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ONLINE INNOVATION AND COLLABORATION IN THE CREATION OF FREE SOFTWARE

Innovation and online collaboration in the creation of free software

Innovación y colaboración en línea en la creación de software libre

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ABSTRACT

Advances in information technologies have led to user-centered innovation of artifacts from cyber culture. This advent of capitalism causes the emergence of approaches that contemplate collective and immaterial production in force in open source software communities. From a post-structuralist perspective, 6 interviews, 2 videos and an online discussion list were analyzed to appreciate the process of building the hegemonic discourse from the logic of equivalence, difference and fantasy. It was found that the speeches of the developers symbolize a presence yet to come, with the particular demands diluted in an equivalence chain that encompasses the largest number of claims, and that there is an effort to create an incessant process of generating value by overcoming the community frontiers, continuously articulating stakeholders to access resources and generate joint solutions in the innovation process.

Keywords: innovation with free software, online collaboration, pug-pe community, discourse theory, speech analysis.

RESUMO

Os avanços das tecnologias de informação propiciaram a inovação centrada no utilizador de artefatos advindos da cultura cibernética. Esse advento do capitalismo provoca a emergência de abordagens que contemplam a produção coletiva e imaterial vigente em comunidades de softwares de código aberto. A partir de uma perspectiva pós-estruturalista, foram analisadas seis entrevistas, dois vídeos e uma lista de discussão on-line para apreciação do processo de construção do discurso hegemônico a partir das lógicas de equivalência, diferença e fantasia. Constatou-se que os discursos dos desenvolvedores simbolizam uma presença ainda por vir, com as demandas particulares diluídas numa cadeia equivalencial que abarca o maior número de reivindicações, e que existe um esforço para a criação de um processo incessante de geração de valor ao ultrapassarem as fronteiras da comunidade, articulando continuamente stakeholders para acessar recursos e gerar soluções conjuntas no processo de inovação.

Palavras-Chave: *inovação com software livre, colaboração on-line, comunidade pug-pe, teoria do discurso, análise do discurso.*

RESUMEN

Los avances en las tecnologías de la información han llevado a la innovación centrada en el usuario de los artefactos de la cibercultura. Este advenimiento del capitalismo provoca la aparición de enfoques que contemplan la producción colectiva e inmaterial vigente en las comunidades de software de código abierto. Desde una perspectiva postestructuralista, se analizaron 6 entrevistas, 2 videos y una lista de discusión online para apreciar el proceso de construcción del discurso hegemónico desde la lógica de la equivalencia, la diferencia y la fantasía. Se encontró que los discursos de los desarrolladores simbolizan una presencia por venir, con las demandas particulares diluidas en una cadena de equivalencia que engloba la mayor cantidad de demandas, y que se busca crear un proceso incesante de generación de valor al superar las demandas. fronteras comunitarias, articulando continuamente a las partes interesadas para acceder a los recursos y generar soluciones conjuntas en el proceso de innovación.

Palabras clave: *innovación con software libre, colaboración en línea, comunidad pug-pe, teoría del discurso, análisis del discurso.*

INTRODUCTION

The current scenario is marked by cultural transformations that have been consolidated since the second half of the 20th century (Batabyal & Beladi, 2019), and are linked to the hegemony of so-called cognitive capitalism, which elects new information and communication technologies (ICT) as the strategic, symbolic assets of the new social production system (Cardoso, Boudreau, & Carvalho, 2019). In this line of reasoning, cognitive capitalism represents another effort to understand the context of the structural changes that constitute the contemporary world (Karakilic, 2019).

The development of new action strategies involves permanent interaction between actors with different skill sets, who are interconnected and exchange an increasing volume of information (Lee & Sohn, 2018). Thus, it is possible to develop ways to incorporate the users of ICTs in the creation and development of the innovation process. This approach represents a step forward from the view according to which companies generated their own ideas and then developed, financed, distributed and supported the entire innovation cycle (Chesbrough, 2003), as an action perspective that encompasses, coordinates and incorporates operations and provokes agents who are linked by innovative projects to rethink innovation strategies in a world connected via organizational networks (Cornelio & Cruz, 2014; Huizing, 2011).

In practice, the issue that arises on the horizon of innovation resides in building a discourse that implements design and development methods and incorporates the user's perspective in a world of open innovation. This inclusive spectrum of innovative action enables the producer of a particular artifact or technological service to account for the dynamics of tastes, preferences and demands for products, as a result of the continuous flow between activities that contemplate the interaction between producer and consumer (Nath & Liu, 2017). This scenario allows the defense of the hypothesis that user-centered consumption and development communities are successful when they receive an incentive from the platform to innovate and reveal their ideas, which can later become competitive in the market.

Here, we can mention the creation of a cooperative of intangible assets between actors who interact via the global computer network (Benkler, 2006; Eboli & Dib, 2013; Lima & Santini, 2008). Various instances of this phenomenon have been occurring over the last 10 years, such as the free software (FS) movement, which has become a global phenomenon and led to the development of an open, global and multipurpose functional platform, GNU/Linux (Cardoso *et al.*, 2019). This movement was born from the idea of exchanging information and cooperating, bounded by data management platforms in social networks.

