A Biography of Open Source Software: Community Participation and Individuation of Open Source Code in the Context of Microfinance NGOs in North Africa and the Middle East

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Declaration

I declare that my thesis consists of 74,000 words approx.

Abstract

For many, microfinance is about building inclusive financial systems to help the poor gain direct access to financial services. Hundreds of grassroots have specialised in the provision of microfinance services worldwide. Most of them are adhoc organisations, which suffer severe organisational and informational deficiencies. Over the past decades, policy makers and consortia of microfinance experts have attempted to improve their capacity building through ICTs. In particular, there is strong emphasis on open source software (OSS) initiatives, as it is commonly believed that MFIs are uniquely positioned to benefit from the advantages of openness and free access. Furthermore, OSS approaches have recently become extremely popular. The OSS gurus are convinced there is a business case for a purely open source approach, especially across international development spheres.

Nonetheless, getting people to agree on what is meant by OSS remains hard to achieve. On the one hand scholarly software research shows a lack of consensus and documents stories in which the OSS meaning is negotiated locally. On the other, the growing literature on ICT-for-international development does not provide answers as research, especially in the microfinance context, presents little empirical scrutiny. This thesis therefore critically explores the OSS in the microfinance context in order to understand its long-term development and what might be some of the implications for MFIs.

Theoretically I draw on the 3rd wave of research within the field of Science and Technology Studies –studies of Expertise and Experience (SEE). I couple the software ‘biography’ approach (Pollock and Williams 2009) with concepts from Simondon’s thesis on the individuation of technical beings (1958) as an integrated framework. I also design a single case study, which is supported by an extensive and longitudinal collection of data and a three-stage approach, including the analysis of sociograms, and email content. This case provides a rich empirical setting that challenges the current understanding of the ontology of software and goes beyond the instrumental views of design, building a comprehensive framework for community participation and software sustainability in the context of the microfinance global industry.

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List of Abbreviations

- CMC: Computer Mediated Communication
- GF: Grameen Foundation
- GF-Tech: Grameen Foundation Technology Center
- MENA: Middle East and North Africa
- IS: Information Systems
- IT-4-D: Information Technology for Development
- MLs: Mailing Lists
- MFIs: Microfinance Institutions
- Mifos: Open Source for Microfinance Institutions
- OSS: Open Source Software
- SE: Software Engineering
- STS: Science and Technology Studies
- SDS: Software Design Studies
- SNA: Social Network Analysis
- SST: Social shaping of Technology
- OSS-4-MFIs: Open Source Software for Microfinance Institutions

Table of Content

List of Figures

List of Tables

1. Introductory Chapter

1.1. Introduction

Muhammed Yunus, the founder of the Grameen Bank in Bangladesh and Nobel Prize laureate pioneered microcredit. As the father figure of the microfinance movement, he was invited to hundreds of public talks, and visited many universities, public institutions and corporate companies. Every time, he tirelessly would explain how access to capital, even on a tiny scale, can have a transformational effect on people (Yunus 2007). He would exemplify how thousands of poor people all over the world use the small stake that a microloan provides as the basis for building a tiny farm, a craft workshop, or a little store that can lift them out of poverty (Ibid). The lack of collaterals and steady employment stands against impoverished people's chances to get access to credit; thus a microloan is indeed a token representing the right of the unbanked to have access to credit and a tool that can improve their livelihood (Helms 2006).

In many ways I believe that there is a striking parallel between microfinance and open source software. Richard Stallman is a well-known outspoken political campaigner who writes about software freedom and defends the rights of users to run, modify and redistribute their software with or without changes (Williams 2002). He and many others from the open source movement see open code as a token that stands for users' freedom of speech and expression; a proxy of the hacker ethics (Coleman and Golub 2008), protecting user innovation and democratising access to information (Von Hippel 2005a). On this basis, I believe that both, Muhammed Yunus and Richard Stallman are active militants, who fight for the freedom of people, as their right to develop and extend their capabilities (Sen 1999).

Microfinance and Open Code have also in common that they were both treated as progenies of the gift economy (Cheal 1988, 9–15; Benkler 2006, 92) – being types of social structures that are based on regular gift giving/receiving with no necessary immediate return. For example, microfinance institutions (MFIs) are confused with charities, as they replace tangible collaterals by mechanisms of social solidarity and peer monitoring[1] (Armendariz and Morduch 2005). The connection between microfinance and the gift economy can also be seen in these overarching pictures below. The first one is a 'representation' of the gift economy found when searching Google (see Figure 1). It is a watercolour by James G. Swan depicting the Klallam people of Chief Chetzemoka at Port Townsend, with one of Chetzemoka's wives distributing potlatch. When I saw it, I found it strangely familiar; it reminded me of a picture in Grameen Foundation website[2]. The latter represents a major lending methodology in microfinance (village banking) showing local communities' commitment to be united in order to ensure their loan repayments (see Figure 2).

