Contradictions and their concrete manifestations:  
an activity-theoretical analysis of the intra-organizational  
co-configuration of open source software

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Introduction
Dialectical contradictions, as conceptualized in Cultural-Historical Activity Theory (CHAT), can be used fruitfully as an analytical tool in order to study organizational change associated with the introduction of new technologies (Groleau, Demers, Lalancette, & Barros, 2011). Drawing from the work done by Engeström and Sannino (2011), this paper aims to contribute to the operationalization of CHAT contradictions by looking at their concrete manifestations. Examples from a case study analysis of the implementation of an open source learning platform (Moodle) in a Canadian university are used to show how the members of this organization experience the contradictions in their daily work.

The paper starts with a theoretical overview of the contradictions and their manifestations in order to distinguish CHAT specificities from other applications in organization studies. Then, examples from the case study are used to show how the primary contradiction between exchange and use value manifests itself in the form of concrete tensions in each element of the teachers’ activity system. The secondary, tertiary and quaternary contradictions are also analyzed as the subjects articulate the social and material specificities of the open source model to their situated organizational context in order to deal with the tensions they face in their activity. The challenges and opportunities of using CHAT contradictions as an analytical framework to study organizational change are then discussed in the conclusion.
1. Bridging CHAT conceptualization of contradictions with the organizational scholarship on paradoxes and conflicts

Several organization scholars share the idea that contradictions are opportunities to change prevailing practices (for example, see Putnam, 1986). The studies of tensions, dualities, and paradoxes have indeed grown steadily in the innovation and organizational literature since the eighties and is still very vivid, as shown by the recent call for papers in *Organization Studies* for a special issue on such topic (Erez, Jarvenpaa, Lewis, Smith, & Tracey, 2013). However, contradictions are not always theoretically defined within that research stream. As a result, they are often equated with paradox, tension, inconsistency, conflict or dilemma (Engeström & Sannino, 2011).

According to Groleau et al. (2011), the conceptualization of contradictions inherent in Cultural-Historical Activity Theory (CHAT) is different from that found in the literature on paradoxes and conflicts in that they are more deeply rooted in a sociohistorical context. Engeström (1987) adapted activity theory to emphasize the collective nature of human activity and to view organizational change as a sequence of events around which practices are transformed, following a process of resolution of contradictions. In line with Marxist dialectics, contradictions are associated to the socioeconomic context of capitalism in which organizations take place. Contradictions are inherent to all activity systems and explain historically accumulating structural tensions within and between activity systems (Engeström, 2001). Thus, Engeström is not content with just describing situations of conflict or paradox, but also invites us to analyze them based on their history throughout time. To do this, he has described four levels of contradiction to denote different steps in the process of transformation: primary, secondary, tertiary and quaternary, as shown in Figure 1. The primary contradiction of all activities in capitalist socioeconomic formations is that between the exchange value and the use value and can be found by focusing on any of the elements of the subject's work activity. When a good or service is produced, it has a use value: we produce it because we want to use it ourselves. However, this good or service also has an exchange value: it is produced because we want to sell it. Engeström claimed that this contradiction exists in all activity systems in capitalist societies and that it cannot be eliminated. This primary contradiction conceptualization therefore is above all based on a critique of the economic dimension specific to the capitalistic system. Hence, it is the existence of the primary contradiction that distinguishes CHAT from other paradox-based studies by extending our understanding of local evolving organizational practices within a
much larger temporal and spatial realm (Foot & Groleau, 2011). In Figure 1, the tensions produced by the primary contradiction are illustrated by the number 1, i.e., in each element in the activity system: subject, object, instruments, community, rules and division of labour.

This primary contradiction is latent and manifests itself in secondary contradictions taking the form of concrete tensions between the constituents of the central activity system. In Figure 1, the secondary contradictions correspond to number 2, which crops up between activity system elements. For example, we can see tension between the division of labour and the instruments when there is a highly hierarchical division of labour that no longer appears to correspond to the new opportunities made possible in the work place through the use of new tools. Unlike the primary contradiction, tensions related to secondary contradictions can be resolved by incorporating new elements into the activity in order to reconfigure it. Therefore, contradictions can be used as an intervention tool by the researcher who can help the participants to face the secondary contradictions and collectively find new ways of organizing their work in order to solve the tensions they experience (Engeström, 2005). To do so, they borrow means and representations from other activity systems as a way to reconfigure their own activity and innovate; in other words, subjects use an external system to relieve certain tensions in their own situation.
As new elements are introduced in the activity, tertiary contradictions can arise between the new and the old elements of the activity. These are represented in Figure 1 by the number 3, which connects the central activity system in its initial form with its new form, or rather “a culturally more advanced central activity”. For example, a tertiary contradiction may occur after a new procedure has been set up should tension exist between it and the old activity configuration.

Finally, the reconfiguration of the activity system can lead to quaternary contradictions between the central and the neighbouring activity systems. These neighbouring activity systems are represented in Figure 1 with triangles called “instrument-producing activity, subject-producing activity, rule-producing activity and object-activity”. The central activity system is related with the neighbouring systems that provide the instruments, or rules. For example, the legislative system, through the laws it enacts, can produce rules for the central activity system.

