Cultures of Science and Technology in the Trading Zone: Biodiversity and Open Source Development

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Abstract. This paper explores the work of building open source biodiversity information infrastructure. We analyse collaboration between a Canadian team and a Brazilian one. In particular we focus on the use of WingLongitude, a GitHub space, as a trading zone within which the two teams co-developed solutions. We show how the choice to work in a neutral space, belonging to everyone, and the use of display, representation and assemblage practices enabled sharing of some infrastructural elements, while maintaining other specificities that best suit their diverse cultures. Working together in this trading zone appears as both a practical accomplishment and a commitment to shared ideals.

Keywords: Biodiversity · Trading zone · Infrastructure · Open source

1 Introduction

Over the past several decades, the world seems to have become a smaller place. We have come to better understand that everything is interrelated, although we may not always understand the dynamics of global systems. At the same time, global problems seem all the more complex, and there is a pressing need to pool resources to meet these challenges, such as climate change, food security or sustainable development. In this context, digital infrastructures play an important role in extending the scope and scale of scientific activities. The ability to deal with enormous quantities of data has improved, spurring a need for systems to support their aggregation and reuse. In the field of biodiversity, research projects increasingly feed data into shared data repositories either at a regional level (such as Canadensys, the Atlas of Living Australia or the Brazilian portal SiBBr) or internationally (the Global Biodiversity Information Facility - GBIF) for reuse. Compatibility, which could be a problem, is addressed on a technical level by internationally recognized standards for metadata. What is less obvious is the work behind the development of this infrastructure for sharing.

This paper will explore the work of infrastructuring [1] in one instance that involved collaboration between a Canadian team and a Brazilian one. In this case, both teams subscribed to ideals of open circulation of scientific information (biodiversity) and shared some of the basic premises of technology development, such as a commitment to and skill with open source development. There are also local particularities

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and some notable differences in how this openness is interpreted. We will show how the socio-political context influences what is meant by open. In particular we will focus on the use of WingLongitude, a GitHub space, as a trading zone [2, 3] within which the two teams co-developed solutions.

The work we present here is part of a larger 4-year study exploring reconfigurations of scientific work in the field of biodiversity. We are particularly interested in the role of digital technologies in changing the division of work, helping coordination, ensuring data aggregation and so on. The centre of this larger project is Canadensys, one of the partners in this collaboration. We base our analysis primarily on information gathered through semi-structured interviews done in person with the Canadian developer (in French), and via Skype (in Portuguese) with the Brazilian counterpart. We were able to conduct all interviews ourselves and in the interviewees' own native languages since our group includes researchers with French, English, Portuguese and Spanish as mother tongues. Like that of our interviewees, our collaborative work also takes place in a multicultural context. French-language interviews were transcribed in their entirety, while the Portuguese interview was summarized in detail in English, and particularly significant portions were transcribed then translated into English. Interview guides were prepared collectively and the resulting material was analysed in our team's working sessions. We also studied the Canadian and the Brazilian platforms as well as GBIF's website, in particular their features, discussions regarding knowledge sharing, and each institution's position statement on data licencing. Finally, we explored WingLongitude, its structure, features and the interactions taking place in this GitHub repository.

2 Relevant Literature

Digital infrastructures such as the Internet play an increasingly important role in scientific activities, and this is especially the case in the field of environmental research [4, 5]. The development of large databases and international Web portals aiming at making ecological science and biodiversity data publicly available has accelerated in the past decade (e.g. GBIF). These initiatives promote full and open sharing of scientific data in line with Open Science and Open Data movements [6]. While new possibilities for sharing and "mining" data across scientific disciplines and research projects have generated great enthusiasm, they also involve significant challenges [7]. In science, data interpretation requires a precise understanding of how, where, and when they were created [8–10]. Knowledge infrastructures must therefore try to capture and transmit this type of metadata.