By opening itself to a multiplicity of technology-intensive goods and services, ICT makes it possible for both industry and users to take ownership of this technology (Lee & Sohn, 2018). This perspective emphasizes the need to rethink the relationship between humans and technological artifacts, which, as in the case of FS, tend to generate a large number of techno-human interactions (Dong, Wu, & Zhang, 2019). Therefore, the contemporary production practices of FS and the communities that are formed for different reasons on the Internet represent, as Shahrivar, Elahi, Hassanzadeh and Montazer (2018) teach us, the emergence of new uses for the

application of a given technology, which already has the appropriate conditions for developing innovative processes aimed at realizing creative solutions.

The discourse concept proposed by Laclau and Mouffe (2001) sheds light on the analysis of a community of user/developers of FS in Pernambuco: PUG-PE (Python User Group - Pernambuco). The analysis seeks to understand the hegemonic component in their discourse in the process of creating FS, using the three logics of discursive construction proposed by Discourse Theory: the logic of equivalence, the logic of difference, and the logic of fantasy. Actors are involved in the elaboration of equivalence between demands, but also in articulating a boundary that defines the limits of their project by the logic of difference. The logic of fantasy provides support for the community's political projects and the individual user/developer's choices.

The need to identify a new language that reveals new social practices that affirm a more effective constellation of governance for emerging innovation processes resulted in the following research question: How does the hegemonic discourse of the developers of the PUG-PE community occur in the context of an online innovation and collaboration process that involves FS?

By choosing the political perspective for understanding the strategies of the PUG-PE group, we want to advance in relation to the functionalist approaches of studies that analyze just the administrative capacity of communities to attract and retain users. This choice also allows us to contribute to discussions in many disciplinary fields, such as the view that FS is limited to a debate on the natural evolution of ICTs, as Steiniger, Fuente, Fuentes, Barton and Muñoz (2017) believe from analyzing urban information systems, such as the simple implementation of electronic devices, addressing the copyright controversies developed by Lessig (2004), issues involving the green patents of Bretas *et al.* (2019), or even public technology policies, as proposed by Heikkinen, Savina, Partanen, Seppälä and Pearce (2020) for discussing the national strategy of open-source hardware in Finland.

Among all these various gaps in the research is research related to open-source technologies, with values such as collectivity, connectivity, collaboration, and shared objectives that result in political disputes occurring in the realm of discourse.

COLLABORATIVE INNOVATION WITH FREE SOFTWARE

The technological system of new ICT will be of no importance in the social field if it is not recognized as a key component of cognitive capitalism (Tseng, 2009; Tutusaus, Schwartz, & Smit, 2018). In the context of Organizational Studies, discourses about what is new and about innovation have been explained from the perspective of a social transformation of the "knowledge society", in which information manifests itself as the main productive force (Cocco, Galvão, & Silva, 2003). Thus, open-source software, a term coined by Eric Raymond, can be presented as an example of the implementation of the diagram of cognitive capitalism.

When talking about user innovation, it is important to highlight the education they have with regard to the new means of production (Jenkins, 2006), making the relationship between users and industries twofold. The consumer can become a producer, and even if some large

companies underestimate the value and influence of these practices, they occasionally take advantage of social production in relation to their products (Loureiro, Romero, & Bilro, 2019). Sometimes there is an appropriation of participatory culture to increase profits (Zhang, Gupta, Sun, & Zou, 2020). For example, some videogame companies have strong communities that provide them with feedback on their games and also generate mods (modifications) or software that improve the quality of their products (Cornelio & Cruz, 2014). Thus, a concept such as *prosumer* represents the hybrid nature of immaterial production today.

The current economic dynamics require an understanding of the different theoretical currents that point to knowledge as an important variable of innovation (Ruoslahti, 2020). Theorists such as Friedman (1953) and Becker (1962), for example, highlight the importance of technical and organizational innovation for capitalist development (Possas, 2008). Given the multiplicity of views on the subject, however, Slappendel (1996) suggests synthesizing three research perspectives: the individualist perspective, the structuralist perspective and the interactive process perspective.

The interactional perspective may be an effort to reduce the gap between individualistic and structuralist views by inserting them into the same innovative effort development process, by preparing a model that encompasses the interface between individual and structural factors (Wang & Li, 2019), but also presupposes innovation as a collective and interactive action, the results of which come from the effort of aligning individual, organizational and contextual elements. (Slappendel, 1996).

The perspective of the interactive process does not seem to escape the unilaterality of most innovation studies, or adapt to the particularities of cognitive capitalism. By considering knowledge to be a neutral resource, software producers continue to suppress political and cultural aspects from the process by establishing a boundary between creators and users, depriving the latter of the opportunity to participate in continuing innovation (Liu, 2017). Thus, they do not consider the opening of borders provided by the new ICTs as support for the new generation of innovation processes and business models.

The critical appropriation of the traditional paradigm of innovation represents an effort to understand the emerging phenomenon of disruptive innovation, which is continually operationalized and developed by agents with an aptitude for bricolage (Taques, López, Basso, & Areal, 2020). Authors such as Ortt and Duin (2008) point out that there is a tendency to replace the linear and endogenous innovation models of the individual firm with a networked, exogenous, multidirectional and chaotic process model, which allows users to participate in the new ICTs.

