period of time (unlike a patent application which have a fixed, point-like date). Because the alliances happened before the patenting, we can assume that alliances were in place creating a network of relationships.

in data availability, the final sample was reduced to two cross-sectional panels from 2005-2006 and 2007-2008.

Despite the drawbacks of my methodology, this dataset contains most of the important players in the Japanese nanotechnology scene. Nevertheless, despite having a heavy presence in the field, some firms were excluded from the database mainly because of their lack of joint R & D patents (e.g., Kao). Before moving on to the main analysis, I briefly review the actual network data and look at it in more detail. As suggested in the previous sections, this is necessary because the network is not simply a field though it can be considered an emerging issue field or an interstitial field. However, this study aimed to uncover field boundaries within this newly forming field.

Analysis of the R&D collaboration network - structural properties

The research focuses only on inter-firm R&D collaborations in nanotechnology. The reasoning for looking at these collaborations is twofold. First, it is an important way for organizations to have a deeper perception of other players' actual technological capabilities and develop relationships with them. Second, nanotechnology is in a research development phase, and thus R & D collaboration can be seen as a fundamental and defining activity of the field.

The network diagram in the figure below shows that major universities (*Tokyo, Osaka, Kyoto, Kyushu, etc.)* and public research organizations (*AIST, NIMS, JST,* etc.) are at the center of the network throughout the five years from 2005 to 2010. These most connected nodes are summarized by their degree number for each two-year period (see the table below). This centrality is most likely driven by two main forces: top-down government support and the basic research stage of the field. A closer look at some ego networks or the patent data reveals that many cross-industrial collaborative relationships include a university or government actor as well as a coordinator.

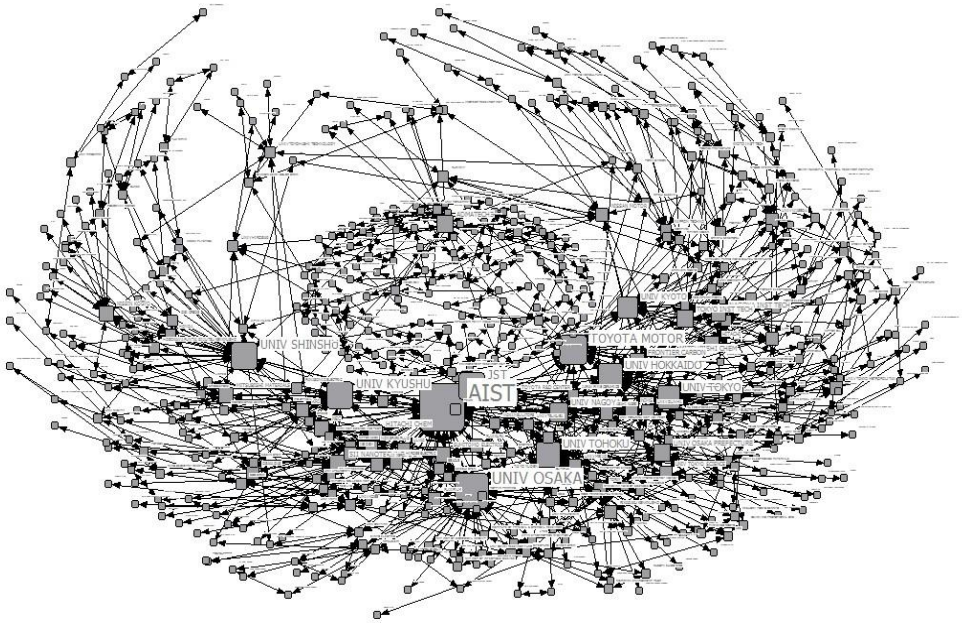

Figure 6 The 2005-2010 network of alliances (with the most central nodes highlighted)

Most connected nodes by degree		
2005-2007	**2008-2009**	**2010-2011**
AIST	AIST	AIST
JST	Toyota Motor	Toyota Motor
Osaka University	Osaka University	Kyushu University
Frontier Carbon (Mitsubishi)	Kyoto University	Admatechs
Kyoto University	Shinshu University	Shinshu University
Nagoya University	Tohoku University	Tokyo Institute of Technology
Toyota Motor	JST	Tohoku University
Shinshu University	University of Tokyo	University of Tokyo
Mitsubishi Chemical	NEC	Hokkaido University
Kyushu University	Sumitomo Electric	Osaka University
Hitachi Corp	Hokkaido University	Nagoya University
Tohoku University	Nissin Kogyo	Kyoto Institute of Technology
Hokkaido University	Kyushu University	TDK
NIMS	SII Nanotechnology	NGK Insulators
Fujifilm	Hitachi Chemical	Panasonic Electric Works
Osaka Prefecture University	Fujikura	Mitsubishi Materials
Nagoya Institute of Technology	NGK Spark Plug	Tsukuba University
NTT	Fuji Xerox	Teijin
SII Nanotechnology	Hirose Electric	Taiyo Yuden

Table 1 List of the most connected nodes

The next step was to try to identify subgroups and fields within the overall network. In the hypothesis test, it will be important to identify cross-boundary relationships. The method applied was to look at cross-industry relationships as spanning a field boundary. However, not all cross-industry relationships belong to different industries. A case in point is the automotive industry. Some electronics firms are traditional parts of the automotive industry, and their collaboration would not necessarily be a relationship across a field boundary. This investigation was done by going through each collaboration and deciding whether they constitute a cross-boundary relationship or not.

As a further step, I investigated what forces shaped the network and what clusters could be identified. These findings were then used wherever possible to adjust the cross-boundary count variables in the final empirical studies, though it is probable that not every potential previously established field was identified.

First, some major keiretsu and group companies' alliance behavior was examined to determine whether these are merely their traditional fields or contain cross-boundary relationships. Because these group companies are highly diversified, they may contain a great number of cross-industry relationships already. We still want to treat some of these partnerships as cross-boundary when an obvious field boundary can be found (e.g., university alliances or firms not included in the traditional group). These sub-networks (I do no call them fields because some of these are newly formed) exhibit slightly different behavior and intensity of partnering. In figure 7, the alliance relationships of Panasonic and Panasonic Electric Works can be seen. Relatively cohesive groupings with university- (light green) and government-consortia (dark green) are the most apparent feature. The amount of partnering is somewhat limited, and intensive in-house R&D is present, as seen in patent data. Figure 8 shows Sumitomo group companies, revealing that single companies do not take part in many alliances by themselves, and it is government consortia that make this sparse network more connected. Figure 9 and 10 is much richer in alliances. Both Hitachi and Mitsubishi take part in multiple consortia during the five-year period. Hitachi Corp., Mitsubishi Chemical, and Mitsubishi Materials are three companies that occupy bridging positions, with a network structure including potential structural holes.

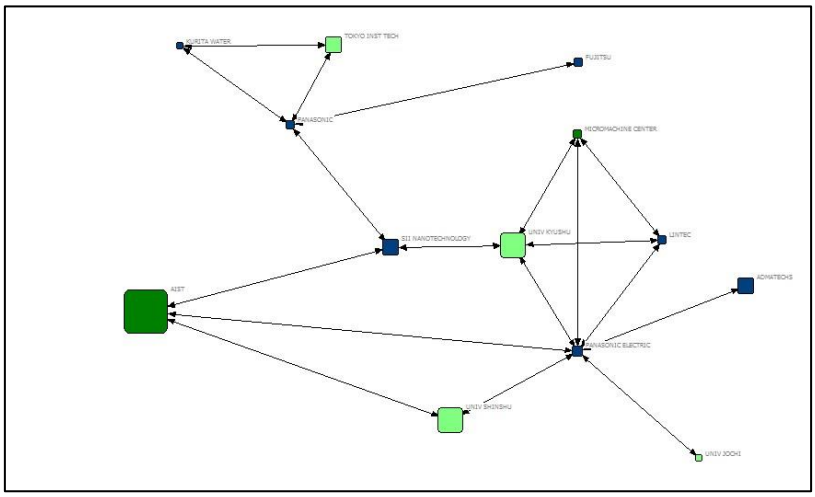

Figure 7 Panasonic, Panasonic Electric Works alliance patterns for 2005-2010.

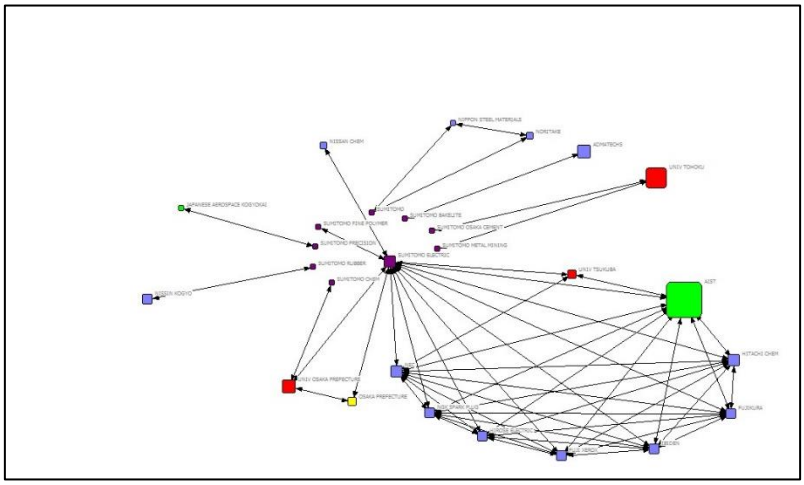

Figure 8 Sumitomo group alliance pattern for 2005-2010.

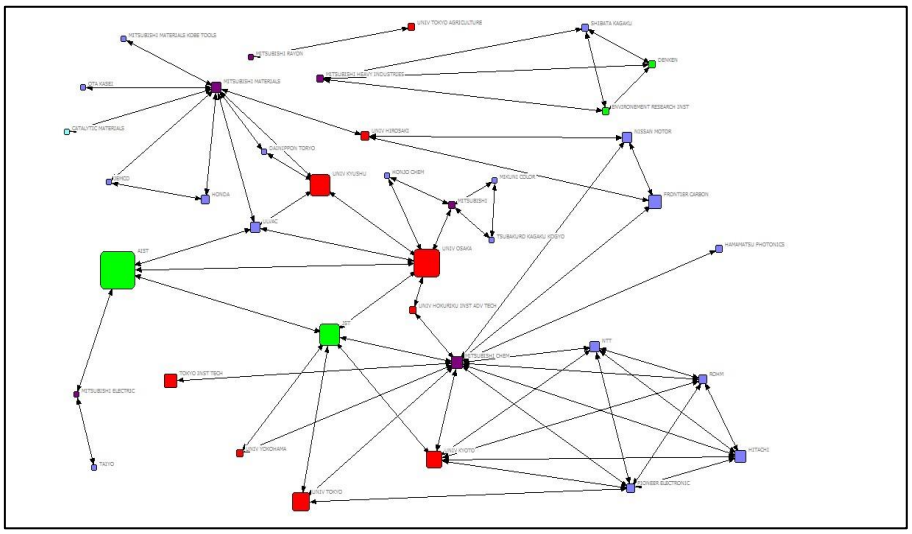

Figure 9 Mitsubishi group alliance patterns in nanotechnology for 2005-2010.

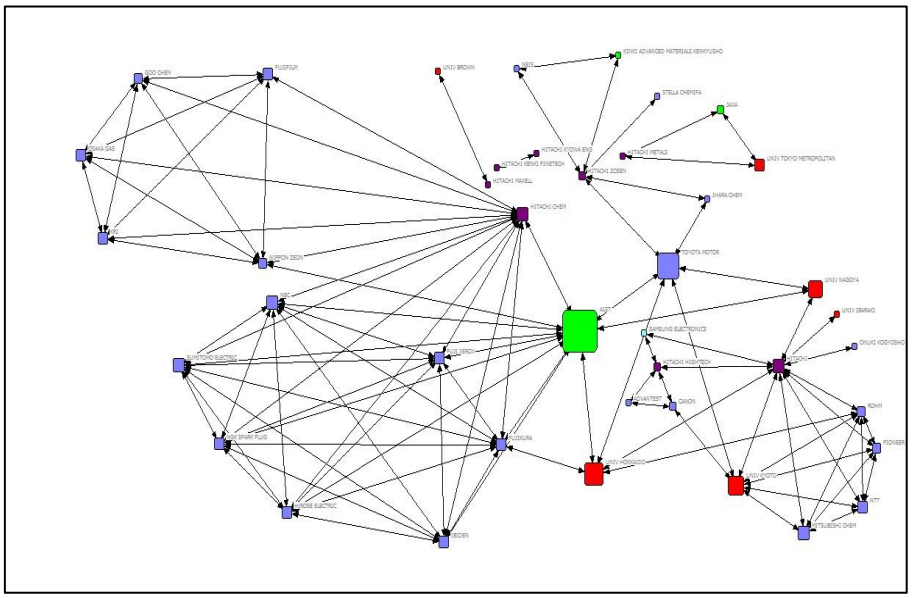

Figure 10 Hitachi group alliance pattern in nanotechnology for 2005-2010

Before moving on to the main analysis, it is necessary to explore what forces act on different subfields. One central question of any field or network formation goes like this: "why does one relational space with a given set of actors form and not another?" (Wooten & Hoffman, 2008). Put in another way, it is important to identify the mechanisms that drive field formation and lead to a given outcome.

To explore some of the macro-level implications of this question, two types of sub-analyses were implemented. One was a QAP regression to determine whether homophily or heterophily is at play using UCInet's QAP regression function (Borgatti, Everett & Freeman, 2002)[191]. The attribute matrices measured the type of industry or institutional form. A weak homophily effect was identified, although there is a great amount of mixing as well[192].

The second analysis was a cluster analysis that identified the major clusters within the network. Here clusters refer to cohesive groups in the network and not necessarily fields[193]. The cluster analysis performed by UCInet shows groups that might form by several different underlying mechanisms: 1) leveraging of past relationships and structural settings, 2) policy guided relational development, 3) conscious agency of some powerful firm, and 4) regional clustering.

Several studies show that firms are more likely to form ties with past partners (Ahuja (2000a), Gulati (1999)). There is also some evidence that old keiretsu relationships are sometimes enabling or sometimes constraining alliance formation (Lincoln, 2009). However, recently, these constraints are beginning to soften (Lincoln, 2011), and keiretsu relations became more open and overlapping with the reorganization of Japanese industries. In my actual network sample, some of these features could be found. Close ties to same-keiretsu group companies had been used to form R&D alliances as well. This implies that these relationships do not necessarily happen across field boundaries, but same-field members come together around a new issue (here nanotechnology).

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191 For more on regression models and networks see Krackhardt (1988).

192 For more on homophily in social networks, see McPherson, Smith-Lovin & Cook (2001). For an argument about homophily happening more within boundary than cross-boundary see Kleinbaum, Stuart & Tushman (2013).

193 Also do not confuse these clusters with 'regional industrial clusters'.

The high centrality of academia and public research organizations was mentioned in the previous section. Even today, government research consortia are the main driver behind alliances in Japan (Lincoln, 2009). Most of the alliances include a governmental or academic actor that acts as a coordinating force.

Agency (as defined by Emirbayer & Mische, 1998) in network formation is a major topic in recent studies (Ahuja, Soda & Zaheer, 2011) as well as conscious strategies to shape the alliance network by alliance management function (Lorenzoni & Lipparini, 1999; Kale, Dyer, & Singh, 2006). Toyota Motor Corporation will be discussed as a powerful actor that consciously attempts to shape its network (Dyer & Nobeoka, 2000).

Last, regional clustering patterns could be observed as well. In this case, the regional partnering activity usually clustered around a powerful actor in the region, for example, a university (Kansai area) or a local firm (Toyota in Aichi prefecture). However, in the first half of the 2000s, the government designated some prefectures as potential industrial clusters and provided funding to these areas. Some of these areas are possible to see in the patterns of networking, especially Nagoya-Aichi and Nagano. Nevertheless, in these regional fields, there were many newly formed partnerships between firms that had not cooperated in the past. These were counted as cross-boundary.

Firm sample dataset for testing the hypotheses

After creating and analyzing the network dataset, another database was created containing firm-specific data for domestic firms found in the network. Due to limitations in data availability, the final sample was reduced to two panels of 357 firms. Firm-level data for control variables were collected from the Japanese *Next Yuho Kakumei* online database for publicly traded companies, while for private firms, information was obtained from company web pages and other miscellaneous directories. Patent application rates were obtained from the patent database mentioned earlier, and network and cross-boundary variables were calculated based on the relational dataset using UCINET (Borgatti, Everett, Freeman, 2002).

7.3.3. Variables

Dependent Variable

The main dependent variable is *nanotechnology innovation intensity* in the next period measured by the number of patent applications in a given two-year period for each firm (including both independent patents and joint-patents)[194]. For measuring innovation success, mostly granted patents and patent citations are used in the literature (Jaffee et al. 1993; Ahuja, 2000a), however in this chapter, we selected patent applications for two reasons. One is a methodological difficulty arising from the fact that Japanese patenting works very slow, and patents in our given period are still under revision. The other reason is that the interest lies in the increased innovation activity within the field controlled for size instead of innovation success.

It has to be noted that patent measures, especially applications, have many drawbacks. First, anyone can file a patent, and a patent by itself does not guarantee quality. Some firms prefer not to patent to keep the technology secret, while other firms prefer to hold a great number of patents around a given technology as a form of incremental innovation. These patents require less effort and only constitute a small adjustment to an original technology. Furthermore, some important ideas remain tacit, and no tangible measurement is possible.

Nevertheless, patent application rates give a general idea of the intensity and pace of innovational activity in a firm in a given period. Our main focus is whether cross-boundary partnerships combined with specific network positions boost this activity by influencing it through the partner firm's institutional logics and micro-foundations (categories, metaphors, language, etc.).

