BOUNDARY OBJECTS IN NEW JOINT FIELDS: ROUTINES, BIAS, AND INCOMPATIBILITIES IN DISPERSED R&D SETTINGS

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INTRODUCTION

In settings where R&D specialists work together on a technical project without physically being together, boundary objects are often used to facilitate understanding and collaboration (Carlile, 2002; Star & Griesemer, 1989). From a practice perspective, boundary objects refer to artifacts that are understood within their local setting, yet have enough common ground to facilitate the shared practice context in dispersed settings. Examples of boundary objects are graphs, designs, documents, intranet, and other entities that can link actors together to allow for collaboration without necessarily having a full consensus on the object (Bechky, 2003; Wenger, 1998). Although the main objective of using boundary objects is to span boundaries between actors from different fields, this objective is often not realized.

When different (dispersed) groups of specialists decide to collaborate on a new project, a “new” joint project field may be established. This field, however, might not be so “new” in the sense that the objects with which people have to work are unbiased and neutral enough to be experienced as new joint boundary objects. Previous conceptualizations of boundary objects tend to ignore the influence a boundary object’s “local embeddedness” can have on its functioning as a boundary object in a new joint setting. In this paper, we analyze the influence that locally embedded boundary objects can have on the development of a “new joint field” in dispersed R&D settings. The study focuses on the question what the influence is of a boundary object’s history within a particular practice context (i.e., a specific local R&D unit) on its functioning as a boundary object within a newly established shared practice context (i.e., the context of a shared practice between two or more dispersed R&D units).

The basis of our analysis exists of a case study of a collaboration effort between a Canadian and a Dutch R&D department of a multinational organization specialized in print technologies. Based on an analysis of data from 33 face-to-face interviews, and literature on new joint fields, boundary objects, and routines, our contribution is twofold. Firstly, we consider boundary objects as elements of new joint fields and show that the historical use of boundary objects with similar functions in local settings can play a key role in the adaption of boundary objects in new joint settings by different groups. Secondly, we argue that boundary objects’ history and local embeddedness can lead to dispersed R&D workers having a “biased” perception of these objects, and that an awareness of this bias allows us to better understand how these boundary objects can have an effect on the creation of a shared practice context in which joint R&D projects can take place.

THEORETICAL BACKGROUND
New joint fields

Introduced by Bourdieu and Wacquant (1992), Levina and Vaast (2005) elaborate on the concept of a new joint field to describe how the creation of a new field within R&D work supports boundary spanning efforts between different fields of practice. They explain that a new joint field allows a new group of actors to differentiate from others not participating in the field, it allows for the development of joint interest (Bourdieu & Wacquant, 1992), and allows actors to overcome embeddedness of practices from other fields (Orlikowski, 2002). Levina and Vaast (2005) argue that the emergence of a new joint field in which R&D specialists from different contexts meet, such as a new joint study, a new project or a new virtual R&D unit, allows them to create a shared context in which they can expose and share their expertise.

Since new joint fields can facilitate a shared context in which different groups are motivated to participate and contribute, they appear to have a somewhat neutral, unbiased character for all actors involved, compared to the different existing fields actors originally came from. From this, a new joint field can be seen as an opportunity to reduce boundaries between (groups of) actors from different fields. A new joint field is created, for example, when geographically dispersed R&D groups are brought together for global collaboration (Bryant, 2006; Hinds & Mortensen, 2005). This presents actors with the ability to jointly negotiate, organize and develop practices and routines, so as to build a collective mind (Weick & Roberts, 1993). Other studies have considered the influence of a shared practice context on for example knowledge creation (Nonaka and Konno, 1998), local practices (Hinds and Mortensen, 2005), information systems (e.g. Roberts, 2000; Schultze & Boland, 2000), computer-aided design systems (e.g. Goodman and Darr, 1998; Leonardi, 2011a), technology and routines (e.g. Leonardi, 2011b) situated knowledge (e.g. Bechky, 2003; Cramton, 2001; Sole and Edmondson, 2002) and organizational knowing (Orlikowski, 2002).