Online collaboration in the development of free software

Online collaboration is a phenomenon that has the potential to change lives and challenge hierarchies (Betzing, Kurtz, & Becker, 2020). It comprises collaborative social media interactions (Castells, 2010) that allow for participation in organizational processes outside the organization's boundaries (Lee & Cole, 2003), and include users and other external actors (Hemetsberger & Reinhardt, 2009). Online collaboration is associated with topics such as the creation of knowledge

(Lee & Cole, 2003), product innovation (Jeppesen & Frederiksen, 2006) and the development of activity systems (Hemetsberger & Reinhardt, 2009).

Lee and Cole (2003), who study online collaboration in FS development, propose a knowledge creation model that is based on community learning. They believe that learning is a collective process of identity formation and acculturation in communities of practices (Brown & Duguid, 1991; Fernandes, Fernandes, Paiva, Leão, & Costa, 2020), in which practitioners may be geographically dispersed; what classifies them as a group is the practice, the métier.

FS is developed in a process of collaboration between volunteers. According to Lee and Cole (2003), the contributions of the different developers are not regulated by a formal contract of paid service, but rather by cultural and legal norms whose mechanisms, which underpin the knowledge building process, can be understood in terms of at least four aspects: 1) widely shared, knowledge building blocks; 2) incentives to contribute as the FS community volunteers; 3) coordination under conditions of uncertainty; and 4) orientation towards quality innovation processes.

In the case of FS communities, Lee and Cole (2003) teach that cultural and legal norms allow for the emergence of the parallel code and two-tier task structures that characterize the processes of the operation and provide a visualization of how it works. The parallel code structure refers to the simultaneous existence of two versions of the same software, a stable version and a test version (Betzing *et al*., 2020). All work is developed on the test version, until the software is considered satisfactory and safe for inclusion in the stable version. This practice enables experimentation, errors, criticism, and error correction.

The context of the Discourse Theory of Ernesto Laclau and Chantal Mouffe

The term that describes the work of Laclau and Mouffe (2001) well is the Discourse Theory (DT), which these authors describe as a "structured totality resulting from articulatory practice" (Laclau & Mouffe, 2001, p. 105). In this discursive logic, articulation represents "any practices establishing a relationship between the elements in such a way that their identity is modified as a result of the articulatory practice" (Laclau & Mouffe, 2001, p. 105), and hegemonic articulation as the "formation of a political and moral-intellectual leadership that involves the articulation of a variety of ideological elements in a common political project that modifies the identity of the political forces behind it" (Howard & Torfing, 2005, p. 12).

DT also introduces the concept of complex society that is totally reconceptualized in discursive terms, consisting of a multitude of identities resulting from articulations (Deligiaouri, 2019). Thus, the social component is permeated by antagonisms and characterized as the realm of discursive differences that are homogenized with the formation of chains of equivalence vis-à-vis a purely negative exterior, that is, an exterior that constantly poses new threats to discursive stabilization.

DT privileges the dynamism of societies and different social groups, which construct and deconstruct themselves in multiple arrangements, the producers of unstable, exchangeable

and sometimes hegemonic meanings (Laclau & Mouffe, 2001). One of the central concepts of DT that is fundamental to our study is hegemony, which is defined as political, moral and intellectual leadership, which depends on the construction of a discursive formation that provides the basis for the inscription of a wide range of demands, visions and attitudes (Torfing, 1999). In the discursive field, it represents the target of permanent debate between the narratives that are in dispute. In this scenario of different conflicting meanings, hegemony occurs when meaning is fixed around a nodal point (Deligiaouri, 2019).

Three fundamental logics of DT come into play in this (impossible) search for plenitude: the logic of difference, which helps demarcate discourse boundaries; the logic of equivalence, which articulates equalities between agents or between a number of different "others"; and the logic of fantasy (or phantasmic logic), which provides the means for understanding certain specific social practices, and how subjects adhere to certain regimes. Fantasy serves to ensure that the radical contingency of social reality remains at the bottom (Glynos, 2008; Stavrakakis, 2004).

METHODOLOGICAL PROCEDURES

In this study, we assume that technology users have been underrepresented in the current discourses on innovation. The work of translating their views into technical parameters is done through the lens of the experts who run the tests, for instance.

In this sense, we propose to investigate the hegemonic component present in the discourse of users/developers of the PUG-PE community, in order to understand how they can be active subjects in defining the functionalities of certain software, that is, in the technical choices that determine the configurations of a software. By entering this field of discursivity, we intend to unveil how the production process extends the innovative work of assigning a different use to software, and can also create a new object in the market. This situation means that there may be an alignment between the identity of the user and that of the innovator.

The matter under study is based on understanding how the hegemonic discourse of the developers of the PUG-PE community occurs in the context of the innovation process using FS. We chose to make use of discourse analysis investigations, a strategy that aims not only to capture the way the word is proclaimed, but also to analyze its meaning. For this perspective, the positions revealed by the subjects, and likewise by the objects, are based on their discursive practices. In these terms, subjectivities are produced discursively (Fernandes, Fernandes, Paiva, & Melo, 2014).