Building on extensive literatures in science & technology studies, Edwards [11, p. 17] defines knowledge infrastructures as "robust networks of people, artefacts, and institutions that generate, share, and maintain specific knowledge about the human and natural worlds." Large-scale efforts to improve science and other knowledge infrastructures have frequently prioritized investments in technical systems over research on accompanying cultural, social, and organizational transformations [12, p. 12]. This imbalance has led some researchers to stress the irreducibly "sociotechnical" character of scientific cyberinfrastructure [13]. Stemming from the realization that infrastructures do not magically emerge, Pipek and Wulf [1] first developed the concept of "infrastructuring" to describe the process of making/designing infrastructures in which new systems are adapted to interface with existing ones through combinations of improvisation, work practices, and continuing innovation by both designers and users. A focus on infrastructuring calls for "scaling up" and rethinking the concept of systems design as a local, punctual activity [1, 14, 15].

A localist [16] or situated [17] perspective on knowledge assumes that perspectives are always partial. If there is no unified centre or defined arrival point, the question of how to share knowledge and understandings across boundaries, and despite differences, arises. The field of anthropology has a long experience of theorizing contact with the "other." Mary Louise Pratt [18] first coined the term to "foreground the interactive, improvisational dimensions of colonial encounters […] A 'contact' perspective emphasizes how subjects are constituted in and by their relations to each other [and deals with] interactions, interlocking understandings and practices, often within radically asymmetrical relations of power" (pp. 6–7). James Clifford [19, p. 7] described the museum space as a contact zone between knowledge systems that meet, not as "sociocultural wholes" but as relationally-constituted systems that enter into relation with each other through a historically situated process of displacement. Haraway [17] introduced the contact zone concept to science and technology studies and added a dimension of multispecies contact to describe the multifaceted relationships between dog and trainer in agility training. Inequalities in the distribution of power are a key component in all these readings of the concept, as is the idea of subjectivities that are shaped in the encounter: people leave the encounter somehow changed in a fundamental way. Haraway talks about reciprocal induction. She also draws attention to the space for playful invention that is opened up in such encounters.

While this last element is of interest in the context of open source development, and power inequalities are present at an institutional level, we hesitate to mobilize the contact zone concept because of its emphasis on changing subjectivities. The developers involved are from similar professional worlds, and the knowledge systems involved are not incommensurable. What is more, while new infrastructures are developed, we did not probe the transformational nature of their contact with one another.

Another concept that has emerged in science and technology studies to address the challenges of sharing knowledge across different social worlds and conceptual frameworks and to describe how such sharing works in practice seems more appropriate for our case. Peter Galison [2, 3] developed the idea of "trading zones" as "places" where inter-languages such as pidgins or creoles develop to allow different kinds of practitioners, such as engineers and physicists, to work together despite their differences. The trading zone enables collaborative activity. Unlike contact zones, it stresses the mechanisms through which the exchange takes place and its product. Galison [2, p. 803] explains the metaphor:

> I intend the term "trading zone" to be taken seriously, as a social, material, and intellectual mortar binding together the disunified traditions of experimenting, theorizing, and instrument building. Anthropologists are familiar with different cultures encountering one another through trade, even when the significance of the objects traded—and of the trade itself—may be utterly different for the two sides.

Working together in a trading zone does not require shared interpretations or interests, nor does it assume permanence and stability of relationships.

> Instead, members of different communities coordinate their actions temporarily and locally, navigating their differences in norms, meanings, and interests only as needed. Engaging in a trading zone suggests that diverse groups can interact across boundaries by agreeing on the general procedures of exchange even while they may have different local interpretations of the objects being exchanged, and may even disagree on the intent and meaning of the exchange itself. [20, p. 39]

Open source development has been called a culture of reworking [21]. It is typically characterized by modularity, with multiple participants working in parallel and then assembling the pieces. Individuals participating in open source software development projects typically share values, norms and action principles that are strong enough to ensure cohesion and channel their activity towards a shared objective [22]. Among these core values are a commitment to sharing both information and one's work. Meritocracy based on competence, participative leadership, and freedom of involvement are other key principles [23, 24]. In this "bazaar" context, customizing and tailoring are frequent, and forking – using existing code to develop a different version of a program or to take it in a different direction – is common. Some sites such as GitHub provide hosting to expressly support independent branches, which considerably reduces social, technical, and financial barriers to forking [25].

