

Conflict Management in an Occupational Community for Free Software Development

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ABSTRACT

In this paper, we present results from the study of how conflict is managed in a globally distributed free software development project. Conflict arises over the use of a non-free tool to create a GNU Enterprise (GNUe) Website graphic. The GNUe developers resolve the conflict using Internet Relay Chat (IRC), persistent relay chats, threaded email discussions, and community digests. We characterize the GNUe virtual organization as an occupational community and show how the beliefs in free software and freedom of choice, and values in cooperative work and community assist GNUe contributors in managing and resolving conflict.

Keywords

Computer-supported cooperative work, conflict, occupational community, organizational culture, free/open source software development, virtual organization

1. INTRODUCTION

Open source software development (OSSD) projects are growing at a rapid rate. The SourceForge Web site estimates 600,000+ users with 700 new ones joining every day and a total of 60,000+ projects with 60 new ones added each day. Thousands of OSSD projects have emerged within the past few years [2, 20] leading to the formation of globally dispersed virtual communities [27]. Studies are needed to understand how people in these projects are able to work together to coordinate software development at a distance, as well as to explore the social worlds that arise to assist in this collaboration. Conflict is inevitable in software development teams but, if managed properly, it can lead to improved performance [22]. Virtual software development communities need to strive even harder to manage conflict in non-collocated work

environments without face-to-face communication. This paper presents the results of a qualitative study of a free software development community and how they manage conflict over instant message streams using internet relay chat (IRC) logs, text-based recording of IRC logs, mailing lists, and summary digests (called "kernel cousins" by participants in our study). We characterize the free/open software developers as an occupational community [30] with beliefs, values and norms that direct their behavior in resolving conflicts.

This study is part of an ongoing comparative study of various types of open software communities [8, 7, 9, 23, 24, 25] including both free and open source software projects. It is important to distinguish between the terms free software [28] and open source [2]. Free software refers to software that is open to anyone to copy, study, modify, and redistribute [28]. The Free Software Foundation (FSF), founded by Richard M. Stallman (known as RMS in open source communities) [31] in the 1970s, advocates the use of its GNU General Public License (GPL) as a copyright license which creates and promotes freedom. The FSF is at the forefront of the free software movement, and advocates that free and open source code is fundamental to the furthering of computer science and that free source code is necessary for innovation to flourish in computer science [2]. For more information on the FSF, see www.gnu.org.

In contrast, much of the world of open source software overlaps the world of free software, but "open source software" is presented, identified, and licensed as something that is more akin to business interests, compared to free software. While definitions and alternative licenses for open source software are available (see www.opensource.org), it should be noted that numerous surveys of open source software projects reveals that the majority use the GPL from the free software world, but otherwise identify themselves as open source software projects. Thus, projects that identify themselves as "free

software" development (FSD) projects are more likely to be closely aligned to FSF, the free software movement, and even to RMS.

Conflict is an integral part of cooperative work in many work settings [4, 5] and is inevitable in software development, especially in virtual organizations where assignments are loosely made, projects are managed informally, and where users are communicating from across the world in mainly text-based venues. Since computer-supported cooperative work (CSCW) research is concerned with the design of systems to support interactions between individuals or groups at work, an analysis of conflict and how it is managed in OSSD would be useful. Conflicts arise between people engaging in collaborative work activities and CSCW should include an understanding of how collaboration may break down and how it can continue in the presence of conflict [4, 5]. Understanding how conflict is mitigated and resolved in open source and free software development communities is beneficial to researchers interested in developing open source CSCW systems, and for managers considering the introduction of OSSD into their organization.

Research has shown that virtual communities need successful conflict management techniques [16, 27] in order to maintain order and stability. One means of mitigating and resolving conflict in a free source community is to use instant messaging and summary digests to articulate problems arising over the use of non-free tools for source code development and documentation [7, 9] This paper presents a case study of a free software virtual community that uses IRC and kernel cousins to mitigate and resolve conflicts. In [7], we give more details regarding this case study and present another one as well.

In Section 2 we describe the research site, in Section 3 we discuss background literature, and in Section 4 we briefly describe our research methods. Section 5 includes a presentation of the case study data followed by a discussion of the data in Section 6. Finally, we present the conclusions in Section 7.

