

The evolvement of triple helix interactions: process perspectives on university - industry relationships

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Abstract

The primary aim of this paper is to develop a conceptual framework for investigating how university – industry relationships evolve over time. Based on theoretical perspectives on the dynamics of interorganizational relationships, this paper investigates the development of several cases of university – industry collaborations. The exploratory study presented investigates the start-up phase of university-industry relationships, emphasizing e.g. the heterogeneity when it comes to rationales for collaboration, partner selection, and organization of particular partnerships. Furthermore, the empirical analysis shows that university-industry partnerships unfold in several distinct ways that are partly dependent upon the initial collaboration conditions, but also that particular partnerships carry several different modes of collaboration and exhibit strong internal variety.

Keywords

Dynamics of collaboration, process perspectives on university – industry relations, longitudinal research

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Introduction

Empirical studies of how university-industry interaction is carried out and coordinated are not as common as research on why universities and firms interact and the institutional arrangements for such relationships. Much empirical research has been cross-sectional and quantitative, and describes in broad strokes how interaction is carried out by identifying categories of links and volume of interactions. Type and degree of interaction is often explained by partner traits and context characteristics, such as field of science, technological fields, size and individual characteristics (Bekkers & Freitas 2008, D'Este & Patel 2007, Schartinger et al 2002). Research on university-industry relations has made substantial progress the last decade through the creation of impressive data sets related to funding, publications, patenting, activities, channels of interaction and more, at the level of individual scientists, departments, disciplines and universities. But until recently there have been few in-depth studies of interaction over time and micro level data is generally scarce. Likewise, research focusing on processes of forming, developing and coordinating UI collaboration has been fairly absent, and there has been little systematic effort to explore development processes in the UI context.

Recent research has highlighted the variety of links between universities and industry and particularly how interaction frequently has an informal nature and is often tied to activities such as consultancy, collaborative research, and education oriented activities (Cohen, Nelson & Walsh 2003, Schartinger et al 2002, Perkman & Walsh 2006, D'Este & Patel 2007, Bekkers & Freitas 2008). However, research measuring the use of different links by survey data underemphasizes that links are used in an interrelated manner and that the use of different links changes over the course of time. University-industry relationships are highly socially embedded relationships and any type of link (for instance a collaborative research project) between a firm and a university department is often based on long-term relationship where partners interact simultaneously and sequentially in many different ways (Thune 2007). Furthermore partnerships between firms and universities tend to develop incrementally from low-risk, low engagement relationships to in some cases lead to institutionalized relationships where considerable resources are invested.

Current research and innovation policy strongly favors interaction between public research and industry: as an instrument for stimulating research and development (R&D) capacity building in firms, and for making academic research more relevant and responsive to industry's needs. Several policy instruments have been implemented to stimulate different types of interaction. Thus, it is all the more important to critically examine how collaborative relationships actually work and what they actually produce. There is a need to look into the "inner life" of such relationships, to get a sense of which actors are involved and which activities take place in collaborative relationships, the organizational and institutional frameworks that interaction takes place within, and how relationships form and evolve over time.

With this in mind, this paper presents the first results of an empirical investigation of the formation and development of university-industry partnerships, based on multiyear case studies. We emphasize in particular the start-up phase, i.e. we focus on the rationales for establishing the partnerships, the selection of partners, the negotiation of agreements, and the initial modes of interaction. This paper aims to fill a gap in the literature by employing a dynamic process perspective which implies looking at how interaction between different parties begins and unfolds over time.

Dynamics of cooperation in interorganizational relationships

Within research on interorganizational relationships, and particularly within research on alliances, process perspectives have been quite fully developed. According to Inkpen & Currall (2004), the key insight from this literature is that alliances are dynamic systems of adaptation and evolution. How interorganizational relationships develop over time is related to initial conditions, but alliance dynamics also have an impact on the outcomes of the alliances. Research utilizing this perspective tends to be