3 Coding for Biodiversity: Co-development to Build a Global Commons

The Global Biodiversity Information Facility (GBIF) is a publicly funded international open data infrastructure. Participant countries and organisations form the nodes of this network coordinated by GBIF's Secretariat. According to its website, the vision consists of "[a] world in which biodiversity information is freely and universally available for science, society and a sustainable future" [26].[1] Its origins can be traced back to a recommendation from a panel on Biodiversity Informatics in an OECD-organised event in 1999. It was officially established in 2001 and its global data portal was launched 6 years later. GBIF promotes common standards and collaboration across boundaries, including the sharing not only of biodiversity data, but also of skills, experience and technical capacity. One of the ways GBIF has promoted cooperation is through organising and funding mentoring projects. The goal is to "enable [new countries] to more quickly supply data to GBIF and also to have portals for their own countries" (interview with Canadian developer).

Brazil's development of its biodiversity information system (Sistema de informação sobre a biodiversidade brasileira - SiBBr) started in 2012 with a team hired specifically

[1] While GBIF is a colossal open data infrastructure, Slota and Edwards [27] have suggested that its philosophical underpinnings may be as important as the data it aggregates. "GBIF as a social movement, as a political and scientific statement, and as the core of an infrastructure for global work in biodiversity science may well be more useful in guiding the course of global conservation policy than the data it contains."

for that purpose. This group comprised a biologist in charge of managing participation (who was also Brazil's GBIF node manager), two developers – one junior and one senior, a webmaster/content and community manager, and a second biologist who assisted the project director at the Ministry of Science, Technology and Innovation. In the project's first years, most of the team was based in the Laboratório Nacional de Computação Científica (National Laboratory for Scientific Computation), in Petropolis, Rio de Janeiro, because this institution was not connected with any specific field of biodiversity and therefore did not have any vested interests while setting up the country's biodiversity information system. In 2015, they moved to Brasilia to be closer to the decision centre, given that the need to fly back and forth to hold meetings at the Ministry was slowing down the development process. Although the SiBBr team worked and was paid by the Brazilian government, they were not civil servants and were hired through the United Nations Environment Programme. Also in 2012, Brazil joined GBIF as an Associate Country Participant. A mentoring project was set up the following year so that this country's biodiversity information infrastructure could benefit from the know-how of an experienced member, namely Colombia.

Brazilian interest in Colombia's experience went beyond learning how their technologies worked; they wanted to "understand the whole business model of biodiversity data" (interview with Brazilian developer), including the role of contributing institutions (e.g. research centres, botanical gardens), and how to publish data, namely which models and standards are used. In fact, although they customised and installed their own version, the Colombian portal – an old version of GBIF's technology – did not satisfy the Brazilian team. Its code was not easy to handle and it was no longer supported by GBIF. Colombia understood their reservations and they had no qualms when Brazil decided they would rather create their own portal.

In parallel with the mentoring project, the SiBBr team had studied other existing tools that might help them implement their system. Their survey had focused on open source software so that they could reuse available biodiversity information portals among other tools. They evaluated two possibilities: the Atlas of Living Australia (ALA) and Canadensys.

Canadensys is "a network of researchers, collectors, curators, information technologists, students, and educators that shares data on the occurrence and identity of plant, animal, and fungi, and other species in Canada" [28]. The online platform was initially developed with the financial support of the Canada Foundation for Innovation, through a competitive fund for university research, as one component of a vast project to equip Canada with a network of excellence in biodiversity research and conservation and to increase the accessibility of data housed in Canadian biological collections. Originally called the Canadian University Biodiversity Consortium, it brought together 11 universities from across the country. Work began in 2009, and in 2011 Canadensys released its first dataset, VASCAN, the Database of Vascular Plants of Canada. Since then, Canadensys has built a network of distributed databases and provided support to partner institutions, primarily university collections, for digitizing, publishing and georeferencing data on plants, insects and fungi in a format compatible with GBIF. It is housed in the Université de Montréal's Biodiversity Centre, a state-of-the-art building that was also built with CFI funds in partnership with the Quebec government and the City of Montreal's Botanical Garden, where it is located.

