BOUNDARY OBJECTS AND BLINDING: THE CONTRADICTONS OF INTER-ORGANIZATIONAL COLLABORATION IN THE AMAZON

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1 Introduction

Over recent decades the shape and nature of work has been transformed considerably in the public sector. Not only is work undertaken within governmental agencies units, but it is now also undertaken with people working in different units and sometimes different agencies and regions. Such new forms of boundary crossing work have arisen in part from the emergence of new professions, increasing levels of specialization and broader trends such as pressure to reduce costs and integrate governmental services (Engestrom 2001; Blackler and Regan 2006). Central to such possibilities has been the ongoing development of information communication technologies (ICTs) that provide for the storage and transmission of data over great distances. Such changes have allowed for new forms of work to take place across occupational, cultural, geographical and time-zone boundaries. The opening up of these boundaries may involve people working with others who they may be unfamiliar with, who occupy very different roles and who hold very different assumptions about work (Engestrom et al., 1995; Suchman, 1994; Tsoukas, 1996). One important literature that has considered the role of ICTs and boundary crossing has been through the concept of boundary object (Barrett et al., 2010: 1200; Zeiss et al., 2009). This concept initially emerged from Star and Griesemer's (1989) study of the ways different professional groups collaborated with each other in the Museum of Vertebrate Zoology at the University of California in Berkley. They analyzed the interactions between philanthropists, administrators, hunters and scientists and found that shared practices (i.e. specimen preservation procedures, note-keeping standards) and artifacts (i.e. standard forms, repositories, general models, and maps) were crucial for the emergence of a fruitful collaboration between the different specialists. Star and Griesemer (1989: 393) referred to the artifacts as boundary objects, namely, objects that "are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites". Building on this initial contribution, subsequent studies have developed a view of boundary objects as being the basis for more engaged forms of social interaction. In particular, commentators have argued that the notion of boundary objects explain how certain objects may become "important means of achieving collaboration, promoting the sharing of knowledge between diverse groups" (Barrett et al., 2010: 1200; Zeiss et al., 2009).

More recently some in-depth studies of the role of boundary objects in particular settings have argued that boundary objects may hinder as well as aid collaboration (Briers et al., 2001; Carton et al., 2009; Levina, 2005; Levina et al., 2006). Notable here has been Barrett and Oborn's (2010: 1215) recent study of the work of a cross-cultural software development team. They found that initially software specifications facilitated collaboration by allowing Jamaican and Indian programmers to share their knowledge about the local context and technologies, respectively. However, following this initial phase, some Indian managers started to use software specifications to impose their authority over the Jamaican programmers in order to speed up the development process. As a result of these events the authors noticed that the software specifications stopped acting as a basis for knowledge sharing and contributed instead to growing frustrations and tensions between the two teams. Consequently Barrett

and Oborn (2010: 1215) suggest that boundary objects are shaped by politics and are themselves subject to changing roles over time. Hence, they concluded that boundary objects should be conceptualized as "both pluralist, recognizing the potential for collaboration and conflict, as well as interactional" (Barrett and Oborn, 2010: 1215).

A central feature of our argument is that issues of reification and boundary objects are fundamental in understanding the contradictory effects of boundary objects. Reification refers to the transformation of entities into things or objects and thus is implicit in the notion of boundary objects. Indeed, reification has been central to the establishment of boundary objects. Despite the importance of reification for understanding the functioning and consequences of boundary objects, so far no study has addressed this issue empirically and theoretically (see Star, 2010; Trompette et al., 2009). Having this underdeveloped area in mind, this paper will draw on the understandings of boundary objects and reification mentioned above in order to explore the ways in which GIS in the Amazon facilitated or hindered collaboration between different occupational groups.

2 GIS and joint work in the Amazon

The Brazilian government has been increasingly using GIS for a wide variety of roles in the last three decades. In particular, PRODES (the program for the calculation of deforestation) has provided yearly deforestation rates which have guided the policies towards the region since 1989, while DETER (deforestation detection in real-time), which was created in 2004, has been extensively used by IBAMA and state-level environmental agencies to enforce the country's environmental policy at ground level. In this way, the use of GIS has become diffused not only in policy-making but also in law enforcement practices in the region. This section discusses how forest rangers in Mato Grosso, scientists in São Paulo and senior officials in the Federal District collaborate using this family of geographic information systems, from now on indicated "the GIS" for brevity.