The documents analyzed were the result of two videos about a Brazilian meeting for developers of the Python programming language (Community Overflow [V1] and Building successful communities [V2]), and six interviews conducted with FS developers from the PUG-PE community (Gileno Alves [E1], Marcelo Caraciolo [E2], Renato Oliveira [E3], Marcos Egito [E4], Daker Fernandes [5] and Henrique Foresti [6]). The conversations were based on an itinerary of questions that aimed to achieve theoretical-empirical progress (Fernandes *et al.*, 2014).

The study participants were intentionally selected, considering their expressive representation in the discursive field in question.

Data were analyzed in three different stages, as suggested by (Fernandes et al., 2014). In the first stage, the data were arranged in order to better investigate the contents we had collected. The second stage was marked by carefully reading the collected data to obtain a broader perspective of the knowledge we had gathered, and to reflect on its significance. In the third and final moment, we interpreted the results we had achieved. During data analysis, each portion of the data was assigned an identifying code, such as E1, § 1R1, where the numbers after the letters correspond to the count of the interviews (E), the paragraph (§) and the reference (R) being highlighted. In Exhibit 1, we present the analysis protocol that we used in the analytical stage of the study. The data from the videos were presented as follows: V1, 01:00-02:00, where the letter V corresponds to the video, followed by the time reference corresponding to the discourses.

Exhibit 1. Five-step research process

IDENTIFY PUG PE
Develop a dense description of the context
Unstructured interviews
Documents and published works of the group
Transcription
Coding in NVIVO
OUTLINE THE STORIES THAT MAKE UP THE GROUP'S DISCOURSES
Search in the online databases of Python Brazil and International
Access magazines of free online software
Access the online mailing list
Identify the lectures and videos of the group members
Semi-structured interviews
EXPLORE THE DISCOURSE REITERATION STRATEGIES IN THE AGENTS
Analyze the online mailing list
Identify and highlight key leaders
IDENTIFY THE STRATEGIES FOR THE CONSTRUCTION OF THE GROUP'S DISCOURSE
Identify equivalences, differences and fantasies
Interpret these discourses
INVESTIGATE THE CONSTRUCTION LOGIC IN THE COMMUNITY'S DISCOURSE
Inferences about the hegemonic component in the discourses of the developers of PUG-PE communities

The proposed inferences are supported by the DT of Laclau and Mouffe (2001), whose foundation is based on the meanings of discourse, hegemony and the three logics of discursive construction: the logic of equivalence, the logic of difference, and the logic of fantasy.

As a way of maintaining the integrity of the analytical procedure, the investigation auditor was present for the debate and results' construction sections, which helped with analysis validation. Constant reflexivity is a way of overcoming any of the limitations that surround research dealing with contingent and dynamic scenarios (Fernandes & Silva, 2015). For Alvesson and Skoldberg (2000), reflexivity is an element that leads to greater security for the operational procedures of research, and a condition that generates transformations in the researcher.

ANALYSIS OF THE RESULTS

This step is based on the establishment of a discursive fixation point around which certain articulatory chains are developed. These chains are constructed from aligning the different individual and organizational demands that influence each other, and are characterized by the construction of a hegemony of discourse. In our case, the interpretative effort was to characterize the articulation of a discourse that constructs equivalences as a way of contemplating innovation that is centered on the contributions of the FS user/developer through the differentiation of practices that deny collective, immaterial and developed production in current flow in open-source development communities. Fantasy, in turn, provides the elements that give credibility to these discourses, in order to captivate the stakeholders with support, in an effort to become hegemonic discourse.

The logic of equivalence surrounding the discourses of the developers of PUG-PE

As in every equivalence chain, the moments of discursive constitution of the PUG-PE community as the "open-source project of software development" are not subordinate to all the demands that go to make up this articulation between key actors of the equivalence chain of that ecosystem, even if this demand variability constitutes a primordial condition to ensure its existence.

With regard to Python, some of the elements articulated in this equivalence chain can be summarized as: 1) interpreted programming language and, therefore, geared towards the programmer's efforts; 2) easy to learn, and highly productive and innovative activity; 3) multiparadigm: object-oriented, functional and procedural implementation; 4) cross platform, open source and fun. This equivalence around Python is critical to the goal of preserving an inclusive environment oriented towards all users/programmers and directed towards ensuring the support of stakeholders. Thus, the support of these successful equivalence chains requires a continuous reiteration of these discourses, and the emergence of general equivalents is a way of maintaining the PUG-PE discourse as a space for innovative projects in Python.

The differences in worldviews between developers are equivalent in discursive fixation points to "collaborative environment" and "community", in which equivalences are maintained in the order of their demands, as happens when developers reiterate, for example, that PUG-PE

meetings are one of the most significant technology events in Pernambuco for stimulating programming, participation and collaboration, or bringing an aura of shared and inclusive space of technological exchange, as shown in the words of Marcel Caraciolo (MC).