In 2014, Brazil finally chose to start collaboration with Canadensys. On the one hand, this decision was based on technological options, since ALA was much more complex and there was more “affinity” in terms of coding practices with the Canadian developers. On the other, it also had to do with ease of communication and receptiveness:

> Canada, from the beginning, from our first interactions with them, they were very helpful, very open, very interested. Neither of the countries [Australia and Canada] had in fact expected that anyone would want to use their portal, their code. It also required a certain amount of work and dedication from their end: to prepare that code so that others could customize and easily use it, and Canada was always very open to this. They were interested and stimulated to have that participation from early on. (interview with Brazilian developer)

Openness may be a general disposition or attitude, but it also has other connotations when it comes to software development or data access. The precise meaning of “open” – what it should include or what considerations should be prioritized – differed somewhat between the teams. What does it mean to build infrastructure for open data? Contextual factors shaped their answers to questions such as how open their systems should be, and to whom. The Canadian team, consisting of one developer and a data manager with a background in biology, had a personal, philosophical commitment to open source development and commons licensing. They regularly explained their position to various potential contributors to Canadensys and were able to convince them to publish their collections using commons licensing. What is more, they were, and continue to be, instrumental in international discussions on the subject led by GBIF and other organisations. More recently, in 2014, they signed the Bouchout declaration promoting more openness in biodiversity. “The mission of the signatories is to promote free and open access to data and information about biodiversity by people and computers and to bring about an inclusive and shared knowledge management infrastructure that will allow our society to respond more effectively to the challenges of the present and future” [29].

Canadensys’ institutional affiliation in a research institute means that it is perceived as primarily an academic endeavour and is able to work free of interference from government or industry. Locally, the team is in a position of force to suggest that collections they publish adopt a Creative Commons Zero (CC0) licence, a waiver of all rights, which they posited “guarantees that our data can be used now and in the future” [30].

The Brazilian team, on the other hand, has to deal with questions of sensitive data (for economic reasons and to ensure the protection of endangered species), and the fact that some partner institutions are more or less receptive to data sharing. Although there are Brazilian signatories of the Bouchout Declaration, SiBBr has expressed concerns regarding the ability to legally enforce a license such as CC0 since it is not accepted in all jurisdictions and may be incompatible with publishers’ and institutions’ internal data policies, a position they argued in a GBIF consultation (April to June 2014).[2] Following a survey by a legal consultant, SiBBr decided to recommend three licences: CC0, like Canadensys, but also CC BY 4.0 (which requires attribution) and CC BY-NC 4.0 (in addition to requiring attribution, it forbids commercial uses). Institutions are nevertheless autonomous in determining the data access rights and are asked

[2] Contributions can be accessed at http://imsgbif.gbif.org/CMS_NEW/DMS_list.php?ID=1230.

to state how much freedom they want to assign to their datasets. Still, openness is encouraged:

> The ideal is to choose the licence that best caters to your needs, but it is important to consider that SiBBr is a platform that aims to support scientific production and policy-making through free access to information on Brazilian biodiversity. As a result, SiBBr recommends enabling published data to be used in the freest and most open way possible, which also allows publishers to have greater visibility and recognition by the users. [31, translated from Portuguese]

More significantly, SiBBr answers to the Ministry of Science, Technology and Innovation. Since they were developing a system for the government, actors from various ministries and at various levels of the hierarchy would have access to the system that was seen to have a role in guiding policy and decision-making. For the Brazilians, then, completely open data access was impossible. It therefore required specific functionalities not contemplated by Canada, such as user profiles with different levels of access to the information.