By reifying particular dimensions of the Brazilian Amazon such as forest clearings and land ownership into digital data, the GIS has acted as a boundary object, so providing opportunities for collaboration between organizations operating across occupational and spatial boundaries in the Amazon (see Figure 1). However, there were some circumstances in which the process of reification promoted by the GIS was undermining the very practices this artifact was supposed to improve. This section will argue that the overemphasis on reifications may hinder joint work by aggravating a process we refer as "boundary-blinding", that is, the inability of the some groups (usually senior officials) to understand the practices taking place across boundaries (usually low rank officials). In particular our analysis has identified two dynamics that have led to boundary-blinding: the belief that the GIS deterministically reduces deforestation and the view that the GIS offers a mirror of the Amazon and of the work of the rangers.

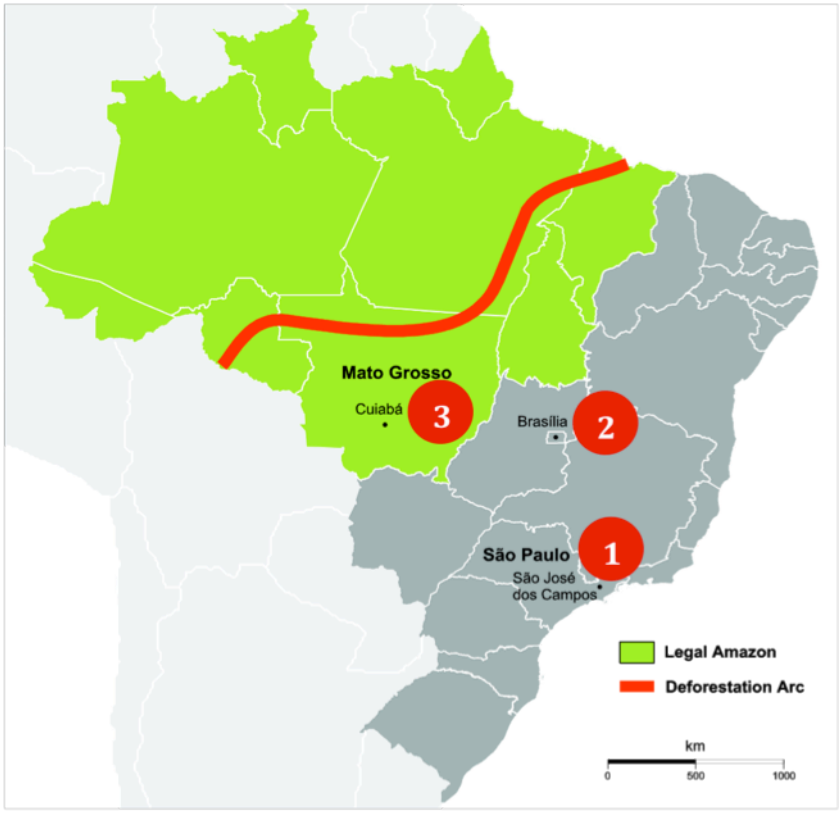

Figure 1 *Location of some of the organizations formulating and enforcing the environmental policy in the Amazon: 1) National Institute for Space Research (INPE) in São Paulo; 2) Ministry of Environment in the Federal District; and 3) Federal Environmental Agency (IBAMA) local offices in the Amazon region*

Technological determinism was evident in our case in a number of ways. The Brazilian government has spent (and continues to) considerable sums in the acquisition of satellite images with higher spatial (i.e. more quality) and temporal resolutions (i.e. more frequent snapshots) so as to try to provide data that is as near to being "real-time" as is possible. Interviews with different scientists and senior officials suggested that behind these heavy investments is a belief that the availability of more detailed and timely data is crucial for reducing deforestation in the Amazon. When it comes to the description of the way these systems are used in law enforcement, senior officials and scientists again provide accounts that are more focused on the capabilities of the GIS than on the actual practices undertaken by the forest rangers. In particular, scientists and senior officials often assume that forest rangers work on the same "real-time" basis as the GIS, expecting rangers to launch operations that are able to interrupt ongoing deforestation and arrest the perpetrators in the act as soon as new deforestation data appears on the computer screen.