To encourage dialogue between activity theorists and organizational scholars, it is necessary to reinforce the conceptual distinction between contradictions and paradoxes. Though the historical character of contradictions is not often recognized in the organizational literature as is the case in activity theory, some scholars interested in organizational paradoxes have already acknowledged such distinctions. While a contradiction implies a choice between two mutually exclusive alternatives (Putnam, 1986), the paradox does not offer any choice, because the two poles constituting the paradox are coexisting and operating simultaneously (Cameron & Quinn, 1988; Clegg, Cunha, & Cunha, 2002). For instance, Marianne W. Lewis (2000) studied different organizational paradoxes such as the coexistence of control and autonomy or the imperative of efficiency versus creativity. She explains that organizational paradoxes are constituted of interrelated contradictory elements (perspectives, emotions, messages, demands, interest, practices, needs, objectives, criteria, values, etc.). Managers, for example, face such competing demands when they are asked to increase efficiency and foster creativity, build individualistic teams, and think globally while acting locally. Hence, organizational dynamics can be explained by the coexistence of simultaneous contradictory pressures.

Paradoxes become visible through interactions and can be reflected in the rules and division of labour through time. Hatch and Ehrlich (1993) have shown that organizational paradoxes
can be located in the humour expressed by actors in their discourse. Indeed, humoristic remarks can reveal facts regarding more or less visible paradoxical situations characterized by incongruity or incoherence. For example, an incongruity is identified when an organizational policy does not correspond to the organization’s requirements or objectives, or when it simply goes against common sense. Incoherence refers to an illogical or absurd situation. By reducing social strain, humour allows the paradoxes to make their way into social awareness where they could eventually become the subject of change efforts. For the researcher, they say that the actors themselves recognize paradoxes that they are facing, not just to eliminate them, but also to recognize the positive role that they play.

Many authors consider that paradoxes do not prevent an organization from being effective (Cameron & Quinn, 1988; Fernández-Alles & Valle-Cabrera, 2006) and that the ability to embrace multiple orientations at the same time is a core feature of effective innovation (Garud, Gehman, & Kumaraswamy, 2011). For instance, Hundnes and Meyer studied a Norwegian telecom company throughout its several reorganizations and found out that the simultaneous presence of two strategic visions—centralization and decentralization—has allowed the organization to better adapt to its environment (Hundsnes & Meyer, 2006).

Organizational scholars have also distinguished conflicts from contradictions. The conflict emerges out of the perpetuation of a proposal to the detriment of other alternatives (Cameron & Quinn, 1988). Contradictions can therefore be sources of conflicts, but are not the conflict in itself (Putnam, 1986). The conflict is expressed as a misunderstanding, a disagreement or diverging points of views and may result in resistance, refusal or rejection. Conflicts can play a major role in collaboratively solving problems, as long as criticism is directed at the tasks and not at the individuals (Sundaramurthy & Lewis, 2003). In their collective action model of institutional innovation, Hargrave and Van de Ven (2006) also consider conflict to be the main driver of change. It enables the players to confront their oppositions and mobilize to improve the situation. At times, conflict resolution may come about through compromise: in other cases, it comes through a critique of the status quo.

Though not anchored in a “CHAT-driven” analysis, the latter examples are not fundamentally incompatible with this perspective, given that authors distinguish contradictions from paradoxes and conflicts. Actually, the dialogue between activity theorists and organization scholars who are studying organizational change through paradoxes and conflicts could be
facilitated by a demonstration of the conceptual distinction between contradictions and their manifestations.

1.1. Contradictions and their manifestations as an analytical framework

Engeström and Sannino (2011) already clarified this distinction by stating that many of the terms misused as equivalents of contradiction should rather be understood as expression of contradictions. For instance, if two different priorities or strategies are combined through the practices of actors, they should not be described as contradictions, but rather as manifestations of socio-historical contradictions. In their study of a healthcare organization, they identified four types of discursive manifestations of contradictions: dilemma, conflicts, critical conflict and double-bind.

Whereas the paradox corresponds to the “two sides of the same coin”, tensions that take the form of dilemmas are rather difficult choices that lead to selecting one of two alternatives: “A dilemma is an expression or exchange of incompatible evaluations, either between people or within the discourse of a single person” (Engeström & Sannino, 2011). The dilemma may be described as an internal conflict within the employee, who must take on two opposing roles. For example, managers at a hospital may face daily pressures due to their twofold responsibility: first of all, they must provide care to patients; secondly, they must reduce the costs associated with these services.

As we have noted in the previous section, conflicts should not be equated with contradictions, but rather as manifestations of contradictions. As for the double-bind, Engeström and Sannino describe it as a specific form of paradox. In the context of work activities, the double-bind corresponds to situations in which players are in a way caught in a reflexive loop, where they feel pressured to do something, but feel unable to act accordingly. Regardless of what he does, the player believes that he did not respond correctly to the request. Thus, completely logical elements, when taken individually, can become illogical once interrelated. To eliminate the double bind, the players must be creative by reframing their experience in order to find a new meaning, so that the opposing poles are no longer in opposition. This is what Engeström names expansive learning (Engeström, 1987). In other words, the subject “expands the context” in which he works to go beyond the information provided to him in order to build a broader scope for his activity. By creating new contexts, he can eliminate the initial constraints.
In short, contradictions must be regarded as sociohistorical dynamics that are behind the tensions, which can be seen in human activities. In other words, the dilemmas, conflicts and double-binds that are creating tensions here and now are expressions of contradictions over time.

According to Engeström and Sannino, a double-bind is a type of paradox that is a manifestation of a contradiction within the meaning of activity theory. I will take up the same idea, adding to it that paradox is not a contradiction, but that paradoxes can be manifestations of contradictions. In the next section, I therefore will use the concept of paradoxes, but also incongruities, incoherence and dilemmas, as defined earlier in this text, to more specifically describe the tensions seen in my case study.