[1] Yet, MFIs protect themselves against non-repayment risk through neighbourhood relations, solidarity and local knowledge transfers.
[2] A Washington based NGO and a microfinance expert leading organisation, see:www.grameenfoundation.org

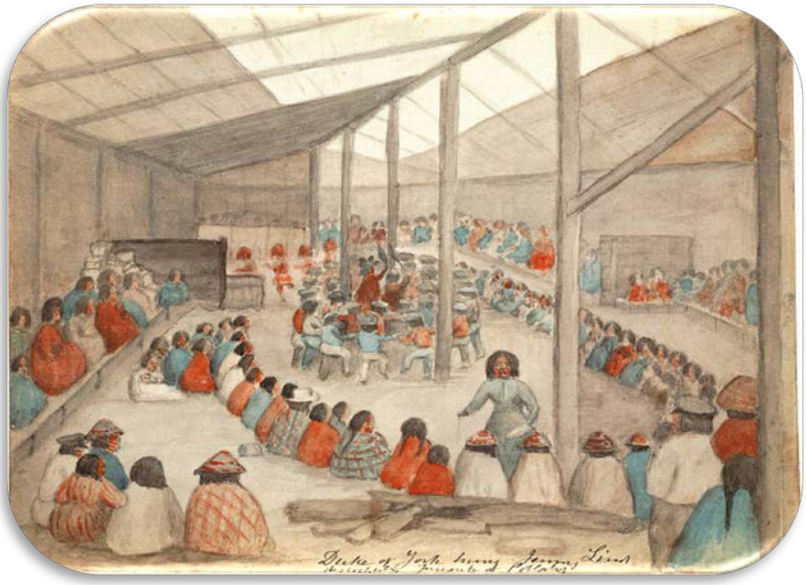

Figure 1
Source: **http://en.wikipedia.org/wiki/File:Klallam_people_at_Port_Townsend.jpg**

Figure 2
Source:**http://jazoon.com/Portals/0/Content/slides/th_a6_1630-1650_vorburger.pdf**

As for open source software (OSS), there are many instances where successful open code projects were provided as exemplars of the gift economy. In his book the Wealth of Networks, Benkler introduces Free/open-source software as an alternative mode of software production where thousands of volunteers come together to collaborate on complex economic projects (Benkler 2006, 59). Coleman also recounts how proponents of other concepts like the creative commons (Lessig 1999), open innovation (Chesbrough et al. 2006; Von Hippel 2005a) and other peer-production groups (Bollier 2008) were influenced by the free software movement and Richard Stallman (Coleman and Hill 2005). Thus, both microfinance and OSS are 'gifts' in popular imagery, where dedicated philanthropists and volunteers give time, labour and money for which they do not seek immediate return, but have high hopes for social reward.

However, the similarity between OSS and microfinance is that neither is a 'gift' in the sense of being a naturally altruistic model of wealth distribution. Such a utopian vision led some to believing that both microfinance and OSS were silver bullets; hence there are reasons for caution about unmet promises in the OSS movement, as well as in many microfinance programs all-over the world[3]. In fact microfinance seeks to reduce the poor's dependency on "charity" and gifts, by giving them access to a line of credit that supports their projects and help them achieve autonomous wealth generation (Mordruch 1999; Armendariz and Morduch 2000; Lascelles 2008; Cons and Paprocki 2008).

Although it is beyond the scope of this thesis to demonstrate the stakes and implications of microfinance on the poor, it should demonstrate that OSS is not merely about free code. Rather, it argues that OSS for microfinance in particular, triggers a strong interplay between all sorts of participants that can potentially lead to knowledge creation, and to extending participants' capabilities more generally. It also sees OSS as a participatory software development approach that has potential to recreate new economic and social opportunities for leveraging code development over time[4].

Accordingly, this thesis is interested in investigating the organising of OSS development in the context of microfinance NGOs (MFIs). It looks more particularly at the Middle East and North Africa (MENA), as a majority of the region's microfinance providers are ad hoc NGOs which have scarce resources and can in principle, hugely benefit from participating in the development of OSS. This thesis therefore asks what are the stakes and implications of producing, using and maintaining OSS for microfinance NGOs. It suggests looking at how OSS develops over time and space and how local agents – MFIs and their local IT intermediaries in particular - participate in the source code design and its long-term development.