However, despite the prevalence of the view that law enforcement takes place in real-time as a consequence of the GIS, a closer look at the actual practices of forest rangers reveals a very different situation. The rangers have to face significant challenges in order to leave their bases and get to the locations pin-pointed by the GIS. It is not uncommon for forest rangers to take two days or more to reach a given location within their jurisdiction. Further issuing fines was very time consuming as it was important that detailed records of coordinate and pictures were taken as evidence in case the farmer challenged the fine that the rangers imposed. In addition to that, IBAMA and other environmental agencies have difficulties in recruiting and retaining forest rangers in the Amazon,

leading to a chronic issue in relation to the lack of qualified personnel. Consequently it is often impossible for the rangers to be able to respond to specific deforestation points as soon as they are detected by officials in Brasília or São Paulo by using the latest GIS technology. Instead, local managers usually have to wait until the number of deforestation points detected cumulate into a sufficient amount for them to consider it worthwhile to send a team of forest rangers to the region. Therefore, typically deforestation is only investigated and potentially prosecuted several months after being detected by officials using the GIS. Further to the delay in investigations, many areas of the Amazon rainforest are not even investigated. This was evident in only 17%[1] of the deforestation detected by INPE between 2004 and 2008 actually lead to IBAMA issuing a fine. Therefore not only deforestation control in "real-time" is infeasible in practice but also that forest rangers cannot cope with the volume of deforestation data currently provided by the GIS. The above suggest the presence of a view that a technology with certain characteristics is able to determine a specific practice independently of the context in which this technology is introduced. A perspective that views deforestation control as a set of canonical practices reified in the technical capabilities of the GIS, and are blinded of the complex non canonical practices involved in the actual enforcement of the environmental policy in the Amazon taking place across occupational and spatial boundaries (Brown and Duguid 1991).

In some cases the emphasis on the technical capabilities of the GIS as being the best approach to reduce deforestation has been so intense that some scientists and government officials believe that it can one day the detection of deforestation and the issuing of fines will be able to be automated, done solely by machine, and without any human operator on the ground. Indeed, one of the main justifications behind the development of SLAPR, a GIS developed by SEMA (the environmental agency of the state of Mato Grosso), is the ability of this technology to capture the full name of the owner and the location of a farm in the Amazon. In particular, some senior officials reported that with the help of the GIS the government aims to exert remote control over farmers by monitoring and issuing fines from a distance. In this way they suggested that the detection of deforestation solely through the GIS would dispense of the need for forest rangers. However, such a view was dismissed by many forest rangers as being fanciful, as the detection of new deforestation and its enforcement within SLAPR and other GIS involves not only scientists detecting the deforestation, but also forest rangers who have to go to the specific location indicated by the GIS in order to find the perpetrator of the crime who might not necessarily be the land owner. Consequently senior officials often wrongly conflate deforestation as that is detected and reified on the GIS with deforestation being under control. This suggests a degree of boundary-blinding whereby the very existence of professionals working across boundaries is denied (Star and Strauss, 1999).

The second way boundary-blinding is hindering joint work in the Amazon relates to the over reliance on the abstract indicators provided by the GIS. In particular our analysis suggests that this trend has prevented senior officials from adequately understanding the social reality of the Amazon and the outcomes of the work of forest ranger. Following the establishment of INPE's GIS in the 1990s, the total deforestation figures released by the institute largely became the main basis for the creation of new policies, and in many cases were also used to evaluate the efficiency of these policies. For example, it was the growing deforestation rates detected by PRODES in 2002 and 2003 that has led the government to create PPCDAm, a new plan to control deforestation. Five years later, the reduction in subsequent deforestation rate as detected by the same GIS led to senior officials from the Ministry of the Environment concluding that PPCDAm was a success. Futhermore senior officials are keen to highlight the total number of fines and environmental licenses produced in a given period while discussing the effectiveness of their agencies in the environmental protection of the Amazon. This suggests that senior officials increasingly relied on the abstract indicators provided by the GIS as the

[1] Percentage calculated by dividing the sum of the areas fined for illegal deforestation by IBAMA by the total deforestation detected by INPE in the same period.

main (and in some cases the only) way to evaluate the outcomes of law enforcement activities and policies in the Amazon.