Independent Variables

There were six independent variables used in the study. The first variable measures the

[194] I took the following two years of patents (including both joint and independent patents) for any two-year period to avoid the trap of a tautological relationship with the independent variable.

extent of cross-boundary experience gained in the past two years. Because firms had multiple cross-boundary relationships, we aggregated them in a variable that we called *heterogeneous experience*. This variable is a count measure[195] increased by one with a cross-boundary tie in the past two-year period. A heterogeneous tie was defined as a research collaboration with a firm operating in another industry, with a public research institution, or a public/private university. All of these offer access to different institutional logics and serve as gateways to potentially different organizational fields. In the case of industries, it is important to point out that although they share many institutional similarities, there is a marked difference between each industry, resulting in slightly different logics, practices, rules, assumptions, language, categories, metaphors, etc.

The next three variables were disaggregates of heterogeneous experience for the given two-year period, categorized into *cross-industry experience*, *university experience*, and *research institute experience*. In other words, I tested what type of field boundaries have more impact. These are also count variables measuring the number of alliances in each type. The fifth count variable measured the number of *same industry* ties. This was included in the final model to look for the effect of collaborating with actors from homogeneous institutional backgrounds.

Last, to measure the network effect, a *structural hole* measure was built based on Zaheer & Bell (2005), who used Burt's (1992) structural constraint measure computed by UCINET (Borgatti, Everett & Freeman, 2002). They were interested in the extent each firm accessed structural holes. Here, I computed the variable in two ways. In one, I subtracted the constraint value from one for non-zero values[196]. In another, I have used the constraint.

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[195] I used a count variable instead of the more widely used Herfindahl index because I wanted to focus on the effect of the existence of boundaries, not the ratio of boundary alliances versus non-boundary alliances. The more boundaries an organization encounters, the more likely it is that network effects are impacted, but even one boundary can impact the ego-network.

[196] In other cases, I added zeros. I have also tested another reduced sample with non-defined values (not-reported here). The outcome was similar, but less robust due to the reduced sample size.

Control Variables

A number of control variables were used to control for effects on the dependent variable. The most important control is *firm size (Size)*, measured as the natural logarithm of the amount of capital stock. This was an essential control variable as larger firms issue more patents, have a larger scale, and more funding. Firm size is also correlated with the propensity to engage in alliances (Belderbos et al., 2006; Duysters et al., 2012). Separate tests (not reported here) with reduced sample size tested the logarithm of employees as a size variable as well. Another control is *age since founding (Age)* to account for differences between the length of experience and historical paths.

Finally, dummy variables to control for the period and industries were included. The period or year dummy was especially necessary because the second period is affected by the 2009 financial crisis, and the number of patent applications is much lower. Finally, to account for the research's time dimension, a lagged dependent variable was also included as a control variable. The correlations between variables can be seen in the table below.

		1	2	3	4	5	6	7	8	9	10
1	Patent Rate	1									
2	Y (t−1)	0.5516	1								
3	Size (log)	0.2760	0.3650	1							
4	Age	0.1774	0.1989	0.5737	1						
5	Hetereogenous Experience	0.2313	0.3588	0.2317	0.0637	1					
6	University Experience	0.2456	0.3555	0.2184	0.0874	0.6712	1				
7	Cross-industry Experience	0.1545	0.2488	0.1500	0.0189	0.8471	0.2614	1			
8	Research institute Expeperience	0.0607	0.1149	0.1235	0.044	0.4777	0.1603	0.2107	1		
9	Same-industry Experience	0.1460	0.1844	0.1175	−0.0042	0.3117	0.1929	0.3017	0.0804	1	
10	Structural Hole	0.2513	0.3829	0.2593	0.0645	0.6644	0.4385	0.5702	0.3111	0.3364	1

Table 2 Correlation matrix

7.3.4. Statistical Methods

For a positive count dependent variable, the Poisson regression method is the usual choice. However, due to significant overdispersion in the data, a panel negative binomial model was adopted (Long & Freese, 2006; Cameron & Trivedi, 1998). As the data set is a panel made up of two periods. There are multiple observations for each firm, which means that it was necessary to use random-effects. The Hausman test showed that random-effects is preferred to the fixed-effects model, and the log-likelihood test supported the panel model instead of a pooled negative binomial regression model. All independent and control variables are lagged one period, and a lagged dependent variable

is also included. A five-year period of alliances is often deemed to contribute to the firm's experience levels (Duysters et al., 2012). In the dataset, partnering is identified from patents, which usually result after an average of two years of R & D collaborations. Therefore, by lagging the variables, there is an approximately four to five years gap between alliance commencement and the measured dependent variable making the period theoretically valid.

7.4. Results

The first table below shows the results of the random-effects negative binomial panel regression models for innovation rates. Model 1 tested the control variables only. As expected, the lagged dependent variable, size, and the period dummy had a strong significant effect on innovation rates. Model 2 contrasted the effects of homogenous and heterogeneous alliance experience. This showed that heterogeneous alliances have a weak positive effect, lending some support to Hypothesis 1a. Model 3 that tested the disaggregated effects of the three different sources of heterogeneity, however, could only show a positive effect for university-industry alliances, partly confirming Hypothesis 3, but not supporting Hypothesis 2, suggesting that a cross-boundary relationship is by itself either have a non-linear relationship or contingent on other factors (perhaps cross-industry boundaries are less prominent).

In Model 4, the effect of structural hole positions was tested. The coefficient showed a strong effect but was marginally non-significant (p=0.116). Then, in Model 5, the interaction effect between structural holes and heterogeneous experience was tested. A separate analysis (not reported here) evaluated their effects at specific high and low values, and the corresponding change of slopes was identified see the figure after the results. This suggested that firms in a redundant, cohesive network with many heterogeneous alliances suffer from the liabilities of a boundary, while firms that optimized their ego-network by positioning themselves in structural holes could benefit from the boundaries. Thus, Hypothesis 4a was confirmed. As an additional check of the role of heterogeneity and structural holes, Model 6 looked at the case of cross-industry alliances and found similar results.

The results indicate that structural hole spanning positions are more beneficial on field boundaries, while the opposite is true for high constraint (cohesive) relationships. Though further evidence is needed, it is quite likely that field boundaries greatly alter the dynamics of traditional network effects. Cohesive clusters that form across field boundaries may not be actually cohesive because members are new, trust has not yet formed, and they do not constitute a field. Although this single set of results cannot conclusively prove this, there is evidence in other studies that my proposition has value. Vedres & Stark (2010) demonstrated this effect in a different type of study, showing that the positive effects of cohesive clusters appear with time, suggesting that early cohesive clusters lack the social cohesion that is associated with them.

On the other hand, structural hole effects are enhanced at field boundaries, implying that within-field structural holes are potentially less beneficial because there is no unique information that can be accessed. Nevertheless, the benefits of structural hole spanning do not disappear entirely within fields, partly because there are sub-fields that can be bridged or because brokerage activity can bring benefits as suggested by theories of tertius iungens and tertius gaudens (Obstfeld, 2005; Quintane & Carnabuci, 2016). The key implication of all this is that network studies should consider field boundaries when analyzing network effects.

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
Constant	0.432107**	(0.1602)	0.4199**	(0.1563)	0.4208**	0 .1562	0.4504**	(0.1663)	0.4454**	(0.1662)	0.4950*	(0.184)
Lagged dependent variable Y (t-1)	1.0415***	(0.0028)	1.040***	(0.0031)	1.0412***	(0.0032)	1.0391***	(0.0032)	1.0393***	(0.0032)	1.0397***	(0.0032)
Year dummy	0.4382***	(0.0906)	0.4583***	(0.0963)	0.4607***	(0.0962)	0.4516***	(0.0931)	0.4735***	(0.0988)	0.4571***	(0.0957)
Age	1.0012	(0.0022)	1.0013	(0.0022)	1.0011	(0.0022)	1.0015	(0.0022)	1.0019	(0.0022)	1.0018	(0.0022)
Size (log)	1.1380***	(0.0232)	1.1308***	(0.0235)	1.1335***	(0.0236)	1.1282***	(0.0238)	1.1323***	(0.024)	1.1299***	(0.0238)
Industry Dummies												
1	0.978547	(0.2051)	1.016	(0.2147)	0.9991	(0.2114)	0.9398	(0.1984)	0.9381	(0.1985)	0.8803	(0.1862)
2	1.0104*	(0.2072)	1.0177	(0.2088)	1.0118	(0.2076)	0.97875	(0.2014)	0.9566	(0.1972)	0.9238	(0.1898)
3	1.087326	(0.3139)	0.98977	(0.2925)	1.0225*	(0.3017)	0.98754	(0.291)	0.9541	(0.2835)	0.9055	(0.2715)
4	0.6183376	(0.1849)	0.62114	(0.1859)	0.6041	(0.1811)	0.5989*	(0.1793)	0.5819*	(0.1742)	0.5445	(0.1632)
5	1.106892	(0.2812)	1.0249	(0.2662)	0.9792	(0.2588)	1.0104	(0.2635)	0.8676	(0.2365)	0.8607	(0.2293)
6	1.127031	(0.3041)	1.0896	(0.2994)	1.0769	(0.297)	1.1048	(0.2967)	1.1260	(0.3002)	1.0437	(0.2789)
7	0.8399283	(0.2308)	0.84067	(0.2312)	0.8321	(0.2288)	0.8118	(0.2234)	0.8107	(0.2229)	0.7874	(0.2163)
Heterogeneous Experience			1.0484*	(0.0268)					0.9005*	(0.057)		
Same-industry Experience			0.9319	(0.0604)	0.9249	(0.0632)						
Cross-industry Experience					1.0004	(0.0416)					0.7739***	(0.0764)
University Experience					1.1081**	(0.0518)						
Research Institute Experience					1.0855	(0.1082)						
Structural Hole							1.4578	(0.3523)	1.097481	(0.3573)	1.29499	(0.4189)
Structural Holes x Heterogeneous Experience									1.2079**	(0.0968)	1.4806***	(0.213)
Number of observations	714		714		714		714		714		714	
Number of firms	357		357		357		357		357		357	
Chi squared	606.55***		629.36***		635.9***		614.59***		643.19***		625.18***	
Log likelihood	-1202.364		-1200.681		-1199.51		-1201.163		-1198.235		-1197.237	

Note: Standard errors are in parantheses. Coefficent beta values are expressed in incident rate ratios. All independent variables lagged one period.
*p<0.10; **p<0.05; ***p<0.001

Table 3 Random-effects panel negative binomial regression model for innovation rate (patent applications). Looking at structural holes.

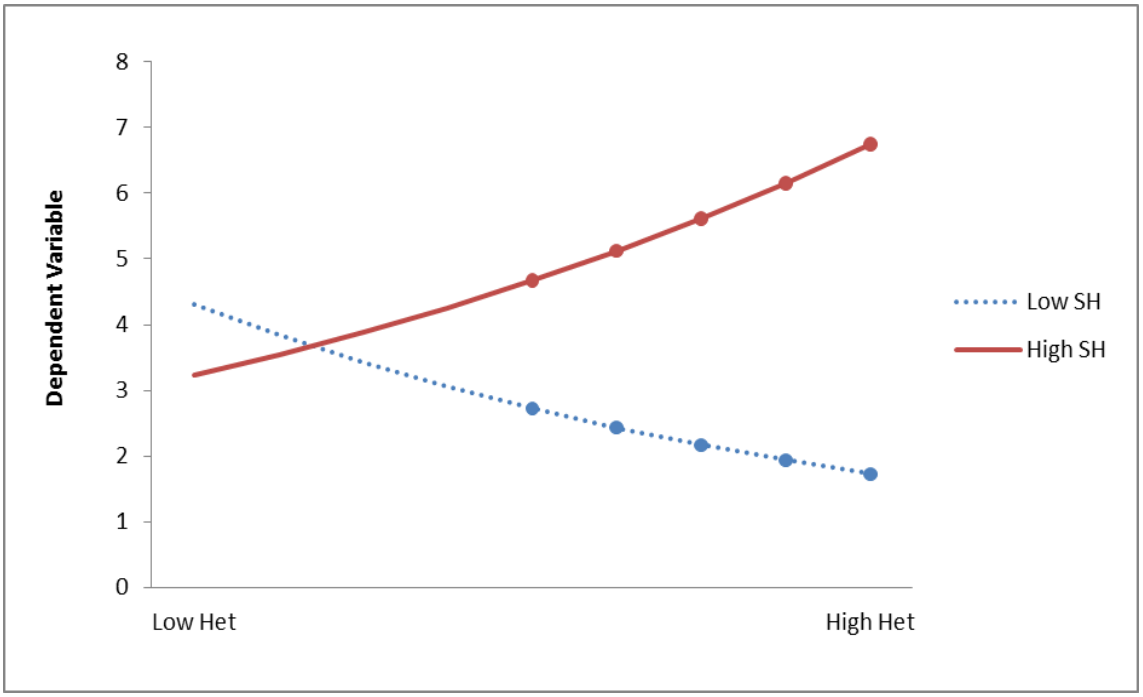

Table 4 Interaction effects for high and low structural hole spanning

7.5. Conclusion

The study faces considerable limitations. The data availability made it difficult to include all firms participating in the network, reducing the sample size from 451to 357. The dependent variable was measured as patent applications (though controls for size and offsets in time made this variable methodologically sound); however, a better indicator for innovations would be a composite variable built on patents' grants and citations.

Another possible weak point is the construct validity of the heterogeneity concept. Some industries (silicon material producing chemicals and electronics, paint, and car manufacturers) are vertically linked while horizontally disconnected. In this case, an existing long-term relationship could have served as a possible medium for institutional influences, and the R&D alliance in question might add nothing new. However, it is important to understand that the focus is on R & D and institutions' influence on the thinking of the laboratories in our sample. Therefore, only in cases where there is an ongoing R&D collaboration between partners in other fields (such as non-nanotechnology related fields) is there a problem. An existing transactional relationship might not mean that there are actual far-reaching institutional influences on future research trajectories by merely supplying or buying products in a manufacturing plant.

Another issue is with the variable that measured same-industry experience conceptualized as homogeneity. These relationships might include competitors whose trust level is low, leading to their collaborations to be less successful. Similarly, cross-industry collaborations might be more

successful because existing buyer-supplier relations create a high-trust atmosphere for joint R&D.

One contribution of the chapter is that it calls attention to the importance of field boundaries in organizational networks. Although related concepts to this idea have a long history in the literature[197], this chapter focuses on boundaries between fields and the effect of boundaries on structural network effects through linked institutional factors from both the macro-level (field-level) and potentially the micro-level (influences through language, metaphors, and categories).

Furthermore, it argues that the concepts of cohesion and structural hole spanning should not be analyzed on a purely structural level. Instead, fields should be taken into account and conceptually mapped onto the network. It can be argued that other field-specific attributes should also be considered, such as field-specific capital and micro-foundational characteristics such as field-oriented logics. The type of knowledge that flows within the ties can also be considered from a field perspective. Field-specific knowledge will be exchanged within the network that might lead to future changes of the network structure of the field influenced, as I will show in the study on cross-boundary filtering effects.

A key finding is that the network under analysis might have some structural features that do not overlap with fields. Multiple fields can be mixed into one network, or subfields can cut through cohesive clusters making predictions from pure network structure features misleading. These misalignments need to be considered. In this particular case, the findings suggest that structural hole bridging positions are more valuable at field boundaries in a high-tech R & D alliance network because they provide both more diverse information and more possible micro-institutional influences (categories, assumptions, practices) that help to determine successful research trajectories. This happens because they can access truly different fields instead of parts of the same field. In a way, the boundary and the structural hole coincide. In other cases, the structural hole might be only a temporary hole within a field, perhaps not offering the same level of bridging benefits.

In an uncertain technology network, it seems that having access to unique information and influences are profiting. However, merely engaging in cross-boundary alliances might not be the answer. Depending on the field and the firm's position within it, many heterogeneous alliances might be detrimental to performance as too much time and effort are taken by managing the difficulties posed by heterogeneity, and too few unique influences are gained.

[197] See the review on alliance portfolio diversity.

8. Case II –Boundaries as filters: The diversification of the Japanese life science field through contacts within the international field[198]

8.1. Background

This chapter examines how one field influences another through shared nodes in their networks and looks at one proposed filtering effect through a boundary. The central question is simply how the underlying network structure influences this filtering effect through a boundary. We look at fields that are loosely overlapping and somewhat disconnected and where the boundaries are clear.

This chapter is also an answer to recent calls from the organizational network literature that has shifted from static structural analysis to a dynamic view (Ahuja, Soda & Zaheer 2011, Powell & Owen-Smith 2012, Padgett & Powell 2012). Early studies on network change focused on both endogenous change within networks (Powell et al. 2005) and responses to exogenous shocks (Madhavan et al. 1998). We aim to look at not mere exogenous shocks and internal changes but to see how one field and its underlying network influences another field through shared nodes.

From the perspective of one field, this can be considered a mix of external influences (i.e., influence from another network) coupled with internal agency (through changed logics of nodes). In order to achieve this, my study looks at how participation in an international field of organizations by building relationships with elite members[199] of that field can shape the domestic alliance networks of the partnering firms within their own domestic fields.

In particular, the study looks at the process through which the Japanese domestic life science network is transformed by influences filtering into it from the international network. Here, we argue that the network structure of Japanese firms' partners in the international network, especially of partners that appear to be able to manage diversity well, such as highly central organizations, can influence Japanese firms through changing their internal logics regarding the selection of new partners for R&D collaboration. Powell et al. (2005) found that the biotechnology sector in the US, to which the Japanese firms are connected, was characterized by a logic that actively pursued diversity in alliances. Here diversity simply refers to the type of alliances and the types of organizations (i.e., type of industry, academia, and government organizations) in a traditional sense. The logic dictates that more diverse organizations in an ego-network mean that the firm can tap into more diverse knowledge and management styles. This pro-diversity logic can then influence the Japanese companies through alliances with American firms possessing this pro-diversity logic, which, in turn, may influence how Japanese firms or their less influential partners (through imitation) design their domestic networks at home[200].

