

# Innovating in the Trading Zone - Organizing Inter-organizational R&D

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## ABSTRACT

*The literature on inter-organizational R&D presents contradictory and inconclusive results regarding the impact of the dyad 'homogenous-heterogeneous' teams on the ability to innovate. This article presents the results of case study of an innovation project where an inter-organizational self-managed R&D team worked on a software solution. The article shows that effective innovation can be characterized by five interrelated practices: interpreting, assessing, strategizing, expanding, and tolerating. These practices constitute the basic elements of a 'trading zone' where team members can collaborate despite their different objectives, interests, and work practices. The trading zone throws new light on the contradictory results previously obtained, by highlighting a negotiation process where different team configurations can lead to a fruitful collaboration and knowledge exchange.*

## INTRODUCTION

More and more organizations participate in inter-organizational innovation projects. This trend is based on the idea that most organizations no longer hold all the knowledge they need in-house, and therefore can benefit from interaction with other organizations in order to gain access to that needed knowledge. Individuals who interact and share ideas with others are more stimulated to make additional associations and therefore make more reflections than individuals who work alone (Perry-Smith & Shalley, 2003). In a time where engaging in innovation ventures also imply significant investments, inter-organizational collaborations are seen as a means to participate in the innovation race by dividing the costs with other partners and there is an increased emphasis by governmental sponsors on the collaborative form to receive funding for innovation projects. This is for example the case in most EU sponsored R&D (Christiansen & Vendelo, 2003).

However, an increasing amount of recent research has revealed that inter-organizational R&D face significant organizational challenges and often fail to conclude with satisfactory results (Bader, 2008), due to asymmetries of expectations to the work process (Flohr Nielsen & Sørensen, 2009); different interests in the project and the research (Johnson, 2008; Lacetera, 2009); lack of overruling authority and power ambiguities (Levina & Orlikowski, 2009); and different organizational cultures and practices (Elmuti et al., 2005).

This article argues there is a need for a deeper understanding of how collaboration and knowledge exchange takes place in inter-organizational R&D, and there is still limited empirical insight into how these inter-organizational teams interact and what practices they engage in to solve their work tasks.

The objective with this article is therefore to examine how team members coordinate and organize the fulfillment of their goals over time.

## **ORGANIZING AND COORDINATING INTER-ORGANIZATIONAL R&D WORK**

Because of the multi-organizational nature of inter-organizational R&D projects, traditional hierarchical power structures do normally not apply. Rather, decision-making tends to be based on the consensus between the partners, and inter-organizational R&D teams can therefore often be characterized as self-managed, or autonomous (Rycroft & Kash, 2004). Literature on innovation has argued that autonomy is an important enabler of innovation (Amabile, 1988; De Jong & Kemp, 2003). It has been widely recognized that autonomy increases job satisfaction (Sprigg et al., 2000); enables more flexible and efficient organizational processes (Delbecq & Mills, 1985); and facilitates learning (Janowicz-Panjaitan & Noorderhaven, 2008). Rampersad et al. (2010) highlighted that a moderate and agile coordination approach; an overall understanding between the parties; and involving all collaborators in decision-making are important in inter-organizational R&D. Other studies argue that bottom-up networks, based on shared interests have a greater innovation performance (Hoegl & Parboteeah, 2006).

Other scholars however have disputed the benefits of autonomy arguing that there is no relation between innovation success and autonomy (Gemünden et al., 2005). Gebert et al. (2003) found that autonomy cause co-ordination problems and therefore does not lead to an increase in innovativeness, but rather to a decline.

Social aspects have attracted significant interest in the inter-organizational R&D literature, in particular, the debate on whether homogenous or heterogeneous groups are more efficient, creative, etc. or not. A number of studies point to homogeneous teams as most innovative (Chatman & Flynn, 2001); more performing (Faems et al., 2005); and more collaborative (Cox et al., 1991). This is explained pointing out that individuals or groups from different backgrounds, professions, etc. are divided by boundaries, which make collaboration difficult (Carlile, 2004; Levina, 2005). More broadly speaking it has been asserted that organizations prefer knowledge overlap between them and their partners and they are considered to increase innovation performance (Ring et al., 2005), especially in R&D projects with high levels of uncertainty (Lee & Veloso, 2008).