2. RESEARCH SITE: GNUE ENTERPRISE

The research site is a free software development community, the GNU Enterprise (GNUE) (<http://www.gnuenterprise.org>). GNUE is a meta-project of the GNU (<http://www.gnu.org>) Project. GNUE is designed to collect Enterprise software in one location on the web. The plans are for GNUE to consist of three items:

- 1) A set of tools that provide a development framework for enterprise information technology

professionals to create or customize applications and share them across organizations;

- 2) Set of packages written using the set of tools to implement a full Enterprise Resource Planning (ERP) system; and
- 3) A general community of support and resources for developers writing applications using GNUE Tools

GNUE is an international virtual organization for software development based in the U.S. and Europe, centered about the GNUE Web portal and global Internet infrastructure that enables remote access and collaboration. Developing the GNUE software occurs through the portal, which serves as a global information sharing workplace and collaborative software development environment. One or more of twelve companies located across the U.S. and Europe sponsor paid participants. These companies provide salaried personnel, computing resources, and infrastructure that support this organization. However, many project participants support their participation through other means. In addition, there are also dozens of unpaid volunteers who make occasional contributions to the development, review, deployment, and ongoing support of this organization, and its software products and services. Finally, there are untold numbers of "free riders" who will simply download, browse, use, evaluate, deploy, or modify the GNUE software with little/no effort to contribute back to the GNUE community [19].

3. BACKGROUND

Researchers have studied conflict in closed source software development environments [22], but not in free/open source software development. Only a few researchers have attempted to understand conflict management in virtual communities [16, 27]. Smith [27] studied conflict management in MicroMUSE, a game world dedicated to the simulation and learning about a space station orbiting the earth. There were two basic classes of participants: users and administrators. Disputes arose in each group and between the two groups regarding issues like harassment, sexual harassment, assault, spying, theft, and spamming. These problems occurred due to the different meanings attributed to MicroMUSE by its players and administrators and due to the diverse values, goals, interests, and norms of the group. Smith concluded that virtual organizations have the same kinds of problems and opportunities brought by diversity as real organizations do, and that conflict is more likely, and more difficult to manage than in real communities. Factors contributing to this difficulty are: wide cultural diversity; disparate

interests, needs and expectations; nature of electronic participation (anonymity, multiple avenues of entry, poor reliability of connections and so forth); text-based communications; and power asymmetry among users.

Kollock and Smith [16] studied conflict in Usenet groups emphasizing the importance of recognizing the free-rider problem. In a group situation where one person can benefit from the product or resource offered by others, each person is motivated not to contribute to the joint effort, instead free-riding on others' work. The authors do a detailed analysis of this free-rider problem and give suggestions for how to avoid it in Usenet groups. For example, it is suggested that bandwidth be used judiciously posting useful information and refraining from posting inappropriate use of bandwidth. Success on a Usenet group also depends on its members following cultural rules of decorum. In this paper, we show how the beliefs and values of the culture of a free software community contribute to the successful mitigation and resolution of conflict.

One way of viewing groups with shared goals in organizations is to characterize them as occupational communities [30] or as organizational subcultures [18, 26, 29]. Occupational communities share similar goals, work practices, beliefs, interests, and value systems. They are bound by socially constructed rules and ethics that promote formation of shared ideologies and cultural forms. Van Maanen and Barley [30] suggested the use of occupational communities as an alternative to an organizational frame of reference for understanding why it is that people behave as they do in the workplace. While the term "occupational community" has been used in previous studies of communal work settings [10, 21], Van Maanen and Barley [30] furthered that work by presenting a definition of occupational community based on four themes:

"By occupational community, we mean a group of people who consider themselves to be engaged in the same sort of work; who identify (more or less positively) with their work; who share a set of values, norms, and perspectives that apply to, but extend beyond, work related matters; and whose social relationships meld the realms of work and leisure" [30, p. 295].

Occupational communities are not necessarily collocated [30]. Using this perspective enables researchers to study occupations with globally disbursed members as organizational subcultures [29] each with their own unique sets of beliefs, values, and norms in addition to those shared by the occupational community. In this paper we characterize the free/open source development

community as an occupational community with occupational subcommunities or subcultures [26, 29] forming within each free/open source project. Occupational subcultures then share beliefs, values and norms from the free/open source occupational community and develop some that are unique to a particular subculture.