Yet, before moving to the thesis' outline and to the rest of the chapters, I reserve the remainder of this introductory chapter to provide a brief overview of microfinance in the MENA region, some of the challenges that face MFIs at the organisational and informational levels and restate my research motivation and questions. The intention is to articulate further the research aim that I mention here briefly. In light of the idiosyncrasies of the microfinance context, I should thus explain that the motivation to look at the organising and practices of OSS long-term development touches the very fabric of how MFIs' activity is organised and the dynamic of community participation. By so doing, I should also account of the current status of research and practice in microfinance, ICTs and OSS.

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[3] See (Mordruch 2000; Dichter and Harper 2007)in the case of microfinance. In the case of open source, there is a schism between proponents of the Free software movement and those of the Open Source Software; For example the OSS terminology was explicitly used to depoliticise Open Source Software and introduce it as a different software production approach part of the mainstream software industry where it is today mostly practiced (Fitzgerald 2006).

[4]See chapter II Conceptual Framework.

1.2. Context and Motivation of the Research

1.2.1. MFIs in MENA: A Brief Overview

Microfinance institutions (MFIs) align on a spectrum from formal to informal depending on the sophistication of their organisational structure, and the degree of oversight by governments (Bluebook 2006). They can be for examples, money lenders, community savings clubs, self-help groups, deposit collectors, credit unions, NGOs, etc. In the MENA region, there are only microfinance NGOs and non-profit financial companies[5]. These are instrumental to the concretisation of policy makers' objectives, as they embody partnerships between local grassroots and international aid. Similarly partnerships enable MFIs in MENA to get funding and develop their social activities locally[6].

Source: Helms 2006

Figure 3

Outflows of financial support do not necessarily transit from donors to MFIs directly. Funding applications are often channelled through a second layer of Northern NGOs which are called microfinance experts, like CGAP, Grameen Foundation etc.[7] They provide technical expertise to MFIs through regional delegates and are in charge of monitoring the health and growth of 'the microfinance industry' in the region. Often they diffuse 'best practices', typically acting as standardisation bodies – see Figure 3 below.

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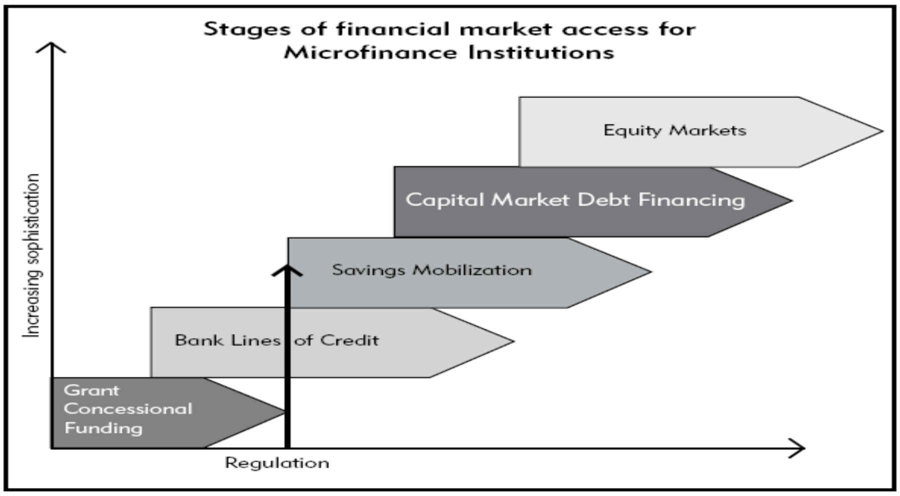
[5]MFIs in MENA deliver mostly microcredit, as legal and political constraints prevent them from collecting savings or delivering micro-insurance products.

[6]Sometimes, governments also subsidise MFIs through national programs – The case of Morocco.

[7] The Consultative Group to Assist the Poor (CGAP) is a World Bank proxy and a microfinance specialist in the MENA region. See http://cgap.org/portal/site/technology/research/publications/

As MFIs' mission is to eradicate poverty through the delivery of microcredit, the common sense appeal for scaling up their outreach is justified by the argument that NGOs capable of alleviating poverty have a moral obligation to help as many poor people as they can (Edwards & Hulme 1992, p.19). Yet, MFIs partners and donors at the meso and macro levels (Figure 3) have put extreme pressure on MFIs to maximise their economies of scale, making scale an ultimatum that goes beyond the charitable desire of helping the poor (Dichter and Harper 2007; Dichter 2007).