Other researchers found that heterogeneity is positively related to group creativity and effective decision-making; the quality of solutions; and product innovativeness (Henneke & Luthje, 2007; Smart et al., 2007).

The results of the debate on heterogeneity vs. homogeneity is highly dyadic and paradoxical, as the entire premise on which it is based assumes that a group is either homogeneous or heterogeneous over time and in relation to any work task.

### ***Interaction features: the trading zone***

In this article a more holistic approach suggested to understand the dynamics at play in inter-organizational R&D projects. The concept of 'trading zone' (TZ) (Galison, 1997) is used to understand the interactions and social dynamics between the participating partners in inter-organizational or interdisciplinary research settings. Galison studied the collaboration of scientists belonging to different scientific disciplines and found that despite their differences they managed to collaborate and exchange knowledge.

Trading zones emphasize how the coordination of ideas and actions are carried out in an environment in which there are differences in objectives, meanings, values, interests, and practices (O'Mahony & Bechky, 2008). Galison describes the TZ as a 'social, material, and

intellectual mortar binding together the disconnected traditions of experimenting, theorizing, and instrument building' (Galison, 1997:803). To engage in a TZ implies the interaction between different groups or individuals, by agreeing on the general conditions and practices of exchange, even though they may have different interpretations of, or maybe even disagree on, the object on which they work (Kellogg et al., 2006). Different groups might come to an agreement on a set of 'rules of exchange' while at the same time disagreeing on the meaning of the very exchange process. This is possible because the partners establish a local coordination procedure in which these differences can be accommodated (Galison, 1997). One way of facilitating the exchange is to create a so-called 'pidgin', a boundary-spanning inter-language, developed in the TZ in order for the partners to better understand each other and thereby exchange information (Vaughan, 1999). Another way of enabling the exchange of ideas is to create common domains within the group, or structural procedures in which actions can be carried out.

In the TZ there are two possible modes of interaction: the multi-disciplinary and the inter-disciplinary mode (Morris & Hebden, 2008). These two modes of interaction can exist within the same setting depending on the situation or object of exchange.

Therefore, even if the collaborating partners create a common lexicon, an overall structure, etc. to better communicate and exchange information, this does not imply that their interests and practices converge. As a matter of fact, within this TZ the different traditions, practices and interests co-exist, but this co-existence does not result in a homogenization of the partners, rather they maintain their separate identities and practices (Morris & Hepden, 2008). However, exchange of knowledge will depend on the extent to which the different groups are able to communicate, and this is what characterizes a strong TZ. As such TZs can be interpreted as physical and cognitive arenas for different partners to collaborate, negotiate and learn (Boland & Tenkasi, 1995).

Inter-organizational innovation projects often include actors belonging to different professional disciplines and different organizations, implying that different paradigms in relation to science project work may exist in the setting. Furthermore, a TZ is described as having an informal structure, in which issues such as governance and membership are not articulated (O'Mahony & Bechky, 2008), and this is exactly the nature of loosely structured, inter-organizational R&D.

## **DATA COLLECTION, DATA ANALYSIS, AND CASE DESCRIPTION**

Data for this study were collected through a longitudinal field study involving non-participant observation, interviews, and document data collected from April 2008 through January 2011. Thirty-two semi-structured interviews were conducted (over 4 intervals), each of which lasted 1-1.5 hours, and fifty-three non-participant observations were made (e.g. weekly team meetings, experiments/tests, seminars, and social events). Furthermore, access was granted to the project wiki, a repository, project mailing lists, and presentations.

To further investigate the coordination mechanisms in inter-organizational self-managed teams, the research set out to observe and examine the practices, routines, and interactions at play in the team (Brown & Duguid, 1991; Wenger, 2000). The research methodology is based on grounded theory techniques and as such it paid attention to contrasts between "*daily realities* (what is actually going on) of substantive areas" (Glaser & Strauss, 1967:239) and "*interpretations* of those daily realities made by those who participate in them (the 'actors')" (Suddaby, 2006:633).