Boundary Objects

In dispersed R&D settings, the creation of new joint fields is strongly supported by tools and artifacts, such as prototypes and collaborative technologies. These tools and artifacts can be conceptualized as boundary objects which help in the creation of a new joint field that transcends particular units’ local practices and interests. In this sense, boundary objects are ‘a sort of arrangement that allows different groups to work together without consensus, and form boundaries between groups through flexibility and shared structure – they are the stuff of action’ (Star, 2010, p. 602). Examples of boundary objects are: documents, (IT) programs, designs, prototypes, and standardized reporting forms (Carlile 2002; Levina & Vaast, 2005; Star & Griesemer, 1989), narratives (Bartel & Garud, 2003) and processes and methods (Swan, Bresnen, Newell & Robertson, 2007; Nicolini, Mengis & Swan, 2011). Star and Griesemer (1989) and later Star (2010) highlight the functionality boundary objects should cover: every object can be a boundary object, but only if it is used between groups to allow for joint action and collaboration. This also means that boundary objects need to have a sufficient level of interpretive flexibility (Star & Griesemer, 1989), meaning that different groups are able to interpret and use the object in such a way that collaboration is facilitated through this object, either by human interpretation of actors involved or by flexibility of the design of the object (Pinch & Bijker, 1984). Boundary objects are flexible in the sense that they can have different meanings for different groups, but still maintain enough commonality to all groups so that they
are recognizable and can be used as a way of translation (Star & Griesemer, 1989). The implications of boundary objects for collaboration have been investigated in several studies on knowledge work practices (e.g. Schultze & Boland, 2000), IS related work (e.g. Levina & Vaast, 2005), design and manufacturing (e.g. Henderson, 1991; Subrahmanian, Monarch, Konda, Granger, Milliken & Westerberg, 2003), and combinations of these fields of study in distributed environments (e.g. Goodman & Darr, 1998; Newell, Scarbrough & Swan, 2001).

**Routines**

When dispersed collaborative settings are initiated, for instance in R&D projects, the embeddedness of boundary objects in their original setting can become problematic. The historical use of a boundary object by different groups in their local setting influences how the boundary object will be used in a new joint field. In other words, if an object has been developed and used by R&D unit A in its local practices, it may be problematic to use this object as a boundary object in a new joint field that consists of a collaborative project with R&D unit B. The situation can become even more complex if different groups use comparable boundary objects that are not sufficiently different from each other, yet not overlapping enough to match and be embraced by other groups in the new joint field. For example, one local group that has developed their own boundary object, such as a tool specialized to capture changes in their specific technology, also introduces this tool into a collaborative setting, without bearing in mind that their tool is completely tailored to the practices and routines developed around their specific work setting. The collaborative setting where this tool is then introduced involves other actors and different work practices, which do not necessarily find the tool equally useful compared to the context it originated in.

This is where the concept of “routines” becomes relevant. Routines, conceptualized as “repetitive, recognizable patterns of interdependent action, carried out by multiple actors” (Feldman & Pentland, 2003: 95), can be seen as the mechanisms that tie boundary objects to practice and human actors. In time and through interaction with human action and practice, boundary objects are given meaning and a shared understanding within a group (Feldman, 2000; Weick & Roberts 1993), and become structured and even standardized in work settings over time (Star, 2010). The ‘path’ that boundary objects undergo in practice embeds them in the routines of the group developing and using them, which at the same time makes it more difficult to decouple them from these routines and use these objects in other settings (e.g. Schreyögg & Sydow, 2011).

Thus, boundary objects are tightly coupled to practice, and therefore not easily transferable across practices. This observation reveals a paradox in the interpretive flexibility that can emerge in the use of boundary objects. If boundary objects in practice have the tendency to become embedded in the practice and routines they are supporting, this can have implications for the use of these boundary objects in other practice contexts, such as new joint fields. It seems valid to identify boundary objects that are successfully facilitating work in one setting and use them in new collaborative fields. However, these new fields will have different practices and routines compared to the fields that boundary objects were originally developed in. When new actors and new practices are confronted with these boundary objects, there is a possibility that previous characteristics of these boundary objects made sense in their original setting can become misplaced or misunderstood. Furthermore, taking into account that these boundary objects will have a different functionality in a new joint field than they had in their original setting, as the practices and routines around them differ, these boundary objects become ‘biased’
for different actors. As can be seen in many empirical studies on boundary objects (e.g., Goodman & Darr, 1998; Henderson, 1991; Leonardi, 2011; Levina & Vaast, 2005; Nicolini et al. 2011; Subrahmanian et al. 2003), a bias can have important implications for the introduction of objects in new joint fields. Investigating this perspective is useful because it can allow for better understanding of the consequences that biased boundary objects have on new joint fields, and more specifically on dispersed R&D initiatives.