Researchers have previously characterized IT professionals as members of an occupational community [12, 26]. Gregory [12] characterized software developers working in Silicon Valley as sharing the same occupational subculture, no matter which organization they worked in, or what kind of work they did. Schein [26] described IT developers as an occupational community with a common base of knowledge, a common jargon, similar background and training, and a sense of identifying with each other. Occupational communities typically grow up around new technologies and the characteristics of the IT itself, computer hardware and software design require certain kinds of people with certain kinds of skills and cognitive styles [26]. He suggested that as IT becomes differentiated, more variations in the styles of IT community members would occur with subcommunities springing up with their own subcultures. In this paper, we characterize the GNUe as an occupational subculture within the occupational community of free software developers. A detailed account of occupational communities and the dimensions as applied to the open source world will be outlined later in this paper.

In order to study the culture of an occupational community, an organizational culture perspective is needed. Using this perspective, a community's beliefs, values, and norms are studied looking for manifestations of those beliefs in the work of the organization [18]. Studies combining the organizational culture perspective with IT are rare.

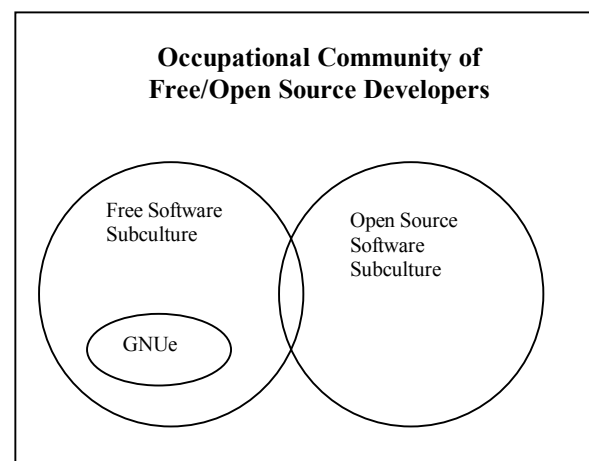


Figure 1. Occupational Community Conceptualization

Researchers have theorized that an organizational cultural perspective would provide insight into IT development and use, but few have applied this to the workplace itself.

Some researchers have depicted the culture of IT developers [26] as creating a cultural divide between how IT developers view design and use of IT systems, and how users perceive and use them in reality. Elliott [6] applied an organizational culture perspective to the occupational community of lawyers and judges in the criminal courts to show how the use of IT changed the work culture and how the work culture influenced the use of IT in the courts. Dubé and Robey [3] studied a software development company's management practices through a three-perspective cultural lens [18] and concluded that the cultural foundation of management practices are important to understand in software development projects.

4. RESEARCH METHODS

The data presented here is part of an ongoing study using the grounded theory approach [11]. The sources of data include books and articles on OSS development, instant messaging [15] transcripts captured through IRC logs, threaded email discussion messages, and other Web-based artifacts associated with GNUe. The data we present below is publicly available on the Web.

We present the GNUe world as an occupational subculture [18, 26] of the occupational community of free/open source developers with shared values and beliefs. We show how the beliefs in free software and freedom of choice, and the values of cooperative work and community are manifested in software development methods, artifacts, and tool choice, as well as how dispersed developers cooperate and resolve conflict in a virtual community. Data collection includes the content analysis of public IRC message archives; summary digests of IRC and mailing list messages (kernel cousin archives); mailing list archives; email interviews; Web site documents and observations; and personal interviews conducted at two open source conferences. One case from IRC and mailing list archives of the GNUe virtual community at work is presented for closer study: a newcomer who criticizes the choice of a non-free graphics tool to create a graphic diagram of the GNUe system architecture that is posted on the Web site which causes a debate over an appropriate tool choice for FSD. The beliefs, values and norms identified in this study are briefly discussed below. For more details and for presentation of another case study, see [8].

Our repeated review, analysis, and coding of the data in our study gave rise to the following coding variables that we use to identify and characterise the trajectory of socially constructed events, situations, values, and circumstances at hand.

Beliefs – Express cause and effect relations (i.e. behaviors lead to outcomes).

Belief in Free Software – Belief in freedom to distribute copies of free source code.