2. **Operationalizing the contradictions: examples from the case study**

The case study took place from 2006 to 2011 and investigated the implementation of an open source learning content management platform (Moodle) in a Canadian university (referred to as “the University”). The methodology was based on a participant observation strategy. Data collection relied on field notes gathered during direct observations, participation in meetings, training and work sessions and access to internal documentation (usage statistics, meeting minutes, reports, etc.). I also conducted face-to-face semi-structured interviews with 16 teachers and eight (8) developers employed by the University as information systems and support personnel.

Since 2007, Moodle has been offered in the University under study as a complement to face-to-face courses (known as blended learning), allowing teachers to share content, create learning activities and communicate with their students. Open source software is a computer program that can be read, modified, reused and redistributed by anyone (Perens, 1999). Although the new forms of work characterizing open source software development communities have been widely studied (Miettinen, 2009; von Hippel & von Krogh, 2003), few researchers have examined how they can inspire new practices in organizations that are not producing software, but are rather using them to conduct their work activities. Moodle was installed on University’s Web servers in replacement of WebCT, the proprietary platform previously used. Public organizations such as educational institutions see open source not
only as a means to reduce the technology acquisition and operation costs, but also as an opportunity to provide a more direct link between design of tools and their uses. Since changes can be made to the source code, it is possible to accommodate users’ needs that were not initially planned by the developers, without depending on a proprietary firm.

It is important to specify that my research is not part of an interventionist approach such as Change Laboratories advanced by Engeström (1987) and colleagues. In fact, I have taken the route of other researchers who use contradictions as a conceptual framework to guide data collection and analysis (Groleau et al., 2011). Therefore, the objective is to interpret tensions observed based on the systemic contradictions in the subjects’ activities. In order to do this, I became interested in the history to identify the different tensions, that shaped its transformation over time and to understand how the subjects themselves experience these tensions. The concepts of paradoxes, incongruities, incoherence and dilemma, as defined earlier in this text, were more specifically used to define the tensions observed.

Since the activity of teachers cannot be limited to the relationship with their work tools, expressions of contradictions are seen in the different elements of the teacher activity system, i.e., their object, tools, their relationships with other members (the community), rules and division of labour. In the following sub-sections, I will first show how the primary contradiction appears in certain cases regarding the elements of the teacher activity system by presenting aspects of their work activity according to the sociohistorical and economic dynamics that mould their representations and anticipations. By identifying the tensions initially experienced by subjects, it becomes possible to describe the broader context in which we can then identify the sources of change that have led to the social and material reconfiguration of their activities. In this case, we are not talking about an exhaustive survey of all the tensions in this activity system, but rather an analysis targeting those that hold the most significance for the subjects, at least the tensions that regularly appear in the discourse and that are reflected in the actions of the subjects I have observed. I then link the different points in the transformation process with other levels of contradiction. This exercise has proven to be especially interesting for identifying tensions that could have been resolved by introducing Moodle, but also those that appear following remediation of the activity system that accompanies the integration of Moodle into the practices of subjects.
2.1 Exploring the primary contradiction within each element of the teachers' activity system

Researchers who have used the primary contradiction concept to study work practices have described it as an opposition between “managerial logic” and “professional logic”. They showed how it could be embodied in different professions, for example, engineering (Blackler, Crump, & McDonald, 1999), architecture (Groleau et al., 2011) and medicine (Groleau & Mayère, 2009), by analyzing the tensions stemming from this contradiction. However, most scholars who have used CHAT contradictions as an analytical framework did not describe the manifestations of the primary contradiction in each elements of the studied activity system. For instance, Deken and Lauche studied the development of a technology by several enterprises by looking directly at the quaternary contradictions between the different organizations collaborating together (Deken & Lauche, 2010).

It should be remembered that, according to Engeström, the primary contradiction is essentially economic in nature, since it is founded on the opposition between the use value of the product or service, which exists to meet needs and its exchange value, i.e., its commercial potential. The primary contradiction has a latent form, with the result that it is impossible to have direct access to it in our empirical study. Therefore, we must approach it via its manifestations in the discourse and actions of the players involved. In the activities of the teachers that we have studied, the primary contradiction appears as tensions between the different competing concerns. In this case, these are tensions between the professional and managerial lines of thought that modulate the teachers’ activity. The opposition of these two poles produces paradoxes, dilemmas and incongruities within each element of the teachers’ activity system, as shown in Figure 2.
Although university, as an institution, has existed since the Middle Ages, it is not immune to the cultural and economic transformations that occur in this day and age. Current developments in the Western university sector are following a path marked by global competition, reduced state involvement, underfunding and restructuring. Some have also described this transformation as a move toward “academic capitalism”, which obliges universities to meet the demands of the market by setting up performance-oriented governance and assessment instruments (Slaughter & Rhoades, 2004). In Canada, public institutions such as universities have to deal with major deficits and budget cuts. Therefore, the studied university faces the primary contradiction opposing a limited access to resources to a need for sophisticated and specialized means to conduct higher education activities. Mintzberg described the university as an example of professional bureaucracy characterized by considerable autonomy of the teacher (Mintzberg, 1979). However, the teacher does not escape the tensions between the manager imperatives and the conduct of his professional activities. The University seeks to improve its performance, especially that of its members, by standardizing the management processes. The techniques and vocabulary related to Total Quality Management are being increasingly used in higher education institutions (Schwartzman, 1995), where it is now common to apply the concept of quality standards, value creation, strategic plans and best practices. In order to be operationalized and evaluated, these best practices must be standardized and monitored. These managerial
processes to a large extent adapt the context of the action and resources to employee availability. Hence, the teacher\textsuperscript{1}—the subject of this activity system—faces the tension between managerial and professional lines of thought manifesting as an authority/autonomy paradox, which has been described in the organization literature as the “control paradox” (Hatch & Erhlich, 1993). On the one hand, he has certain rights, such as freedom of action and thought, which distinguishes him from other types of workers. People have confidence in his ability to determine the best way to carry out his work. On the other hand, this authority/autonomy paradox puts the subject in a particular position where “academic freedom” comes with constraints related to employee status within an institution that pays him and requires him to have a certain level of performance in order to meet performance objectives. Among others, we expect that teachers will master the new pedagogical strategies, including the use of learning technology. These skills, even if they have not been formally expressed in job descriptions or work contracts, are associated with the “best practices” desired by managers. The tensions produced by the authority/autonomy paradox are expressed by teachers in their discourse when they talk about the pressures they feel, especially those who have not integrated ICT into their teaching. Computer support team members at the University also observe this tension in certain teachers, who are major specialists in their respective fields, but also often puzzled by the use of computer tools. Teachers who are less comfortable with the technological tools provided by the University may be unfavourably compared with their more advanced colleagues by both administration and students.