The team studied in this article consisted of 9-14. The team was supervised by the research director (a university professor) and by the official project manager. The latter was not involved in the daily activities of the team, having mostly an administrative role. Most team members did not know each other beforehand, and those who did, only to a limited degree. The team members were co-located at the same location more than fifty percent of the time.

Within the team there were significant differences between the team members; in terms of work practices, project objectives and interests. The university members were interested in producing research results, primarily academic publications. In their view the software development carried out during the project had the purpose to demonstrate a research proposition. Those representing the firms (industrial PhDs) had the business objective to develop results that can be patented and lead to the development of new products. They also expressed that participating in such projects gave access to highly specialized workforce for future recruiting. The applied research institute also had commercial objectives, and being a consulting firm they were interested in gaining domain-specific knowledge, in order to provide counseling to its clients, and they were therefore interested in a wider array of research topics.

## COLLABORATING IN THE TRADING ZONE

Five interrelated practices were identified that characterized different phases related to the TZ: interpreting, assessing, strategizing, expanding, and tolerating. Three of these phases occur *prior* to entering the TZ and represent individual cognitive work, where as the last two phases are collective social practices carried out *in* the TZ.

	Phase	Description	Cognitive work or Practices	Type of process	Theoretical relation
Pre-trading zone	Interpreting	Individual interpretation of the project meaning	Bracketing and labeling raw data Making connections	Individual cognitive	Enactment + selection (Weick, 2001)
	Assessing	Individual evaluation of the meaning of the project in relation to one's own work	Comparing own interests to those of the project	Individual cognitive	Retention (Weick, 2001)
	Strategizing	Individual planning of the collaborative process: try to make the opposites meet, and make the most out of it.	Avoiding involvement in irrelevant work Asserting Influence on the common goals Calculating own contribution to the common tasks	Individual cognitive	Exchange logics (Bouty, 2000)
Trading zone	Expanding	Collaborating through give and take, accommodating the interests of all team members	Developing boundary-spanning inter-languages Creating common domains Developing mechanisms to facilitate collaboration and knowledge sharing	Collective social	Trading zone (Galison, 1997, Vaughn, 1999) Transferring and translating knowledge (Carlile, 2004)
	Tolerating	Collaborating while still leaving space for individual, at times contrasting, interests.	Incorporating individual work into the collaboration and knowledge sharing mechanisms (e.g. through the creation of sub groups)	Collective social	Trading zone (Galison, 1997)

Table 1. Collaborating in the TZ: process and practices

### **Pre-trading zone: cognitive work**

When individuals enter an inter-organizational innovation setting they face a new situation and find themselves dealing with a new research topic; dealing with a new organizational structure, and interacting with individuals they are not familiar with. In the case a number of team members expressed that this situation triggered a series of reflections related to behavior in the setting and to making sure their goals are reached. These reflections have been analyzed in order to understand the process that comes prior to entering the TZ, and three distinct practices were identified: interpreting, assessing, and strategizing.

#### *Interpreting*

In the official project description the word 'toolbox' was not described into much detail, leading therefore to multiple interpretations among the team members. It turned out that there were mainly two interpretations of 'toolbox': one that indicated inter-connected software elements; whereas the other was a much more indistinct interpretation indicating simply new knowledge about pervasive positioning. The different interpretations may have developed partially as a result of the very open formulation of the formal project description, but it is also likely to be related to the ambiguity and uncertainty of the project expressed by the team members. It illustrates that team members bring with them into the TZ different interpretations of the overall purpose of the project, and thereby signals a potential conflict between the participants.