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[198] Parts of this paper have been published in Fazekas (2015).

[199] Elite members in an industry are relatively easy to identify. They also occupy the more central positions within the network. In this case, elite status coincides with centrality.

[200] Behind this common concept of diversity is the fact that members from different fields come together. Diversity,

Some of these firms may follow their globally-recognized partners by building and leveraging increasingly diverse networks around themselves. However, domestic firms with less influence might simply create a more diverse domestic network only, instead of a diverse ego-network containing international and diverse domestic partners.

Taking another industry as an example, firms in the Japanese electronics industry are increasingly looking outside their existing keiretsu group to form alliances and are in the process of opening up (Lincoln & Guillot, 2011). This change in the perception of diversity would first manifest in selecting more diverse partners for cooperative R&D, leading to more diversity in ego networks. We focus on partner diversity because it is easier to select diverse partners than to consciously seek out beneficial network positions and engineer brokerage when knowledge of the global network is limited (see Van de Rijt, Ban & Sarkar, 2008). It is also conceivable that domestic partners try to imitate these field-bridging Japanese firms, as argued above (DiMaggio & Powell, 1991). This, in turn, leads to higher diversity in these partner's own ego-networks.

I trace this 'filtering' effect in my study and look at how firms in central positions in a far-away international network can have quasi-agency effects that facilitate changes in a relatively insulated and closed domestic network.

My focus is on Japanese organizations in the broadly-termed life science industry, which are also members of the international life science field and are connected to its network. I focus on Japan because it is an ideal case with a trend in the last two decades of growing overseas production and internationalization. More and more high-technology firms seek international partners or acquisitions to access international networks (Shintaku, 2014; Asakawa, 2006). At the same time, Japanese domestic networks are not entirely integrated into these international networks. During the investigation period, domestic networks were relatively closed and highly cohesive (Lincoln & Guillot, 2011).

The life science industry is an excellent example of the ongoing internationalization and implementation of global practices, such as alliance management and venture investments. I selected this industry not only for the above reasons but also because biotechnology, which is now a key driving technology in the life science industry, started late in Japan relative to the United States (Asakawa, 2006).

The closed Japanese networks and keiretsu-based relationships have been considered superior in incremental refinements of technology. However, at the same time, they have not been conducive enough to access diverse technological and other forms of capital in far-away networks (Powell et al., 1996). Although corporate laboratories have built up a large number of patents, successful commercialization has rarely followed, even in the 2000s (Wakabayashi 2013b).

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however, is not the same things as a field boundary. Diversity exists within fields. For example, tall and short researchers might be working in the same lab, went to the same schools and are from similar backgrounds.

Deciding on future R&D plans has not been easy for organizations in these types of networks.

Traditionally, most firms relied on their in-house R&D capabilities and refrained from more open, network-based innovation. After a period of catching-up in the postwar years, however, Japanese firms found themselves no longer in the roles of followers of technologies invented elsewhere but at the forefront of progress.

In order to access more diverse networks, organizations in the US and Europe began to form alliances and consciously influence their fields and networks (Powell et al. 1996). This turn to alliances has been very well-documented in management theory. Although Japanese firms had been relative late-comers in the life science scene, they also started to steadily increase the number of their alliances in the 2000s (Takatori, 2009).

To achieve a better performing life science industry, the Japanese government, alongside Japanese firms, embarked on a quest to reinvent Japanese corporate networks (i.e., the field of the domestic life science industry) and reform existing inter-organizational structures.

In biotechnology, leading companies went to find promising partners in the United States, Europe, and elsewhere. For example, Japanese multinational pharmaceutical companies have been increasing their reliance on alliances with international firms and prestigious US universities (Asakawa, 2006). This has most likely led Japanese firms to learn and incorporate new management practices and be affected by various other influences, such as the perception of diversity from overseas partners. These influences began to filter into the Japanese domestic network, and this is the cross-field event that the present case study focuses on. In the next section, I briefly review some additional theories that are necessary to build my hypothesis.

8.2. Literature and hypothesis

Organization network dynamics have become the focus of attention in organization network research (Powell et al., 2005; Madhavan et al., 1998; Ahuja et al., 2011).

Traditionally, organization network research focused on static images of networks and theorized about the impact of certain structural features on innovation and performance, such as positions of *nodes*, where nodes represent the organizations in the network, and strength of *ties*, where ties are the relationships or alliances in the network (Coleman 1988, Burt 1992, Ahuja 2000, Burt 2004, Zaheer & Bell 2005, Uzzi, 1996b, Stuart 1998, Reagans & McEvily 2003). All of this has been introduced in Part I.

However, this static view is being complemented by a temporal and more dynamic approach that attempts to answer questions about network formation and evolution. Although an early thread of research focused on network tie formation (Gulati 1995, Gulati 1998, Stuart 1998, Ahuja, 2000b; Baum et al. 2000, Hagedoorn et al. 2006), it mainly looked at the factors that facilitated the formation of networks.

There have been some attempts to look at how exogenous shocks affect networks (Madhavan et al. 1998). Later, Powell et al. (2005) called attention to the importance of network dynamics. They look at how networks evolve over time and what logics might be behind this change. After testing four alternative logics of attachment (accumulative advantage, homophily, follow-the-trend, and multi-connectivity), they found that in the US-centered life science sector, a pro-diversity logic played the most prominent role.

Ahuja et al. (2011) defined network dynamics as change in network architecture (nodes, ties, and structure). They emphasized that it is not only the network structure that can change but also the content of the nodes. Thus, a change in logics at individual nodes can bring about changes in the network structure. This can be considered a form of micro-dynamics or agency.

This study is built on this framework, but instead of looking at internal logic or exogenous shocks, we want to look at how changes in internal logics within one network are brought about by influences from another network. In other words, we are interested in how underlying field networks influence each other across field boundaries. It is also informed by a theory of micro-dynamic processes within network change.

There have been studies that ask somewhat similar questions. Al-Laham & Amburgey (2010), for example, found that start-ups in the German biotechnology sector were able to gain more centrality in their alliance networks through gaining experience in international alliances. This relationship was especially strong when firms had a more diverse mix of nationalities in their alliances. However, multi-partner alliances limited this movement to centrality. Studies like this make it clear that capabilities and management experience obtained from international partners translate to changes within a domestic network. In this sense, organizational learning seems to be a key facilitator of change (Argote & Miron-Spektor, 2011).

There is a long tradition in management research of describing networks as sources of learning (Powell, 1990; Powell et al., 1996; Stuart & Podolny, 1996; Uzzi, 1996a). Beckman & Haunschild (2002) looked at how prior experience gained from diverse partners influenced future acquisition premiums. They found that firms learn by sampling the diverse experience of their network partners, leading to cheaper and better performing acquisitions. However, they too relied on the static view and stressed the importance of network variables influencing firms. Most studies only explain how learning can benefit individual organizations by having a positive impact on performance or innovation.

Another strand of research calls attention to the importance of alliance management and alliance capability (Heimeriks & Duysters 2007, Duysters et al. 2012). Learning and experience gained from alliances translate to better management skills of future cooperative relationships. According to this view, well-optimized ego networks can also be beneficial to bottom lines and innovation rates.

In this study, I propose that learning plays a vital role in facilitating network change. However, the focus here is on learning about field-specific knowledge and about logics that operate in other fields. This type of learning about field-specific knowledge from collaboration partners is what influences alliance formation patterns the most and thus needs to be studied. The field boundary here has a key role. Field boundaries are abstract places where this kind of learning is facilitated. I formulate that a change in logics can easily bring about large-scale changes in network architecture (nodes, ties, and structure) and that the network structure plays an important role in these different flows.

In this paper, I focus on the pro-diversity logic that Powell et al. (2005) highlighted in the US-based biotechnology alliance network. They found that firms tend to partner with heterogeneous partners instead of the more natural homophilous attachment pattern, where organizations prefer to partner with others that are similar to them. Highly central firms in this US-centred network are therefore more likely to possess this pro-diversity mindset.

We expect these types of influences at Japanese firms that have been involved in alliances with highly central US firms. While these network-bridging Japanese firms might have a hard time influencing international networks even if their logics change, they might have more leeway in influencing their own domestic networks where they command more authority. We propose that firms whose international partners score higher on their centrality measures are more prone to be imbued with a pro-diversity logic, and consequently more likely to pass this logic on through its domestic network. This is because US or European partner firms in highly central network positions help Japanese firms perceive diversity as more beneficial, which contributes to a change in their core assumptions leading to acceptance of the pro-diversity logic.

This, in turn, might also lead to imitating behavior at Japanese organizations as they try to recreate the diverse networks in their domestic alliance network that they have seen around international partners. Consciously engineering a structural hole rich network would quite difficult without knowledge of the overall network structure. Therefore, as a first step, it is more likely that firms simply resort to choosing seemingly more diverse partners, including international ones (their domestic network might or might not become more diverse). As these firms might have a legitimacy benefit (Stuart, 1998) for being international, their domestic partners in Japan might start to imitate them, thus leading to higher levels of partner diversity in their domestic networks in a future point in time. However, some of these firms might be less prestigious, so that they might have fewer international partners but more diverse domestic ego-networks. The overall network slowly and gradually becomes more diverse, and this filtering effect is what slowly transforms the perceptions and assumptions of Japanese managers. Thus, we propose that:

Hypothesis *Partnering with foreign firms that are in central positions in the*

international network imbues Japanese firms with a pro-diversity logic (at time t), which leads to higher diversity in their domestic partner's ego-networks (at time t+1).

In the next section, we discuss what datasets we use for the international and domestic networks.

8.3. Methods

8.3.1. Data

This study focuses on the life science sector in Japan and relies on multiple datasets to trace influences between networks. The first dataset (what we here call the Kansai dataset) actually includes two sub-datasets: a relational dataset for the network and a firm-level dataset for the firms contained in the network. These datasets are explored in more detail in Wakabayashi (2013a) and Wakabayashi (2013b).

This domestic network dataset has been assembled from joint patent data of organizations in the life sciences industry by Wakabayashi and his workgroup (myself included). This data was obtained from the Japanese Patent Office database. The dataset focuses on firms that are located in the Kansai area, which is the most dynamic biotechnology cluster in Japan with such pioneering innovations as the well-known iPS cell technology, and we limited the scope of our search to 2000-2007. We assumed that these joint-patents are the results of previous alliance relationships. Based on this assumption, this database can be seen as an R&D alliance dataset. Using this alliance data, we assembled network matrices for two four-year periods, 2000-2003 and 2004-2007, respectively, including all of the above organizations. This gave us an initial sample of 1558 firms for two periods.

For this sample, organization-level data has been collected from multiple sources, but mainly from the Japanese Patent Office database. Other sources include the *EDINET database*, the *eol database*, the *Teikoku Databank*, and the now-discontinued *NEXT Yuho Kakumei* database. In some instances, webpages and other available documents were used to obtain missing data. We collected attribute-based data for the firm-level dataset and added network variables computed from the relational dataset using UCINET (Borgatti, Everett & Freeman, 2002). The dataset contains 893 organizations, including 779 firms, universities, research institutes, non-profit organizations, and government institutions. Due to missing or incorrect data, the final working sample contains 1159 organizations.

The other main dataset (what I call the international dataset) is a relational dataset of more than 2000 firms based on the widely used Bioscan data (see Schilling, 2009). I used this dataset because Powell et al. (2005) showed that there is a pro-diversity logic behind the evolution of the network. My interest behind the hypothesis was whether this pro-diversity orientation influences the Japanese (what I will call domestic) network through network bridging alliances and whether it can be passed on to other networks through micro-dynamic processes. While the Bioscan

database is mainly centered around US firms, some other countries are represented as well. I focused on the approximately 100 Japanese firms that are contained in the database and matched them to our other dataset (the Kansai dataset), which resulted in a 57-firm sample for each period. Although there was a little overlap between the two networks, as Bioscan also reported alliances between Japanese organizations, the extent of the overlap was negligible.

Using the full international relational dataset, I computed network variables with a 5 year lag (1995-1999 (Bioscan) for the 2000-2003 period (Kansai); 1999-2003 (Bioscan) for the 2004-2007 period (Kansai)). My aim was to compare how effects from time t influenced the domestic network at t+1. As seen from the above, I had two initial "t"-s depending on the panel. I will use the subscript j to refer to the panel (t_j). To help with understanding, I use t for the two panels from Bioscan (t_1 =1995-'99 and t_2 =1999-'03 respectively) and t+1 for the two panels from the Kansai dataset (t_1+1=2000-'03 and t_2+1=2004-'07). To make the theoretical exposition simple, I will leave out the subscript to talk about t and t+1 in general, but the reader should keep in mind that these "t"-s combine two-two panels and should be t_j and t_j+1. This procedure gave us a final working sample of 97 observations for my cross-network analysis. I also added firm-level data for these 97 network-bridging organizations collected from the Kansai dataset.

It is important to note here that being part of the international network does not mean that firms are definitely international or that they should have overseas offices, but that they actively pursue R&D alliances with foreign firms located in a larger international network. Most firms in the domestic sample have been international in the former sense (overseas production, sales offices, marketing, non-R&D alliances, joint-ventures, investments, etc.), but the same firms may still be reluctant to be part of open innovation networks involving international partners.

In conclusion, I focused on 1) the network of alliances between Japanese domestic firms (i.e., domestic firm-domestic firm network), for which I used the Kansai dataset, and 2) the network of alliances between international firms (i.e., international firm-international firm network) for which I used the Bioscan database. This international network contained Japanese firms as well, which provided the bridge between the two networks. This enabled us to look at the relationship between the international and the domestic networks. I focused on this relationship because the two networks are relatively far from each other.

Other studies might investigate relationships between two domestic networks (e.g., the domestic nanotechnology network and the domestic biotechnology network) or between international networks (e.g., the international chemicals industry and the international car industry). However, these relationships might be much more connected, thus making inference more difficult. The present study focuses solely on the influences between an international (i.e., US and EU-centred) network and a domestic (i.e., Japanese) network.

8.3.2. Variables

Dependent variable

My dependent variable is *domestic partner diversity* at time t+1. I was interested in how partnering with highly central firms in the international network (at time t) influenced domestic partners and especially the diversity of their ego-networks at t+1. For this, I computed the average value of a network bridging firm's domestic partners' ego-network diversity. A network bridging organization (Japanese organization A) is an organization that was present in both the domestic and the international dataset (i.e., one of the organizations in my final working sample of 97 organizations). This organization then had partners both in the international network (at t) and in the domestic network (at t+1). For this variable, I focused on the domestic (t+1) dataset.

The computation of the variable followed several steps. First, I looked one by one at the network bridging organization's collaboration partners and counted the number of heterogeneous alliances of each partner in the domestic network (t+1). A heterogeneous alliance was such that the two firms forming the alliance belonged to separate organization fields (a different industry or a different institutional setting, such as universities, government organizations, and research institutes). By doing this, I obtained the number of heterogeneous ties for each partner of Japanese organization A. Then, for each network-bridging organization (i.e., Japanese organization A), I computed a mean value from all the heterogeneous tie scores of each partner.

$$Domestic\ partner\ diversity_{i,j} = \frac{\sum_p X_{i,j,p}}{p}$$

Where $X_{i,j,p}$ is the number of heterogeneous partners for network bridging organization i's partner p in the domestic network (t+1 only), from panel j. For panel j=1, I used data from the 2000-2003 period (same as t_1+1 above), and for panel j=2 we used data from 2004-2007 (same as t_2+1 above). Both of these panels constitute the conceptualized t+1 (i.e., domestic network).

Independent variable

I only used a single independent variable for this study. This was a centrality measure computed with UCINET from the international network dataset at time t. I computed *eigenvector centrality of foreign partners* for each network-bridging Japanese firm. Then, I averaged these to get one value for each network-bridging firm, similar to the method we used above. I related this variable to my dependent variable at time t+1 to see how experience gained from partnering with highly central firms translates to more diverse partner ego-networks in the future domestic network.

The assumption behind this was that highly central organizations are more likely to possess the pro-diversity logic (Powell et al. 2005), have more clout in the field, and thus will be more likely to influence the Japanese network bridging organization. Measuring the diversity of the international partners directly would perhaps be a more rigorous method, but we had to rely on

network centrality because of the limitations in the dataset. Network centrality, however, seems to be a key factor behind the pro-diversity logic, as Powell et al. (1996) showed it in their study.

Control variables

I used a number of control variables to control for confounding factors and alternative hypotheses in both stages of the model.

I used firm-specific variables, such as *firm age* and *firm size*. These were necessary because younger firms might be more conducive to change, and larger firms might have the resources and the reputation to participate in the international network of alliances. I included a *time dummy (j)* to identify the panel. I also included performance variables to account for firm effects (*sales*, *profits*, *patent applications,* and *patent grants*).

Finally, I looked at network variables to characterize the network of the firms. *Eigenvector centrality* and *structural hole spanning* were both computed with UCINET. Eigenvector centrality is a measure that tries to capture the extent to which a certain node is important in a network). Structural hole spanning nodes are nodes with access to non-redundant information and brokerage benefits by joining unconnected sub-networks. Eigenvector centrality was simply computed using the built-in UCINET command, while for structural hole spanning, I used Burt's constraint value that we subtracted from 1 (Zaheer & Bell, 2005).

I also computed a *heterogeneity measure for the network bridging firm's domestic ego-network* by counting the number of ties a firm had. Next, I added a variable that measured the *average of the focal firm's partners' eigenvector centrality*.