Belief in Freedom of Choice – Belief in freedom of choice in assignments and in selecting tool of choice in developing free software.

Values – Express preferences for certain behaviors or for certain outcomes.

Value in Cooperative Work – GNUe contributors show the importance of this value in the way they strive to cooperate and resolve conflicts in a virtual community.

Value in Community – GNUe contributors work as a team and despite their lack of face-to-face contact, they meet regularly online to discuss technology and personal issues.

Norms – Express which behaviors are expected by others and are culturally acceptable ways to attain outcomes.

Open Disclosure – Open content of GNUe Website including source code, documentation and archived records of IRC, kernel cousins, and mailing list archives.

Immediate Acceptance of Outsider Reviews – Outsiders are welcome to join GNUe daily IRC at any time.

Informal Management – No lead organization or prime contractor, emergent form of an organization with meritocracy instead of managers as norm for decision making.

5. CASE STUDY: CONFLICT AND DEBATE OVER USE OF NON-FREE GRAPHICS TOOL

This case study reveals a trajectory of a conflict and debate over the use of a non-free tool to create a graphic diagram that is posted on the GNUe Web site. This exchange takes place one day on the IRC channel and ends the next morning. This example illustrates the ease with which a newcomer comes onboard this FSD project and then criticizes the methods used to produce a graphical representation of the system architecture on the GNUe Web site. Table 4 displays the total number of contributors and the number of days of the conflict. Eight of the nine regular GNUe contributors were software developers and one was working on documentation. The infrequent contributors drifted on and off throughout the day – sometimes lurking

Table 4 – Contributors and Duration of Conflict in Case One

Total Contr-	Regular Contributors	Infrequent Contributors	Number of Days
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ibutors			
17	9	8	1

and other times involved in the discussion.

The **strong belief in free software** of the outsider leads to conflict among those insiders who have a moderate view of the use of free software for GNUe software development. A daylong debate ensues among Neilt, creator of the graphic; CyrilB, the outsider; and other GNUe contributors regarding the use of a non-free software tool to create a graphic for a GNUe screenshot for Website documentation. This first excerpt shows how **CyrilB** gets on the IRC and expresses his concern for the “shocking” use of a non-free tool on a free software project¹:

<CyrilB> Hello
 <CyrilB> Several images on the GNUe website seems to be made with non-free Adobe softwares, I hope I'm wrong: it is quite shocking. Does anybody now more on the subject ?
 <CyrilB> lynx -source
http://www.GNUe/modules/NS-My_eGallery/gallery/GNUe/GNUePkgArchitecture.png | strings | head
 <CyrilB> We should avoid using non-free software at all cost, am I wrong ? (**Strong belief in free software (BIFS)**)
 <CyrilB> Anyone awake in here ?

Reinhard, a core maintainer, arrives and points out to **CyrilB** that the main goal of the project is to produce good free software and *how* it is produced is not a main concern. In this next passage, Reinhard explains his moderate view of the belief in free software and surprisingly, he accepts the criticism of **CyrilB** (note the **Immediate acceptance of outsider passage**) engaging him in conversation to explain the reason for allowing such work on a GNU free software project:

<reinhard> CyrilB: our main goal is to produce good free software (**Moderate BIFS**)
 <reinhard> we accept contributions without regarding what tools were used to do the work
 <reinhard> especially we accept documentation in nearly any form we can get because we are desperate for documentation just like any other gnu project. just as long as the format itself isn't proprietary, and it can be viewed without proprietary programs, anything is ok for us.
 <reinhard> at least that is my understanding (**Moderate BIFS**)
 <Maniac> reinhard: good point of view
 <reinhard> but if you want to redo those pictures in dia (or

whatever) we will _gladly_ take it

<reinhard> the contributor was not familiar with dia at all and felt that he would be more productive when he used his adobe which he is used to because he used it before and we were ok with that
 <reinhard> well i think "contributor" is a bit of an understatement for neilt

<reinhard> please s/contributor/core team member/ :)

<CyrilB> I understand your point of view but if you accept contributions that can be viewed with free softwares, you also have to be able to modify the contributions.

<CyrilB> What if we need to add a component to this graphic ? Even ASCII art graphic would be better.

<reinhard> CyrilB: isn't png viewable with free software?

<CyrilB> reinhard: png is viewable with free software, you are right.