#### *Assessing*

As each team member began to grasp the different meanings of the project, and thereby of the toolbox, each team member entered in a process of assessing what this implied in relation to his/her own work. There were several different outcomes of this assessment process. One is that it was considered difficult to combine something, which is precisely defined in advance (software) with something that has not yet been explored (research):

*It is very hard to convince yourself that it is ok to contribute to such (ed. shared software), when research is what you are doing. Because to contribute to this, is to do purely coding! The premise for the toolbox is that it should be something recyclable, which can be used at a later time, and this makes it very difficult to do research on that (interview)*

There appeared to be a paradox in how standard software development is combined with cutting edge research, and the research team members found the two tasks irreconcilable, leading them to the assessment that because they were researchers it was hard to see the use of the software development tasks.

Another evaluation outcome, was the conclusion that if the toolbox consists of software elements, they would need to spend time on developing generalizable and neat code for the toolbox, and that this would take away precious time from their main interest: research.

*When you as a researcher get your article accepted and published, and you have made a presentation of it, then there isn't really any benefit in working on the code you developed. (interview)*

Most team members found that their related work would not benefit their personal interests, if the toolbox were a collection of inter-connected software pieces.

Based on the interpretation of meaning and the subsequent assessment, the single team member had to find a way to make the ends meet in order to proceed as a member of the project.

### *Strategizing*

The first strategizing step lied in figuring out how to avoid too much involvement in 'irrelevant' work. Here the team members looked first to the contractual obligations. Several team members referred to interpretations of the contract in justifying their intended modest participation in the software development tasks. But they also hinted to a certain consideration for their fellow team members, by referring to what they thought the other team members would expect of them:

*This is what I get away with: just to say that here is something for the toolbox: this article, and this guide, or this technology analysis, they are a part of the toolbox. (interview)*

The next step was to enact one's own interests, with the purpose of influencing the common work and making sure these interests were taken into consideration in the project:

*I contribute to that shared core of functionality, because I need it as well. And then I participate in the design of it, because that way I can make it fit into my own work. (interview)*

The third step was to calculate one's contributions to the common work. This aspect was expressed by several team members, who accepted that they had to contribute to the common work. It therefor became a question of figuring out where a work contribution could be made.

The three strategic behaviors were strongly interrelated and were clearly expressed by the team members, and they constitute an important premise of the TZ. With the avoidance strategy interaction would be minimal; with the contribution strategy the individual would take part in the group interactions, but with little commitment, whereas with the influence strategy the individual would be very active in the shared activities in the TZ.

### **Practices in the trading zone**

The next phases took place within the TZ, where actions were carried out and social relations were enacted. This is the stage where the team members went from cognitive reflections about the work ahead of them to actually engaging in the teamwork trying as best they can to preserve and secure their interests. The TZ was characterized by two co-existing practices: Tolerating and expanding

#### *Tolerating*

Simultaneously with the acceptance of a shared contribution to the content of the prototypes, the team members also expressed tolerance for individual/organizational interests. It was considered acceptable that the single team member worked on his/her own research interests, and that this work was at the expense of the common project activities:

*I would say there is a more internal respect for one another, combined with a wish to deliver the best work you can. But, for example, Roger also has to deliver a dissertation, and I don't! (...) but they do have a different type of obligation than we do, and so we try to match those obligations in the best possible way. (interview)*

It was also accepted that a team member would work towards his firm's interests or business models. In fact, it was not only the university researchers who had their own agendas. These

specific individual agendas were often discussed openly at weekly team meetings and they did not appear to constitute any annoyance to the team members.

In the months following the first discussions about the features and the nature of the toolbox, the team entered into a stage where they discussed the project more into detail and planned how to proceed. The purpose was to map what specific topics they should work on; to come to a shared understanding of these topics; and to decide how to organize their work. Out of this process came an agreement of what aspects should be focal to the project and a set of very clear and detailed descriptions of the main concepts within these different themes. At this point they had agreed on applying an abstraction level so large that it could embrace all team members' interests and integrate the applications of different organizations. They called these abstractions 'services'. They decided that the overall common denominator for their work was to be indoor navigation; an area, which to a certain degree, was considered interesting and relevant to all teams members.