These differences could have been problematic in co-development, were it not for the flexibility of open source development in general, and one tool in particular. The SiBBr team was already in contact with Canadensys during the mentoring program, and a Canadian developer participated in meetings with the Colombian team. As a result, there was knowledge exchange between the three countries and they created an open code repository – WingLongitude – to help the sharing and co-development of tools between Brazil, Canada and Colombia but also to make them available to other countries working on biodiversity informatics projects. This repository was created on GitHub, reported to be "the world's biggest collection of open source software" [32]. This hosting service includes collaboration tools, such as a wiki and feeds regarding releases and issues. In addition to being the centre of collaborative development, WingLongitude serves as a library and encompasses the "core," with the basic features that interest all participants. Each country then creates its fork project on its local repository by customising the shared version. Canada and Brazil are very active in co-development, whereas some countries or regions, like French Guiana, only use the library.

WingLongitude is considered to be a neutral space that does not belong to any of the countries or their institutions, which also have their own repositories on GitHub. "To reduce frictions, we decided to create a repository that is just neutral. So, it doesn't represent the University of Montreal, it doesn't represent any of the ministries of the other countries" (interview with Canadian developer). The neutrality of WingLongitude is mentioned in its description on GitHub and the developers interviewed highlighted this status.[3] The goal is to enable "a free space for collaboration" (interview with Brazilian developer) that can bypass any restrictions that might arise regarding the

[3] This is not to say that GitHub itself is value-neutral, however. As Akrich [33], Winner [34] and others have noted, technology designs incorporate "scripts" that enable and constrain communication in particular ways. In the next section, the description of the trading zone in action attests how GitHub enables practices that are in line with the values of open source culture and commons-based peer production [35].

relation between institutions. Its name comes from an inside joke among the developers and animal names were chosen to designate coding projects, reinforcing said neutrality.

Although the developers enjoy a good relationship, they are aware of political pressures at the institutional level, as well as differences in how the institutions operate that they have to consider. The collaboration arrangement between partner countries was defined at the institutional level, not by the developers. Both partners have shared information on organizational and political aspects of their work, for instance regarding participant institutions and data management, aiming to understand best practices and help with problem solving. Still, software development has been the main focus of their exchanges. With a much larger team than Brazil and Canada, Colombia has more capacity for autonomous development, and tends to follow the cooperative efforts of the other two countries with less direct involvement. Regarding biodiversity, the Brazilian and the Colombian contexts have much more in common with each other than they do with Canada.

Collaboration between Canada, Brazil and Colombia is regarded as a fruitful one, "here in the Americas we have been able to structure a good collaboration in terms of biodiversity. One of the goals is to connect the community of biodiversity more around that universe of technology and training" (interview with Brazilian developer). This success has led to the development of a new mentoring project, this time involving Canada, Brazil and Colombia to help Uruguay become a GBIF contributor and create a data portal. In one of the workshops in Uruguay, the mentors trained not only Uruguayan technicians, but also representatives from Argentina, Chile and Cuba. Moreover, as GBIF started developing a closer relationship with Atlas of Living Australia, Canadian and Brazilian developers participated in meetings aimed to strengthen interactions between different biodiversity information systems. Uruguay is expected to benefit from these synergies.

4 The Trading Zone in Action

A few specific examples of how the teams of developers actually worked together will allow us to show how WingLongitude acts as a trading zone. Following Kellogg et al. [20], we identify practices of display, representation and assembly to describe what and how they "traded."

Firstly, the teams **displayed** their work, making it visible and accessible to one another. The collaboration between Canada, Brazil and Colombia has been enacted in face-to-face meetings as well as through computer-mediated communication. There is an attempt not to overburden each other with too much communication through too many channels. Email and Google Hangouts play an important role. Screen sharing is one of the features that make the latter so useful to their work, since all the participants can see what the other is doing or trying to explain, rendering the discussion more concrete. Meetings are scheduled around a specific topic and minutes are taken and later shared through Google Drive, allowing everyone access to past discussions. GitHub remains the main collaboration tool given that in a single space they are able to manage the workflow, keep track of issues and their resolution, share code changes and discuss. By using WingLongitude as the centre of their collaboration, the co-development of the code is made visible not only to each other, but also to the wider software development community. Visibility and its relation to coordinative practices emerged early as a key research issue in the CSCW (computer-supported cooperative work) community. An overview of this vast literature is available in [36].