<CyrilB> You can consider this PNG as a binary distrubution of the contrib, not the source code.

<CyrilB> We NEED to be able to modify the code.

<reinhard> so we need someone that can do the graphic in dia?

<CyrilB> And we can't modify adobe files with free softwares.

<reinhard> so we need someone that can do the graphic in dia?

CyrilB emphasizes the need for free software again. **Reinhard** agrees in principle but wants an interim solution on a practical level.

<CyrilB> We need people do be able to use free softwares.

(**Strong BIFS** And produce free documents.

<reinhard> ok (**Immediate acceptance of outsider**

<reinhard> you know someone who would want to do this graphic

<reinhard> as well as maintain it for adding new modules etc over the next few years?

<reinhard> i think we have to seek such a person. till we found it i think we can live with what we have now as an intermediate solution

<CyrilB> If this solution is considered as an intermediate solution, it is ok for me. (**Strong BIFS**)

After several interchanges with **CyrilB**, **Reinhard** recalls from **CyrilB**'s name that he is a regular participant in the fsfeurope (Free Software Foundation in Europe). As such, he asks **CyrilB** for any other comments that he may have on GNUe.

<reinhard> any other comments on gnue? iirc i saw you a few times in #fsfeurope

<reinhard> but never here on #gnuentier

<CyrilB> This is the first time for me in #gnuentierprise.

Immediate acceptance of outsider)

<CyrilB> Did the author of this graphic understood that this file has to be freed ?

<CyrilB> If think that if he is able to produce this kind of graphics

¹ The IRC excerpts are presented verbatim with extraneous text eliminated for clarity. They are in a different font than regular text. The codes are shown in parentheses in italics bold type.

with non-free softwares, he can easily do the same with free softwares.

<reinhard> from what i know about the author i think he is aware of the issue but he works on mac mostly and afaik not so much free software is available for mac

<CyrilB> This discussion is interesting and I have to talk much with you later but I have to go outside now.

<CyrilB> See you later.

Action:² CyrilB is away

Eventually, **Neilt**, the original creator of the GNUe diagram (using Adobe Photoshop), joins the IRC, reviews the previous discussion on the archived IRC, and returns to discuss the issue with **Reinhard** and **CyrilB**. A lively argument ensues between **Neilt** and others contributing suggestions for the use of free tools to develop the Adobe graphic. This excerpt illustrates **the values in community and cooperative work** when GNUe contributors work together as a community to resolve the issue in a cooperative manner.

<reinhard> hello **neilt**. i just had a discussion about the graphics you did for the homepage (*Value in community and cooperative work*)

<reinhard> i hope what i said is ok for you

<neilt> hello

Action: **neilt** goes to look at log

<neilt> **reinhard**: it would be nice if we had free software that would do nice diagrams. it does not exist

<reinhard> IIRC i have never made such a diagram in my entire life neither with proprietary nor with free software :)

<reinhard> so i can't tell but i can imagine very well you're right :)

<neilt> you do know that my graphics are the most viewed screenshots on the web site :)

<neilt> and it was not me sitting here hitting the reload button :)

<reinhard> lol

<neilt> i think i missed the point

<neilt> what is the problem with the graphics

<reinhard> his point was that only you have the "source" and only you can change the graphic

<reinhard> if i understand him correctly

<reinhard> as you are probably the only one among us that has this adobe software

<neilt> any program that reads png which is a standard format can edit the graphic

<neilt> if you can suggest another format, derek said this was the preferred for graphics, then I will convert to a better format

<reinhard> i think his point is that usually you create such a graphic with a vector drawing tool

<reinhard> however this is somewhat "silent post"

<neilt> png is a vector format graphic, so all vector information is in the version on the web

<reinhard> i thought png is a pixle graphic format

<reinhard> but i can be wrong i'm not sure at all

<neilt> portable network graphic

<neilt> <http://www.libpng.org/pub/png/>

CyrilB returns and suggests the use of the xfig tool. **CyrilB** and **Neilt** have an exchange about beliefs regarding free versus non-free software. **Neilt** finally agrees to change the graphic recreating it using "free" software if there is an alternative. However, he also points out that his freedom of choice is being rescinded by this strict adherence to the use of free software to develop GNUe.

Action: **CyrilB** is back (gone 00:00:01)

<CyrilB> I'm back.