*The prototype has been defined based on the fact that it is in this topic that most people could have an interest in – the domain of indoor navigation. This means that the majority had an interest in making a good core and working on this together, while at the same time using it to explore their own research interests (...) I think we can all see something for which we can use the indoor navigation scenario for something in our research. (interview)*

Determining the overall theme of the work and the overall structure did however not eliminate the existence of differing interpretations or interests. Rather, the broad nature of these specifications allowed the team members to take different deviations. Each team member spent much time working individually, whether they were working on individual agendas or on a shared task. Working individually was a way of making sure certain tasks or topics were included into the project, and team members expressed that if they wanted something to be included in the project they had to carry it on their own.

*And the parts that I need (ed. from the platform) I would make it on my own, because if you don't do it yourself, you won't be able to point the project in the right direction. We enter the areas where we can benefit from it, and then of course we also make sure it fits into the rest. (interview)*

They decided to work on several different demos that aimed at showing a functionality for the toolbox, and others that were purely theoretical and related to specific academic research themes. As a result the team members engaged actively both in toolbox related prototypes and purely academic prototypes. In the time that followed an increase in interaction between the team members was observed, and the team members also noticed this intensification:

*Well, there is a lot of collaboration when we have to develop prototypes. And ...everyone has his own objectives with them, and that is ok (...) so in that sense there is a lot of collaboration because a lot of shared code is build up, that we all use – so we exploit some of the resources. (interview)*

At this point the team members began to have a more positive view of the toolbox work and the team also started to show a shift in how they compromised on the work practices. For example, since the beginning of the project the university researchers had a very untroubled approach to software development, something that caused the firm team members to complain about lack of discipline and order in the handling of data. This issue caused some

commotion as this untroubled behavior ended up costing the team members a lot of time. At this stage a change in assessment and strategizing reflections among university researchers were observed as they started to acknowledge their faulty approach and tried to continue their work in a more disciplined and systematic way:

*If you constantly change the design, and you then have to change the code that follows the design you might end up using all your time adjusting the code to the new design! (...) So now we have agreed that make it as good as we can, and we don't touch it. And in June we will make a version 2, and on our way we collect all the ideas and all the issues that may have, and then we make a new one which will remain stabile. (interview)*

As they managed to organize their work in a coherent way and the team members started to interact more actively through prototype work, they also reached an agreement that they should work in such a way that their activities could be integrated into the software platform

*It has been predominantly researchers working on the code, and this means that none of them actually saw the software in the platform as the only outcome. To me it is more important to get one more publication on my list than it is to get a really cool software platform out of this project (...) but we are all more conscious about the fact that our work has to be integrated into the platform. (interview)*

The team spent much time discussing how they could work towards a common project. This discussion had been fuelled by the persistent declaration of the research director to work through the development of prototypes. The initiative was therefore not entirely a bottom-up decision, but most likely a mix of bottom-up and top-down. In these discussions it was clear that not all team members perceived a benefit from the contributions to shared prototype, but they were nevertheless willing to do their share of the work.

*There has been a lot of focus on making a coherent collection of tools (...) We could just say that the toolbox could consist of one hundred different things, that do not fit into the same holes. But right now we actually do try to create a toolbox in which everything works together. (interview)*

Despite their lack of interest in generalizable toolbox prototypes, the team members did have a sense of obligation that they should produce some common work.

## **DISCUSSION**

With so many different interests and different ways of working it could be expected that there were be significant problems getting the project completed. However, in this case the team indeed did complete the project satisfactorily. How was this possible?

### ***Pre-trading zone***

Three reflective practices were identified in the pre-TZ and it is important to better understand these reflections, as they are likely to partially explain the individual behavior in the TZ. The notion of 'reflective practice' of Schön (1983) can help to describe the pre-TZ cognitive work as practices, referring to his 'reflection-in-action' concept. On this basis practice is not only what can be observed or which is related to action; practice may also be repeated reflections.