The incarnation of the primary contradiction within the object of the teachers’ activities results in a dilemma for the teacher, which leads him to consider the student as a client or learner. By this very fact, the teacher, in his capacity, is torn between two positions with regard to his role that of a service provider and of a partner in the student’s learning. Between 1978 and 2008, the proportion of operating revenues from Canadian universities dropped from 84\% to 58\% for government subsidies, and increased from 12\% to 35\% for tuition fees (ACPPU, 2011). Given this trend, it is not surprising to see that a university education is being considered more and more as a provision of a service in which the “product” of the university, namely the degrees or the university credits, has an exchange value. This gives the student the status of independent client with the freedom to choose a “tailored” product that

\textsuperscript{1} In this case study, “teachers” refer to both professors and lecturers.
corresponds to his needs and means. Since he pays tuition fees and receives loans that must be repaid, the student, expects a “return on his investment”. As part of this view, learning is akin to a quasi-commercial transaction and the student’s role is reduced to a contractual dimension. On the one hand, the administration expects teachers to have uniform operational skills, and, on the other hand, the student also compares the “services” offered by the different courses for which he registers. When the “offer” does not suit him, he will let people know. Teachers who do not integrate ICT into their teaching are pressured by their students who believe this is a service that they are rightfully owed. In fact, students believe it is unfair that some of them can have a course with a teacher who provides digital resources, while others cannot, even though they are all paying the same tuition.

For the purposes of this article, I will now focus the analysis on the instruments, examining how the tension between managerial and professional imperatives is embodied in the uniformization/diversity paradox, which manifests itself in the different ways of seeing the technologies provided by the University to teachers. Indeed, these technologies can be looked at in two ways, depending on whether an administrative or professional perspective is used. On the one hand, they can be considered to be work tools that meet the homogenous requirements identified by businesses supplying them to the University. These suppliers are looking for similarities in the work processes of their clients in order to offer them a generic solution based on an “average and standard model of their clients’ needs” (Cardon, 2005) so that the product appeals to the largest possible market. This vision fits well with technologies such as the telecommunication infrastructure or the video equipment used in classroom. However, technologies such as a learning platform mediate the relationship between the teachers and their object in a particular way. Teachers use it to create and share learning activities and resources and communicate with their students, in situated pedagogical and organizational contexts. When a learning platform plays an important role in the teacher’s activity, it becomes its extension: the mean by which his/her voice circulates. Therefore, it should be flexible enough to accommodate heterogeneous and ever changing work practices. In all, the primary contradiction appears here in an uniformization/diversity paradox, since technology can be both a generic work tool made standard through the commercial offering and a tool that meets specific pedagogical needs.

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2 In my thesis submitted in September 2012, I explain in more detail how the primary contradiction looks like in other elements of the teachers’ activity system.
2.2 Understanding the transformation process through secondary, tertiary and quaternary contradictions

After carrying out a literature review of the articles published by researchers who used activity theory, Foot and Groleau (2011) noticed that most researchers who use the concept of contradictions do not apply the four levels proposed by Engeström, thereby overlooking the forces of change specific to each of these levels. It is worth mentioning that secondary contradictions take on the form of concrete problems as tensions arise between the elements of the activity system, i.e., between the vertices of the triangle identified by number 2 in Figure 1. It is the secondary contradictions that lead subjects to question and change their practices, since they provide opportunities for subjects to analyze their activities to try to solve the resulting problems (Groleau et al., 2011). In other words, a new activity configuration has developed out of the contradictions inherent to the previous configuration.

In our case, the tension related to the primary contradiction regarding the manner in which to consider work tools translates into a secondary contradiction in which the “administrative” view of the tool goes against the teachers’ object. Indeed, the model specific to the proprietary software that prevailed with WebCT, the platform used before Moodle, produced concrete tensions in the teachers’ activities. The lack of flexibility in the WebCT platform and the dependency on the company that markets it limits the possibilities of the subjects in carrying out their work. The diversity in the teachers’ work context and objectives generates heterogeneous needs, which, combined with the autonomy characterizing their work, lead to a strong demand for customization of the instruments. Since the University developers did not have access to the source code for this software, local adaptation was impossible without the supplier involvement. Most of the time, requests were rejected by the supplier because they were specific to the University and did not cover the needs common to several of its clients. In order for a request to be accepted, the University had to prove to the supplier that its need was not unique, which was often impossible to do. Even in cases where requests involved more than one client, it was very difficult to have any control at all regarding the company’s development schedule. Since the platform could not be fully adapted to the context at the University, the University had to implement procedures to standardize the practices of its teachers, forcing them to “live with the system by default” (Pollock & Cornford, 2004). In the words of a developer, the University makes do with being a WebCT client, at the mercy of the decisions made by the proprietary company.
In this regard, the Moodle open source solution was considered by the subjects as an alternative that could potentially ease these tensions. The open source model was seen as a way to provide teachers with a flexible solution that would better suit their heterogeneous needs, as expressed by a vice-provost:

*Proprietary tools force teachers to restrict their pedagogic methods to a commercial offer. We wanted to join an open community in which everyone could contribute in order to progress more quickly.*

By adopting an open source platform, the University borrows specific properties from an external activity system (the open source community) to re-configure its activity in order to solve some of its inner tensions. At the basis, free software is an application whose source code can be read, modified, re-used and redistributed by anyone. It was Richard Stallman who first proposed the term “free software”, and who popularized since 1984 what we could qualify as the “political movement of free software” by founding the Free Software Foundation (FSF) (Stallman, 1992). This trend is based on the statements made by the FSF and represents the most radical and libertarian view originating from Stallman’s ideas. His refusal of any form of copyright is seen by many free software players as an obstacle to deploying free software in a company. Among them, Eric S. Raymond and Bruce Perens instead recommended the expression *Open Source Software*, which puts emphasis on the development method for this software, based on the accessibility of the code that allows anyone to retrieve it and adapt it as he sees fit (Perens, 1999). It seems that this development model fosters the creation of a community that has the development of software at heart, since “each person working on it is certain that his work will benefit all, in the same way that that person will benefit from everybody else’s work” (Perline & Noisette, 2004).

When we introduce elements from another activity system (the open source community for Moodle) into the central activity system (the University), material and social mediations reinvent themselves in the central system. This external activity system provides several representations and ways to see the technological development process within the University, firstly regarding the organization of work for Moodle management. Indeed, the implementation of Moodle in the University under study involves reconfiguring the division of tasks, which reflects that the pedagogical tools belong to the teachers rather than the programmers. Unlike several open source communities, which are primarily made up of programmers from the IT world, the Moodle community comprises mainly teachers and developers working in the educational sector. The platform was originally created by a Ph.D.
student in Education in Australia, and then developed through contributions from users around the world, i.e., teachers or developers in the field of education. It is interesting to note that its implementation in the University under study is part of the same paradigm, so that reconfiguration of the division of tasks occurred, as noted by one of the internal developers:

(...)WebCT had always belonged to the IT division, and it is not normal for an online learning product to be identified as belonging to the IT division. (...) Moodle is one of the rare products that does not belong to anyone (...) It is as though it belongs to everyone but no one at the same time. And this I believe is the first time at the University that a product does not come under a specific division. The IT division installs Moodle. The faculties use it, and budgets are allocated by a committee.

The committee in question is made up of teachers from each faculty, a student and representatives from the different service divisions, who make recommendations to the vice-rector who approves its budgets. This organizational combination results in “end users” of the platform being at the heart of the decision-making process with the Committee members being seen as representatives and spokespeople for their colleagues. Thus, the management and development of Moodle at the University departs from the regular model where computer tools are strictly managed by one or more administrative divisions. By setting up Moodle in the University, the idea has also been adopted that the platform must “belong to everyone, but to no one at the same time”, since this way is more suitable for a product used in teaching. This clearly shows that the collaborative culture specific to the free software development modes is gradually becoming “paradigmatic” (Proulx, 2011). This paradigm makes certain representations available to members of the organization when they envision a way to design, manage and support technical tools. These representations migrate and are transposed into the organization’s universe in which open source acts as a “metaphor” for the collaborative ideal.

Moreover, accessibility of the Moodle source code enables developers to have better visibility regarding the internal functioning of the tool and to change it even after its implementation based on any problems or needs that crop up while the teachers integrate it into their practice. This new option has changed their way of responding to user requests. Although teachers who use Moodle cannot directly work in the source code, they take part all the same in customizing it by interacting with the developers who have access to it. It is important to point out that there were no formal initiatives to put users and developers in contact before and after implementation to foster participation in the customization of the tool (besides the
teachers who are Committee members). Discussions arose rather when users encountered a problem or when they tried unsuccessfully to find a way of doing something specific with Moodle.

Although most of the teachers interviewed did not know that Moodle is open source or did not understand what code accessibility allows, those who used WebCT before saw the difference in their interactions with the developers. This was also expressed by a developer:

(...) When the user speaks with us, we see the situation. We do not say “leave it to me, I don’t really know” and call him back three or four days later leaving the user insecure because we have not giving him the information within a reasonable time. When we access the source code, it is fun overall... we can modify and adapt it, we can think about it, and it is nice because of that (...) When the user speaks with us, we spring into action, even while talking with the user, we are solving the problem. Whereas with proprietary code, we can just receive (...) we have nothing to say to the user because we, ourselves, are on shaky ground for finding the problem. It is another way of working... another way of doing.

Thus, open source code provides an ideal context for continuous adjustments, unlike the lack of transparency of proprietary software, which made internal developers dependent on an intermediary (the supplier), who “blocked”, as it were, the ability to act and respond. Opening the Moodle source code allows in-house developers to more easily identify problems reported by users. This post-implementation meeting place between developers and users is described in more detail in Section 3.