<reinhard> wb. please read the logs. the author of the drawings was here meanwhile

<CyrilB> I've read the logs. Did the author left ? (yes) 2 hours ago

<reinhard> yes he left. but i think he got your point

<CyrilB> The point is not vector drawing or pixel drawing, as you say I don't deal with non asciifiles. (*Strong BIFS*)

<CyrilB> The point is free software VS non-free software.

<reinhard> oh

<CyrilB> **neilt**: welcome back.

<reinhard> **neilt**: you have a watchdog or something like that?

<neilt> yep :)

<CyrilB> <neilt> **reinhard**: it would be nice if we had free software that would do nice diagrams (...) it does not exist

In the next interchange, we see that **neilt** is willing to accept a suggestion from **CyrilB**, the newcomer illustrating the **immediate acceptance of a newcomer**.

<neilt> **CyrilB**: what do you suggest (*immediate acceptance of newcomer*)

<CyrilB> **neilt**: friends of mine are using dia and xfig for this kind of graphics.

<neilt> dia ****

<reinhard> i can second that

<neilt> what is xfig

<reinhard> dia can't even display the same font on screen as it does when printing out

<CyrilB> **neilt**: dia **** less than adobe non-free softwares

<CyrilB> **neilt**: but dia ****, you are right

<neilt> **CyrilB**: i am sorry, but i am not a biggot about software

<CyrilB> <http://freshmeat.net/projects/xfig/>

<neilt> my time is valuable. anything that wastes my time is not good, free or not

² The term Action: is used occasionally by contributors to signify a physical movement of some sort often in humorous terms, or to bring attention to a statement.

<CyrilB> What is 'biggot' ?
 <neilt> biased
 <CyrilB> neilt: I don't agree at all, we should use free software at all costs. **Strong BIFS)**
 <reinhard> CyrilB: no i don't agree here. we should develop good free software at all costs (**Moderate BIFS**)
 <CyrilB> reinhard: using non-free software _do not_ 'develop good free software'.
 <reinhard> it can
 <CyrilB> and promoting them is really a shame.
 <CyrilB> reinhard: not in this case. **Moderate BIFS)**

Neilt installs xfig in realtime:

Action: neilt does install xfig
 <neilt> installing now
 <reinhard> i don't see that this is promoting
 <reinhard> a "normal user" doesn't see where this png comes from
 <reinhard> afaik
 <CyrilB> reinhard: neilt just said Adobe non-free software make him avoid losing time.
 <CyrilB> reinhard: and free software DO make him lose time
 <neilt> CyrilB: i agree to goal GNUe, that is to use free software for stuff in cvs
 Action: CyrilB is shocked (**Immediate acceptance of newcomer**)
 <neilt> so if there is a free software alternative, i will support that (**Debate reinforces beliefs**)

During the debate, the **beliefs in free software and freedom of choice** are reinforced by the persistent recordation of the arguments. Through real-time testing and team discussion of free tool alternatives, the conflict is resolved. However, Neilt expresses his displeasure in restricting his **belief in freedom of choice**.

<CyrilB> neilt: I've used xfig a couple of times, I can help you.
 <neilt> i did not know xfig existed. i am installing now. i'll let you know how it works.
 <neilt> otoh i see no reason to avoid non-free software either (**Belief in Freedom of Choice (BIFC)**)
 <neilt> if this is really a freedom thing then we should be free to use whatever we want
 psu (psu@manorcon.demon.co.uk) joined #gnuenterpise.
 <ajmitch> hi psu
 <reinhard> neilt: i agree. neilt: as long as we don't take away freedom from others
 <neilt> in your case you are saying it's not about freedom i guess, it's about using what the free software movement tells you to use. that is just another form of bias
 <psu> hi aj
 <reinhard> i think it's ok if i use vi, emacs or even windows notepad to write my source code

<ajmitch> psu: seems you've walked into a free vs non-free debate again :)
 <reinhard> but if i used winword and stored as .doc i would take away freedom from those wanting to read the text
 <neilt> again. only because i am being told that using non-free software is bad :(
 <neilt> i wish we could just leave the opinions about free vs non-free out (**BIFC**)
 <reinhard> the main point is that we want to achieve something
 <reinhard> a very ambitious goal actually in this project and everyone tries his best to reach that goal
 <reinhard> and we make compromises if it helps the overall goal
 <reinhard> anyway. gotta get me some sleep. night all

While Neilt questions the credentials of CyrilB who is causing him to redo a trivial diagram, another contributor makes a suggestion to use dia, a free graphics tool, after testing it using Neilt's diagram. This is an example of how the norms of **open disclosure** and **informal management** enable the real-time testing and discussion of solutions that promote the community spirit that ties the GNUe developers together. In order to preserve the "free" nature of GNUe, all work together to find a solution.