> Another point is that I like this collaborative cycle and I think it's important to exchange information, and one of the motivations for participating in these free software communities is the exchange of information. I did one thing in way X and another in way Y. If I hid the X way of doing the thing, I wouldn't figure out the potential failures or improvements that I could have. So, the idea of exchanging this information is a cool thing of these free software communities, and you won't pay anything for it, you'll only be exchanging knowledge (E3, § 6R3).

This represents the existence of the elements that express the constitution of the identity of actors belonging to a group that can provide them with good experiences, together with the fact that after 2010 PUG-PE expanded its technical online collaboration activities to include several other universities (more than ten in Pernambuco) and, therefore, to attract the attention of local companies that start using this programming language in their projects. This effort to position PUG-PE as one of the main technology encounters in Pernambuco, therefore, is the result of the integrative strategy of defining themselves as the most active developer community in the city, which is competing to match or surpass the traditional Java, one of the main programming languages used by local businesses.

The successful strategies of including Python as a viable option for the local business community are due to Marcel's competent leadership, which is recognized by the other members, and to the efficiency and simplicity of the language, which eventually attracts other stakeholders, thereby "increasing the critical mass" of the group. The group's current success is aligned with the success narrative of most ICT-related ventures, which alludes to the story of an agent who alone believes in his/her idea and manages to aggregate key people from the environment, and so paves the professional way for achieving business success. The following excerpt illustrates the reiteration of this rhetoric in this process:

> [...] we started small there at the Informatics Center UFPE. It all started there, but we started evolving, evolving and today we have a website, a mailing list, blogs, and a video channel that are well organized now... We started very slowly by promoting small courses in 2009. In 2010, we started having meetings with new participants, and the more meetings we did, the more people showed up... So, we've done a lot of things that justify who we are today... We have a good set of companies that use this technology, such as Nokia, for example, and particularly the startups, and we even created a tool that mediates the success of candidates for election with their voters... So do it, do it, do it. There's no point in standing still. I got there at Cin, saw what I had to do and together with some friends we started to make things happen (V1, 07:35-15:00).

The metaphors that dominate this narrative of the group's history report a "difficult start" with "several failed attempts" until a "chaotic agent" appeared, Marcel Caraciolo, who began to give a new direction to the destinies of the group. It "gains critical mass" and visibility in the local ICT scenario, and attracted the attention of "researchers, companies, enthusiasts, developers and paratroopers" who have an interest in technology, and so they strive for Python to advance in the state. The differences in world view are equivalent in the points of discursive fixation to a "successful community", maintaining the equivalences in their demands, as shown in Figure 1, which is composed of excerpts from PUG-PE's mailing list (Exhibit 2).

Exhibit 2. The equivalences of the "successful community" signifying chain

Mailing Lists - § 1 coded reference [33.71% Coverage]	Hello guys After giving more than 20 lectures in February alone, with an estimated audience of more than 3,500 people who have watched these videos, we're very happy to receive the staff and speakers who have been involved in the cause [---] We're promoting improvements in the hangout app in partnership with PyCursos/Pingmind that will make it even easier to promote the talks throughout the month. The lectures are free and any person can participate! If you have some Python-related ideas or projects, here's a great opportunity for you to present what you know to people who are interested in the subject or experts on Python, networking and sharing technical experiences.
Mailing Lists - § 3 coded references [47.55% Coverage] reference 1 [36.39% Coverage]	Hello everyone, I would like to congratulate everyone involved in holding the III PUG-PE Meeting today at the Informatics Center-UFPE. I'd like to say that I was very happy today to see a number of people that I never imagined for our meeting. A lot of people stopped me in the hallways, asking: "Is this where the meeting's happening?!" I couldn't believe it! This is proof of the effort and work we're doing to keep this group moving forward. I'm not exaggerating, but we have all the potential to become a host-candidate in the coming years of Python-Brazil. Proof of that?! Today we had people from Alagoas (PUG-AL), people from Paraíba and people from Recife. This integration is fantastic!
Mailing Lists - § 1 coded reference [11.35% Coverage]	Guys, I tell you with great satisfaction that the article about our community was published in *Revista Espírito Livre* (Free Spirit Magazine), one of the most outstanding Brazilian magazines about free software. The article is on page 72!! http://revista.espiritolivre.org/pdf/Revista_EspiritoLivre_029_agosto2011.pdf Congratulations to everyone here, you built this: Onwards!
Mailing Lists - § 3 coded references [17.08% Coverage]	Guys, I inform you that the group of Python users from Pernambuco has joined the *Células Empreendedoras* (Entrepreneurial Cells) network. This followed the formalization of the group, which has become our first python entrepreneurial cell. I believe this group can motivate and lead the creation of Python cells throughout the state. May this group serve as an example for many of us, with the entrepreneurial organization it has.

The function of these narratives, therefore, is aligned with the perspective of Deligiaouri (2019) when he states that they refer to the strategies of discourse simplification in order to enunciate a discourse that is more accessible to others who are part of the equivalence chain;

that is, people from different origins, with different perspectives on the group's complex issues, "identify " with this discourse, creating a network of equivalences and eliminating differences. They mobilize to build an equivalence chain involving the various arguments and meanings of PUG-PE. This means that certain issues and topics of interest can be debated and analyzed within the community.