CASE STUDY

To investigate the above reasoning, we conducted a case study at a multinational organization (which we will call “Graphic”) primarily specialized in B2B laser and inkjet print technologies. The company has about 800 employees working in R&D in the Netherlands, and several smaller R&D sites in Europe, Asia and North and South America. In this study, we focus on a niche technology belonging to Graphic, printing high quality images on various materials, for which the expertise was developed in a Canadian unit of Graphic; GraphicCA. The Canadian unit was originally acquired about 14 years ago. With about 50 specialists and engineers working in GraphicCA, most research, design and integration of these display graphic technologies was held by the Canadians.

As in various other product technology organizations, Graphic’s designers, specialists and engineers worked with 3D computer aided design (CAD) software to develop their technologies. This software allowed them to design in a virtual 3D environment, in which drawings could be combined with all sorts of calculations and tuning to incorporate, for example material and movement. At the time the Canadian unit was acquired by Graphic, they already operated their own 3D CAD format, which was different from the format in the Netherlands. Because Graphic did not have any concrete plans for collaboration after the acquisition, GraphicCA was in the position to continue operating its own 3D CAD software.

Project Mesa

About twelve years after the acquisition of the Canadian unit, Graphic decided on a collaborative project between GraphicCA and a group from R&D in the Netherlands, GraphicNL. Starting development in 1999, GraphicNL had designed an automated table that could lift and move material on to the work surface of printers. Around 2007, Graphic decided that it could be useful to integrate the table with GraphicCA its technology, to enable higher volumes and different kinds of material to be printed, without any manual help of lifting and placing material on the table. To start collaboration, project Mesa was initiated, and Graphic allocated 20 engineers specialized in the table technology as well as print technology and the full R&D unit of 50 engineers from GraphicCA to the project. Management and lead engineers paid several mutual visits to get familiar with the people and technologies different units were involved in. Although many R&D managers and engineers of both sites expected project Mesa to result in a profitable innovation, the project was canceled by management about two years later.

Data collection within Graphic became possible a few months after cancellation of project Mesa, which resulted in 33 face-to-face interviews at both sites. All interviews were coded with Atlas.ti. Two examples of boundary objects were studied. The first example demonstrates the use of 3D CAD models as the way to jointly design and develop a virtual prototype. It appeared that the two sites used different CAD systems that were not compatible.
(knowledge could not be shared through these models), and because both systems were so highly ingrained in the practices of both units, it seemed too costly to adopt only one of the two. The second example demonstrates the use of an online wiki as a way of jointly discussing technology and retracing technological decision making. The wiki was new to both sites, but gradually engineers became motivated to use the wiki as a primary communication tool. While both boundary objects share important design functions and thus could play a crucial role in the collaboration, only the wiki was successfully exploited as a technological boundary object. Our full article covers our findings in detail.

Findings from this study suggest that the extent to which a boundary object has been developed and used in previous settings within different groups that are expected to collaborate, in this case in the Mesa project, does have a significant influence on how a boundary object can be shaped and used in a new joint field. New joint fields, which are created to pursue joint interests, in which actors can overcome embeddedness of practices from other fields (Orlikowski, 2002), and in which they can jointly shape and develop a new shared practice context, do appear to be unbiased or untouched fields. From this point of view, it is assumed that the development of a shared practice context involves the creation of boundary objects that have the same kind of unbiased character or are at least negotiated before being implemented in the new joint field. In this way, the new joint field maintains its unbiased character which is essential for joint knowledge work to evolve (e.g. Frost & Zhou, 2005; Nonaka & Konno, 1998). If the new joint field is created and has matured over time, undoubtedly new shared routines will be formed through practice in the field. However, as can be seen in the case of the CAD tool, it is not always possible to introduce an unbiased boundary object within a new joint field. If boundary objects that are introduced in new joint field have a history in other fields where actors were using the same boundary object, then these actors will see the boundary object as familiar and embedded within their routines. If a number of actors in the new joint field previously used another boundary object similar to the new joint boundary object, but not similar enough to be compatible with their local boundary object or existing routines, this can cause discrepancy between groups. Part of the newly formed group can transfer their existing routines within the new field by using their local boundary object, while another part of the group will not be in the same position. In the case of the Mesa project, the new joint field became equipped with partly biased boundary objects, namely CAD systems that neither of the joining groups could adopt from each other.