multilevel and emphasizes the non-linear and interdependent nature of development processes. Also, process research often uses micro models to explain macro level phenomena. Phenomena such as understanding, sense making, commitment, familiarity and trust are used as explanations for organizational developments. The focus is on how human behavior and social interaction are integral features of interorganizational behavior and how such features influences the results achieved in interorganizational endeavors such as alliances. The “dynamics of cooperation” perspective has largely focused on phenomena such as alliance formation and development (Larson 1992, Ring & Van de Ven 1994, Arino & De la Torre 1998, Doz, Olk & Ring 2000, Ring, Doz & Olk 2005), governance of interorganizational relationships (Vlaar, Van den Bosch & Volberda 2007, Inkpen & Currall 2004) and learning and knowledge transfer in interorganizational relationships (Nooteboom 2002, Vlaar, Van den Bosch & Volberda 2006, Janowicz & Noorderhaven 2008).

Several authors have contributed to the research on how alliances are formed and how they develop over time. Larson (1992) has developed a phase model of network dyad formation based on an exploratory ethnographic study of entrepreneurial firms. Her study suggested that the formation process of network dyads had three phases. In the first phase the preconditions for the exchange were developed. Central in this phase were prior established personal relationships, and personal and firm reputations, which became the source of mutual trust on which the formation of a new relationship is founded. These factors contributed to reducing uncertainty and established the expectations that enhanced early cooperation. According to her, the “social context provides the environment within which economic exchange can be initiated” (ibid, p. 84). After this informal phase of the relationship, the transformation into a stable and formal exchange relationship progressed in phase two. The conditions to move from an informal to a formal exchange tie involved both considerations of economic advantage for both parties, but also the further development of trust and norms of reciprocity during a trial period. An incremental development process through which the organizations get to know each other and how to work together was an important step for the formation of the tie. The trial phase led to the institutionalization of rules and procedures as well as the development of clear expectations, which together formed the initial structure for exchange. In the last phase the relationship was solidified through integration between partners. Operational integration, strategic integration and integration and control through social relations were important forms of coordination as the relationships matured.

Ring and Van de Ven (1994) have developed a theoretical model of developmental processes of cooperative interorganizational relationships. They claim that cooperative interorganizational relationships move through repetitive sequences of negotiation, which consist of both formal bargaining processes and informal sense making processes that lead to development of joint expectations, familiarity and trust, building commitment for action, execution of commitment and assessment of how the relationship is unfolding. Ring and Van de Ven’s main point is that such processes are ongoing and cyclical rather than sequential as interorganizational relationships are formed, evolve and eventually terminate. This means that the processes of negotiation and commitment building are processes that reoccur throughout the lifespan of the collaborative partnership, and are never dealt with once and for all. Furthermore, these processes consist of both formal and informal sub-processes. In terms of negotiation, both formal negotiation leading to the establishment of a contract or a working plan is central, but also the informal processes whereby the members of the organizations that are participating in the consortium, try to make sense and establish a framework for action. The same goes for the commitment building processes, which on one side consist of implementing the plan of action of the consortium, but also concerns making organizational participants commit to and work towards the goals of the consortium rather than the goals of the separate organizations.

Based on these initial and quite simple process models, more detailed development of phase models of cooperative interorganizational relationships have been developed, identifying both more phases and activities in the alliance development process, but also identifying patterns of variance in

development processes stemming from key differences in initial conditions and framework conditions. Doz, Olk & Ring (2000) have identified nine phases of collaboration development, but claim that not all phases are equally important in all alliance development processes due to the initial conditions that spurred the decision to form collaborative ties to other organizations. They relate the initial conditions to two different formation processes: *emergent* and *engineered*. Ring, Olk & Doz (2005) later added a third formation process that they called *embedded*.