The equivalence networks of "business success" cancel out the differences between the community and the companies who use and produce software, and highlight the differences with the education systems taught in the colleges and universities with which it maintains partnerships; or between community and government programs that encourage entrepreneurship and technological innovation. This institutional action is marked by the formulation of an articulatory strategy that extends from the network of equivalences beyond the boundaries of the community and leads it towards the universal sphere, because it produces a desirable discourse of identification (Chan & Li, 2010).

Logic of difference: community and market versus developer and community

Understanding the differences between the moment-elements that are part of the discursive chain "community" helps when it comes to understanding the equivalential bonds that create discursive connections in this equivalence chain. Moreover, it is worth mentioning that the idea of identity infers difference, that is, if there is no difference this may mean that we are dealing with the same subject, because PUG-PE builds its identity from the existence of other distinct identities. Such is the case with communities that adopt other technological approaches, as shown in the excerpt from the interview of Marcos Egito (ME):

> People exchange pieces of code in Python without complication. In the case of PUG, there is an open mailing list. You just need to register, and if you have any questions about the code, you have a group of people who are willing to work with you on it. There's no kind of restriction like, uh, you're not a partner, you have to pay X. There is none of this that happens in other groups out there (E4, § 10R2).

In relation to the market, this difference occurs from a strict logic demarcated by only aiming at profiting from technology (the utilitarian view), forgetting the dimension of the passion of users/developers for technology (the playful dimension). The work by Benkler (2006) is elucidatory in this sense when he argues that the development process of open-source software is based on a peer production mechanism, and is not similar to the classic market and business model. If we proceed from Iannacci's (2005) understanding that "transparent, community-based production with a collaborative management model was the greatest innovation of Linux" (p. 48), then the strict logic of the market may constitute the antagonistic perspective that defines the "other", the difference that has a dichotomous relationship with the discourse demands of the Python community of Pernambuco, as can be seen in the following excerpts.

> I see those businesses as a future threat to certain types of communities. But for Python, I find this difficult to happen because the community itself is made up of many people and does not have a company controlling everything. But you never know about tomorrow, do you? (E2, § 3R3).

> The use of free software or the matter of participating in communities, contrary to what most people think, is not only for the little penguin, but I go to the essence of it. So today I make use of free software, and use it in my classes, without generating and stimulating the disparities that are already in the market (E4, § 2R1).

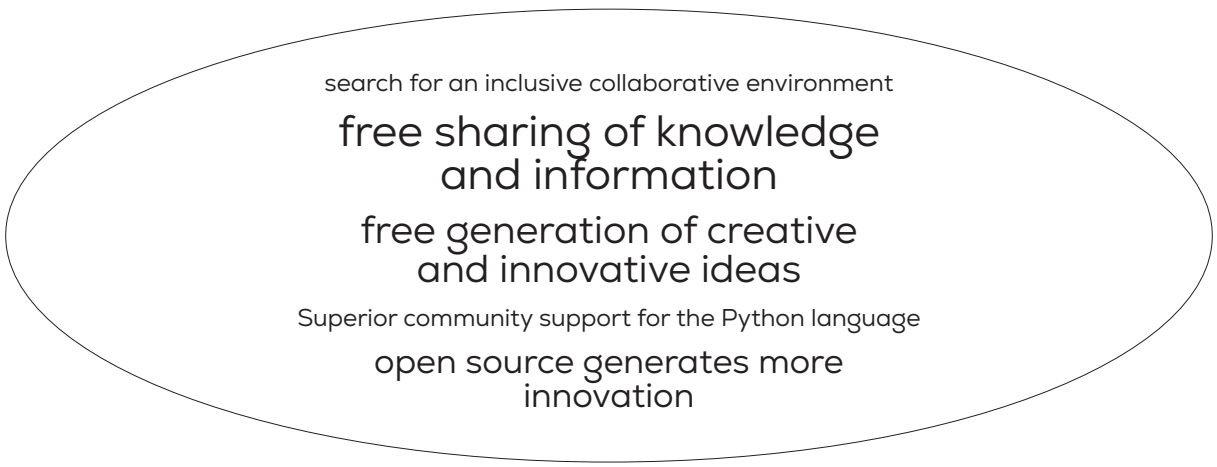
Under this logic, the difference condition is the element that allows articulatory practice to take place, through the same differences that combine in a precarious and contingent way, in a nodal point that has the characteristic of expressing a common meaning to them. Once again, it is difference that enables the articulation between interagents of the equivalence chain.

The universality of this logic of difference goes beyond the political field to reach the normative field (Dong *et al.*, 2019). Based on certain data, such as the number of monthly meetings, the number of members, the volume of startups that use Python, the number of universities that have established partnerships, the amount of footage recorded on video channels and the number of projects posted on GitHub, Marcel Caraciolo argues that PUG is different from other developer groups.

The logic of fantasy forging an inclusive collaborative environment

The logic of fantasy provides support for the community's political projects and the choices of individual users/developers. The fantasies are basically supported by the discourses shown in Figure 1:

Figure 1. The discourses of fantasy



These thematic constructions are obvious ways of thinking about how the community is affected and sustained by fantasies. These structured desires phantasmally shape the nature and content of the demands of developing users, and structure how emerging questions are answered. The two excerpts below are indicative of this when the interviewee refers to the Python programming language:

> It's a high-level language used in many environments such as Linux, Windows, Mac. It's what's called cross-platform interoperability. Another important key aspect that I like to draw attention to in Python is that it's being used a lot in universities to teach programming. So this is fantastic (E2, § 1R1).