### *Interpreting*

The discussions about the meaning of 'toolbox' triggered a first step of a sensemaking process at the individual level; the transformation from raw data to meaningful information (Weick, 1995). Parallels to this phase can be drawn to two of Weick's sensemaking concepts 'enactment' and 'selection' (ibid). Enactment consists of bracketing and labeling the stream of experiences and data, and in a research project characterized more by uncertainty than certainty this process was highly important for action to happen. Through cognitive work confusing data must be put into a logical order, or networks of causal sequences, before an individual is capable to make an assessment of how to act next (Weick, 1995). Moreover, interpretation is not only the process of bracketing and labeling the stream of data; it also encompasses the process of 'selection', or linking the labels together making plausible connections (ibid). It is worth mentioning that the process of interpretation was clearly linked to the ongoing collective discussions in the team on the meaning of the toolbox, but the fact that there were different interpretations of 'toolbox' shows that this is indeed also an individual cognitive process.

### *Assessing*

To better understand the process of assessing it is useful to draw once more on Weick's theory of sensemaking as the assessment phase shows similarities to Weick's concept of 'retention'. Once an individual has 'bracketed' and 'labeled' the events and data, he or she will be able to articulate plausible maps that summarize the situation at hand (Weick, 1995). In other words, the individual team member is ready and able to engage in a comparison between own interests and those of the project, and this comparison will enable the individual to develop a strategy for how to act, and in this case the assessment outcome was a potential conflict of interest between the perceived goals and own goals and intents.

### *Strategizing*

The process of strategizing is the process through which an individual creates a plan of action based on the perception of future challenges and future opportunities. In the case the strategy becomes that of avoidance, influence, and contribution based on the idea of give and take. Bouty (2000) described a similar phenomenon among scientists in an inter-organizational innovation project. She identified two logics of exchange among the scientists when they had to evaluate whether to exchange resources or not with their partners. She found that even though a scientist was capable of or ready to exchange a resource with another scientist this did not mean that he or she was willing to do so. A process of evaluations set in, and this process had mainly two outlets, or strategies: 'profitable exchange' and 'equitable exchange' (Bouty, 2000). The 'profitable exchange' indicates that the exchange is purely based on bartering: an individual gives something, and gets something in return. The strategy lies in not providing any resources or knowledge if nothing is given in return. The second logic is about helping each other out without expectations to get something in return for the help. Even though Bouty focused on the willingness to exchange resources, there are some clear parallels to her findings on exchange logics and the findings of avoidance, influence, and contribution. Avoidance describes an unwillingness to engage in the exchange of resources, and it may contribute to the profitable exchange logic. Along the same lines, influence is an indicator of how one can benefit from an exchange and is therefore also similar to the profitable logic. Put together, avoidance and influence are two elements of profitable logic; one is about not giving and the other is about giving, and those actions are carefully calculated. Contribution is based on the realization that there are certain obligations in participating in these types of projects and that one's contribution may not provide any immediate returns for one's own interests. There are therefore parallels between Bouty's equitable exchange as the individual contributes with work and resources that may not necessarily be to his benefit. Bouty's equitable logic suggests

that some actions are altruistic; the article argues that even when a contribution is made 'free of charge' it is still based on a strategic calculation.

### ***Practices in the trading zone***

With a strategy the team members enact the TZ; the place where interactions and negotiations about the project takes place and where innovation work is carried out. The practices of expanding and tolerating indicate how the team managed to accommodate differing interests, objectives, etc.

#### *Expanding.*

One of the first activities the team members carried out was a discussion about the features and the nature of the toolbox. This discussion can be considered one of the very first steps towards collaboration, and it may be compared to Galison's (1997) idea of 'pidgins'. Pidgins are team developed boundary-spanning inter-languages whose overall purpose is to create a shared lexicon that can be applied to enhance communication. Carlile (2004) presented a similar activity in which syntactic boundaries were transferred and semantic boundaries translated. The team not only created a shared lexicon, but also put much emphasis into the meaning of these words and concepts. It is based on this process that they slowly determined for example the architecture surrounding their toolbox work.

Another tool applied to enhance collaboration was on the creation of a common domain (Galison, 1997). The team agreed that the overall research topic was to be 'indoor navigation', an area that was considered interesting and relevant to all teams members. By agreeing on this common domain, a very broad term, the team members all felt that there was a place for their specific research interest in the project, and this encouraged them in their work.