Figure 1 shows how GitHub displays information about the project's progress over time, in particular the various contributors and the types of contributions. Clicking on the statistics below each person's name provides access to their specific contributions. If we visit the "Issues" page, we can see how the co-developers tried to solve the problems they faced while coding. "Fork" allows us to see the different existing versions of a given project and the changes they have undergone through time. The interface can thus display information on various aspects of the project from multiple views and levels of detail, according to what is sought, facilitating coordination.

In terms of **representation**, the teams used a common coding language in order to make their work legible to others. What is more, the inner mechanics of co-development through GitHub are based on practices widespread in the open source

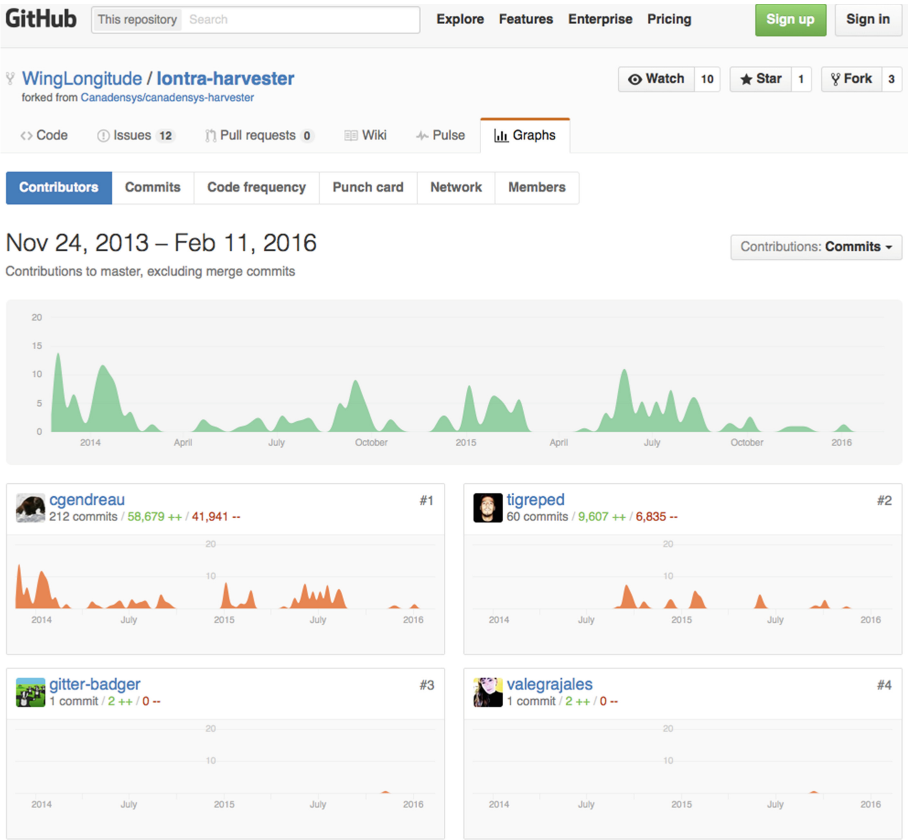

Fig. 1. Contributors and their contributions to a coding project on WingLongitude (note: gitter-badger is a GitHub robot)

world: forking, registering and discussing issues, adding commits (code changes) to the project repository, etc. Regardless of differences in team size or structure and work culture, developers are able to collaborate with a low level of friction. There are still differences in the development of open source software; that is why Brazil was interested in Canadensys: they thought that the learning curve to implement their system would be significantly less steep since they used similar technologies and there was some affinity in coding practices. This proved to be true: using collaboration tools, forking and sharing of coding practices enabled SiBBr to have its biodiversity data portal up and running in a matter of months. As they perfect their collaboration workflow, they expect to help Uruguay to set up their portal even faster. In the words of Donnellon, Gray and Bougon [37] “a shared repertoire of communication behaviors” enables groups to coordinate their actions in the absence of shared meaning. This focus on form over content is emerging as recurrent feature of distributed work on collaborative platforms. For example, Cardon and Levrel [38] identify attention to procedures as a key organizational feature of Wikipedia governance, while the work of Denis and Pontille [39] on OpenStreetMap and that of Demazière, Horn and Zune [22] on the open source community Spip illustrate the development of rules and procedures that enable collective action. In this specific case, the focus on form is all the more expected since what the partners are building is in fact a shell for country-specific content.