Accessing financial markets: Progressive stages for MFIs



Source **WWB, 2004, p.1**

Figure 4

Indeed microfinance is deeply rooted in canonical Development Economics,[8] and the Democratisation of Finance[9] (Stiglitz 1998; Meier & Stiglitz 2000; Stiglitz 2006b, p.28; Stiglitz 2006a; Mishkin 2007, p.4). From this perspective it is a global 'anti-poverty strategy' (Armendariz and Morduch 2005) and an instrument of credit democratisation (Pozuelo-Monfort 2007), which should grow in the future to be an extension of the banking industry (Bluebook 2006; Helms 2006). Then, MFIs are seen as 'socio-financial bridges' that exemplify the ethos of the market economy (Ray 2007; Barr 2005; Aghion and Armendariz 2002); hence they should not remain dependent on donors and state subsidies. On the contrary they are expected to stand against 'development as charity' (Mordruch 2000; Bluebook 2006; Helms 2006; Pozuelo-Monfort 2007) by becoming themselves financially sustainable, and acting as professional financial institutions under the oversight of national and international regulatory bodies – see Figure 4. This way, they can themselves tap into commercial sources to create capital – once they maximise their outreach (Johnson, Doyle, and Emrul 2000, 121).

[8] It is associated with Local-Community-Development and the idea that communities can contribute along with markets, governments and individuals to the success of economic growth (Stiglitz 2006a: 51).
[9] Ertuk et al. (2005) define finance democratisation as the "broadening and deepening of access to the capital market for ordinary, moderate income individuals and households."

1.2.2. The Limits of Scale

Jonathan Mordruch (1999) has termed the trade-off between MFIs' financial sustainability (scale) and social impact, the 'win-win' promise of microfinance. There is undoubtedly a note of sarcasm in the author's voice, as it is difficult to see how MFIs can still nurture a social impact locally if they do not dedicate resources to accompany borrowers, support their microenterprises, and implement systems of social monitoring and comprehensive welfare measurements. In fact, large-scale NGOs are seldom financially sustainable. Their services are often customised and the costs of their individual products are high – meaning they cannot mitigate administration costs (Cameron 2000, 51–63). Yet, MFIs are again believed to be different from welfare NGOs, because their activity is similar to banks' (Ibid) – in that MFIs' transactions are standard and distributed according to categories uniformly predefined.

I though argue that if MFIs are to have a social impact on local communities, they cannot avoid partially behaving like welfare NGOs; so scaling up should necessarily affect their organisations and increase overall service costs. Indeed, studies show that MFIs which are financially successful, while remaining socially committed are rare and their impact limited (Fernando 2006; Dichter and Harper 2007; Lascelles 2008). Also donors and experts' excessive pressure about scale and financial returns threatens MFIs' accountability. In MENA – as well as in other parts of the world - MFIs' mission has become increasingly blurred (Bhatt & Tang 2001; Copestake 2007; Cull et al. 2006; Demirgüç-Kunt et al. 2008; Dichter & Harper 2007; Fernando 2006). Many among the local MFIs that I visited[10] know that their survival should not be sought within the development arena; so they try to maximise their loan assets by delivering a few standard credits[11], and dedicating few resources to monitoring beneficiaries' welfare. More importantly, the repercussions of such a situation have snowballed at the organisational level. Many MFIs in MENA grew considerably in very short periods under the pressure of their partners. As a result, their organisations and information systems (IS) have suffered from not being able to plan change ahead of time.

The next section articulates the relation between scaling up outreach and MFIs' IS. It argues that growth affects information management and causes unexpected organisational changes. Ambivalent about their priorities and their social calling, MFIs cannot anticipate and decide what they expect their information systems to achieve. Increasing technological investments should furthermore exacerbate the opacity of their systems – especially if they are to be approached unwarily. Based on that, this section concludes that it is necessary to examine how MFIs can **take a participatory role** in the long-term development of their information systems in order to stay in control of their activity and mission.

[10] See Appendix I

[11] Such a situation had noticeable side effects on repayment risk and threatens to put in jeopardy the very fabric of the microfinance and financial sectors notably in Morocco (CGAP 2008).

1.2.3. MFIs, Information and Accountability

Edwards and Hulme (1992) argue that NGOs typically grow three ways (Hodson 1992, 13–14) – by addition, by multiplying and by diffusion. By addition means that NGOs grow as they increase the size of their operations and expand their outreach (Ibid). The authors add that NGOs can also grow by achieving a higher impact on the targeted beneficiaries (multiplication) – even though they say it is harder to measure. Finally, NGOs grow by diffusion when their growth is spontaneous, unorganised and follows a natural spread (Ibid). Based on that, one can qualify MFIs' growth in the MENA region as being additive and to some extent, also diffusive. First, it is additive as MFIs tend to maximise financial services delivery by multiplying branches and loan officers downstream, while administration and support activities lag behind. Then it becomes also diffusive, as demand (people) is attracted by the availability of credit, making MFIs' delivery increase in unpredictable ways.