Their argument is that different initial conditions lead to different formation processes of alliances. When environmental interdependence and similar interest motivates organizations to cooperate, the formation process follows an emergent pattern. But when a triggering entity – an external agency - initiates the cooperation, the formation process follows an engineered pattern. When the potential collaborators from the onset enjoy strong social relationships, formation processes tend to follow an embedded pattern. In the first, organizations experience common environmental threats or face a common need for resources, which lead them to form a tie. Their common interest generates a consensus on the domain of their cooperation and establishes a strong expectation of continuity of interaction. This expectation leads them to develop a formal structure for their relationship. In the engineered pattern of tie formation, an intervention of a triggering entity or champion is a necessary condition for tie formation. The organizations do not experience strong external stimuli to cooperate like a common threat or need of resources, and as such does not have apparent common motivation. The champion creates “a perception of the need for the collaboration” (p. 251). With this as the starting point, the formation process follows a “hub and spoke” approach, where the nodes in the network cooperate with the triggering entity, but only indirectly with each other. Since the organizations at the start do not recognize similar interest their expectations as to the relationship is likely to be less, and the relationships tend to have an explorative orientation. However, with increasing cooperation between the alliance partners, the organizations can develop similar interest and in time, Doz, Olk & Ring (2000) argues, engineered alliances can lead to networks governed by emergent processes. Over time, cooperation leads to common interest, expectations of continuation and trust between participants that further embeds the organizations in a social structure from which further ties are formed.

The different development models as described above also include a number of specific issues that have been addressed in further detail within the dynamics of cooperation perspective – particularly the issues of governance and learning. The question of governance is highly relevant to research on interorganizational relations, due to the fact that interorganizational alliances and networks are seen as a governance mechanism of a particular kind (Powell 1990). Governance in alliances is neither carried out through pure market exchanges regulated to contracts nor by tight hierarchical control. The literature highlights that trust and formalization are involved in the governance of interorganizational relationships (Inkpen & Currall 2004, Vlaar et al 2007). Whereas trust and formalization previously were seen as substitute forms of governance mechanisms, recent research also indicates that they are interrelated and function as complements. Increased trust can lead to higher level of formal control, according to Vlaar et al (2007). On the other hand, Ring & Van de Ven (1994) argue that governance mechanisms develop over time and that informal coordination processes, personal relationships and psychological contracts gradually supplant formal contracts and processes of coordination in interorganizational relationships. However, through processes of institutionalization, informal coordination processes can be transformed to new organizational routines (Nelson & Winter 1982), which serve to coordinate further activities in the collaborative relationship.

Another central issue within the dynamics of cooperation literature is learning and knowledge transfer between alliance partners, as many alliances are implemented with the purpose of promoting knowledge transfer and interorganizational learning. At the same time, knowledge transfer across organizations is fundamentally challenging due to absorptive capacity, and problems of transparency and stickiness of knowledge. Research indicates that repeated interactions between partners can lead to increasing trust and familiarity, but also increasing cognitive proximity, that are all resources

considered beneficial for interorganizational learning (Nahapiet & Ghosal 1998, Muthusamy & White 2005, Nooteboom 2002). Research indicates that informal learning processes, where individual boundary spanners interact with their networks is a key source of interorganizational learning in alliances (Janowicz-Panjaitan & Noorderhaven 2008).

Within the literature on scientific alliances there have been attempts at exploring the micro-dynamics of knowledge interaction (Bouty 2000, Porac et al 2004, Schrum et al 2001). Focusing on this level of analysis, the social mechanisms involved in exchanging knowledge becomes apparent, such as familiarity and trust. Bouty (2000) shows that social capital resources impacts on both the researchers' expectations (benefits expected to be obtained by interacting) and the types of knowledge resources exchanged between scientists in industry. Bouty also show that exchange relationships between industrial scientists develop gradually. Initially scientists engage in low-risk exchanges and try each other out. Through repeated interactions relationships can grow into equitable exchanges governed by norms of reciprocity and deep trust.

As seen in this brief review of research on the dynamics of cooperation, collaborative relationships develop in different ways, which is partly related to differences in initial conditions. Some of the work reviewed above identified separate stages in how collaborative partnerships evolve, where others emphasize repeated cycles in how interorganizational relationships evolve. In general though, the evolutionary models point to the fact that it takes considerable time to develop stable interorganizational relationships and that interorganizational relationships develop substantially and continuously along the way.