<CyrilB> neilt: you are compromising our freedom by using non-free software: we can't modify and/or redistribute the source vector file. (**Strong View BIFS**)

...
 <neilt> CyrilB: what do you do professionally?
 <CyrilB> neilt: sysadmin in a european isp
 <neilt> CyrilB: cool, thanks

More people get involved now and discuss the technical details of which format and tool to use. Finally, CyrilB exits and apologizes for any offensive behavior:

<CyrilB> neilt: excuse me if I said stupid things.
 <neilt> CyrilB: no problem, i don't take things badly
 <CyrilB> neilt: do not hesitate to contact me if you have any questions with xfig: cyb@gnu.org
 <neilt> i just feel free to express myself
 <neilt> as everyone else should
 <neilt> CyrilB: thank you

The issue ends with a clarification by derek (a core maintainer) that contributors can use any tools necessary to create free software even if some are non-free tools. In addition, he indicates to CyrilB that if the graphical object were part of the free software product, GNUe (not for a graphical diagram intended for documentation), then he would be more concerned. The discussion ends with reinhard reminding everyone that the issue is resolved

(with **neilt** agreeing to redo it at a future date with free software).

6. DISCUSSION

Our analysis of this case study and related data reveals how the beliefs and values of the GNUe occupational subculture are manifested in conflict mitigation and resolution. Van Maanen and Barley [30] identify occupational communities using four dimensions: boundaries, social identity, reference group, and social relations. Each of these dimensions is discussed below with particular references to the GNUe occupational subculture.

6.1 Boundaries

Van Maanen and Barley [30] discuss how it is misleading to use co-habitation of territory or similar backgrounds as the basis of defining a community. More important are the social limits of the bonds and situational factors that delimit or enable the common identity. They use the term “consciousness of kind” [13] to describe a fundamental basis for a community. The term refers to a system of accounts used by members and observers to explain or justify a member’s behavior. Hence, an occupational community is composed of people who consider themselves to be members of the same occupation, and who may or may not be collocated.

Free/open source developers have unique and esoteric skills and ways of doing software development that differ from a proprietary in-house arrangement [20]. The boundaries of the free/open source community, in general, and GNUe, in particular, fluctuate constantly as new software developers contribute new code, suggest design changes, and fix bugs. High-speed networks enable the worldwide discussion of software development on live chat-lines, email, or mailing lists. For example, the GNUe project includes core software developers from the United States, New Zealand, Estonia, and the United Kingdom. “Meetings” occur over the Internet spontaneously or as planned. Often these developers view themselves as different from the rest of society and call themselves “geeks” [20]. Thus, the free/open source occupational community of software developers has a fluid boundary not necessarily collocated and they share a sense of accountability for developing and exchanging reliable software. In fact, one of the priorities in the “geek” culture is truth in dealings with each other [20].

The **strong belief in free software**, espoused by **CyrilB**, and the immediate action taken by GNUe developers in response to his criticism reflect this sense of accountability within the community. The **belief in free software** and **belief in freedom of choice** serve to define the boundaries

of the occupational community. This assumed system of accounts ties the community together in their efforts to resolve conflict.

6.2 Social Identity

Members of an occupational community derive valued identities or self-images directly from their occupational roles. Members of an occupational community have social selves that are constructed and reconstructed in daily interaction with others as people learn to view themselves from the point of view of others [30]. People present occupational identities to others “with some pride and are not identities easily discarded for they are central to an individual’s self-image [30].” Occupational identities can be fostered by 1) high involvement in the work itself; 2) members possessing certain esoteric, scarce, socially valued, and unique abilities; or 3) claimed responsibilities for others (e.g. firefighters). Technological innovation in some settings may generate occupational communities whose members possess new forms of esoteric skill [30].