In the case of NGOs and MFIs in particular, such a rapid and disorganised growth limits their flexibility of action, as they are subject to greater pressure from multiple stakeholders making various information demands upon them. Growth is indeed highly associated with stakes of information requirements and accountability (Powell and Friedkin 1986, 180–181); hence managing organisational change means in this case managing information and accountability (Espeland & Sauder 2007; Powell 2006; Newman 2004). For NGOs, information is a way to honour their partnerships with donors and other stakeholders (Davies 1997) – report how they use their resources, how transparent, efficient and prudent they are and how they can learn from experience (Edwards & Hulme 1996a, pp.10–11).

Yet, for MFIs, stakeholders are numerous; they range from international donors and partners to national and regulatory bodies, such as ministries, tax agencies, central banks, etc. For example, MFIs in Morocco must regularly make public audited records of their spending and turnover (loan outstanding portfolio) in order to prove to the national microcredit fund that they are financially self-sustainable (Brandsma and Burjorjee 2004; Mourji 2002; Reille and Lyman 2005). In Egypt and Jordan, many MFIs are accountable to the local authorities through general accounting procedures – in addition to their donors. Furthermore, MFIs' responsibility to provide timely information is also extended to banks legally once they get long-term loans and credit facilities. This means that they must conform to banks' reporting standards, and manage different ways to process information – which is indeed unique among NGOs[12].

Adding to that, MFIs are also reliant on information for internal purposes. No matter how small or parochial their activities are, their service delivery must be monitored through standards and bookkeeping procedures (Thompson 1967, pp.16–17). For

[12] Microfinance is a paradigm in which accountability and transparency are paramount. Whereas welfare NGOs are generally bound by their responsibility towards their beneficiaries, MFIs primarily account to banks, commercial investors as well as regulatory bodies.

example, most loan officers in MENA process clients' applications, perform credit checks and channel information to HQ for loan approvals and repayments – as registering and channelling daily information records are a condition *sine-qua-non* for isolating and reducing the risk of error, fraud and repayments defaults. Finally, MFIs in MENA collect rich data about their clients on a daily basis. For example loan approval forms include categories, such as clients' household indicators, social and professional situation, individual status, project social and economic sustainability, etc. It is expected that such 'social data' is processed and communicated to donors and partners, but MFIs efforts in this respect tend to be quite disparate and depend on the social responsibility of the MFI rather than norms and regulation.

In fact, MFIs process different types of packaged data for themselves and for a wide array of social partners and commercial stakeholders. Information presentation, meaning, legitimacy and effect are dependent on the way it is presented, and communicated – as varying ways of packaging information, rather than varying the information itself, communicates awareness and shows common concerns (Davies 1997). Hence, **MFIs pay in information cost the price of having nurtured multiple identities and being at the crossroad of several networks** (Powell 2006)**— in terms of organisational complexity and informational challenge.**

1.2.4. IT-4-MFIs: Current Challenges

Indeed, MFIs struggle to produce information with high frequency, quality, volumes, and accuracy; thus, their demand for software has increased, encouraged by the propensity of scholarship on the 'transformative' effects of ICTs. First, IT for development scholarship (IT4D) argues that IT is today indispensable for civil society, aid and development grassroots (Madon 2000; Powell 1999; Madon & Sahay 2002; Edwards 1994). Also, some reckon that IT can potentially improve NGOs transparency and professionalism (Heeks 2000; Lewis and Madon 2004).

Adopting a rather more assertive stance in favour of IT, microfinance scholars claim IT is positively associated with escalating volumes of financial transactions (Ivatury 2004; 2006; Mathison 2005). It is also said it reduces risk of fraud and probabilities of error (Campion 2001; Dailey 2005; Mathur & Ambani 2005; Parikh 2006) and lowers transaction costs of data processing in a timely manner (Waterfield 1999; Ivatury 2004; 2006). Finally IT is said to be highly efficient and easy to manage (King & Waterfield 1995; Ferrand & Havers 1999; Campion 2001; Ivatury 2004; Mathison 2005). Based on such high hopes, IT innovation spread –fuelled by a substantial influx of investment capital from donors and financial companies. An increasing number of microfinance experts have hosted initiatives with a heavy emphasis on IT; for instance CGAP Mobile Money, and the Grameen Village Banking programmes. These have a strong delivery focus while others like CGAP MixMarket[13] seek to harness the capabilities of web 2.0.