Within research on university-industry relationships, this perspective has to a limited extent been employed. There are, however, few reasons to think that interorganizational relationships between firms and universities are markedly different, even though there might be some additional complexity due to differences in missions and the type of resources being exchanged. The evolutionary perspective would add to present knowledge on university-firm relationships, partly by providing concepts and empirical evidence on how such relationships are formed and develop over time, partly by providing further knowledge on processes of coordination and control and how this is related to formalization and institutionalization of university-industry partnerships. Questions concerning knowledge exchange and learning are also particularly relevant to address in the context of university-industry collaborations. Having this in mind, the research project reported in this paper has utilized the dynamics of cooperation perspective as a sensitizing framework for an exploratory empirical study of university-industry partnerships.

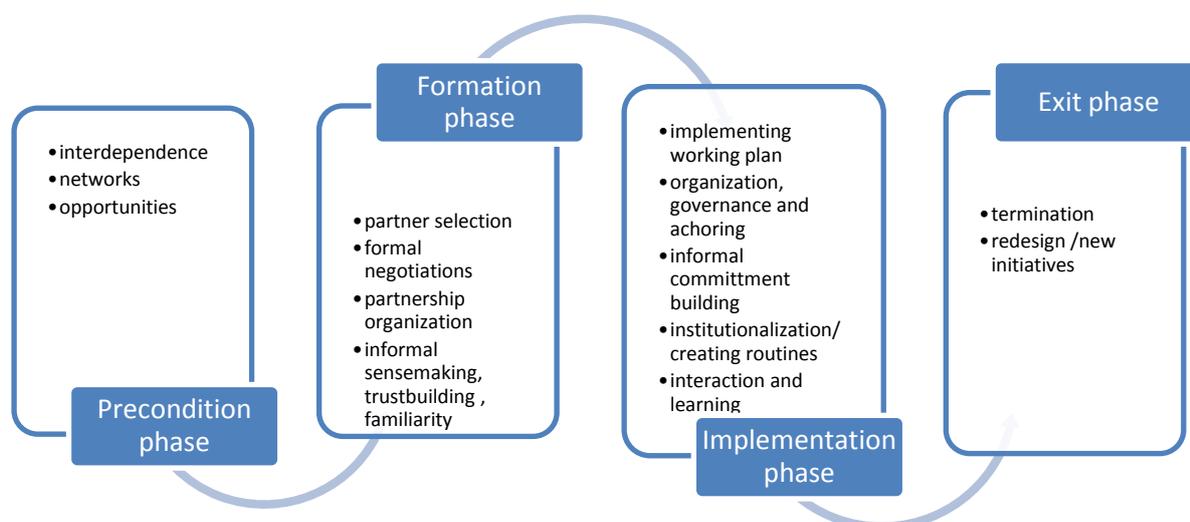


Figure 1: A process model for investigating university-industry relationships

The framework identifies four main phases, but emphasizes that the stages tend to be overlapping and cyclical, i.e. that a particular partnership investigated might move back and forth between stages repeatedly. Furthermore, the framework emphasizes that there are formal and informal processes involved in developing university-industry relationships, and that these need not be “in sync”. For instance formal bargaining and trust building processes are not likely to be running in parallel, although they are both key aspects in partnership formation. Secondly, the initial conditions of particular university-industry partnerships likely influences formation processes and might also influence how particular relationships are implemented and carried out. Of particular importance is the insight that different initial conditions, such as interdependence, networks and response to external initiatives (opportunities), create different conditions that influence how partnerships are formed. On the other hand, empirical cases most likely carry a mix of different conditions, which needs to be mapped out in detail as they likely influence collaborative relationships in quite subtle ways.

An empirical study of university – industry collaboration

Methodology

Methodologically, research utilizing an evolutionary perspective on interorganizational relations requires detailed empirical evidence where particular cases of collaborative relationships are followed over some time, and where sampling is analytically motivated; that is motivated based on theoretical expectations concerning initial conditions, phase or patterns of development . In terms of research strategies, first and foremost, an exploratory approach is needed where the “development story” of each individual case is needed, as to map these processes in the context of university-industry relationships. This knowledge could be used as input in further cross-sectional research that is more fully able to capture the complexity of relationships, and also investigate the relationship between different forms of partnerships and issues such as coordination, learning and performance in university-industry relations.