Finally, I also used variables that count the number of different types of ties (i.e., alliances). *Ties to Large Enterprises* counted the number of large firms a network bridging firm (Japanese firm A) collaborated with. *Ties to SMEs* counted the number of small and medium-sized enterprises, and *ties to PROs* counted the number of public research organizations and universities. The definition of SMEs was based on the number of employees. In this paper, companies with 300 or fewer employees are treated as SMEs. I used this cut-off point because I looked at Japanese firms.

I used these to characterize the focal firm's ego-networks further and account for network and alliance-based effects. I standardized all variables and implemented logarithm transformations where necessary.

8.3.3. Statistical analysis

We used a two-stage Heckman selection model. This was necessary to control for selection bias and deal with endogeneity. Japanese firms that are present in the international network might have some special properties that make them more likely to pursue diverse alliances and collaborate

with foreign firms (e.g., are more open to diversity in the first place). These kinds of more open firms would be more likely to have diverse and central partners in the international network and thus more likely to pursue diverse alliances in the domestic network as well. This might lead to self-selection bias and make the sample non-random. In order to check whether there is such selection bias, we employed the Heckman selection model.

The first stage of the Heckman selection model tested the factors that decide participation in the international network. The second stage tested the effect of international partner centrality at time t on domestic partner diversity at time t+1. As the reader can see in the correlation matrices in Tables 1 and 2, multicollinearity was an issue.

I excluded highly correlated variables to test for any change in overall significance levels. I also ran separate tests employing GLS panel regression models that can better deal with multicollinearity. These robustness checks revealed that multicollinearity was not a major concern. I used standardized variables and a pooled sample in the regression models. Finally, I also compared my result to that of a simple OLS regression (with robust and clustered errors) using a partly different set of variables (we tested other relevant network variables, such as structural holes), which confirmed my conceptualized mechanism.

8.4. Results

Table 6 provides an overview of the descriptive statistics and correlation matrices. The correlation matrix reveals a few highly correlated variables. The previous section explained how we dealt with this multicollinearity.

Table 5 Descriptive statistics and correlation matrices for the first and second stage

No.	Variable	N	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11
1	Firm Age	1680	45.3619	31.5099	1										
2	Firm Size (capital stock logged)	1344	10.9728	3.2401	0.4608	1									
3	Firm Performance (Sales)	1301	17,800,000.0000	104,000,000.0000	0.1136	0.2696	1								
4	Firm Performance (Profit)	1181	476,506.2000	4,159,857.0000	0.2173	0.2002	0.4296	1							
5	Centrality (Eigenvector)	1786	0.0095	0.0321	0.1132	0.2615	0.006	0.058	1						
6	Structural hole spanning	1786	0.1024	0.2518	0.1671	0.3149	−0.0262	0.0213	0.4219	1					
7	Number of Patent Applications	1786	1.6657	3.6905	0.1485	0.2675	−0.0078	0.0018	※0.6802	0.639	1				
8	Number of Granted Patents	1786	0.1293	0.4397	0.0961	0.1613	−0.0147	−0.032	0.4347	0.3705	0.6039	1			
9	Ties to Large Enterprise	1786	0.8555	1.4986	0.1597	0.2578	−0.0136	0.0331	0.629	0.6626	※0.8147	0.4492	1		
10	Ties to Public Research Organization	1786	0.2816	0.9624	0.1086	0.2427	−0.0004	0.05	0.5889	0.4661	※0.6951	0.3706	0.4508	1	
11	Ties to SMEs	1786	0.2648	0.5873	0.0728	0.0681	−0.0086	−0.0097	0.212	0.3767	0.4516	0.2361	0.6144	0.2129	1

Note: ※ In order to check the robustness of the results, separate models were tested that exluded highly correlated values, but as this did not change the overall significance levels in any excessive way, all variables were included in the final model. We also considered models with logs of variables with large values.

No.	Variable	N	Mean	S.D.	1	2	3	4	5	6	7	8	9
1	Firm Age	114	65.7719	26.6043	1								
2	Firm Size (Capital stock logged)	106	13.7330	2.2980	0.4608	1							
3	Number of heterogeneous ties	112	2.2500	3.0000	0.0845	0.1395	1						
4	Centrality in domestic network (Eigenvector)	114	0.0316	0.0596	0.1132	0.2615	0.5858	1					
5	Centrality of domestic partners (Eigenvector)	114	0.0518	0.0825	−0.0227	0.0856	0.1599	0.5419	1				
6	Ties to Large Enterprise	114	1.7719	2.2461	0.1597	0.2578	0.6565	0.629	0.1502	1			
7	Ties to Public Research Organization	114	0.8860	1.9677	0.1086	0.2427	※0.8281	0.5889	0.1991	0.4508	1		
8	Ties to SMEs	114	0.3421	0.5924	0.0728	0.0681	0.5405	0.212	−0.0533	0.6144	0.2129	1	
9	Centrality of partners in the international network at t (Eigenvector)	114	0.0113	0.0206	−0.0822	0.1123	0.0719	0.0232	−0.0521	0.0348	0.098	0.1227	1

Note: Descriptive statistics for firms that are both in the international and domestic network dataset. ※ In order to check the robustness of the results, separate models were tested that exluded highly correlated values, but as this did not change the overall significance levels in any excessive way, all variables were included in the final model.

The table below gives the results of the first stage of the Heckman selection model. As expected, older and more established firms are more likely to be present in the international alliance network, while firms with ties to mostly SMEs are less likely to be involved in this international network. We also observed that firms in structural hole spanning positions - a position that may imply that they are more equipped to perceive diversity as beneficial - are more likely to be in the international network in the first place. This first stage model controls for the adverse effects of potential endogeneity and sample selection bias.

Variables	1		
Age	0.1451	(0.0886)	*
Capital (log)	0.4867	(0.0876)	***
Sales	−0.2674	(0.1833)	
Profit	0.0153	(0.0811)	
Year dummy	−0.1257	(0.1269)	
Centrality (Eigenvector)	0.0505	(0.0595)	
Structural hole spanning	0.1860	(0.0763)	**
Number of Patent Applications	−0.0896	(0.1160)	
Number of Granted Patents	−0.0287	(0.0653)	
Ties to Large Enterprise	0.1076	(0.1235)	
Ties to Public Research Organization	0.0903	(0.0694)	
Ties to SMEs	−0.1187	(0.0733)	*
Constant	−1.4922	(0.2040)	***
N	1159		
Overall chi square	227.32***		

*Notes: * p<0.1, ** p<0.05, *** p<0.01; All variables are standardized and mean-centered.*

Table 6 Heckman selection model for participation in the overseas network (first-stage)

The second stage, then, looks at the determinants of partner heterogeneity. The Mills lambda showed that selection bias was not as influential as expected.

I start with the interpretation of the control variables in Table 7. These controls are important to test whether it is merely the domestic network structure that makes the firms more diverse or whether the influence is actually from the international network. First, we found that younger firms are more likely to have partners with diverse ego networks. This is quite natural as older firms might tend to be more conservative, having more ingrained ways of doing things. The time dummy (j) also tells us that firms in the second period tend to have partners with more diverse ego networks. While this is not ultimate proof, this is also in line with our expectation that both heterogeneity and the number of firms with pro-diversity logic grow with time.

Next, I turn to network variables. I found that the domestic eigenvector centrality of network-bridging firms has a negative relationship with domestic partners' ego network diversity. This can simply be interpreted as more central firms having partners that are less central and with fewer ties. Less central partners with few ties will probably have lower average partner ego network diversity due simply to the fact that they have fewer ties. In contrast to this, we find that the

centrality of network bridging firm's domestic partners does have a positive relationship with partner ego network diversity.

Variables	Model 1			Model 2		
Firm Age	−0.9010	(0.5307)	*	−0.73878	0.518545	
Firm Size (Capital stock logged)	1.4084	(1.1012)		1.042255	1.082309	
Time dummy	1.9918	(0.7860)	***	2.164708	0.765907	***
Number of heterogeneous ties	0.4566	(0.3787)		0.491749	0.370552	
Centrality in domestic network (Eigenvector)	−0.8203	(0.3665)	**	−0.82653	0.353831	**
Centrality of domestic partners (Eigenvector)	4.7134	(0.3986)	***	4.800224	0.392965	***
Ties to Large Enterprise	0.1703	(0.6080)		0.11979	0.586816	
Ties to Public Research Organization	0.0502	(0.4403)		−0.03565	0.429087	
Ties to SMEs	−0.1140	(0.4884)		−0.1615	0.472364	
Centrality of partners in the international network at t (Eigenvector)				0.738588	0.372692	**
Lambda	2.4296	(2.4515)		2.0417	(2.3773)	
Constant	−4.0885	(4.8310)		−3.50427	4.677327	
N		97			97	
Chi square		212.60***			227.32***	

*Notes: * p<0.1, ** p<0.05, *** p<0.01; All variables are standardized and mean-centered. All variables are measured at time t+1 expect international partner centrality, which is measured at time t.*

Table 7 Heckman selection model for partner diversity in the domestic network

This, again, is quite natural as more central nodes are more likely to be more diverse than non-central nodes with fewer ties. As such, if the network bridging firm's partners are highly central, then the overall diversity of the partner's ego network can be expected to be higher.

Finally, I find that the independent variable, *centrality of partners in the international network at t*, is significant, thus providing support for my sole hypothesis. It is important to keep in mind that this finding needs to be interpreted along with the logical framework that informs the analysis. This single variable could not be explanatory if we did not establish prior to the study its theoretical foundations. This theoretical basis tells us that central firms in the international network do possess a pro-diversity logic and that they do have the clout to influence other firms. My findings are based on these prior assumptions. Though these are assumptions, there there is ample evidence in the literature that they can be considered reasonable assumptions. Another important theoretical mechanism at play was explained in the theory section and is based on the framework of fields set out in PART I. According to this, behind the larger-order organizational network variables are fields of individuals. Micro-processes of logic filtering through boundaries is behind the gradual change of structural field characteristics.

8.5. Conclusion

Japanese firms that had partnered with central firms in the international network (at time t) have partners with more diverse ego-networks in the domestic network (at time t+1). I proposed a theory that this happens through micro-level influences. While I did not empirically test the mechanism itself, the control variables and the Heckman model lend some support to my theory.

For one thing, the network gets more diverse over time (based on the significance of the time dummy variable). We also know from Powell et al. (2005) that there is a pro-diversity logic involved in the formation and evolution of the international network (which was based on the same Bioscan dataset).

I also found partial evidence from the literature that the Japanese domestic network used to have fewer alliances, which again means that it used to be less diverse, mainly focusing on in-house R&D (Asakawa, 2006; Takatori, 2009). This assumption, however, is probably only valid for the life science industry. Nevertheless, these points suggest that there could have been some influence from the alliances with the highly central firms. With time, these influences probably also contributed to the changing alliance patterns of the Japanese life science network. Takatori (2009) also showed that there had been a general trend of a growing number of alliances, and we showed that ego-network diversity also grew in the 2000s.

In this study, I focused on network change as part of the agenda set forth by Ahuja et al. (2011). Instead of looking merely at internal or external factors (Madhavan et al., 1998; Powell, 2005) influencing network architectures, I studied how a remote network can have an effect on another network influencing shared nodes that become the facilitators of change through a field boundary. As a major contribution, I showed that partnering with highly central nodes in a network with certain logic (in this case, pro-diversity logic) can influence another, relatively distant network if the focal firm serves as a bridge between the two. This can mean that bridging ties can transfer not only nodal contents (such as knowledge or technologies) but also features of the overall network structure through a certain logic.

The major issue in our analysis was endogeneity and selection bias. It might be the case that firms with pro-diversity logic are more likely to go overseas, and thus we cannot talk of any kind of real influence. I implemented a two-staged selection model and added crucial controls in an effort to avoid this.

However, even if this given situation was at work, the 'filtering effect' still remains relevant through the process of legitimization. I consider here this alternative mechanism. Firms possessing pro-diversity logics in the first place might not be accepted and emulated at the beginning; however, after partnering with highly central global firms, they gain legitimacy. This can enable them to influence their domestic networks further, spreading pro-diversity logic. Either way, the remote network, and its structure do exert an influence on the domestic network, and our findings stay relevant.

Another objection could be that the pro-diversity logic is not only transferred from the firms in the international network but mainly arise spontaneously in the domestic network. This can happen through different mechanisms, such as a rational realization of the benefits of having more diverse partners, a necessity in light of stagnating performance, or even through US-influenced

MBA education. Moreover, Asakawa (2006) talks about a radical shift taking place through the spread of genomic medicine, which requires more radical forms of innovation. He also explains that the old type of pharmaceutical innovation is much more incremental in nature. However, even if multiple mechanisms are at play, it is likely that either our pro-diversity logic mechanism or the alternative legitimacy mechanism still have an important role, as US-based biotechnology has been at the forefront of technological progress, and it is quite unlikely that partnering with key players in a high-status industry (with firms such as Genentech, Pfizer, etc.) would have no influence on firms that are still more or less in a catch-up phase. However, these world-class firms are shown to prefer partnering with dissimilar organizations (Powell et al., 2005).

The key contribution of my study is that it calls attention to the importance of other fields exerting constraining or enabling forces on a focal field through micro-dynamic processes and that the two fields underlying network structure play an important role in this. This is essential for understanding network change as it is different from internal forces and simple exogenous shocks. This gradual filtering effect is a long-term process and can permeate relatively remote networks. As the connection between networks becomes stronger, this filtering effect can increase in intensity. This is not to say that two-way and more complex back-and-forth influences cannot exist, as they most certainly do, but the legitimacy argument predicts that networks with nodes that possess higher legitimizing power might have a stronger influence, resulting in one direction of the flow to be more pronounced.

One general implication of this is that network change can potentially be influenced (or controlled) by joining networks through shared nodes and adjusting the bandwidth of access. On a more practical level, this means that change is more likely to happen from network-bridging nodes. It is necessary to note that these kinds of changes might not be beneficial to domestic firms in all cases, and careful consideration of these ongoing processes might be necessary. Nevertheless, partnering with internationally experienced firms in the domestic arena can speed up the transfer of global know-how.

Future studies might benefit from building a multi-step model to trace filtering effects. Furthermore, I only looked at alliance logic (i.e., the pro-diversity logic), but the influencing effects of other nodal contents might also be interesting to analyze.

Traditional studies on knowledge transfer and learning (cf. Argote & Miron-spektor, 2011) focus on how firms can learn and improve their innovation performance. This paper, however, traced how networks themselves can be influenced through network-bridging alliances. Combining the two concepts would almost certainly yield exciting results.

More focus is needed on a nuanced view of boundaries. Investigating the filtering effect based on boundary structure would also be an interesting avenue of research.

9. Case III – Boundaries fading: Improving a firm's position in a different field through strategic M&As in the life sciences[201]

9.1. Background

My third study is an extension of the case of filtering. This case goes a step further and asks what happens when two fields begin to blend. In this case, the actual blending happens through corporate mergers and acquisitions across field boundaries (in this case, national borders). In the previous study, my focus was on structure and logics. Here more emphasis is put on resources and 'capital'.

Research on mergers and acquisitions (M&A) strategy has proliferated in the literature in the last two decades. There is no place for an extensive review; neither is it very important to deal with the intricate details of M&As. M&As have been studied through a strategy framework, and it has been done mostly within the realm of finance. From a strategy lens, the traditional reasons for engaging in M&As are clear. Just to mention a few basic strategies, the common reasons are geographic extension, vertical integration, the extension of product lines, relieving overcapacity issues, R&D, and something as non-strategic as a mere investment of excess cash (Bower, 2011). In the last two decades, M&A has become a key strategic choice in a large variety of industries.

In this paper, however, we propose a novel strategic motivation for M&As. We argue that along with the above-mentioned traditional strategies, M&As can also be undertaken and analyzed with a field or network perspective. Whereas M&As are recognized as tools for extending a business, they can also be thought of as particular tools to improve an organization's position within an institutional field and build specific network positions. Thus, a number of strategic M&As can help a company move towards a more beneficial position and gain access to vital resources embedded in the network through social capital. Boundaries can be weakened. Fields, as I defined them in Part I, have an inherent hierarchical structure, where some actors are more prominent, having more connections and more resources. Competition often plays out in these fields as well as in markets. I hold that, in our imperfect economies, both economic and social factors are behind firm performance. This is especially true for R&D intensive industries, where access to knowledge and technology is essential. This access is provided through networks of relationships. Entering these networks can be daunting for outsiders, but gaining a central position is even more difficult. This is why I am interested in how companies can do this through M&As.

I ask the following questions: Can poorly embedded firms who have other forms of capital in

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a field increase their position through M&As? How can firms utilize social capital available to other firms? Can they access it through mergers and acquisitions?

The first questions will be analyzed through a quantitative study, while the remaining two need to be answered through a qualitative research setting. In my investigations, I look at top firms in the Japanese life science industry and try to find out how these firms can become more central in the international network, where they do not occupy the most central positions at the moment. Before moving to the analysis, however, we first have to define some key concepts for explaining our theory.

9.2. Literature and hypothesis

First, it is useful to clarify a few basic concepts in the M&A literature. I do not intend to give a comprehensive review here -- I only look at the theories and strategic motivations for M&As. Trautwein (1990) provides an overview of the different theories describing why companies execute mergers and acquisitions. He talks of efficiency theory, which views M&As as a means to achieve synergies. Synergies are often cited as reasons for M&A; however, the evidence for synergies is lacking. Then, there is monopoly theory where mergers are executed to gain market power; valuation theory in which managers are assumed to have better information about company value than the public; empire-building theory proposes that managers maximize their own utility instead of that of stockholders'. Then, there is process theory that can be considered a more sociologically-engaged explanation based on the fact that managers' rationality is accepted as bounded and organizational routines and structures play a major role in selecting targets for M&A. Finally, we can talk of disturbance theory where external shocks, such as economic disturbances start a merger wave. Trautwein (1990) finds that most of these theories are insufficient by themselves, and we can add that it is quite likely that a combination of these is at work.