Free/open source developers possess esoteric, specialized skills in such languages as HTML, Perl, XML and Java. Within their occupational community, their skills are valued and revered such as the “famous” programmer Linux who released the famed open source operating system called Linux. GNUe software developers require esoteric programming skills to contribute to the ongoing development of their ERP system. Free/open source developers may also be motivated by a sense of community identification treating other members as kin [14]. Several GNUe developers mentioned the concept of “giving back to the community” when discussing motivations for working on the GNUe project.

6.3 Reference Group

To maintain a social identity, support and confirmation from others is required. Van Maanen and Barley [30] describe how in occupational communities,

“...members take other members as a primary reference group who share a distinct pattern of values, beliefs, norms, and interpretations for judging the appropriateness of one another’s actions and reactions...To say an occupational community provides members with a value system is to say that members make use of a collective perspective in everyday matters, that they evaluate themselves in its light, and that such a perspective carries over to matters falling outside the realm of work itself.”[30, p. 303].

One of the conditions favoring adoption of shared occupational values is when an occupation penetrates multiple aspects of a person's life. Free/open source developers tend to surround themselves with computers - either working in an open source project around the clock (at work and at home or just at home), or working in a business requiring computer use during the day and developing open source systems at night when arriving home. GNUe contributors "meet" online during various times of the day depending on availability and coordination of time zone differences. The previous section detailed how the GNUe's social identity is closely associated with the **beliefs in free software and freedom of choice** and the **value in cooperative work and community**.

6.4 Social Relations

The fourth dimension of occupational communities is the melding of work and leisure activities [30]. This blurring of the distinction between work and leisure activities may be the result of leisure associated with work or extensive overlap in work and social relationships. Several conditions encourage this connection including but not limited to: where an occupation restricts members' social relations such as shift work or night work; or occupational intrusion into all aspects of life. In the "geek" culture, social relationships often center on Internet-based connections made by mutual code sharing, software development, and the like. In addition on projects such as GNUe, contributors gather online during off-hours when people from around the world in different time zones must meet to resolve software development problems. Often GNUe chat lines include social interactions, inside jokes, and references to personal anecdotes.

7. CONCLUSIONS

We have shown how the community spirit of the occupational subculture in the form of collective beliefs, values, and norms of the GNUe project fosters collaboration and resolution of conflict that emerge within the group of GNUe contributors during software development in a virtual community. Results have implications for software developers and managers planning to initiate open source projects with similar global temporal collocation and virtual communication characteristics. The two main conclusions from the research follow, though others may be found elsewhere [8]:

1) Text-based CSCW systems and related artifacts in the form of IRC instant messaging streams, persistent IRC logs, digests (kernel cousins), and mailing lists enhances management and resolution of conflict in a virtual work community.

Results from this study indicate that when someone like a newcomer or frequent contributor generates a debate on the use of free versus non-free software for GNUe development, the articulation of strong (somewhat polarized) views of free software strengthens the community. Anyone can come onboard in the middle of a debate, review the previous day(s) worth of IRC messages and/or mail list postings, and fairly quickly come up to speed on the issues. This fast access to archived information perpetuates the cultural beliefs that have been articulated and assists in the management and resolution of the conflict.

2) Strong organizational cultural beliefs in a virtual community tie a group together so that conflict is more easily managed and resolved.

The beliefs in freedom, free software, and freedom of choice create a special bond for the people working on free software projects. These beliefs foster the values of cooperative work and community building. Schein's (1985) theory of organizational culture includes the revelation of underlying assumptions of cultural members that are on a mostly unconscious level. In the GNUe world, the underlying assumptions of cooperative work and community building become engrained in the everyday work practices in their pursuit of an ERP system implemented as free software. These beliefs and values enhance and motivate management and resolution of conflict despite the distance separation and amorphous state of the contributor population.

This research indicates the importance of recorded logs of instant messages for resolving conflicts in virtual work communities. The use of persistent recordation of IRC and mailing list archives serves to tie the GNUe virtual work group together, contributing to conflict management and, at the same time, reinforcing the beliefs in free software and freedom of choice, and the more tacit values of cooperative work and community building. Managers of open source projects who are cognizant of the "geek" culture [20] are better equipped to manage OSSD.

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