**IMPLICATIONS**

The purpose of our study is to understand why some boundary objects within project Mesa were highly successful in bridging boundaries between dispersed R&D teams, while other boundary objects which were important for collaboration were not successfully incorporated within the new project setting. Besides differences in flexibility of the structural design of boundary objects themselves, we found that when boundary objects partly overlap with established and embedded boundary objects within separate fields, then this impacts how boundary objects can be established in new joint fields – when boundary objects are already embedded in local practices, it becomes very difficult to embed them in a new shared practice context. Our analysis helps to understand how routines that shape boundary objects in one setting can hamper the adoption of boundary objects with similar functions in other settings. The level of embeddedness of boundary objects at different Graphic sites had different impacts on the
establishment of new joint fields. Furthermore, the boundary objects in our example show different levels of interpretive flexibility, which also plays a large role in how easily boundary objects can be copied from one field and adopted in other fields.

Our example of local boundary objects that do not succeed as unbiased boundary objects in joint fields does not stand on its own. Other studies have shown conflict in the use of boundary objects in collaboration (see for example Henderson, 1991; Leonardi, 2009; Levina & Vaast, 2005; Nicolini et al. 2011), many of them because boundary objects did not fit properly within the existing context of people and work practices. In the light of new joint fields this is an important finding since the bias that some boundary objects can bring along into these fields can play a large role in how neutral these joint fields are organized from the beginning. In our analysis we found that the fact that boundary objects work in one context does not automatically imply that these boundary objects can be adopted and function as boundary object in other (similarly looking) contexts. Although the word ‘object’ might give the impression that boundary objects are loosely coupled and easily transferable, we show that the historical and local embeddedness of these objects shapes how they can be transferred to a new joint field (see also Bechky, 2003; Carlile, 2002). This has implications for literature on managing dispersed R&D, in the sense that the previous usage of these objects and their embeddedness within existing fields can make these objects somewhat biased for different actors in new joint fields. Levina and Vaast (2005) discussed the difference between designated boundary objects and boundary objects-in-use, in which the former category can be seen as ‘intended’ but not necessarily fulfilling their role as boundary object, while the latter category shows enough characteristics to facilitate new joint fields at all times. Especially in dispersed settings, when the role of boundary objects becomes very important because a shared practice and social context are less evident, it is more likely that when creating new contexts, boundary objects will be designated instead of more naturally emerge through routines as boundary objects-in-use. Considering our conclusion that routines from different groups have a strong influence on how boundary objects are formed in existing fields on the one hand, and adopted by new fields on the other, an interesting avenue for further research could be to explore how routines and boundary objects interact in more detail.

Another implication can be found in the way new joint fields are observed in a more general sense. As noted before, literature on new joint fields in R&D gives the impression that these fields are new neutral settings in which different groups of actors come together to build a shared practice. Our findings show that these fields are not necessarily ‘neutral’ or ‘unbiased’ but can largely consist of elements that different groups bring along from their own existing fields. Obviously, when considering R&D from a practice perspective, this is understandable because the knowledge that is brought into these new fields is already embedded in people, their work and their routines. However, if these boundary objects become too biased, for example when part of the new group is able to adopt the boundary object while another part is not, the boundary object becomes a biased object and can hamper the creation of a new joint field as opposed to acting as a stimulus. Considering boundary objects as important building blocks or elements of new joint fields, our findings have implications for literature on new joint fields because they say something about the interpretation of these fields as being “new”. Established to create a shared context between different groups, it would be interesting for the conceptual development of new joint fields to further examine how biased boundary objects fit within this context.

REFERENCES AVAILABLE FROM THE AUTHOR