Bower (2001) found that the main purpose of M&A can be put into five distinct categories. Overcapacity M&As take place when a company buys another company to solve overcapacity issues by eliminating capacity, gaining market share, and streamlining operations. Geographic roll-up M&As occur when a successful company buys another to expand geographically. Product or market extension M&As add new products to an existing product line or extend the company's international coverage, M&As as R&D take over the role of in-house research and development to achieve greater speed. Finally, industry convergence M&As aim at establishing a foothold in a new emerging industry (Bower, 2001).

In this study, we propose a different strategic consideration for doing mergers and acquisitions. It is grounded in the new institutionalism in organizational theory (DiMaggio & Powell, 1983). We propose that firms poorly embedded in a certain field, lacking crucial social

capital and access to the best resources, can improve their positions within the field through strategic mergers and acquisitions and can successfully fight off threats posed by other competing members of the field. Through this, they can weaken the field boundaries that prevent them from accessing capital and being accepted as a core member of the field. However, this strategy is long-term and needs to be carefully implemented lest the firm loses key social capital access through reorganization and key personnel loss. M&As, therefore, do not guarantee success; it is only a tool that can be put to use.

Before further outlining this theory, we first need to look at some of the key concepts from PART I and show how they are applied in the context of this study.

Social capital has been used as an umbrella term, but here I define it in line with PART I as resources embedded in a social structure that are accessed and/or mobilized in purposive action, as Lin (2001) suggested. Keep in mind that this definition is quite different from the one proposed by Coleman (1988) but similar to Bourdieu's original idea of social capital as embedded resources (Bourdieu, 2005). The type of social capital I try to use here is analyzed at the individual level and looks at what type of resources a firm can access and what other benefits the firm's unique position within a field or network provides. It is both structural (as it is embedded in structure) and qualitative (as it cannot always be easily quantified).

For successful innovation, intra-organizational resources are rarely enough. This means that companies need to look outside of their organizations to find embedded resources and utilize them through collaboration or prior-acquisition Lin (2001). This is also the thesis of the older resource-based view and population ecology. Social capital plays a clear role in successful innovation in the biotechnology and pharmaceutical industries.

I will discuss now what the actual resources are. Again, here we follow Bourdieu and Lin, who conceptualize social capital as embedded resources. On a most basic level, we can talk about all kinds of economic capital, a small part of which would be rent-producing products (in the life science industry, this would be licensable medicines or purchasable medicine products that a firm can then develop further or sell on its own to produce rent). Second, another resource would be human capital or human resources and their skills and knowledge, such as R&D personnel, engineers, star-scientists, and talented managers. A third important type of resource would be financial capital or access to financial markets through banks, venture capital, or angel investors. Fourth, there is another set of resources in the form of intellectual property and technology, including proprietary technologies and even more material manifestations like buildings and specialized equipment, though this can also be seen as a subset of economic capital. Fifth, we can talk about knowledge, which can be procedural & technology-oriented. This is organization-level or explicit (i.e., transferable). A special subset of this would be field-specific knowledge that helps the actors to navigate within a field, but this again might be part of the individual, so perhaps it is

better to add it to the second type. Finally, there is access instead of resources. Access cannot be categorized among resources, but they are very important. One can think of sales networks and access to markets where products can be sold.

We can realize that when a company acquires another company, then it is not just the company's immediate resources that are being acquired, but potentially its access to other capital and its position within the network.

A wide breadth of research has proved that certain network positions provide unique benefits to firms Coleman (1988), Burt (1992), Powell, Koput, Smith-Doerr (1996), Ahuja (2000), Baum, Calabrese & Silverman (2000), Zaheer & Bell (2005) as well as certain types of relationships such as strong ties, weak ties and bridging ties (Granovetter, 1973; Burt, 1992; McEvily & Zaheer, 1999) and structural forms (Krackhardt, 1999). Of course, the social capital of a target is not easily measurable, and neither does it remain the same after a merger. Some social capital might instantly dissolve, especially when the buyer is a foreign company or when the company is involved in a hostile takeover. However, some specific forms will most likely remain and will become available to the new firm. Based on Lin, this is just an opportunity, however, and in many cases, it must be actively pursued in the right manner.

So far, we have been looking at social capital and the firm from an organization-level perspective. However, the firm is not alone, and the network is not ad-hoc. We use the concept of field to try to conceptualize the structure that the firm is embedded in. The field concept from PART I is a social space made up of different actors (such as individuals or organizations) where social norms and the rules of the game are set, maintained and contended. There is a clearly (or vaguely) defined hierarchy where some players are endowed with more resources (i.e., different forms of capital) than others. Fields are nested in one other, and parallel fields are also possible. These parallel fields can then compete and form a new, larger field. Organizations are fields themselves.

We have seen that the relations of forces within the field (Coleman, 1988) are difficult to map out. Instead of trying to do this, we resort to network theory[202] and use a network of alliances[203] between the most important firms that make up the field to approximate its underlying structure. Unfortunately, it is just one structural representation of the field. This is far from an adequate representation of what goes on in the real field, but we lack better alternatives.

It is important to mention that this conceptualization probably works because of the life science industry's characteristics, especially the prescription medicine field. It is an R&D intensive industry where products (prescription medicines) can be thought of as the source of further economic capital (profit). Granted patents and approvals from state institutions (such as

[202] See Nohria & Eccless (1992), Borgatti, Everett, Johnson (2018).
[203] For more on these kind of studies see Gulati (1998), Hagedoorn (2002), Schilling (2009) or the relevant sections in PART I.

the FDA in the US) are necessary. The underperformance of in-house R&D and the spread of university-originated technologies all necessitate more collaboration. Powell et al. (1996) located innovation taking place in the network instead of within individual firms. Because of these features of the alliance network, it is not unreasonable to accept the alliance network as a structural representation of the field.

Next, we have to move back from the organizational field level to the level of the individual firms that occupy it. It is important to remember that Fligstein and McAdam (2012) thought that fields themselves were embedded in larger fields and had different relations of power within themselves. We keep this conceptualization and treat firms as fields within a field. In particular, our focus will be exclusively on relatively poorly embedded firms (Ahuja, Polidoro & Mitchell, 2009), but firms that do not lack other forms of capital.

Here we again draw on the network representation and think of more central positions within the field as roughly corresponding to increased power in a field through better access through social capital to different forms of embedded capital. In our context, this crude approximation is more or less reasonable.

Central positions have been shown to confer benefits on the firms that occupy them (Baum et al., 2000; Cattani, Ferriani, Negro, Perretti, 2008). Networks do not remain static but are dynamic and subject to change (Ahuja, Soda, Zaheer, 2011), just like fields. The question then becomes how a poorly embedded firm can achieve a more beneficial or more central position. Becoming more central in a network might not necessarily translate into better results but would probably provide better access to much-needed resources and dissolve some of the effects of a strong field boundary.

From the literature, we know that poorly embedded firms tend to form asymmetric alliances with larger, more central firms, and they usually own minority stakes in joint-ventures (Ahuja et al., 2009). In a study of smaller German biotechnology firms, Al-Laham & Amburgey (2010) found that alliances with international partners enhance the movement towards a more central position, while multi-partner alliances inhibit it. This suggests that a more open network can be beneficial and social capital from alliance partners can help.

If alliances can help these firms achieve a better position within the network, then we can assume that M&As can help and, in a way, more so. I defined more central network positions as more influential positions within the field. Being closer to the center, accessing information quicker, and utilizing existing relationships for future deals lead to more power and better results making the firm's new positions more solidified among the incumbents. Therefore, I propose that,

Hypothesis 1. The more outward M&As a poorly-embedded company engages in, the more central it becomes in the international network.

9.3. Methods for the quantitative study

9.3.1 Research setting

Our choice of the research setting reflects that the Japanese life science industry is still in a catch-up phase Asakawa (2006). The Japanese pharmaceutical industry started as a collection of merchant families trading medicine. A handful of merchants turned from trading traditional Japanese and Chinese medicine towards importing and selling more efficient Western-style medicine around the beginning of the previous century. As these merchants formed companies in the new Meiji era, they established a new field by gradually incorporating research and development functions in the 20th century. However, the field has started relatively late compared to the industry in Europe and North America (Asakawa, 2006), and until recently, it has lagged behind in the recent revolutions in biotechnology.

Another reason for choosing this industry is that, as mentioned in the study on filtering effects, the Japanese domestic field is not fully integrated into the global network. Domestic networks are often characterized as somewhat closed and highly cohesive (Lincoln & Guillot, 2011). However, this has been changing in recent decades with more integration into the global field. The life science industry is also a good example of the on-going internationalization and the implementation of global practices, such as alliance management and mergers and acquisitions.

Nevertheless, the closed Japanese fields can be seen as lacking access to the most important resources in the global field, and gaining resources often means that the company has to settle on second-rate resources or pay a premium.

Traditionally, most firms relied on their in-house R&D capabilities and refrained from more open, network-based innovation. Not a few internal laboratories were known for their blockbuster products, but recently their performance has fallen. Companies began to form alliances to gain access to diverse networks and coveted resources developed by biotechnology firms and other organizations in North America and Europe.

Although Japanese firms were relative late-comers in the life science scene, they also increased the number of their alliances (Asakawa, 2006) and later attempted to engage in mergers and acquisitions.

These M&As are the focus of this study. We are especially interested in outward M&As that constitute a special point of access to the different forms of capital embedded in the international network. Access through alliances or joint-ventures is relatively limited, while acquisitions can give full authority over the resources. A question we attempt to investigate in our qualitative study is whether the buyer can indeed access the social capital available at the target after the acquisition.

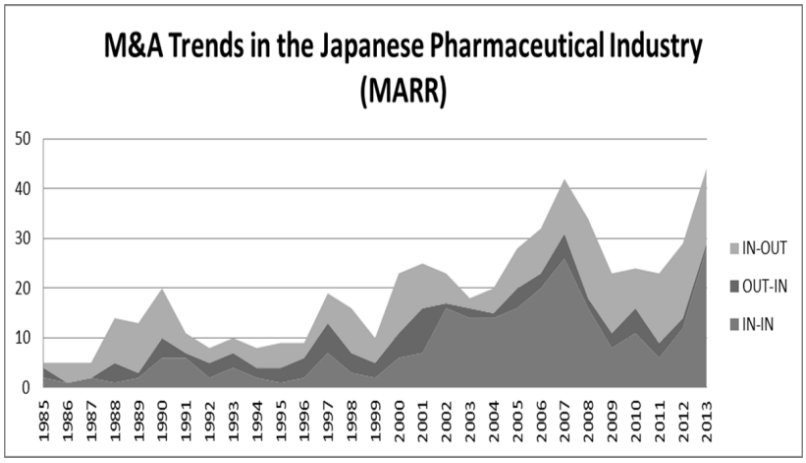

Table 8 M&A trends in the Japanese pharmaceutical industry (Source: MARR)

The graph shows how M&A activity increased in the Japanese life science industry. Since the 1980s, there have been many outward M&As undertaken. At first, these were acquisitions of a foreign business unit in Japan, a joint-venture stake buyout, or just a simple purchase of a minority stake. However, in the 2000s, a new trend of acquiring whole companies became mainstream.

Takeda, the industry leader among Japanese pharmaceutical companies, is one of the foremost proponents of this strategy, but most of the major companies have attempted or been the target of buyouts. The graph above also shows an increase in the number of foreign firms buying Japanese assets. Chugai's partnership with Roche is a case in point. The domestic companies viewed this as a threat to the industry, which led to a major reorganization of the industry in the second part of the 2000s. Major mergers followed each other (Daiichi and Sankyo formed Daiichi-Sankyo, Fujisawa, and Yamanouchi merged to create Astellas, Tanabe, and Mitsubishi became Tanabe-Mitsubishi, and Dainippon Sumitomo was born through another merger) and the number of OUT-IN M&As dwindled. The major strategy in the industry today is to create world-class pharmaceutical firms that can compete in the global life science field. Our study is looking at these crucial moments.

9.3.2. Data

We used a number of data sources to assemble our dataset for the test of our single hypothesis. First, a network dataset of Japanese life science firms was created[204]. We collected patent data from the Japanese Patent Office and built a database based on joint patenting, theorizing that firms patenting together were probably in a research alliance. Based on these relationships, we created our relational dataset (i.e., network matrices). The firms represented in his dataset were then

[204] See the previous study for references and more details.

identified, and firm-level data was accumulated from different sources[205].

For the international alliance network, we relied on the Bioscan database used widely in the literature (Schilling, 2008; Powell et al. 1996). I created a network dataset for the whole international network for the preceding five-year period for every year. This dataset was made up of more than 2000 companies and included universities and research institutes, and other government organizations. I then identified 55 companies present in both datasets and complied a new combined dataset for two panels (2000-2003 and 2004-2007), bringing the number of observations up to 110. I collected network data from both networks and added them to our firm-level data. A large part of the data was used in the previous study. In this study, the above-mentioned network and the firm databases were combined with newly collected data from the MARR M&A data books. This data source lists every M&A deal Japanese firms engage in in a given period.

9.3.3. Variables

Dependent variable

As we mentioned earlier, we used firm-level data (size, age, etc.) and two sets of firm-level network data from different networks (domestic and international) and time periods. Network data was computed with UCINet (Borgatti, Everett, Freeman (2002). My dependent variable is the firm's eigenvector centrality computed from the international network of the following five years (for 2000-2003, it is computed from the network corresponding to the 2004-2008 period, while, for 2004-2007, it is computed from the network corresponding to the 2008-2012 period). I used normalized values and included lagged variables as controls.

Independent variable

My independent variable is the number of outward M&As a company undertook. It is important to mention that a large portion of the targets were companies or their subsidiaries (sometimes in Japan) of North American and European firms in the international network. Therefore these can be considered as attempts to build a better foothold in the international network.

Control variables

As mentioned above, I added a lagged dependent variable, age, and size of the company, year, and industry dummies as standard controls. I also controlled for eigenvector centrality and structural hole spanning in the domestic network to see the extent to which the firm was already occupying a prominent domestic network position. I also included a structural hole measure in

[205] Sources include the Teikoku Databank, the Hitachi's now discontinued Yuho Next annual report database, the eol database, Iryohin Kigyo Soran data books and company webpages.

the international network to see whether the firm has already established a bridging position in the larger field. Then, I calculated the centrality of partners in the international network (averaged) and structural hole spanning of partners in the international network (averaged) because I wanted to know if the prominence of the firm's partners in the international network played a role in their future movement towards a central position.

9.3.4. Statistical analysis

I used a pooled OLS regression model and added a lagged dependent variable to account for past centrality, and calculated robust errors.

9.4. Results of the quantitative study

The table below shows the correlations between variables. The second table introduces the two models. Both tested the effects of outward M&As on firms' future centrality in a network that the firms were previously poorly embedded in (i.e., the international network, mostly made up of North American and European firms with industry leaders and top universities at the center). The first model included only the control variables. This model shows that age and size did not play a key role in defining greater centrality. However, I found that companies with a more open network in the domestic alliance network were more likely to secure a more central position. This might follow from structural hole theory (Burt, 1992), though the effect disappears when I include our independent variable. Next, I tested hypothesis 1 in model 2 and found a significant connection between the number of outward M&As and the subsequent centrality firms, which supported my hypothesis.

		1	2	3	4	5	6	7	8	9	10	11
1	Dependent variable (Eigenvector centrality in the next five years in the international network	1										
2	Y (t- 1)	0.2600*	1									
3	Age	0.0776	-0	1								
4	Size	0.1038	-0	0.4087*	1							
5	Year dummy	-0.1747	-0	-0.129	0.0193	1						
6	Centrality in the domestic network (Eigenvector)	0.2753*	-0	0.0301	0.0953	0	1					
7	Structural hole spanning in the domestic network	0.2521*	-0	0.0291	0.1821	0	0.5002*	1				
8	Structural hole spanning in the international network	0.0506	0.1	-0.0619	0.0698	-0	-0.0309	-0.15	1			
9	Centrality of partners in the international network (averaged)	0.2657*	.3914	-0.0826	0.1123	-0	0.0232	0.0762	0.0795	1		
10	Structural hole spanning of partners in the international network (average)	0.1383	0.2	-0.0397	0.0122	0	-0.0202	0.0659	-0.2371	0.5867*	1	
11	Number of outward M&As	0.4341*	0.1	-0.0327	-0.004	-0	0.0698	0.1467	-0.0492	0.0097	0.1456	1

Table 9 Correlation matrix

	Model 1		Model 2	
Constant	−0.0009	(.0068)	0.001	(0.0065)
Y (t− 1)	0.4666 **	(.2023)	0.3501 **	(0.1598)
Age	0.0001	(.0001)	0.0001	(0.0001)
Size	0.0028544	(.0018)	0.0022	(0.0014)
Year dummy	−0.005019 **	(.0027)	−0.0045 *	(0.0025)
Industry dummy	included		included	
Centrality in the domestic network (Eigenvector)	0.0408905	(.0426)	0.0434	(0.0410)
Structural hole spanning in the domestic network	0.0080672 *	(.0045)	0.0059	(0.0042)
Structural hole spanning in the international network	0.0013897	(.0034)	0.0012	(0.0033)
Centrality of partners in the international network (averaged)	0.0265867	(.1345)	0.0988	(0.1164)
Structural hole spanning of partners in the international network (average)	0.0004252	(.0061)	−0.003	(0.0050)
Number of outward M&As			0.006 ***	(0.0023)
R squared	0.3480***		0.4379 ***	
Observations	105		105	

*Note: *** p < 0.01; ** p < 0.05; * p < 0.10. Robust standard errors in parantheses.*

Table 10 Eigenvector centrality of the focal firm in the following five years in the international network (Pooled OLS regression with robust errors)

It is important to mention that the time-period investigated saw only the first wave of the M & As that took place since the beginning of the 2000s, but we were already able to see the effects of this M & A activity. The number of M&As and the size of the deals has been steadily increasing at the top firms since 2010. Therefore, we can anticipate an even larger increase towards more central positions, but we reach the quantitative study's limits. To see how the actual process is unfolding, I now turn to my qualitative study. There I find a more nuanced and a more problematic picture.