The team also came up with solutions for collaboration procedures, when it faced organizational challenges. The team solved the problem of incongruent work practices by deploying different mechanisms enabling their collaborative work and the transfer of ideas: the use of pieces of shared administrative structure; agreement of organization of architecture; and rules for handling of data (Vaughan, 1999).

Through these three mechanisms the team created an organizational structure that could accommodate all interests, while at the same time making sure that the shared work was carried out (Kellogg, et al., 2006).

The determination of the research director to produce prototypes affected the work in the TZ as it forced team members to work jointly on these prototypes and demos. By doing so the research director ensured inter-disciplinary work in the team. Morris and Hepden (2008) describe how TZs may exist of both an inter-disciplinary mode of interaction and a multi-disciplinary mode. In the inter-disciplinary mode of interaction a convergence of roles and constructive discussions may arise during interaction, whereas in the multi-disciplinary mode of interaction, each discipline will work in a self-contained manner, and exchanges are more formal, more circumspect or may even be non existent (Morris & Hebden, 2008). Morris and Hebden argued that the exchange of knowledge would depend on the degree to which the different disciplines are able to create a balanced mix of the two interaction modes. In the case studied in this article the mechanisms deployed to enable collaboration and knowledge exchange it possible for the individual team members to work on their specific research interest (and thereby created the premises for the multi-disciplinary interaction mode) while at they at the same time united the team members in shared work tasks (and thereby created the premises for the inter-disciplinary interaction mode). Team members were rarely rejected if they had an idea, as these ideas were simply incorporated into the overall objectives of the project. This environment of shifting inter-disciplinary and multi-disciplinary interaction modes

created a sense of belonging in the project and caused the team members to engage more actively in the activities that did not seemingly have any interest to the individual.

### *Tolerating*

The second characteristic of the TZ was tolerance for contrasting individual work activities. In some instances individual interests were not coherent with the overall objectives of the project, but nevertheless these interests were incorporated into the project objectives. This is fully in line with Galison's observations that equivalence or similarity of interpretations is not a prerequisite for enacting a TZ Galison, (1997). It is possible to tolerate divergent interests, because the TZ accommodates both local and global interpretations as long as they agree on the general procedures of exchange (Kellogg et al., 2006). The team simply accepted the fact that some tasks carried out in the project were not for the common good, but rather for individual/organizational purposes. Like expanding, tolerating seemed to be a practice that functioned as a motivational factor to the team members, leading to a feeling of autonomy (Hoegl & Parboteeah, 2006).

Giving space for different interpretations made team members more willing to contribute to the common cause, because they do not feel forced to fit into an artificial common interpretation. It was clear to everyone in the project that there were personal/organizational interests, but it was also apparent to them that they had a 'psychological contract' to complete the prototypes and toolbox (Ring & Van De Ven, 1994). The work around the toolbox and the related prototypes thereby becomes the TZ for their work interests. This can be explained by a feeling of safety and autonomy. When team members felt "safe" and unconstrained their lines of thought synchronized somewhat, as they become more willing to work together (Clegg et al., 2002).

The five practices of the TZ are about making sense of the situation and then choose what to do, but this strategy is then potentially challenged in the TZ, for which the individual will have to make sense of the new situation and strategize according to this. But when they entered into the TZ the strategies did not work out because the two strategies were in conflict, and therefore a new round of pre-TZ practices were initiated. In this case they found a new solution, which could accommodate all the parties satisfactorily. The five practices of the TZ are therefore to be considered an ongoing spiraling process of reflections and actions.

In Figure 1 this spiraling process is illustrated. After going through the process of interpreting, assessing and strategizing the individual enters the TZ. Here the team engages in both tolerating and expanding work practices, and when a new situation arises (illustrated by the star) a disruption occurs within the single individual that requires to re-engage in the interpretation-assessment-strategizing process in order to react to the disruption.