Developers also reiterated that they had the impression of being able to provide better service to users than at the time of WebCT. However, access alone to the source code does not guarantee improved service to users. The greater malleability of the tool’s material properties means nothing if developers do not have the autonomy needed to take action to fulfill requests. We observed that developers had a relative level of autonomy in decision-making, at least in most cases. They can indeed take the initiative to make certain changes without requiring Committee approval. The cases submitted to the Committee are those requiring additional resources or “political support” to drive things forward for areas where developers do not have formal powers themselves.

These examples show how subjects can take inspiration from an external system to alleviate certain tensions in their own environment. However, these transformations can also create
tensions between the new and old elements of the activity, which are known as tertiary contradictions. These appear as tensions between the new practices and institutionalized practices (see Figure 1 earlier in this document).

In particular, the greater autonomy of the University developers, along with increased co-configuration possibilities that allow them to adapt Moodle based on the needs of users, contributes to introducing a “demand-driven culture” in which the informal rule guiding the work of developers is “if you can help a user, you should”. By this very fact, it also increases the workload of developers who before would send their user requests to the supplier. In-house developers work for an institution that provides limited human and material resources bound by rules and a certain division of labour inherent at the University. Therefore, these constraints can be inconsistent with the new possibilities of open source, which multiplies the opportunities for action, and, in turn, the responsibilities and tasks to be carried out.

In addition, the reconfiguration of the central activity system may result in quaternary contradictions that manifest themselves as tensions with the surrounding activity systems. Indeed, even if the activity system is the unit of analysis of the activity theory, it cannot be studied as an isolated, autonomous system, since each of its elements is the product or aim of a neighbouring activity system (see Figure 1 earlier in this article). We can illustrate this inconsistency by examining an example of tension between the system of the University under study and that of the open source community in charge of the official version of Moodle. Although a proposal was adopted by the Committee to the effect that everything developed at the University was to be shared with the Moodle community, the developers did not systematically include their local changes or additions so that they would be integrated into the “official” version managed by the community via the Moodle.org Web site. The developers told us that contributions to the community take considerable time and effort: firstly, it is necessary for University developers to closely follow the standards recommended by the community, and, secondly, to document their changes and additions when they include them. However, this process is too time-consuming and the developers do not have enough time to ensure that their modifications are coded as per Moodle standards. This compromises the compatibility of the local Moodle version with that of the community, since the new “official” versions do not integrate these local changes, which must be recoded each time in-house. Thus, accessibility to source code fosters a certain plurality of uses by
allowing the accumulation of “local” differences in the tool, but encompasses other contradictions on a global level.

3. Uncovering a specific form of co-configuration

One of the contributions of this research is to identify the singularities related to the interactions between users and developers after implementing an open source solution within the organization that decided to carry out by itself the support and customization of this solution, whereas the organization’s main activities are not related to software development in itself. The co-configuration process here involves a solution that already exists, which was chosen by the organization that decided to implement it, because its “standard” form meets the “basic needs” of its employees, while being sufficiently “open” to allow for changes. In-house co-configuration practices aim to model this technology so as to create a local version that is better adapted to the context in which the employees use it. They appear as a continuous “user service” rather than a design method. They therefore need an implementation context in which developers who can modify the technology remain in contact with users not only at the time of implementation, but throughout the life of the user organization in order to see the actual needs and problems cropping up over time.

This form of co-configuration differs from that described by Engeström (2004) and Victor and Boynton (1998), who examined situations in which suppliers had in their best interest to work with their clients in order to create the solution to meet their specific needs. In their case, co-configuration is considered to be an appropriate business strategy for responding to the complex realities of the new economy. It takes shape through the partnership relationship between suppliers and their clients. The co-configuration process that we described in this study takes place in a different organizational context. This is why we call it “intra-organizational” co-configuration. This is not a case of supplier-client relations, but rather interactions between developers and users who are in fact colleagues from different teams within the same organization. Whereas Hasu and Engeström (2000) focused on the time when the technology is transferred from developers to users, who belong to their own organization respectively, in our case, there is no “passing” from one group to another, since they continue to work together following implementation. Although we find similar dynamics to those in the supplier-client relationship (since developers provide support for the tool used by teachers), collaboration between them does not take place in a business relationship in which
it would be formally carried out. In fact, the co-configuration process that we studied is characterized by emergence, self-organization and adaptation. Collaboration between users and developers takes shape without any central authority or formal rules governing it. It comes out of the interactions between colleagues on an ad hoc and unplanned basis. In this way, it is a type of employee-driven innovation.

Opening the code plays a prominent role in the co-configuration practices described here by creating favourable conditions for establishing tighter links between the computer development activities and uses. By increasing the ability of developers to act, access to the code creates a more favourable context for taking into account user requests. The incremental nature of changes made locally assures that developers can accommodate certain very specific and even unique needs while meeting the standard needs of the majority of employees within the organization. As well, I have seen several situations in which the developer decided to meet the need of the teacher even if it was not a “universal” need, because he was able to do so, was interested in the challenge and it did not require much time. When the change was made quickly, developers put it in their tasks themselves and did not have to have the decision validated by their superiors or the Committee, as a developer explains below:

*If we believe that it will take one hour and it will not disrupt much and it will help out the teacher, we will do it (...) Anything that can be done informally, if it will not take too long, and if it is technically possible, we will do it.*