9.5. Method for the qualitative study

For the qualitative study, I profiled the top 10 pharmaceutical companies in Japan and some other major international players as points of comparison. Annual reports, magazine articles, and other company announcements have been used. I have also had non-structured interviews and informal conversations with mid-level managers and R&D personnel in some top Japanese pharmaceutical companies, mostly in the Kansai region (i.e., Osaka, Kobe, and Kyoto). In these conversations, I asked about the performance of mergers and acquisitions and other alliances. I also assembled a database of mergers and acquisitions from the MARR data books and looked at some of the larger deals through magazine articles and other announcements. I used the Lexis Nexis database to find information on international mergers of foreign firms. Unfortunately, I could not systematically interview all parties, so I had to rely on only the Japanese side accounts. The exact details of these talks have to remain confidential, limiting my discussions to some general trends.

9.6. Results of the qualitative study

The first thing to establish is the usual motivations for mergers in the case of Japanese

pharmaceutical companies. As mentioned above, some of the mergers were born out of necessity. We can think of parents buying out joint venture stakes and buying up distressed business units. Then there are other strategic considerations. Reasons for undertaking M&As vary. As a matter of course, we also face some methodological difficulties. Magazine and news articles can hide the real motivations for M&As, but combined with magazine interviews and information gained from my research interviews. I find that most of the motivations are relatively short-term and tend to be undertaken for quite ordinary reasons (even though most of the time, synergy and learning are mentioned and the usual vocabulary of legitimation is evoked). Of course, in most cases, as firms themselves are fields with contending motivations and aims, it is difficult to pin down a single reason. Justification for failed attempts can also obscure the original motivations. This being said, we found that four of the most often cited reasons were 1) to open up marketing and distribution channels, 2) to create a much-needed R&D base in certain fields (especially through purchasing biotechnology companies), and 3) to buy a product or access to some key technology, and 4) to create learning opportunities.

Then, I was also interested in how employees and managers saw the mergers and acquisitions and the post-merger integration process. I found a generally negative view. Some were outright failures (Daiichi Sankyo buying an Indian generic medicine company), others were more nuanced. People often talked of 'necessity' and change of times. Most people saw M&As as some undesirable but necessary strategy. A number of other managers and R&D affiliates talked about the problems Japanese companies face when they acquire North American or European companies. They stated that several problems happened at the Affiliate. There were often problems with retention. The company often struggled to achieve original goals, and there was a mismatch between the two companies in culture. Several have mentioned language problems.

Interestingly, I found that in a number of cases, power relations were obscure too. One participant said that while working with their US partner (i.e., a firm acquired by a Japanese company), he sometimes felt that it was actually the US partner that had more power even though the firm had been acquired. A cautious interpretation of this could be that because the acquired company had access to universities and the government, they had more social capital available than the Japanese company. This suggests that targets with high social capital might be difficult to control and might retain some leverage over the parent firm.

After establishing how managers and more general employees think about mergers, we can now turn to how social capital (as defined earlier) can be accessed over field boundaries. The problem is that resources that can be accessed through social capital are more difficult to access by non-field members. Newcomers need to establish a strong foothold before they can utilize the same resources.

I profiled the top Japanese companies, but I only report the case of Takeda here. Takeda has

started with a joint venture, TAP Pharmaceuticals, with Abbott Labs. This can be considered the first instance where the two fields began to blend, and field boundaries weaken. This early experience was quite an important defining moment for the company, and the CEO, who first actively pursued the new M&A strategy, has received his first impressions and formed his strong views about strategy within the international field while working with TAP. Recognizing the importance of the international field is the first step. Trying to find a better foothold in it is a second. This example also lends additional support for the previous study in that it shows how individuals on the boundary can be influenced by the logic of another field (here about M&A strategy).

I traced Takeda's moves through a network. As it increased its presence in the international network, it also started to build more alliances in the domestic network.

The first benefits of social capital, which the company had obtained, were realized in the first investments in Cephalon–a company within the close vicinity (in network terms) of Abbott and TAP. Figure 11 shows Takeda's R&D alliance network in the 1990s. Here we added Millennium, a company that would be acquired by Takeda in the 2000s. Millenium is still independent, but it is clear that it has a large alliance network (of non-Japanese firms), and we found it quite close to the center of the overall network (not shown here).

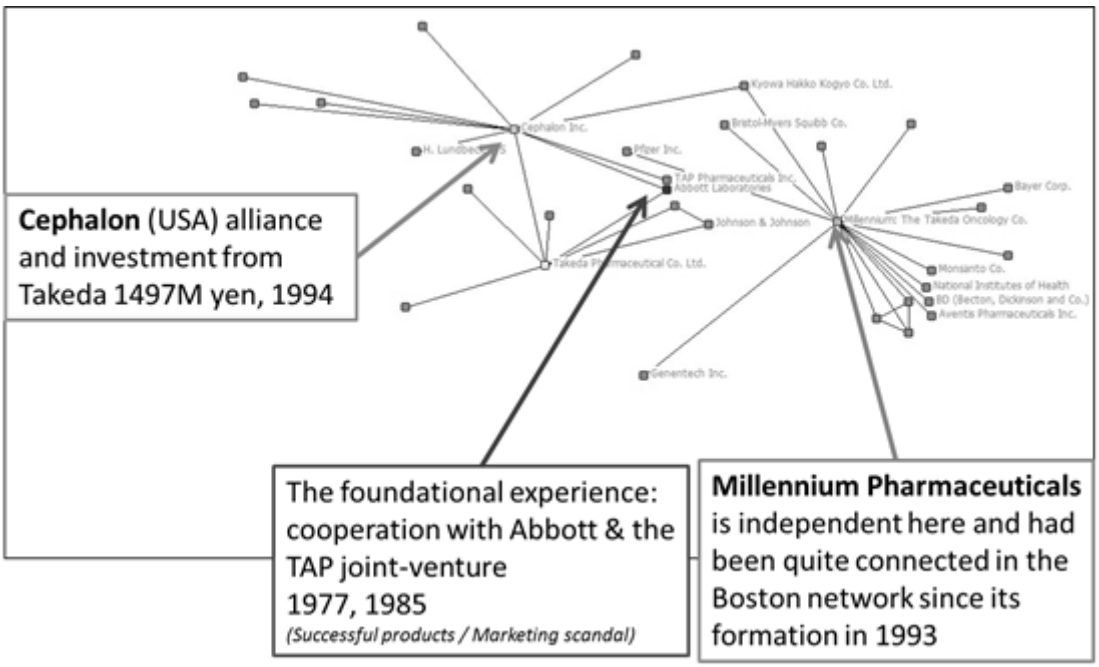

Figure 11 The beginnings: Takeda's network in the 1990s

As we move into the 2000s, we can see that Takeda is increasing its domestic alliances. The change towards a more outward orientation can also be discerned from Takeda's establishment of

an in-licensing office in 2003. This move coincides with a larger shift in government policy. The early years of the 2000s have seen technological cluster policies and university reform as well as the facilitation of alliances between universities, government, and industry. This change led to an overall increase in the number of domestic alliances, as seen in Figure 12. However, it is also evident that Takeda is not yet well integrated into the international network, and it has not established many links with overseas firms.

After this initial period, we can now focus on two other snapshots that show the first acquisitions. Takeda buys companies to establish its research base. Syrrx, located in the San Diego biotechnology cluster, was bought in 2005. This was followed by the acquisitions of Xenon in 2006, and Paradigm Therapeutics in 2007, a company founded by Cambridge University researchers. These strategic moves were the first steps in building new research capabilities and can be seen as, probably, longer-term strategies. These moves helped Takeda establish a more prominent foothold in the international network.

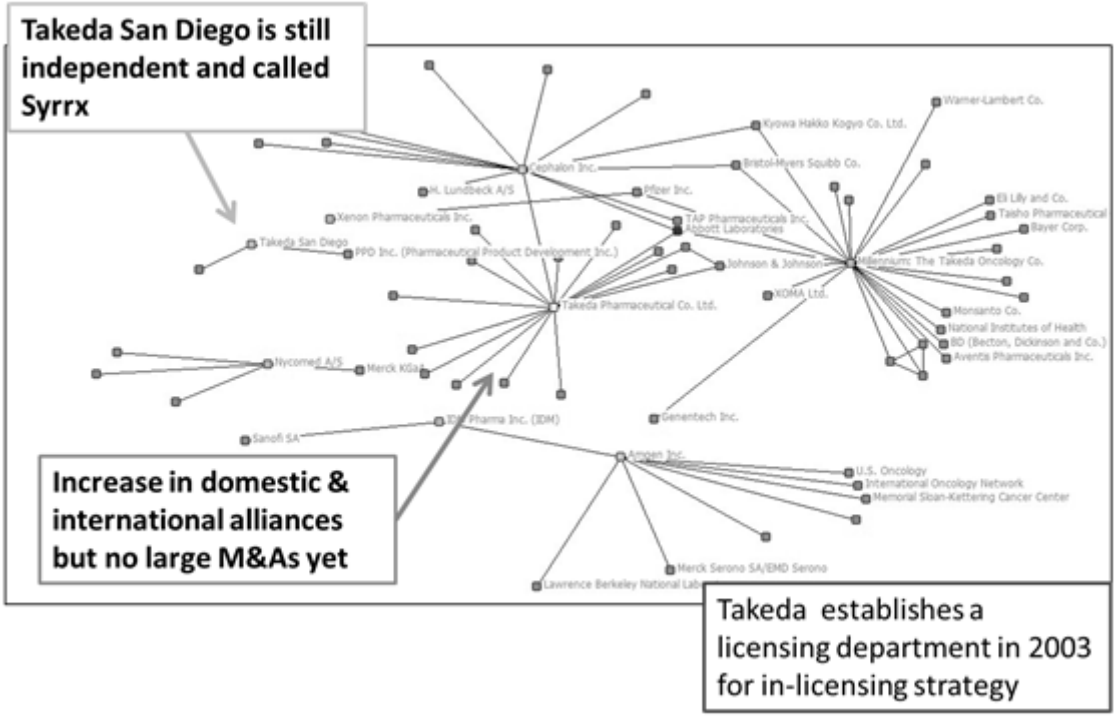

Figure 12 Alliance strategy spreads in Japan: Takeda's R&D network between 2000 and 2004.

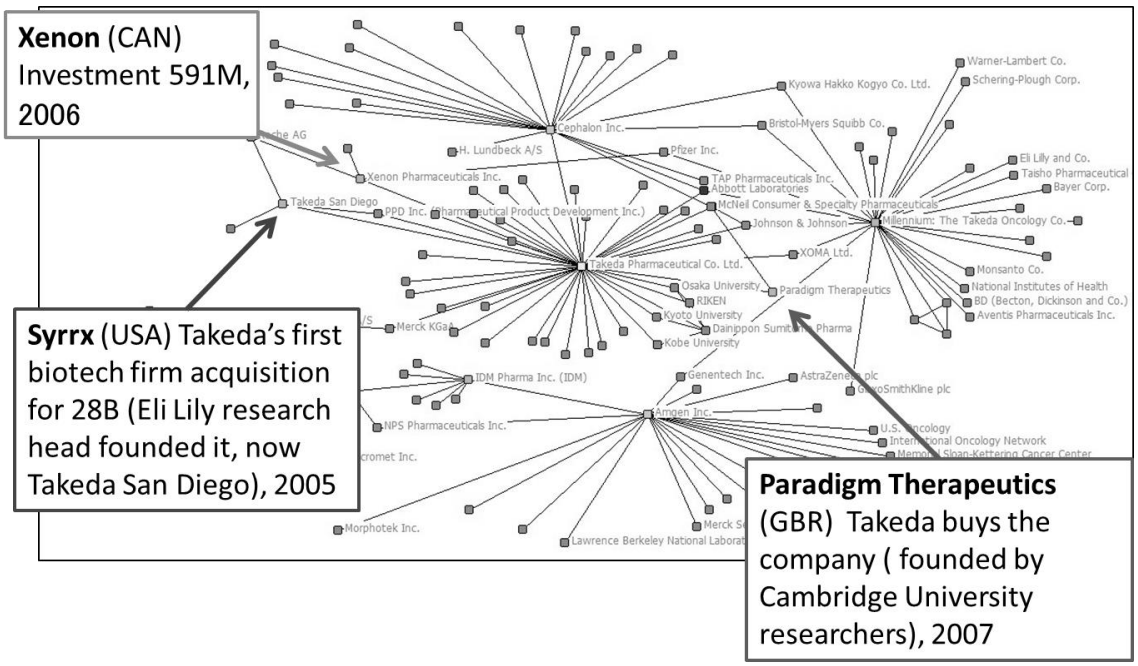

Figure 13 The first real attempts at M&A strategy: Takeda's R&D network between 2003 and 2007.

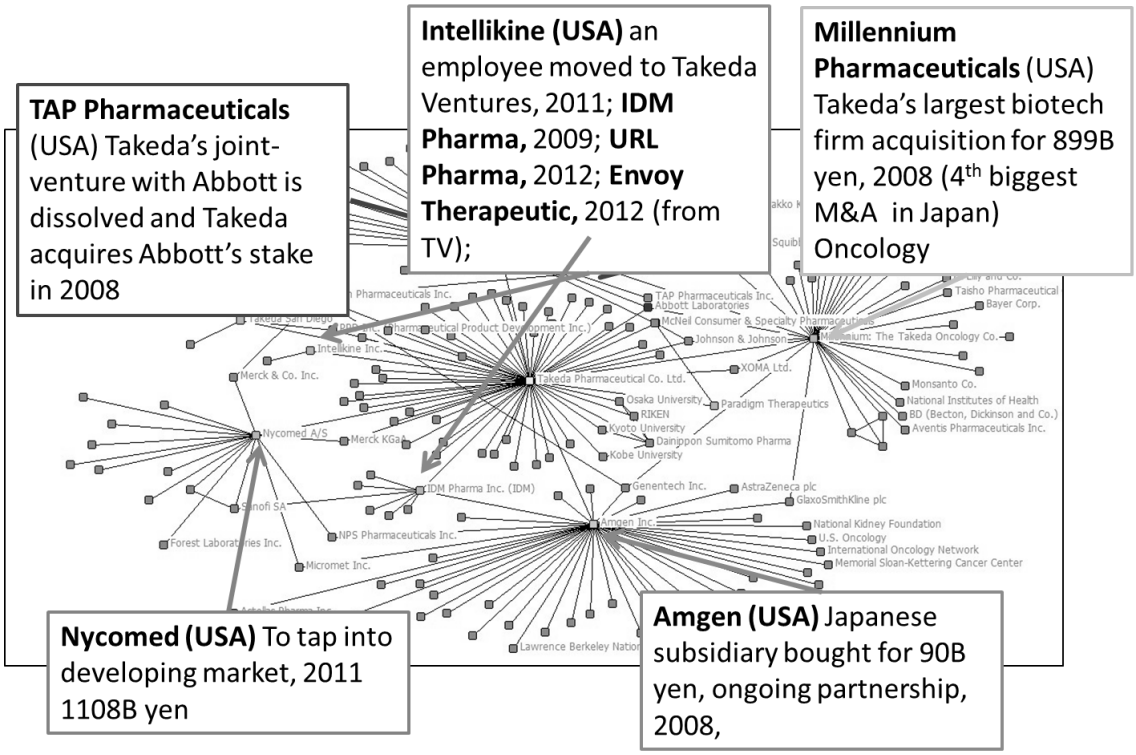

Figure 14 M&A strategy on center stage: Takeda's R&D network between 2008 and 2013.

M&A activity and internationalization accelerated in the following years. The CEO, whose thinking was imprinted in the early joint venture project, dedicated himself to a long-term M & A

strategy, which can be considered an example of our strategy outlined above. In 2008, the company bought out its take at TAP and dissolved the joint venture, purchased Amgen's Japanese subsidiary, and engaged in one of Japan's largest acquisitions at the time, buying Millennium Pharmaceuticals. Other smaller acquisitions followed this until the large-sized buyout of Nycomed in 2011.

In all this, I was mainly interested in cases for social capital use and access to embedded resources. I found several instances where individuals from the target companies contributed to advancing the company's position within the field. A simple example would be employees originally from acquired companies who are working at the venture capital arm of Takeda (TVI). They use their own network to find the right fit for Takeda's portfolio. Another one would be an executive from Millennium who helped broker the Nycomed deal. It is needless to say that the products purchased through the acquisition (mainly of Millennium) became a source of income for the combined company. What is more remarkable is that one of the most profitable medicines purchased was at the beginning overlooked and came down to Takeda over a series of mergers that took place within the field. If we extend the field in time, we can see that the resource was from another part of the network, accumulated through time in one specific organization. Apart from this, Takeda also accessed a number of technologies and other platforms through its alliances -- alliances that it could form because it was already part of the field.

There are three main findings that I uncovered during the investigation. 1) Outward M&A strategies in Japanese pharmaceuticals became prominent because of outside pressure, change in mentality, and managers in intra-firm fields who had early experiences in foreign joint-ventures or subsidiaries. The external threat (being bought out by foreign companies) compelled managers to increase their status in the international field and to rely more on these internationally minded managers. 2) M&As can help the companies to achieve better positions in the overall network and through "purchased social capital" provide the buyer with unique opportunities. However, these unique opportunities may diminish if the acquisition loses key personnel and the nature of its relationships in the field changes. 3) By looking at Takeda's case, I found that key personnel can help with venture investments, new acquisitions, finding successful products, new technologies, and providing access to other resources through social capital.