In this project, to explore how collaboration is initiated and developed in university-industry relations, we opted for a multiple case study approach following seven cases of university – industry relationships over a period of three years. Through a selection of cases from different disciplines, universities, industries, phases (some recently started and others nearly finished) and with different types of public support, we have tried to achieve an analytical generalization and uncover processes of collaboration at the micro level that may be relevant for all types of university-industry relations. The initial sampling of cases was based on two selected dimensions, which we expected would influence how the partnerships were formed and how they developed: degree of formalization of partnership and length of existing relationships involved in a partnership.

For each of the cases, we have collected and analyzed substantial documentary evidence in each case, as well as interviews with project leader and a range of participants from different partners (universities, research institutes, industry, others). We have aimed to get a balanced selection of interviewees, i.e. to include also PhD students and not just senior personnel. In total we have carried out around 70 interviews. In this paper we will present the first results of the case analysis with an emphasis on the *start-up phase*, i.e. we focus on the rationales for establishing the partnerships, the selection of partners, the negotiation of agreements, the organization of the partnerships and the initial forms of interaction between participants.

Empirical results

Initial conditions for collaboration

We see a mixture of the initial conditions described in Doz et al. (2000) and Ring et al. (2005), i.e. there are traces of emergent, engineered and embedded formation processes in all our seven cases. The *emergent* part is clear in most cases; the informants emphasized strongly the importance of

personal networks and a prehistory of collaboration. Previous relations between public researchers and firms have led to weak or strong types of interdependence and common technological and scientific platforms. The firms and university/research institute researchers thus develop similar motives or overlapping goals that create a rationale for further collaboration. All parties are furthermore well acquainted with the plethora of public support mechanisms for R&D and innovation, which often constitutes a common environmental factor that further strengthens the interdependence across sectors.

Many of these shared motives for collaborations have roots in research projects and networks stretching back several decades. The medical imaging collaboration is fundamentally based on a radically new ultrasound project started in the early 1970s. Even one of the newer partnerships between solar cell companies and public research organizations can trace its history back several decades through some of the involved individuals. This obviously points to a possibly strong side of the Norwegian innovation system. But it is also to some extent a “lock-in” situation where it may be difficult for other firms (or academic partners) to enter into these existing close collaborative relationships. Several informants pointed at problems, e.g. that one company becomes an academic group’s “main partner” and that other companies involved in centers and projects become more “remote partners” or “sleeping partners”. Several of the larger centers seem to have a core group of close collaborative partnerships and a periphery group consisting of firms and academics that in various ways are connected to the core.

The *engineered* part of the collaboration formation processes is also obvious as all these partnerships depend (partly) upon public funding with certain criteria and goals. Especially in the case of the centers for research based innovation, which was a completely new funding instrument when it appeared in 2005, we see processes related to the CRI funding acting as a triggering mechanism for existing and new partnerships. CRI criteria of a “consortium agreement” dealing e.g. with intellectual property rights (IPR) issues and the requirement to have multiple firms involved, have strongly influenced the formation dynamics of these three cases. For the other cases it is perhaps not justified to speak of the public funding as a triggering mechanism for the university-industry collaboration. It is rather more valid to see the formation process as “existing cross-sector partnerships” on the lookout for public funding and support.

The *embedded* part of the formation processes is, as described in section 2, related to existing strong personal and social relationships between the potential collaborators. Although all seven cases are based on previous partnerships, this embedded formation process is most clearly seen when academic groups collaborate with spin-off companies that came out of their own organization. This is not a rare incident – more than half of the firms involved in our seven cases are, in fact, spin-offs from Norwegian public research organizations. The personal networks are many and complex, e.g. the entrepreneur who returned to academia and became leader of a center or project involving “his” spin-off, or the graduate students who started a new firm and entered a partnership with “their” academic unit and supervisor. In these cases, informants see university-industry collaboration as natural and neither triggered in particular by threats and opportunities in the environment nor by specific funding instruments – which nevertheless give direction and volume to the partnerships.