It should be noted here that the Python programming language is vested with properties that exceed its purely technical components; when, for example, this programming language appears in individual narratives as something fantastic, superior, fun, innovative, competitive, it becomes the object from which users/programmers experience sensations of heroism, freedom and autonomy in the effort to control their performance.

Fantasy plays a fundamental role in constructing and supporting the community's discourse and in the relations established between its members. Glynos's (2008) view of this process highlights that features that are often confused coexist with both ideological and normative aspects. The ideological aspect would be in the discourse of the community that tries to present PUG-PE as a closed and homogeneous totality, through the fixation of a nodal point, and in its non-recognition of the infinite world of differences (Laclau & Mouffe, 2001). In other words, ideology would be in the desire to build the discourse of totality. At the same time, the normative signifier of the ideological dimension of fantasy would be related to the function of maintaining the political character of relations in the community, which are associated with the production, appropriation and distribution process of knowledge and information.

Fantasy promises a harmonious resolution of social antagonisms, since it provides a filling for the emptiness of discourse. For Stavrakakis (2004), only in this way can the discourse be constituted as a desirable object of identification, as shown in the excerpt below:

> The community really attracts a lot of people. And not everyone is there necessarily out of interest in Python. You'll see people who go there because they have an idea and want to share it, they have a problem and are looking for a solution and think the community can help them. So, the community diverges from the scope of technology and begins to expand (E2, § 6R4).

Fantasy organizes and supports the apparent multiplicity of identities, aligning itself with the study of Glynos (2008), when he explores practices of the workplace that are recognized from the aspect of fantasies. Thus, the results show that one of the structuring fantasies of the workplace concerns leadership, particularly individual leadership, which is experienced in hierarchical

superiors: examples of this would be leaders who are careful, or accessible or omnipotent. The motivation for programmers to want to stabilize the community's discourse to support fantasy should not be confused with rational actors who seek to satisfy their interests, but rather with actors whose identity is dependent on discourse. The incompleteness of the discourse forces the actor to build a complete illusory identity through acts of identification (Howard & Torfing, 2005). In this sense, the actors are strategic and non-rational, that is, the community's articulators act in order to improve communication effectiveness with its members through the production of useful knowledge, which has a chance of being adopted by the participants or improved by the market. The phantasmic logic of discourse also operates when the subject is invested in some fantasy, in such way that anything that would destabilize the phantasmic narrative of the subject is seen as a threat.

The logic of fantasy helps us understand how the process of innovation production occurs in the PUG-PE community, since this logic reveals the community's ideology and, thus, how the effort is developed to insert or transform the existing social logic of the production, appropriation and distribution of information and knowledge (Betzing *et al.*, 2020).

Construction of the hegemonic discourse of developers of PUG-PE

The scenario in which PUG-PE emerges is entangled with discourses that call for new models of innovation management, a new approach to services, and the constitution of new collective identities that meet the rigid hierarchies of the industrial era (Taques *et al.*, 2020). These issues stand out in the hegemonizing discourse of the developers through the logics of equivalence, difference and fantasy.

The concept of hegemony is fundamental to DT, since it represents the particular element that has the function of symbolizing an absent fullness (Laclau, 2005). The process of its constitution as an equivalence chain has, as its starting point, the chain of discourses that enunciate the preservation of a community sense of a group of people who share certain values that differentiate them from other groups, and other market proposals by maintaining the status of an "experience-sharing group that had a slow and difficult start", as shown in the excerpt from a video by Marcel Caraciolo presenting PUG-PE:

> [...] the PUG-PE mailing list started in 2007, and at that time, having meetings was complicated because usually people would not attend them. To give you an idea, the first meeting was in the Bugaloo restaurant, but people want to code and not eat, and no one came, just the one guy. The years 2008 and 2009 were more or less like this (V2, 3:02.1-3:20.5).

In this process of establishing an identity of its own, it managed to leave a small cell and has evolved, and today is recognized as "one of the main open-source technology meetings in Pernambuco". The clash of interests, benefits and losses that is established in this process of

discursive construction, the search for the discourse hegemony "of the successful community", is aligned with elements of fantasy, such as the fact that it is a FS group that "cultivates diversity and innovation" (E3) in a context where market competitiveness demands trained, creative and self-employed professionals at work.

In the universe of interagent groups, equivalence chains are built that establish nuclei around which discursive elements align, linked by a concern with celebrating the expected gains from insertion in an open innovation chain, organized in a network of information flows in which PUG-PE is a disseminator of intelligence in Python, so establishing connections with different stakeholders. This discourse originates from the mixture of post-Fordist arguments claimed by the expansion of the notion of the "new economy" that gained notoriety with the work, The Network Society – The Information Age, by Castells (2010), who calls this new hegemonic productive model "informationalism". There are also contributions from Gorz (2005) that provide formulations about "immateriality" and the loss of the usual measures of labor value.