Finally, **assembly** of separate contributions across boundaries emerges as an organizing principle in the WingLongitude trading zone. Assemblage is a key element of the open source “culture” [21], and the modular character of the co-development of the biodiversity information systems discussed here enables this assembly. “In the world of software, there is no reason to reinvent the wheel. The best of all worlds is to reuse software. But in order to reuse software, it has to have a modular, intelligent architecture, that is ready for customization” (interview with Brazilian developer). Each country contributes and implements only the modules they find useful. Some modules are shared among the three countries. To give an example, Canadensys now uses the Lontra harvester co-developed on WingLongitude and has abandoned the original version they had created before the collaboration started. In other cases, modules differ from country to country. Canadensys chose not to integrate a Spanish-language interface developed by the Brazilian team although this would have potentially enlarged access to Canadian collections (the Canadian portal is available in English and French, while the Brazilian one has four languages: Portuguese, Spanish, English and French). The ability to aggregate third-party information in the portal is also limited to the Brazilian biodiversity information system. These features are integrated in the fork projects stemming from the neutral repository that is used as a library in a “modules within modules” approach, facilitating customization. Each new country may therefore fork its version and change only the files required to adapt to its needs. The teams can reuse, revise and align their work over time, as their needs change.

This points to one final aspect of the trading zone that merits consideration. The infrastructuring work described here is part of an ongoing, evolutionary process. The biodiversity infrastructures are not conceived of as finished products, but as systems that will grow and change. This focus on ongoing adaptation means that nothing is fixed permanently, and everything provisionally open to renegotiation. Thus, deep commitment and consensus are not required for collaboration. Collaboration can be periodic, temporary, driven by needs. If disagreements do arise, definitive decisions can be deferred to a later time, as required, something that Kaplan and Orlikowski [40] refer to as “provisional settlements.” This flexibility enables work to continue. Nor is there any long-term commitment to working together or continuing down the same path. The multiple combinations of partnering – Colombia-Brazil, Brazil-Canada, Brazil-Canada-Colombia, Australia-GBIF-Canada-Brazil, Brazil-Canada-Colombia-Uruguay – also exhibit differences in permanence and stability of relationships over time.

5 Conclusion

Although the idea of mentoring suggests an asymmetrical relationship, the core of the situation we have described here is not one of unidirectional knowledge transfer, but of horizontal cross-boundary coordination. The choice to work in a neutral space, belonging to everyone, is clear evidence of this relationship. Instead of transferring local knowledge and trying to adapt it culturally, the development teams present their ideas in a form that is legible to the others. The WingLongitude trading zone does not require shared understandings and adhesion to common goals, although this helps – e.g. commitment to open source code and Creative Commons licensing, the underlying premises of GBIF that biodiversity data should be freely accessible. Instead, the teams make their work visible to one another, use a repertoire of shared representational practices (the open source code) and juxtapose their local understandings and working conditions and practices into a collage of contributions. This enables them to share some infrastructural elements, while maintaining other specificities that best suit their diverse cultures.

In order for a trading zone to exist, there must be sufficient interest in the exchange, and sufficient ability to understand one another. The teams using WingLongitude are all concerned with building their respective biodiversity infrastructures, and see collaborative, distributed work as an efficient means toward that end. Although each team maintains its particularities in terms of organizational structure and work practices, they also find “common ground” in their knowledge of open source coding and practices, in their dedication to open sharing of biodiversity data, and in their appreciation of the importance of interconnecting infrastructures at a global level. Working together in this trading zone is thus both a practical accomplishment and a commitment to shared ideals.

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