[13] MixMarket: http://www.mixmarket.org/

However, hype and the rhetoric of supply permeate and build on such exemplars of IT innovation[14]. Indeed, the general enchantment with the promises of a new technology can be high in its early stages; yet there is little evidence to challenge suppliers' claims (Pollock & Williams 2009, p.53). In this case microfinance experts have offered their partners (MFIs) the opportunity to be involved in new IT projects, and to get subsidised software packages (gifts), selected on the basis of sophisticated features and enhanced functional appeal; yet they misjudge the complexity of implementing such systems locally and do not account for what their long-term development entails globally – in terms of future customisation, maintenance and extra costs. So cases of IT project failures, software misuse or rejection are common in the MENA region[15].

From this perspective, microfinance experts unwarily turn IT into a critical mass, promising change that should improve MFIs organisations and miraculously bridge the gap between the poor and the banks. They understand IT as means to an end – i.e. seeing in software the effective spokesperson of their research policy and the argument in favour of scaling up MFIs (Reille 2008). Yet in the end, there is still little empirical research supporting their claims, and there is even less reflection on what might be a comprehensive IT-4-microfinance paradigm that would enable MFIs to understand their information flows and re-appropriate their identity[16]. Indeed, this urge to make MFIs embrace technology hides – rather than addresses - the challenges that local MFIs face with regard to the changes of their organisations, the nurturing of internal competences and the development of their social identity as development agents.

1.2.5. Research Motivation

However, the awareness of negatives in the mainstream approach to software should not obscure the potential for innovation (Powell 2006); so the rejection of the instrumental view of technology does not mean ignoring the dynamic of IT advances and their effect on MFIs altogether. Indeed, The rhetoric of software supply also conveys a strong message about the desirability and, perhaps, the inevitability of following particular technological pathways (Pollock & Williams 2009, p.55). These pinpoint shifts in social relevancies and related changes in multiple aspects of political, cultural and technological life. They announce a social transition of which MFIs are part and which they cannot choose to ignore.

From this perspective, this research is strongly interested in IT innovation for microfinance. It particularly suggests studying open source software and the proclaimed benefits that it can offer for MFIs. Recently, it was heralded that MFIs are uniquely positioned to benefit from the advantages of openness and free access to open code (Dailey 2003b; Parikh and Dailey 2003; Grameen Foundation 2007; Augsburg and Schmidt 2006). Such a claim comes as no surprise, given how popular OSS has become

[14]Hype and the rhetorics of supply are a form of technological determinism. See Chapter II, section 2.1.1, footnote 22
[15]See Appendix 1.
[16]An exception is the IT and Financial Inclusion Project: http://www.ictformicrofinance.org/?q=node/51

in public policy, and across the spheres of international development (Lindman 2011). OSS gurus are convinced there is a business case for a purely open source approach that can benefit everyone, even more so MFIs – which are undoubtedly at a disadvantage in the software market given their scarce resources. From this perspective, MFIs are deemed the ideal candidates to benefit from the 'free' labour of volunteer developers – and if not entirely so they can still pay less, by mutualising costs with other MFIs and software companies who have shared features and interests.

The philosophy behind developing open source software is that software companies or freelance developers start by giving away open access to a few lines of code, which are used, and continually upgraded, improved and expanded by a community of users/developers including MFIs. The idea of a community including MFIs that should participate in the design of OSS makes such technology highly interesting to look at given what I explained earlier on the particular circumstances of MFIs and the little choice they have; but this research is also valuable in the context of a large majority of software studies where OSS communities are users and developers at the same time; I am therefore suggesting to bring to the fore the social dynamic of heterogeneous community participation and mechanisms of collective knowledge production and lay expertise.

Clouded by the idea of the gift economy – as I mentioned in the early section of this introduction - it is difficult to draw the line between popular fantasy and the reality of OSS long-term development (production, use, maintenance and cycles of changes and upgrades). Today, it is still hard for people to agree on what is meant by OSS (Lindman 2011). Research shows a lack of consensus and documents stories in which its meaning is negotiated locally[17]. Unpacking OSS in the context of NGOs, development studies and microfinance is even more challenging given the few qualitative studies of OSS projects in this area – apart from a few exceptions[18]. Therefore, this thesis suggests critically examining the qualities of OSS development in the context of MFIs. To do that, it should explore:

- What the OSS paradigm can bring to software studies;
- What does it entail to organise code production and use in this context;
- How and to which extent can MFIs be intrinsic to software production;
- How MFIs can co-participate in code long-term development.

Finally, the principal question I seek to answer is whether such a journey of software becoming can potentially lay the foundations for alternative processes that sustain code (in itself) and MFIs' capabilities at the same time.