CONCLUSION

The aim of this study was to reveal the hegemonic component present in the logics of the discursive construction of PUG-PE's developers. These agents want to position collective and immaterial production in the circuit of innovation production, but without succumbing to the strict logic of linear market innovation and the current intellectual property regime. In practice, the challenge is to build a discourse that implements methods of conception and the development of innovative ideas that allow the incorporation of the user/developer perspective, that is, that allow the innovation approach that is centered on the firm to expand.

In this sense, we recapitulate the fundamental question of the study: How does the hegemonic discourse of the developers of the PUG-PE community occur in the context of an online innovation and collaboration process that involves FS? Phantasmic logic plays a key role in protecting against displacements by strengthening identity and articulating part of the group's rhetorical strategy. In this sense, in view of the need for PUG-PE to survive, it was necessary to build a discourse that presented the particularities of the group as having the conditions needed to meet the demands of different users/programmers in their efforts to satisfy their passion for the Python programming language, improve their skills, work on a project, acquire the skills required in the labor market, set up an ICT startup, and explore an innovative idea.

The PUG-PE community is a body that is divided between its own particular discourse of differentiating itself from the business logic, and the more universal signification of not ceasing to receive new meanings. This expansion of the equivalence chain corresponds to an operation of hegemony. This scenario confirms the hypothesis that the success of the PUG-PE community depends on the aggregation of subjects who are curious about technology and who seek to differentiate themselves through their skills and be guided by quality in innovation processes. This represents a way to participate in innovative projects that attract the attention of the market and eventually compete with market distribution by creating their own startups.

The contribution of the study lies in its adoption of the DT approach, which reveals the tensions and constant changes that are part of the world of PUG-PE's developers, moving one step beyond the reductionism of structural determinations, such as economic interpretations that are solely guided by the logic of the market and that leave aside the logic of the social and the political, such as firm-centered innovation approaches, which are questioned by authors such as Chesbrough (2003) and Chesbrough and Henry (2006). It also allows us to question the Utopian views of new ICTs that claim beneficial transformations for society, putting this discourse into perspective and showing the particular demands that conceal it.

DT also provides the opportunity to understand FS projects as a political and socially localized construction, an approach that is not found in academic writing and the discourses of FS development communities. At the same time, it makes it possible to think of innovation as a process related to issues of political dispute and discursive strategies.

Finally, the PUG-PE discourse works by symbolizing a presence that is yet to come. Thus, each of the members of this community are abstractly related, since their demands and questions are symbolically diluted in a community equivalence chain that has to divest itself of part of its meanings so it can understand a greater number of demands, and so the construction logic of this discourse can be understood, basically by identifying demands, general equivalents and fantasies.

From the point of view of the potential implications/contributions of these findings for managing innovation in communities, they should orbit, fundamentally, around the individuals who are part of them, more than the technological and infrastructural devices they have for generating innovations. In this sense, it is necessary to use innovative processes that are distanced from the traditional organizational routine, developing a creative environment that is oblivious to classical administrative tasks and the strong division of labor, allowing for the creation of new ideas. Rules, regulations, governance strategies need to be aligned with individual demands, so that there is the necessary identification between the objectives of the community and those of individuals.

As strategic actors can exercise their agency as something that is not fully realized, this means that they have to articulate with agents from organizational structures to meet their objectives in a recursive and dialogical process, given the contingency process that involves the actors and structures. This harmony is necessary in the relationship between the user community and the firms in order to increase the chances of achieving individual and collective objectives. The exchange of ideas demands an organizational environment that is receptive to newcomers and to situations that lead to possible diversity and renewals in investments in creative solutions.

The individual subjects who are active and the protagonists of these innovation movements require a focus that adds the financial perspective, technical efficiency and the satisfaction of the passion for the technology used that can represent organizational actions to be adopted by the communities; that is, traditional managerial actions, such as professional training, certifications, bureaucratic processes and monitoring conceived of from a classical viewpoint are useful in other contexts because they do not achieve the same results in the context of open-source

communities. Organization in open-source communities does not guarantee innovative processes/product generation, but is related to the creation of the cultural and structural standards that are developed in communities to enhance innovation.

Although the study was conducted with a FS development community, this approach to discourse can be used to reveal other tensions that emerge as a result of the transformations that the information economy and its effects generate in the software industry, music, film, book, and other sectors where divergence overcome convergence. It would also be interesting to conduct studies with an academic inspiration using other research approaches, as a way of enabling a future meta-analysis of the propositions addressed here in other studies.

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AUTHORS' CONTRIBUTIONS

The authors declare that they participated in all stages of development of the manuscript. Nelson da Cruz Monteiro Fernandes and Fernando Gomes de Paiva Júnior worked on the conceptualization and theoretical-methodological approach. The theoretical review was conducted by Osiris Luis da Cunha Fernandes. Data collection was coordinated by Marconi Freitas da Costa. Nelson da Cruz Monteiro Fernandes, Fernando Gomes de Paiva Júnior, Osiris Luis da Cunha Fernandes and Marconi Freitas da Costa participated in the data analysis. All authors participated in the writing and final review of the manuscript.