Based on these facts, a further proposition can be added.

> *Proposition 1.* Social capital from acquisition target firms will increase the cross-boundary buyer's social capital after the merger and raise its position within the field, making the boundary weaker.

9.7. Conclusion

We can say that firms can indeed improve their relative positions within a field through M&As. I

argue that this is one of the fundamental reasons why firms undertake M&As, even if the strategy is not overt. Improving the firm's collection of resources and capabilities are important, but this often translates to a better position within the field.

I saw that some of the more traditional strategies of M&A are short-term. They are often rationalized through a long-term explanation that will serve unspecified benefits to the firm, but actually, they might be nothing more than quick fixes. In this study, I tried to describe a strategy that is, in its nature, long-term. Improving one's position in a field is not easy. There is a lot at stake, and the conflict inherent in fields can create undesired effects. M&As are nothing else than two fields being integrated, and in some cases, a structure of power is completely altered. This will cause difficulties to the individuals within the firm, and we already know what adverse consequences this can have on morale. Conflict thus is an inherent feature of M&As. It can be thought of as an example of Bourdieu's struggle within fields.

Furthermore, even if we focus on the underlying network, improving the firm's position in a network does not guarantee success by itself. For one thing, a field is in constant flux, and incumbents can reinforce their positions, excluding newcomers, or other newcomers can disrupt the gains. It is, therefore, important to look into the qualitative nature of what goes inside the firms.

Because a company in itself is a field, its inner workings will be crucial for success, and there must be an understanding of the organization's long-term goals.

In other words, the company as a whole must become part of the elite of the target field. The reader can understand the difficult choice faced by Takeda and other multi-national pharmaceuticals in Japan. On the one hand, it is at the top of the Japanese life science field, but it must also try to become a major elite member in the US-centred international field. This means that it has to alter its identity to fit the international field. To fasten this change, the firm decided to hire more people who had originally been members of the international field. This, however, alters Takeda's role in the domestic network because these new managers are outsiders to the domestic field. Other firms also struggle for similar reasons. The solution can only be long-term and strategically planned.

I have to mention that isomorphic M&As can also happen. Followers might execute M&As as a kind of imitation because they see every other company engaged in this type of activity. It would be interesting to see, however, whether these non-strategic acquisitions lead to some unexpected serendipity.

Next, we need to consider the practical implications of this study. Buyers need to consider not just the target companies themselves with their resources, capital, and intangible assets, but also their position within the overall network and the potential benefits that the target companies can provide for future moves within the network. However, access is just an opportunity, and the

expected benefit might not materialize due to key personnel leaving the company or other regulative issues. Planning for network positioning is a complicated matter where it is difficult to predict outcomes. However, the inherent opportunities must not be overlooked. Future acquisitions through partners can also prove to be disastrous, especially when the acquisitions happen just because the partners offer the opportunity. Each transaction must be carefully weighed with traditional methods, but it is clearly important to keep in mind that acquisitions can lead to new partnerships and potential new acquisitions, which provide access to unique resources and power.

There have been considerable limitations to my study. We have already mentioned most of it in the course of the chapter, so I will not repeat it here. Unfortunately, I could only focus on one specific context, the Japanese context, and a limited set of companies. The next step could be a more precise study of the mechanisms behind social capital utilization and a better theory that explains how social capital contributes to activity within fields. We also need to think about poorly-embedded firms without ample resources for M&A. Another line of research could potentially look at how incumbents can defend against upstarts and whether they can consciously build networks that are difficult to enter.

10. Case IV – Boundaries managed: Toyota and field engineering

10.1. Introduction

Finally, I turn to my last case. This case looks at not a complete field, but a powerful organization, Toyota Motor Corporation. Its sheer size and power within the domestic Japanese economy are such that it is capable of influencing the automobile industry and many corresponding fields. In the following, I investigate how a powerful organization can create fields and manage boundaries.

The approach taken in this study will be different in this last case study. The focus is on the ways an organization can dissolve or reinforce field boundaries through management practices. Both Bourdieu and Fligstein & McAdam (2012) claim that powerful members or their coalitions (incumbents, elites, or governance units) exert a significant influence on the rest of the field. As I pointed out in Part I, Bourdieu's theory explicitly states that field boundaries are actively created, reinforced, and changed by these powerful members who defend against newcomers' erosive forces, less powerful members, and outside fields. They also set the currency of capital with the most relevance in the network, though their choice often stems from necessity or outside pressure. In this case of Toyota, I investigate how a powerful firm can do this and what the implications are.

Another thing to note is that field boundaries can act as insulators that block or regulate flows between fields, or conversely, can act as conductors that facilitate cross-boundary flows. These features can have far-reaching consequences for network theory.[206] In the following, I describe the main fields of Toyota and discuss their relationship with each other.

10.2. Toyota and its fields

Toyota has been the center of management research both in Japan and in the US. It is one of the most researched companies in management, and its literature is a rich source for qualitative analysis. The Toyota Production System and lean production have been analyzed in detail (Womack, Jones & Roos, 1990; Liker, 1990). There has been a great deal of research on the way Toyota makes strategy and successful innovation. Dyer & Nobeoka (2000), as well as Clark & Fujimoto (1991), described a *learning network* between the long-term suppliers and subcontractors of Toyota that provided the basis for Toyota's competitive advantage. Nishiguchi and Beaudet (1998) described how this network could flexibly respond to crises through an example of a fire in one of Toyota's suppliers.

However, the term 'network' is used in the literature in various ways, and it is not necessarily consistent with the definition I have been using in this dissertation[207]. In the following, I discuss

[206] The nested nature of fields can add an interesting element to network theory as well. Because larger-order networks have nodes that have their internal networks, nodes can theoretically have very intricate behaviour within networks. This research direction, however will not be tested.

[207] See Part I. Also, in the previous studies, I measured network ties through interfirm R&D alliances.

the different network concepts related to Toyota and describe what fields Toyota can be associated with.

In Dyer & Nobeoka (2000), 'network' refers to a corporate group led by a core (often parent) company. These types of groups are often controlled to some extent by the parent company. The members can include group companies and other suppliers.

In the Japanese context, many networks refer to 'keiretsu' or a wider network of affiliated companies, including long-term suppliers and other firms, not in the supply chain (also see corporate groups[208]). With time these keiretsu have become more open, and their traditional cohesive structure loosened. These can be thought of as distinct organizational fields or networks of organizations, and while I did not map these relationships in a quantitative manner, it is possible to describe them with the help of the literature. In the core, we find Toyota Motor Corporation and the Toyota group, surrounded by a vertical keiretsu consisting of suppliers and other affiliated firms. As Fujimoto and Takeishi pointed out, this keiretsu is not completely closed but has outside ties. Nevertheless, the keiretsu and its core can be thought of as an organizational field. Toyota's organizational learning takes place in this field.

There is, however, another kind of 'network' mentioned, probably association would be a better word to use. This 'network' is just an association of member firms who learn together. These networks or fields are organized by internal governance units (Fligstein & McAdam, 2012). Dyer & Nobeoka (2000) describe how these supplier networks and association networks are maintained by special organizations such as the Kyohokai in Japan and the TSSC in the US. These organizations foster communication and cooperation with Toyota and enable the firm to exercise control over the supplier through monitoring and other feedback. Many of the suppliers, however, do not belong to just one organizational pyramid under Toyota, but in many cases, supply parts to other car manufacturers as well (Fujimoto, 1999)[209]. The learning network is based on a long-term relationship, cooperation, with a relatively high level of cohesion and trust, with a high degree of stability.

However, corporate groups and their affiliated companies need linkages to outside fields. Within Japan, the clout of the core company (Toyota) is large enough to establish new connections with research organizations and government institutes. However, links to international organizations are of a different nature. With newly developing technologies, it is often necessary to go outside the well-established 'network'. I look at two aspects of Toyota's R&D network that was necessary for nanotechnology-related research and fuel cell technology development and discuss how these outside networks relate to the other part of the corporate group.

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[208] See Colpan, Hikino & Lincoln (2010) for more on corporate groups and on the Japanese context.
[209] My simple review of data from the Nihon Jidosha Buhin Kogyokai confirmed that on average a company supplied parts to at least three companies.

10.3. Data

In order to look at the field around Toyota, I mainly relied on reports in the literature (Dyer and Nobeoka, 2000; Fujimoto, 1999; Clark & Fujimoto, 1991). These sources provided a rich source of descriptions about the different networks around Toyota.

I have also collected data about different fields around Toyota. As mentioned above, I have collected car parts supplier data to see what the original parts network looks like. For this, I have used the data books from the Nihon Jidosha Buhin Kyogyokai. I have consulted Japanese language literature on Keiretsu relationships and reviewed Toyota-related articles and publications[210].

This was followed by gathering patent data for three car companies (Toyota, Honda, and Nissan) regarding fuel cell research and development. I looked at joint patents to see whom Toyota cooperated with. These cooperative partnerships form a loose R&D field.

I also relied on the dataset from chapter 6 based on 700 Japanese firms involved in establishing a nanotechnology R&D field. From this data, I analyzed how much partnering was going on with non-Japanese partners. In the figure below, the number of international, non-domestic partnerships are shown. These were also complemented with magazine and trade journal articles on fuel cells, along with other case studies in academic journals.

10.4. Managing fields in the Toyota way

Dyer and Nobeoka (2000) observe that Toyota's US supplier network changed its structure as it developed. Fujimoto (1999) describes a similar pattern in Japan. An initial one large network with a core firm (Toyota) as a hub was transformed into a large network with multiple "nested networks". Bilateral relationships with the core firms turned into multilateral relationships, weak ties became strong, and structural holes decreased as the network became more cohesive. While the original network was only capable of transferring mostly explicit knowledge, it was later capable of transferring both explicit and tacit knowledge. As it is shown by Nishiguchi and Tsujita (2017), this relatively "open" structure became a more close-knit community through shared norms and an increased amount of mutual trust.

Recently, Nishiguchi and Tsujita (2017) have shown that firms participating in Toyota's supplier network developed community capital based on shared norms such as the adoption of TPS and knowledge sharing routines. Community capital enables unconnected firms to quickly develop relationships of trust, even on the periphery, as they share certain norms. It is a badge of

[210] A light introduction to the topic is Miyashita & Russell (1995). For a more serious treatment and a review of business groups in general, see Colpan, Hikino, Lincoln (2012).

honor that identifies members as belonging to the same field, which dissolves network (!) boundaries.

The way Toyota creates a community based on trust is described in the following way. "By openly sharing all of the valuable production know-how at its disposal, Toyota creates a norm within the network that very little of the knowledge that a firm possesses is proprietary (except certain product designs/technology)."[211] This is partly the first catalyst in the formation of community capital, as defined by Nishiguchi and Tsujita (2017). Dyer & Nobeoka (2000) explain that "[p]roduction processes are simply not viewed as proprietary and Toyota accepts that some valuable knowledge will spill-over to benefit competitors. Thus, any production-related knowledge (cost, quality, inventory management, etc.) is viewed as accessible to virtually any member of the network (with perhaps the exception of a direct competitor)." In other words, there is an openness about production processes that extends to the suppliers. This openness invites suppliers to open up. The mutual benefits create a bond that forms the basis of the Toyota fostered-field. As the relationships deepen, the field becomes more robust and its boundaries more defined.

The two researchers also add that "Toyota creates a norm of reciprocal knowledge sharing within the production network by providing free assistance to suppliers and allowing suppliers full access to Toyota's operations and stock of knowledge (the only exception is the new model design area which is available only to certain key suppliers). Suppliers must be willing to open their plants to other network members if they choose to receive Toyota consulting assistance and/or participate in jishuken/PDA core groups. This requirement essentially eliminates the free-rider problem because the price of entry is a willingness to open up your operations for inspection."[212]

These 'networks' contribute not just direct technical knowledge about the overall product architecture but also knowledge about outsourced parts. Long-term relationships and cooperation create a field where different kinds of technical knowledge, as well as organizational knowledge, are shared and managed in common, contributing to competitive advantage, as observed by Takeishi (2002). Outsourcing without involvement can lead to organizational loss of knowledge.[213]

Dyer & Nobeoka (2000) write that "a fundamental dilemma for a knowledge-sharing network is providing assurances to members that proprietary knowledge will be protected while at the same time encouraging members to contribute valuable knowledge to the collective good. Toyota

[211] Dyer & Nobeoka (2000).

[212] Dyer & Nobeoka (2000).

[213] Takeishi also found that the traditional keiretsu groupings were opening up (hence the number of parts supplied to other companies). There are other indicators to this opening up, but as we will see, there are also ways to mitigate the adverse effect of opening up.

solves this problem by simply eliminating the notion that there is 'proprietary knowledge' within certain knowledge domains (e.g., production, quality, etc.)."

However, it is important to note that the new model design is only available to certain key suppliers. Dyer & Nobeoka (2000) found that the only kinds of proprietary knowledge that are not opened up to the supplier network were product technologies and designs. While development is contained within Toyota's core development network, this proprietary knowledge can be protected. However, in the case of new technologies, going outside the network is unavoidable, making the company more vulnerable to outside influence. The development of radically new technologies, like fuel cells, are likewise not shared openly with most members.

This study focuses on a vaguely defined boundary between new model design and the more open process knowledge. Our research indicates that a large number of firms were involved with fuel cell technology development, but these companies were not always part of Toyota's traditional Kyohokai supplier network.

To investigate the different fields that form around Toyota, it is necessary to review how Toyota conducts its research and development. Ku (2011) describes in detail Toyota's R&D network. He found that Toyota tends to outsource the development of a large number of parts, but this outsourcing mostly takes place within its supplier network and its traditional R&D network. This network is built around a number of key organizations spearheaded by Toyota Motor's technological center. These include Toyota Chuo Kenkyusho, the Higashi-Fuji Technical Center, the Nihon Jidosha Buhin Sogo Kenkyusho, or SOKEN (jointly created with Denso), the Konpon Kenkyusho (Genesis Research Institute), and Toyota Technical Development Corp. These are helped along by other research institutes affiliated with the main supplier. In our case, Equos Research would be such a firm affiliated with the Aisin Group. Therefore, it is clear that new product development does not occur in-house. Toyota has long been collaborating with its suppliers in R&D. However, Toyota's R&D does not merely rely on its supplier network; it builds bridges to other entities such as universities and foreign organizations.

The Mirai has become the main result of Toyota's long-term fuel cell technology development[214]. This fuel cell-powered car had to overcome multiple obstacles before being sold

[214] A fuel cell can be used to power vehicles from passenger cars to trucks. A fuel cell powers an electric motor and in Toyota's case, it fits into Toyota's hybrid architecture. The idea of a fuel cell was actually worked out in the nineteenth century, but in real commercial use they only become common after the 1950s, albeit in a limited way. The first concepts of fuel-cell powered cars appeared in 1991. And from the 1980s, Toyota, Honda and Nissan started limited research into the technology. Toyota and Honda were among the first to sell fuel cell powered cars. Toyota started developing fuel cell cars from 1992. Its first concepts the FCHV-1 and FCHV-2 was tested in 1996 and 1997, these were followed in 2001-2002 by the FCHV-3, FCHV-4, and FCHV-5 concept cars. By 2008, Toyota started working on the FCHV-adv in order to find solutions for specific problems such as operation in low temperatures. The company also developed buses, the Hino FCHV Bus, powered by fuel cells. Road tests were conducted in Japan with FCHV-4. Toyota needed to integrate fuel cells into the hybrid platform. This happened in the second phase. The aim was also to improve output and operation. In 2003, Toyota also tested the compact MOVE FCV-K-II. In the next phase, nanotechnology research has experienced a boom and Toyota took a central place in the nanotechnology network as seen in Figure 17. This is also the period when research projects with overseas universities first appear. Toyota funds research at Georgia Tech.

to the public. I have undertaken an analysis of Toyota's fuel cell research through reviewing patents related to the technology. Figure 11 shows that compared to competitors, Toyota engaged in more cooperative alliances and joint development.

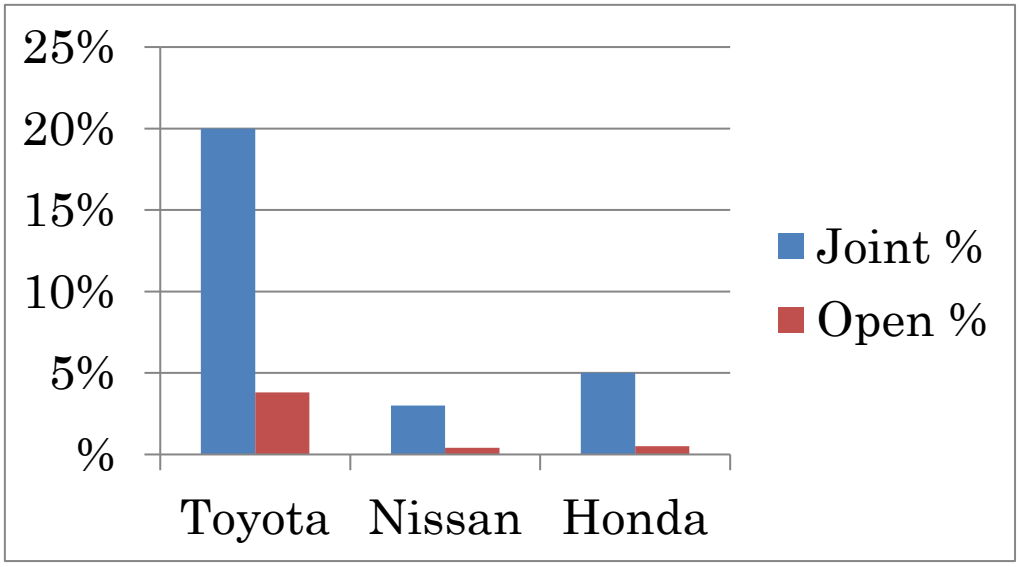

Figure 15 Percentage of out-of-field partners (red) and percentage of joint patents (blue) of all patents applied.