[17]A subsequent and more detailed review of the OSS literature is proposed in Chapter II.
[18]See (Puri and Sahay 2007a; Heeks 2008; Augsburg and Schmidt 2006; Diniz et al. 2008; Diniz, Pozzebon, and Jayo 2009)

1.3. Thesis Outline

Chapter 2 of this thesis articulates a conceptual framework to study the biography of open source software. It constructs a long-term view of the social production of code across implementation, use, maintenance and upgrade. This chapter combines French philosopher of technology, Gilbert Simondon's (1980) thesis on the individuation of technical being and Pollock and William's (2009) concept of the biography of software. It also extends the biography conceptualisation to the study of open source software in the context of microfinance. To do that it first isolates key dimensions which are present in open source long-term development, such as the software code, the open source community, participation and the open source platform. Finally, it focuses on the social 'action' of producing code over time, examining the notion of sustained community participation and what it entails for open source project developers, owners and users.

Chapter 3 is about the research methodological design. It introduces the approach to studying an open source biography as a single case study that relies on the interpretive IS tradition; this is based on a single open source project, Mifos. At the same time, chapter 3 presents a three-stage methodological scaffolding which provides context, triangulation and an ethnographic-like narrative. The first methodological stage is about designing network visualisations that capture interpersonal connections among mailing lists (MLs) subscribers and aims to provide an overview of their post-exchanges. The second methodological stage constructs a picture-sociogram-text assemblage that traces back the genealogy of the Mifos project. The third stage consists of analysing the content of posts and threads in the MLs. This chapter concludes with a brief overview of the methodological design of the thesis explaining methodological choices and decisions with regard to the thesis' conceptual framework.

Chapter 3 ends the theoretical underpinning of the thesis and prepares for the empirical study. The empirical case study is composed of four chapters: the first is a brief and descriptive overview of the case study (Chapter 4), followed by three analysis chapters, organised according to the three methodological stages mentioned above (Chapters 5, 6 and 7).

Analysis Chapter One studies the structural aspects of Mifos community participation, using the MLs as a research proxy that reflects the social dynamic of the Mifos community over time. Analysis Chapter One explores subscribers' posting strategies based on their positions in the sociograms (network visualisations) and identifies divisions and landmarks in the data – see Chapter 5.

Analysis Chapter Two pursues the study of Mifos community participation by re-contextualising the activity of subscribers in the MLs within the broader dynamic of the Mifos project over five years. Analysis Chapter Two also emphasises change in subscribers' relations and stresses their emergent aspect by exploring further sociograms (network visualisations) within time intervals that are called time waves. Building on that, Analysis Chapter Two provides a qualitative description of the multiple aspects of Mifos community participation and how they impact Mifos code long-term development over time – see Chapter 6.

Finally, Analysis Chapter Three operates an analytical cut inside the MLs dataset, so as to investigate the coproduction of knowledge through post-exchanges in the MLs and the co-construction of collective meaning. From this perspective, Analysis Chapter Three sets the thesis on an explanatory path, revealing in-depth mechanisms underlying community participation – especially MFIs' participation - and Mifos code continuous redesign – see Chapter 7.

Chapter Eight is the discussion chapter of the thesis. It consolidates the insights of the three Analysis Chapters and reframes them from the perspective of the notion of Open Source biography – as reviewed in the conceptual framework presented in Chapter Two. The Discussion Chapter emphasises the long-term development of Mifos and its gradual concretisation showing a 'potential becoming' which today lays the ground for future software innovation by microfinance local agents and MFIs' increased participation. This chapter concludes its insights by comparing certain aspects of Mifos long-term development with one proprietary software solution for MFIs in the MENA region, revisiting the idea of open source code being a 'gift' and the extent to which it applies in this case. Finally, Chapter Nine provides conclusions to the thesis. It summarises the thesis and highlights its main theoretical, methodological and empirical contributions. It concludes by signalling its limitations and providing suggestions for further research.

2. Theory Chapter

2.1. Preliminary Definitions

2.1.1. The Process of Individuation

There is today increasing references to Gilbert Simondon's work on the individuation of technical beings in science and technology studies (STS) (Barthélémy 2008). Yet, when it was first published in 1958, many of those who read Simondon's thesis (1980) interpreted his rehabilitation of technical development as a form of technicism[19]. Through an examination of recent interpretations of the work of this 'forgotten' philosopher, there is evidence that Simondon has rather engaged in a critique of "technology qua instrumental rationality" (Toscano 2007, p.202). His work shows a deep ethical concern for how technology has been trapped into a conjunction of productivism and market alienation, which led to the loss of social meaning (Simondon 1980; 1992; Combes 1999, 54–57). In this respect, Simondon aligns with C. P. Snow's critique of the 'culture split' in the early 1960s –the idea that culture has shrunk, as it became the realm of 'absolute' ideas and humanities exclusively, whereas the technical is intrinsically 'non-human' and hence interests technicians only (Mitcham 1994, p.141; Simondon 1980, p.5; Latour 1988; 1991).[20]