As seen above, the reification of work with the help of GIS enabled the coordination of different joint work practices. However, it is important to note that these reifications constitute a very selective image of the Amazon and of the work of the rangers (Taylor and Johnston 1995). Thus the reifications provided by the GIS are often restricted to aspects of the Amazon that are quantifiable, spatially located in a precise way and observable from outer space and those aspects of the Amazonian reality that are immeasurable and complex often remain invisible to policy-makers. For example, the amount of work necessary to produce a single fine can vary considerably depending on the distance of the deforestation from the local office, the degree of danger involved in undertaking the operation, the willingness of the farmer to help to establish ownership as well as the complexity of individual cases. Additionally, not all forest rangers are able to issue fines and licenses with the same level of proficiency. This can led to some fines for illegal deforestation being withdrawn or overturned when they are challenged by lawyers and attorneys. Despite these differences the data provided by the GIS does not distinguish between the issuing of well-formed fines and faulty documents, and instead provides an aggregated figure of the total number of documents issued in a given period. This meant that senior officials were often unable to identify the relationship between these indicators and the actual punishment for illegal deforestation. Moreover, the emphasis on the quantity rather than the quality of fines means that senior officials tend to disregard the need for an improved legal and GIS training for the rangers. Hence, by relying exclusively on these figures, senior officials often remain blind to the outcome of the rangers' practices and their actual implication for the environmental protection of the Amazon (Lipsky 1980; Blackler 2006).

So what does our case suggest in terms of the idea of boundary-blinding? Shouldn't some form of boundary-blinding practices be expected in any geographically distributed organization? Commentators have already noted that organizations continuously adopt strategies that enable distributed and complex organizations to be manageable from afar (Law 1987; Cooper 1992). Strategies such as black-boxing (i.e. ignoring the details of the work done within a given group) and interfaces (i.e. reduce the communication between groups to a set of inputs/outputs) are often used as ways to reduce complexity (Kallinikos 2006; Spinuzzi 2008). Furthermore, the relation between the GIS and the blinding of outcomes in the Amazon should not come as a surprise. Studies exploring the implications of GIS and other technologies have already explored at length the inability of abstract symbols and related positivist epistemologies to capture the richness of social life (Pickles 1995; Taylor and Johnston 1995; Scott 1998). More specific to the public sector, these findings also confirm the problems generated by a growing emphasis on targets and indicators (Lipsky 1980; Miller 2003; Chapman 2004; Blackler 2006). However, what is particularly significant here is that boundary-blinding is preventing the different organizations working in the protection of the Amazon from understanding each other's demands and therefore is preventing the creation of more effective polices, technologies and law enforcement strategies.

3 Conclusion

By acknowledging the important ways in which reification is implicated in the functioning of boundary objects and especially with regard to the process of boundary-blinding we are able to offer some observations on some of the recent debates on the potentially contradictory character of boundary objects. As mentioned above, some authors have already noticed that depending on the circumstances boundary objects may change their role from facilitators to hinders of collaboration (Carlile 2002; Levina and Vaast 2005; Barrett, Orlikowski et al. 2007; Barrett and Oborn 2010). In the case of the Amazon as in the case study proposed by Barrett and Oborn (2010) these negative effects are related to differences in power and status between the different groups involved. So in the case of the Amazon as in the case of Indian programmers we could observe how the use of boundary objects (e.g. GIS, software specifications) became a way from a more powerful group (e.g. managers) to

control other groups (e.g. rangers, Jamaican programmers). Yet, the accounts provided by the current literature suggest that boundary objects either helps or hinders collaboration at a given time and context, precluding the possibility of hybrids or more fuzzy situations. Furthermore, the social dynamics indicated as elements hindering collaboration (e.g. politics, stereotyping) seem to be unrelated to the dynamics providing opportunities for collaboration across boundaries (e.g. flexibility, single identities, shared practice). However, in this paper we argued that the same process of reification which helps joint work by providing mobility and scalability also creates tensions through fostering boundary-blinding. In particular, on the one hand our case showed that reification is crucial for enabling the tailoring of GIS to the work needs (i.e. scale) of specific groups, and to the disembedding between time and space required for the overcoming of spatial and occupational boundaries. On the other hand, however, the reification promoted by the use of GIS as a boundary object has also promoted the invisibility of work practices and outcomes - a phenomenon that is hindering the ability of the Brazilian government to effectively tackle deforestation in the Amazon. From this analysis it is possible to conclude that in some cases the role of a boundary object as both an aid and an obstacle to joint work cannot be separated from each other. From this it emerges that the introduction of ICT in the public sector as an aid to inter-organizational collaboration should be analyzed as a potentially contradictory endeavor, whereby the same forces that enable collaboration may on the long run also hinder it.

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