Organization of partnerships and initial modes of interaction

As mentioned, all our cases of university-industry relations are based on earlier networks, but some of the funding instruments have required that the networks should be extended. For these centers, it is clearly a challenge to work with several firms at once who are in the same business, unless the research is defined as “basic” and long-term and the industry contributions come with absolutely no strings attached. In the centers where there are several firms involved, there have been various tensions and a long process in defining IPR and niches to ensure that the firms do not have overlapping interests. Since the number of firms involved in the projects basically follows the requirements of the Research Council of Norway, this becomes an important institutional framework

for partner selection and the further collaboration dynamics since the number of firms involved in university-industry relations emerges as one of the key defining characteristics of our cases.

The consortium agreement etc. seems to play a fairly important role in many of the projects, especially with multiple partners. A lot of work is often put into this document, informants talked about months of negotiations and deliberations. All partners define what they bring into the project and their rights to results from the project within their designated fields of interest. The principle is exclusive rights, i.e. to define input IP in such a way that it does not overlap for any of the involved partners. The reason why this is time-consuming seems mainly due to the complexity of the process, the relatively low level of experience with such agreements in the system, as well as the involvement of the fairly recently established TTOs. No informants emphasized particular conflicts during the contract negotiation phase, although a few of the representatives from smaller firms indicated that they to some extent had to take the “leftovers” when the large firm(s) in the consortium had defined its interests. But no template exists for these agreements, and several informants criticized the research council for requiring complex consortium agreements yet offering little in terms of support and templates. It is interesting that the cases follow very different fundamental principle. Whereas one of the collaborations has defined in its agreement that “no one should own anything together from this project”, another is based more on a principle of “shared ownership”.

The process surrounding the negotiations and formulations in the agreements is both preconditioned by trust and challenges existing trust. Some informants described a new situation when universities claim IP ownership. Some of the smaller firms seemed quite happy with this (after a period of doubt), as it would reduce their financial burden (e.g. related to patenting costs) and/or make them less dependent upon larger firms. Most of the companies also stressed that they understood and respected the academic partner’s need for open publication – perhaps more than they had done in earlier collaborations. Some informants were nevertheless skeptical, e.g. arguing that the language of IPR was created more to deal with situations of low or no trust – and that it did thus challenged trust in embedded and emergent network formation processes.

The actual involvement or interaction in the centers and projects varies very much, from almost daily collaboration to a clearly mostly symbolic interaction. This seems to be related to many different aspects, e.g. funding issues, type of R&D work and organization of the collaborative ventures themselves. In the larger collaborations the work packages or “sub-projects” becomes the framework for the actual interaction going on between universities and firms. These sub-projects include different actors and types of research or other activities, but most often only one firm is involved in each sub-project. So far we have only found one example of firms working *together* within a work package in our cases.

The meetings at the center/overarching project level thus becomes, in most cases, the only place where firms meet each other and not just meet the academics related to sub-projects and work packages. In this sense the network formations are engineered with the university representatives as the triggering entity and the firms are only networking indirectly with one another. Consequently, most of the cases follow a “hub- and-spoke” type organization, identified with the engineered pattern of relationship formation. Another key finding that is related to the hub and spoke mode of collaboration is that the cases all demonstrate strong internal variety in modes of collaboration, between the different partners in an alliance, but also variance over time. This means that it is impossible to talk of one mode of interaction in the consortia; in each center a range of different modes of interaction can be seen (see table 1).