Through the requests made by the teachers, developers see a wide variety of their practices, which vary based on their respective area of teaching, the pedagogical strategies they recommend, as well as on the division of tasks specific to a faculty or a program of study. Here, we note the example of a faculty in which the role of coordinator was given to a professor who taught a course given simultaneously by several teachers (this role does not exist in other faculties). The coordinator must ensure that all teachers giving the course use the standardized pedagogical resources, since most of the evaluations are common among all course groups. In particular, the same exam is administered to all students taking the course, regardless of whom the teacher is. The coordinator is responsible for creating and maintaining a meta-course on Moodle, i.e., a shared site that can be accessed by all students in all course groups. Thus, the student has access to two Moodle sites: the course site of his teacher and the meta-course of the coordinator. The specific responsibilities of the coordinator require different permissions from those normally granted to teachers. To meet
this specific need, the University developers created a “coordinator” role in Moodle, and then added a function for them called “Tool for Course Coordinator”. Here, this specific division of tasks remains invisible to the developers until a user tries to take an action made necessary by his coordinator responsibilities and realizes that tool cannot be used for a given use. For the coordinator, it would have been difficult to communicate this information to developers before implementing Moodle, since he would have been able to see the possibilities or constraints of the tool regarding this specific need. This need became concrete only when this faculty noticed that Moodle could and should be used to support the distribution of standardized pedagogical resources in coordinated courses after certain coordinators were able to try out Moodle and understand how it worked.

In short, the type of co-configuration described here is an iterative process based on compromises between what the employees would like to do, what the tool allows them to do, and what the organization wants them to do with the tool. Consequently, the University developers organize their practices based on the flexibility provided by the accessible source code and the organizational latitude they have, which appears as a certain level of autonomy when making technical decisions.

IT system designers and managers can take inspiration from this informal co-configuration process and the new possibilities for action from the open source code solutions in order to relieve tensions in their own activities, even if they occur in different organizational contexts. Since intra-organizational co-configuration involves incremental micro-innovations, it is not designed to bring about drastic changes to the tool. Nevertheless, this organizational form has a certain potential for improving the technical services to support work practices that are highly heterogeneous and scalable in order to better manage their diversity. The experimental opportunities in a real work context and the interactions between the users and developers provide a context conducive to self-examination by the players of the tensions that characterize their respective practices. They, in a way, authorize the players to share what they have learnt about their experiences, whether it involves problems, errors or incongruity, at a time when they deem it relevant to do so. Moreover, the AGILE method, which has become increasingly popular today, is based on the idea that software development must occur iteratively (Beck, 2001). Instead of planning all development phases ahead of time and launching the finished product once all phases have been completed, an initial version is quickly launched that is then continuously to improve over mini-cycles of successive
development (known as “sprints” in the AGILE method) during which feedback is asked from all stakeholders, including end users. This iterative approach goes hand in hand with the idea according to which innovation may best be seen as a continuous process, with particular product embodiments simply being arbitrary points along the way (von Hippel & Tyre, 1995). However, it appears important to specify that the co-configuration practices described in this article cannot replace participatory design or AGILE development methods, since these methods are concerned with the involvement of users in previous design phases. They can however be improved by positioning the co-configuration as a post-implementation service. Instead of creating, we redevelop, adjust, expand, add, etc. Therefore, I propose considering the intra-organizational configuration as a user service rather than a design methodology. This proposal differs therefore from those already existing using participatory design approaches. Although the ethnographic studies that often constitute the basis of participatory design approaches are needed to take user needs into consideration, the fact remains that they can only bear witness to current practices. However, teachers’ practices have not been established once and for all: they will continue to evolve as tensions are resolved in their activities, to the point that tool customization cannot stop past a certain phase if the emerging social structures are to be supported. Positioning co-configuration as a service enables the organization to recognize that it is impossible to see how the tool and its related practices will evolve and that it is therefore necessary to adapt its organizational structures so as to initiate and facilitate collaboration between users and developers throughout the life of the tool. This also allows to accept the error value by admitting at the outset that the starting points are only methods for getting the project underway and that it will be necessary to reconsider these methods once the tool has been integrated into the practices. This means that it is necessary to not only seek to fill the gap between users and developers at the time of design, but to continue to do so when the user activity develops along with the technology. In their advocacy of the importance of the human intentionality concept put forward in activity theory, Kaptelinin and Nardi (2006) proposed giving users the ability to customize their tools themselves, by, for example, using the potential of initiatives such as end-user programming (Lieberman, 2000). Instead, I am proposing that we view co-configuration as a user service, so that users are not left to their own devices and can benefit from the skills of developers.

We have seen that developers felt that they were giving users better service since they had access to the software source code. In this way, open source is a way for the organization to increase its ability to support future uses and adopt a “sustainable development” perspective.
in IT. The connection between the past, present and future is key to sustainable development, which aims to better meet the present needs while not compromising the possibility of future generations to meet their needs (World Commission on Environment and Development, 1987). In addition to the ability to adapt the tool to future needs, sustainable IT development goes hand in hand with the responsible use of public funds. Even if universities are competing to recruit “student clients”, they should not be competing for the tools they are using. Thus, it seems illogical that each university should pay enormous sums so that the supplier of proprietary software makes a change to its product, when these developments could be pooled so that several universities would share the costs. In this way, adopting open source code software may be an opportunity for universities to join forces and share the costs of developing and customizing their tools. Responsible and sustainable management of sociotechnical resources based on re-using, sharing and improving open solutions should become a main priority of university administrations. The case that we studied is a striking example of the need for this type of approach, and of its feasibility.

4. Discussion

By replacing WebCT by Moodle, an open source code platform, the University under study takes the social and technical properties specific to a given external system, i.e., the community developing and using it. These new resources and ways of doing and thinking about things help resolve certain in-house tensions and drive change. The attachment to the values of free software does not necessarily mean the effective, unilateral adoption of a static model, as we have seen when we discussed the reconfiguration of the work of the University developers. The open source code software is also not seen as the definitive solution to all problems. Nevertheless, the integration into the open source movement provides greater access to possible alternatives.