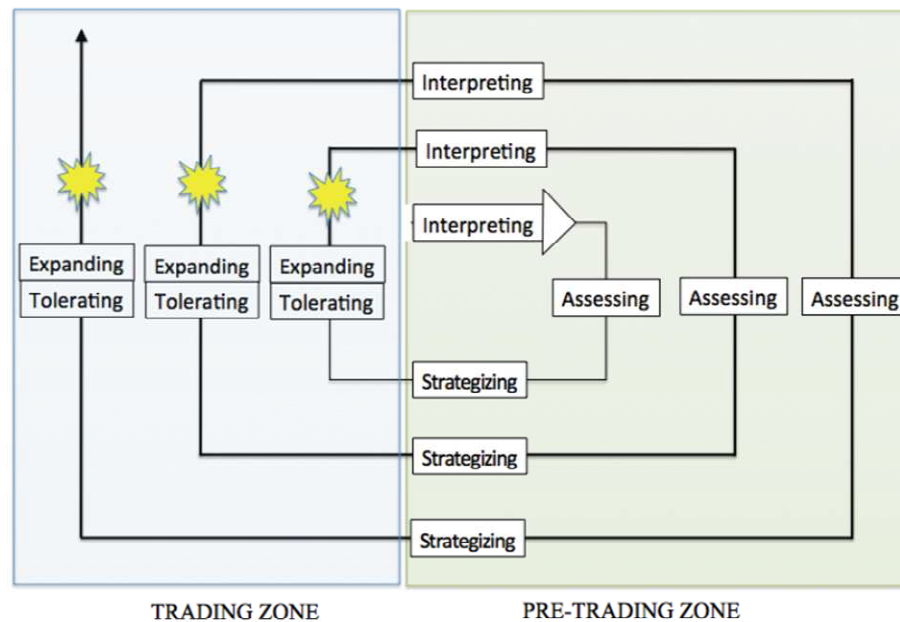


Figure 1. The spiraling process of TZ practices

## IMPLICATIONS

This study shows that in self-managed inter-organizational R&D team members enact a number of practices that constitute a TZ where different interests and practices can co-exist. This system enables the team members to develop and expand on their own interests, and this has a motivating effect, which lowers the strategic guards of the team members and thereby opens up for more interaction, collaboration and knowledge sharing.

### *Practical implications*

This study implies that the practice of strategizing seems to play a significant role for whether collaboration and knowledge exchange will occur in the setting. If avoidance is the dominant practice among participants it is unlikely that interaction will take place and thus excluding knowledge exchange and collaboration. If, on the other side the practices of 'asserting influence' and 'calculating contribution' are dominant there is a good foundation for collaboration across boundaries. In practice this means that attention should be paid to the pre-TZ reflections, by trying to assess how participants perceive their potential influence in the project, as this will be the key to their behavior in the TZ.

### *Theoretical implications*

The theoretical implications are primarily linked to the identification of the five phases of the TZ. Getting to a point where the collaboration and knowledge exchange appears to work is a

long process, which encompasses a number of interpretations regarding the setting and the situation at hand, and a study will for example not yield the same results if inquiring at the initial stages as one would at the final stages.

The results also have implications to the debate on heterogeneity vs. homogeneity as it provided a different view to this dyadic debate by implying that collaboration efficiency does not depend on team composition, but rather that it is influenced by a complex set of evaluation, strategizing, and negotiation processes enacted by the participants in the setting. Furthermore, the findings indicate that autonomy plays a role in the constructive enactment of the TZ, but rather that in combination with other favorable factors autonomy may have a positive effect on collaboration in inter-organizational R&D projects.

## CONCLUSIONS

This article investigated how inter-organizational R&D is organized and coordinated by team members at the operational level. Five practices were identified that explain why individuals and organizations with apparently contrasting interests and different work practices manage to collaborate and create results. They did so by working around a number of agreed upon procedures of exchange. This left the team members space for their differing interests, objectives, values, practices, etc., and instead of insisting on one common objective, practice, etc. they rather accommodated these differences into the project. This sense of autonomy evoked a sense of obligation towards collaborative efforts leading to the exchange of resources between the participants.

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