UI interaction	Seamless web	Coordinated efforts	Parallel projects	Positive attitudes	Symbolic
<i>Description</i>	Close collaborative relationship involving joint research, consultancy, and more. Very often close geographical proximity or collocation of industrial and academic R&D units. Often related to an academic spin-off or a large sophisticated company.	Fairly close collaborative relationship, normally with the firm(s) influencing the research agenda of a project hosted by the academic group. The firm is often an academic spin-off.	A collaboration where the firm is mainly oriented at developing its own technological platform, but with a view to new results and commercialization opportunities from the academic partner carrying out a project within a specialty that is of interest to the firm.	Formally expressed interest in collaboration, some personal networks but no attempts at mutual influences on research and development agendas.	No signs of interaction despite receiving public funding for interaction. Partners are not very aware of what the others are doing.
<i>Formation dynamics</i>	Embedded: strong personal networks and no questioning of the rationale for collaboration. Parts of the research agenda are clearly defined by the industrial partner.	Embedded/emergent: fairly strong personal networks and a strong sense of common interests related to economic and technological developments and to new R&D funding opportunities.	Emergent: personal relations and a prehistory of collaboration but most of all a common sense of threats and opportunities – the latter not least related to public funding for R&D and innovation.	Emergent/engineered: some personal relations but the collaboration is highly dependent upon public funding.	Engineered: there may be some personal relations but the relationship is created to fulfill formal criteria in R&D funding.
<i>Mode of interaction</i>	Close relations between many types of R&D personnel in the firm and the academic unit, possibly also other people from the company (marketing, production, etc.). Many adjunct positions.	Some collaborative relations mainly through one or several PhD students and/or post.docs who work either in the company or in the academic unit (or both).	Collaboration mainly takes place through communication between gatekeepers/boundary spanners on each side. If there are PhDs/post.docs involved, they work in the academic unit.	No formalized personnel exchange, but the involved parties meet at annual or biannual workshops and more.	No personnel exchange; there are opportunities for networking at annual workshops, but in practice the company representatives do not give priority to such meetings.
<i>Commitment</i>	The company pays for at least some of the work that is done on the academic side, but subsidized by public funding.	The company may pay for a PhD scholarship etc. but other contributions are mainly related to the time of own R&D personnel and free use of technology in the collaborative project.	The company does not pay for a PhD scholarship etc. and defines its contribution to be own R&D personnel in their own “sub-project”.	The company’s contributions are only “in kind”; could be vulnerable e.g. in difficult financial situations.	Not clear.
<i>Governance</i>	Defined by a framework agreement but carried out informally.	Coordination at consortium level, more informal at project level	Coordination at consortium level, more informal at project level	Arms-length	Arms-length
<i>Trust</i>	High	High in certain dyads	High in certain dyads	Low	Low

Tabell 1: Modes of interaction

Furthermore, the informants strongly emphasize that the mode of interaction differs between interacting with spin-off companies (close affinity with and a long history of interaction) and other commercial partners with whom they have little collaboration history, although there exists a personal relationship between key individuals in each of the collaborating organizations. At the same time, interdependence between the parties – for instance small spin-off firms that rely on the research facilities of their larger public research partners – also promote close interaction and a high degree of commitment to the partnership. This indicates that the initial conditions have an impact on how collaborative relationships are carried out, and particularly points to the importance of subtle institutionalization processes within the framework of formal collaborative relationships.

Concluding remarks

The study presented here has first and foremost attempted to tease out a conceptual framework for exploring evolutionary perspectives on university-industry relationships, drawing upon insights from the literature on the dynamics of cooperation. As seen in the above presentation of a number of case studies, the development processes found in studies of interorganizational relationships more generally are readily observable within the university-industry context as well. Three key findings emerge from these exploratory case studies, which are relevant for further investigation of university-industry relationships.

First, initial conditions seems to spark off particular development processes of university – industry relationships, which has implications for recruitment of potential partners, negotiation of terms, organization of collaborative relationships, but also on processes such as trust and commitment building, which has an impact how activities are carried out, governance and knowledge transfer.

Secondly, university-industry relationships are complex interorganizational relationships, and in most of the cases investigated, different modes of collaboration with different initial conditions co-exist. That also means that with a given partnership we find indications of several distinct evolutionary processes.

Thirdly, we find clear indications that formal and informal processes involved in developing university-industry relationships are neither substitutes nor in sync. For instance, the formal arrangement of a partnership (number of partners, level and type of commitment, rights of partners etc) in many cases reflects framework conditions, particularly funding requirements. However, the form of the collaborative relationship this might have relatively little to do with how collaborations are carried out in practice, and particularly the relationship between formal collaborative arrangements and institutionalization processes is of interest in further research. As a consequence, empirical research needs to follow both formal manifestations of relationship formation, but also the subtler, informal processes that influence how university-industry relationships develop over time.

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