From a conceptual perspective, the contradictions model not only allows to use the activity theory as a descriptive tool, but especially use it dynamically to analyze the transformation of the activity system following the introduction of Moodle. The activity theory, like with other approaches that allow organizational change, view change as a process, i.e., a sequence of events around which the transformation of practices revolves. Adopting a CHAT-based analysis of contradictions means that the problems and disturbances faced by the subjects in situation reflect the historically formed systemic contradictions of the activity.
The analysis that we have carried out shows that the manifestations of primary contradiction can be identified in each element of teachers’ activity. In our case, we are able to identify economic tensions where we did not expect them. Indeed, although the main purpose of a public institution, such as a university, is not to generate profits or create value for shareholders, the tensions linked to the opposition between management and professional imperatives are clearly presented in the teachers’ activities to the point of interfering in its various elements. The entrepreneurial model that prevails in business organizations is also used in public institutions such as universities, which have to manage their material and human resources based on “good management practices”. Thus, the teacher activity system shows a growing trend of considering the student as a client and treating teaching as a commodity, which produces tensions in the form of paradoxes and dilemmas in each element of their activity system.

In interventionist research, the identification of contradictions in an activity system helps participants to focus their effort on the root causes of problems. But when used as an analytical tool, as was the case in this study, the researcher focuses on the way in which the contradictions are experienced by the subjects themselves as their activity system is reconfigured through changing circumstances and the introduction of new elements. Even without the involvement of a researcher, the resulting contradictions and paradoxes can be understood by the players as a way of reframing their experiences and therefore leading to organizational changes. By identifying these contradictions, the researcher in a way expands his field of vision: instead of only studying the tensions and their effects in the “here and now”, he also turns his attention to the roots and origins of the problems, which enable him, in turn, to understand why certain changes cannot be fully brought to fruition. With the different levels of contradictions, we can better understand the dynamics inherent in the transformation process and the links between the new patterns of interaction and the institutionalized practices, as well as the implications for the neighbouring activity systems.

There is an opportunity for activity theorists to show how their conceptualization can be used to enrich and precise the vocabulary and approaches available to scholars studying innovation and change in organizations in order to clearly define the relation between contradictions and other type of tensions. For instance, the practice perspective, though now well established in organization studies, can still benefit from the development of vocabularies and approaches
that allow the transcendence of the division between the various levels of analysis (micro, meso, macro). While the orthodox language of social science, including organization studies, carves up phenomena into three levels: from the very micro (what people say and do); to the meso (routines); to the macro (institutions), the concept of practices calls for an understanding of practice as taking place simultaneously ‘here and now’ as well as historically constituted (Miettinen, Samra-Fredericks, & Yanow, 2010). Because there is no such thing as a single and unified theory of practice, practices can be approached from a variety of theories, such as activity theory, which allow organizational scholars study a living practice and relate it to its history and to its larger institutional context. In that sense, a "CHAT contradictions-based" analysis provides a comprehensive framework that enables the researcher to take into account the sociohistorical constructs undergoing tension that come from different levels: the government through its policies, the professional context that stipulates certain methods and the specific organizational context with its own rules.

As for primary contradictions, Miettinen (2009) had already suggested that the open source model questioned the opposition between the exchange value and the use value, since many believe that this model has the potential to question certain aspects of capitalism. At the end of our research, we considered it rather as a model that had found its place “in spite of” and “along with” the ever-dominant capitalist model. Von Hippel and von Krogh (2003) had already described the possible hybridizations between this collective development model and the private models traditionally recommended by companies. Moreover, the case that we studied shows this form of hybridity, since it comprises methods inspired by collectives that develop free software and managerial imperatives inherent to the institutional context of the user organization. However, what appears to be especially interesting to us in our research does not concern so much the economic aspects of open source, but rather its potential to rethink other aspects of activity related to the development and use of work technology. Indeed, open source represents a paradigm change not only regarding the way in which software is developed and marketed, but also how it is deployed and maintained, especially concerning the interactions between users and developers after implementation. In light of these observations, it would appear necessary to go beyond the strictly economic nature of the primary contradiction. Based on Blackler (1993), I believe that the tensions that human activity entails is rooted in other sociohistorical constructs than this opposition between the exchange value and the use value. Thus, even if this dimension remains relevant, reducing the analysis to a strictly economic contradiction does not allow to explain how certain
changes come about in the daily practices of the players. Since work tools convey ways of thinking, acting and accomplishing the tasks of their designers, the fact of adopting a tool that can be modified increases the ability to do things that may have not been initially foreseen. The open source culture takes into account the ability of subjects and tools to develop together for more and more complex purposes. In the case that we studied, the visibility of Moodle’s source code by internal developers makes it easier for them to “locate problems”. Its openness enhances their ability to meet their needs and thus adapts the nature of their interactions. At a time when rules and standards are increasingly institutionalized in technical devices, if they are more flexible and open, it enables users to participate not only in the development of their tools, but also of their work practices. In this way, greater transparency of the internal workings of open source tools is but one answer to an economic problem. Tensions that are at the source of innovations are not just the outcomes of the contradiction between the exchange value and the use value. In addition to the economic dimension, there is also a political dimension related to the different forms of worker autonomy, as well as to the creativity, resistance and reflexivity that these workers may use with regard to their work tools.
5. References


World Commission on Environment and Development. 1987. *Our Common Future*