A single Toyota group company files most of the patents related to fuel cells, and a large proportion of joint patents features the same few close associates introduced above (including Denso, Aishin Seiki, and SOKEN). However, when we look at the list of partner companies, it is clear that a large proportion (59%, according to Figure 16) are outside companies. As fuel cell technology is not part of the company's traditional technological repertoire, Toyota needs to find pieces of knowledge that can only be found outside of the traditional network. These pieces of knowledge are scattered about in other non-related companies, foreign entities, research organizations, and universities. New links need to be established for these organizations.

Developments shifts to production method and cost reduction in 2007-2008. More emphasis is placed on overcoming narrow problems, making fuel cells lightweight and relatively inexpensive. Cold-weather performance became important. Precious metals used for the catalyst needed to be reduced and the proton-exchange membrane needed to be made less expensive.

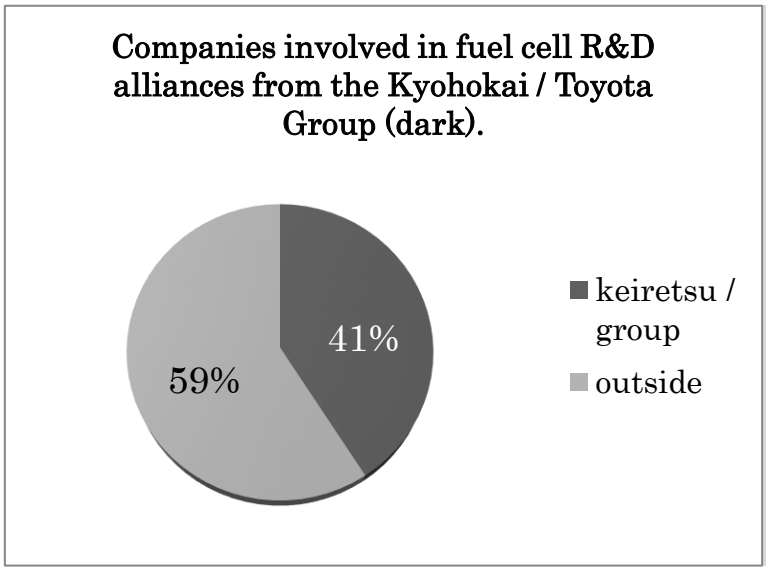

Figure 16 Companies involved in fuel cell R&D alliances

A similar picture can be drawn in the case of nanotechnology-related alliances. The figure below shows the network around Toyota Motor[215]. It is immediately noticeable that universities and governmental research institutes take a disproportionate role in the different alliances. While core Toyota companies are included in the network, it gives a very different picture from the traditional Kyohokai, which focuses on production processes and cooperation with long-term suppliers, or the core Toyota R&D field that engages in more traditional R&D.

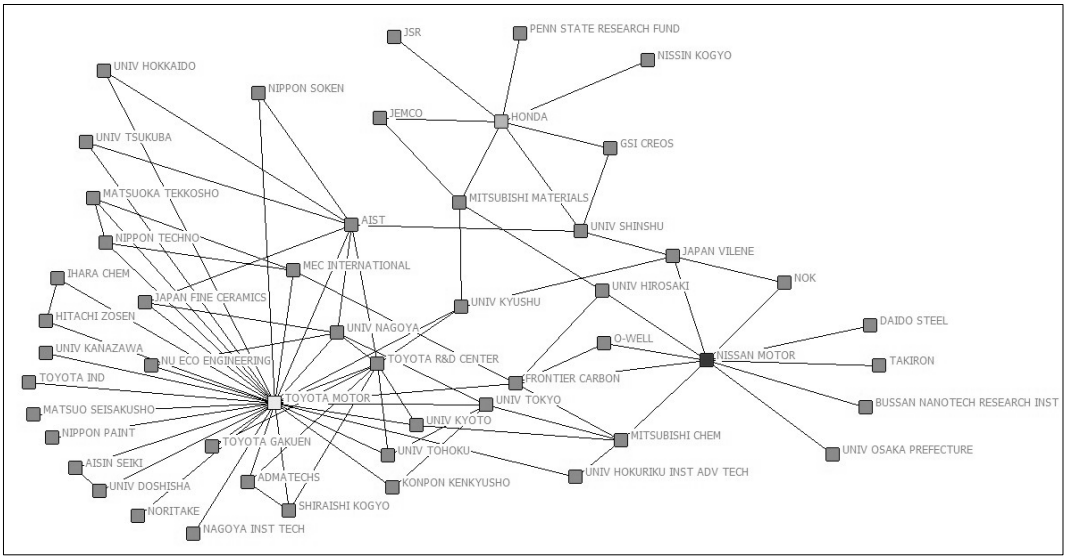

Figure 17 Toyota's alliances in the nanotechnology network.

[215] The network of all the fuel cell R&D alliances is too big to show here. It has a hub-and-spoke structure which makes it not very different from a mere list, therefore here I only show the nanotechnology-related alliance network.

This illustrates that Toyota is managing multiple fields that are separated in subtle ways. Though Toyota has released its patents[216] to facilitate the technology's acceptance, during the research process, it has not shared the technology widely within its other fields. In fact, the Mirai was produced in a close-environment in a special part of the Motomachi factory, called the LFA Works, where cars are built by preselected experts, while fuel cells were assembled in the Honsha factory.

Toyota faces multiple difficulties in these development projects. For one, sharing knowledge with suppliers can lead to leaks to competitors if they work for multiple car companies. We cannot forget that competitors developed fuel cell cars. Honda[217] and Nissan[218] worked on fuel cell technology.

Then, collaborations with multiple outside companies or even foreign companies can lead to leaks or even negative backward influence. Certain practices or logics might get adopted by Toyota employees that might erode or alter Toyota's field structures (as seen in the case of pharmaceutical companies).

Toyota has formed a relationship with an outside field. In this, there seems to be a great deal of similarity to the firms in the life science industry, as seen in the previous studies. This outside fuel cell research field was centered around the United States and Canada. One of the first fuel cells were assembled at Case Western Reserve University, and they were researched in a number of North American universities.

There were two leading companies in North America in the 2000s focusing on these technologies: UTC Power and Ballard Power Systems. Daimler AG and Ford had a joint venture with Ballard Power System, the Canadian developer for PEM fuel cells, called the Automotive Fuel Cell Cooperation. The same company, Ballard, has collaborated with Honda in its development of fuel cell cars. However, Daimler abandoned fuel cells to focus on battery power, and Ballard has acquired assets of the Automotive Fuel Cell Corporation. UTC Power was probably the most experienced fuel cell company in the U.S. prior to its acquisition by ClearEdge (now acquired by the South Korean Doosan Group). UTC developed fuel cells for NASA's Apollo program and the space shuttle. Overall, it has to be noted that the fuel cell industry is not highly

[216] Sam Frizell (2015) "Toyota Wants Everyone to Know How It Made Its Hydrogen-Powered Car", TIME Magazine. Accessed at https://time.com/3654899/toyota-mirai-patents-hydrogen-power.

[217] According to the official homepage of Honda, the company started research in the 1980s. These efforts led to the development of the FCX-V1 and FCX-V2 concepts, and incremental innovation to its fuel cell stack making it lighter and usable in low temperatures (-20 degrees Celsius). The Canadian PEM fuel cell company, Ballard has contributed to the success of Honda's fuel cell cars. By 2008, the FCX Clarity was ready. Honda conducted joint-research not only with Ballard, but also with Stanford University. It is important to note, that Toyota did not have alliances with these organizations at least according to the data I have collected.

[218] Nissan also started working on fuel cell technology and started developing its FCEV technology from 1996. It has already tested its technology in cars in 1999 and went on to create a new type of battery stack in 2011. Through its alliance with Renault, Nissan also started joint research with Ford and Daimler A.G, companies that had a joint venture with Ballard.

developed, relatively weak, and car companies could have much influence. This means that it is a very different context compared to the life science industry.

The boundary between Toyota and the outside field is limited. Less than 5% of Toyota's joint patents were filed together with an overseas partner. In the following, I will look at a number of concrete collaborations.

An early research project was with Meijin Liu at Georgia Tech. Toyota founded research on proton electrolyte membranes for fuel cells between 2003-2008. These PEM fuel cells are used in the Mirai. In 2008, Toyota also partnered with UTC Power, and also in 2008, Toyota started collaborating with Ilika Technologies, a UK-based material research corporation. The company's reported first commercial customer was Asahi Kasei in 2004, so they had a strong relationship with Japanese companies from the early start. Other outside collaborations include Case Western Reserve University, HZB (Helmholtz Zentrum Berlin), and Sandia National Laboratories.

However, the number of overseas research links are limited. Organizational influences are presumed to be small. They are likely to have a limited impact on Toyota's development process or how it organizes its fields. I do not expect far-reaching influences, such as the kind we have seen in the life science industry. Indeed, community capital and the macrostructure were upheld because outside organizations' contact was relatively limited and not highly influential. The status of the outside alliance partners was much lower. Though there was some overlap, the two fields were distant, and then it can be even argued that the outside network was subordinated to Toyota as it appeared as a key buyer and influential developer of an underfunded technology.

Another feature of the different new-technology fields that they are more short-term, more temporal. This also minimizes the impact of cross-field influences and significant change.

Toyota, therefore, is using different kinds of strategies (I do not claim that they do this consciously because it can be the result of simple necessity) for different kinds of fields. They create issue fields around new technologies, but these issue fields do not influence the structure of other fields through filtering effects. It is possible that a shift in technology will alter the structure, but mere field influences seem to have no overreaching effects. Boundaries are drawn up among different functions. The most apparent boundary is between the things Toyota is ready to share with its traditional supplier network and the more proprietary new product designs that the company keeps separated in either within the core member field or in other insulated temporary R&D fields. This way, Toyota can act as a network insulator by using field boundaries to insulate fields from each other.

The literature also suggests that Toyota is adept at dissolving strong boundaries and inviting suppliers into its field. It can create community capital by opening up and sharing, but in the meantime, Toyota can also subsume its suppliers under limited control. In the field, Toyota retains the ultimate control as the most powerful member.

10.5. Conclusion

Another implication relates to nodes in networks. Toyota is itself a very complex node. Organizational networks cannot be thought of precisely in the same terms as networks of individuals. Organizational networks are more complex because nodes themselves are made up of sub-networks. By looking into nodes, we can identify mechanisms that regulate flows and contribute to performance. Beyond the simple thinking of nodal attributes, this view highlights the importance of nodal structure.

In traditional analyses, the concept of compartmentalization is often used. Different functions are compartmentalized as needed. The idea is very similar, but the importance of fields lies in the fact that fields can create compartmentalized spaces even when no actual or physical compartmentalization occurs.

Conclusion

This dissertation showed that the concept of the field is necessary to interpret network data. Networks and fields are not identical. In fact, networks often stretch over different field boundaries unless one field is carefully mapped by design. Even then, the network stretches over nested subfield boundaries. I argue that taking the boundary into effect is necessary when one wants to consider network effects such as effects from structural hole spanning, cohesion, and centrality, or network evolution and change.

In the first two chapters, I have reviewed the literature on the concept of the field. Starting with Warren (1967), Martin (2011), Bourdieu (2005), Bourdieu & Wacquant (1992), DiMaggio & Powell (1991), Scott (2013), Wooten & Hoffman (2008), Powell, Fligstein & McAdam (2012), Furnari (2014), Zietsma et al. (2017), I reviewed the change in the concept of fields in general and discussed organizational fields and institutional fields. I found Fligstein & McAdam's (2012) definition as the most developed and built on Zietsma et al. (2017), who found two types of fields: issue fields or fields that form around certain issues and exchange fields, which are more traditional organizational fields.

I accepted that 1) fields can be multi-level and nested, 2) networks are not equal to fields, but they are a structural representation of some aspects of fields, 3) roles, hierarchy, and power are essential, 4) symbolic systems such as norms, values, etc. are inseparable from fields, and 5) different forms of capital and tangible objects can shape the power relationships within the field and thus the networks.

I then discussed boundaries and field interaction reviewing the relevant literature. In the empirical section, each study focuses on a different kind of boundary.

In the first case, I found that in a newly forming field where boundaries are numerous, field boundaries increase structural hole effects and decrease cohesion effects. This was illustrated by the Japanese nanotechnology field. Though the findings cannot be generalized to fields that are not made up of interorganizational R&D alliances, it is still conceivable that field boundaries influence network effects in a general context.

Second, I found that field boundaries can be spaces where influences can filter through from other fields. The Japanese biotechnology industry was investigated, and I found that firms that partner with more central firms in the target network influence their domestic network more, suggesting that boundaries can behave differently based on their structure and the nodes that take part in it.

In the third case, I found that field boundaries can decrease through M&As, making an outsider firm more central in the target field. The Japanese pharmaceutical industry and Takeda's acquisitions were analyzed. As firms embed themselves in the target network, their social capital

increases giving them more access to resources.

Finally, in the last quantitative case, I have discussed the managerial implications of the findings. I proposed that field boundaries can be managed by powerful members, as illustrated by the case of Toyota and its many fields under management. I argue that Toyota can create field boundaries that act as insulators that separate different fields.

There have been many limitations[219] in the study and whether the findings can be generalized outside fields of technology firms remains a question. However, some of the findings are supported by theoretical reasoning, which lends credibility to my proposals even if the empirical part is not strong enough. Suggesting that a structurally invisible boundary would influence network effects, for example, is a theoretically sound argument. However, more empirical proof is necessary to be able to accept it as fact.

Again, more research is needed to investigate the many exciting avenues uncovered during my research. I list these interesting research directions here.

First, more research is needed to understand how networks and fields operate together. In the theoretical section, I proposed that there are role-hierarchy networks as well as the more traditional relationship (transaction, alliance, cooperation, etc.) networks. Understanding how the two different types of networks can work together would be challenging, but reducing the two to one analytical framework would be interesting. Perhaps, an ecosystem model suggested by Sugiyama can help. Perhaps some new concept is required. Nevertheless, understanding the intricate interrelationships between roles, instead of a more traditional tie structure, would be interesting. Perhaps, future research can investigate all three (field, role network, relationship networks) together.

Second, the field contains many quantitative elements (categories, rhetorical frames, language, metaphors, and different forms of capital). Integrating these into a network framework would be an enormous, but perhaps rewarding, challenge.

Third, more network effects could be analyzed by looking at field properties. Perhaps, boundaries can also be categorized into different types. A typology of boundaries and their structural features would be a very fruitful direction in future research. Other field properties might influence network effects as well. One could look at what these properties are and what influences do they have on the networks. One such property, a field-specific logic, was investigated in the chapter on filtering effects. Moreover, it was shown that logics could directly influence the structure by informing members about partner choice. Capital, struggle, elite members might also have significant influences and should be analyzed in future studies.

Another important question posed by this dissertation is whether organizational-level and individual-level networks behave identically (as claimed by Burt). Because of the nested nature

[219] See the final part in each study for details.

of fields (Fligstein & McAdam, 2012), it is evident that there is a fundamental difference between the two types of networks. Organizations are themselves fields and thus have network structure, which means that they are nodes with an internal network, suggesting that nodes are not identical. While it is true that individuals are also different, they can only be treated as having different characteristics. Organizations, however, might act differently because of their internal networks. Perhaps, there are general types of nodes that can be discovered. Research on networks within networks can be an interesting new direction. One can think of general node types such as conductors, insulators, capacitors, amplifiers, dampeners, and sinks[220].

I have also found that boundary management suggests that there are different kinds of boundaries. Some are more potent, others weaker. Some are conducive to the transfer of things or knowledge. Others act like walls that insulate the different spaces. Some might act as intricate filters that can let in some kind of influence while keeping out other kinds. Understanding the structure of these different elements can be beneficial to organizations, which could use this knowledge to build more competitive positions by fine-tuning the boundaries within the firm and around the firm.

Because field boundaries and structural holes often coincide. A thorough review of the two concepts is also necessary. Structural holes can form within fields or between subfields, but they often signal a clear field boundary. Boundary spanners connect unconnected parts of the network or are bridges across field boundaries. However, structural holes and field boundaries are very different. Analyzing the differences could help build a more robust theory while investigating structural hole types could prove vital to a deeper understanding of how they operate in networks.

Field boundaries, and structural holes, are not static but change as the fields and networks around them evolves. Looking at longitudinal cases is important in understanding how boundaries evolve and what role temporality plays in field boundary behavior.

Another large topic that has been only touched upon in this paper is field interaction. Bourdieu claimed that it would be an impossibly complex topic, and Fligstein and McAdam only began to tackle it. Through Zietsma et al. (2017), the investigation has now turned towards field typology (issue and exchange fields), and they began to look at how fields can interact seriously. Field interaction can be a major field of research in the coming years, and understanding how fields interact with each other might provide the most important answers in sociology.

[220] Tentative definitions can be given to each proposed node-type. Contagion models have already proposed a few of these types, but their simple model can be extended. Conductors transfer knowledge and influences quickly, while insulators block the transfer. Capacitors store the ideas and influences and release them at a later time influencing many more nodes. Amplifiers are powerful nodes that amplify and strengthen the influences, while dampeners dampen the influence. Sinks are similar to insulators in that they take in all the influences and block them from further propagation. Many more of these node types can be theoretically created.

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