Today, the culture split is not a dusty concept of the 60s; it is being re-enacted through taken for granted divisions and common beliefs. In software research and practice, Pollock and Williams (2009) argue that software scholarship is in majority partitioned between studies of code design and those of software implementation/use. Each one of these perspectives operates in disconnection (Ibid). More importantly, we, consumers acknowledge and accept such a separation and contribute that software advances remain restricted to those who create and control innovation in production (Stiegler 1998, 1:32; Simondon 1980). So, we acquire new software packages in a 'use and throw' fashion, helping those who control software to mystify innovation and increase our dependence. From this perspective, the relation between the technical and the social is an instance of consumption –this is ruled by economics (Stiegler 1998, 1:32).

Economics regulates the production of commodities[21] (Kopytoff 1986, 64), including software; it gives them an exchange value –that is a price- which organises their worth and affordance. This price often corresponds to the monetary counterpart of their design, making them no more than the sum of their features. As, the affordance of an

[19] Technicism: a condition in which practical results or methods are stressed (Oxford English Dictionary, accessed 20October 2009). Technicism is also a variant of technological determinism.

[20] Simondon argues the exclusion of technology from public spheres causes a loss in social meaning, as it makes technical knowledge entrenched and abstract (Simondon 1980).

[21] In line with Political Sociology, Simondon believes that the massive commoditisation of technology leads to the commoditisation of society (Stiegler 1998, p.32). Not only machines but all the individuals who design, produce and use technology constitute a series of interdependencies within an economic model that is geared towards the generation of surplus-profit.

innovation becomes dependent on its features (design) alone, technology commoditisation is hence a form of technological determinism[22].

Such a functionalist view of commodities restricts though a comprehensive understanding of technology and software in particular. Commoditisation is intrinsic of technologies' development and their social meaning. Kopytoff (1986) draws an interesting analogy between the processes of commoditisation and enslavement (pp.64-65). He claims that a commonsensical definition of slavery is "the treatment of a person as a property" (Kopytoff 1986, 65) –this status also applies to technology when it is treated like a commodity. However, Kopytoff adds that such a definition only partially translate the ubiquity of the idea of slavery.

When an individual is stripped from its identity (enslaved), kopytoff argues she is by the same token reinserted into a new host 'milieu' where she is forced to acquire a new social identity (Ibid). From this perspective, technologies, like individuals, have a potential for re-individuation –that is a possibility to transform inherent qualities into a new and unique "configuration of personal relations", enabling readjustment and change. Commoditisation is not about converting objects into inert properties; instead, it creates a social milieu for them, where they circulate between people and organisations, potentially acting on themselves, as well as on others.

From this perspective, a comprehensive understanding of software does not stop at the process of commoditisation –or capital market alienation; it reintegrates the economics of software commoditisation as part of its evolving meaning, extending its potential for individuation. The reason according to Simondon is that the potential for individuation is what defines individuals[23] (Simondon 1992, 298); whereas individuals –including technology- can be anything that contributes to establishing new relational configurations through interactions with others (Ibid). Nonetheless, an individual might not always be viable, as there will always be a 'region of uncertainty' in its formation. According to Simondon, "individuals are what is to be explained –rather than being this that explains"; hence their meaning remains necessarily incomplete (Guchet 2008).

Researchers record the formation of beings; i.e., they retrospectively re-constitute what might or might not be an individual, by isolating the object of scrutiny from its relations to other influences (Simondon 1992, p.300). Yet, they leave by the same token "pre-individuated-left-overs" i.e. potentials, making possible future individuations (Combes

[22] Technological determinism refers to a common belief that technology is a kind of univocal determining force with a momentum and highly predicable outcomes, be they positive or negative (Bijker 2001, 26; Winner 2001, 12). There is a case of positive determinism when people –seemingly oblivious to historical contingency and arbitrary technical decisions- promise social change on the premises of design features (Winner, p.14). Second, extreme versions of negative determinism take over the discourse of loss, technological alienation and human decline that was attributed to rapid technological development (Ibid). Both, positive and negative determinism reach something of an agreement that technology is defined through essential qualities, among which the instrumental rationality of design – or efficiency (pp. 13)

[23] Individuation is similar to 'co-production' (Jasanoff 2004, 1–12) –i.e., the transforming of material elements into the making of social orders (Ibid); both concepts define things through performance –rather than see them as unified, essential entities (Combes 1999, 5; Barthélémy 2008; Toscano 2007, 199).

1999, pp.6-9). Whether an object is 'finished' or is yet to be individuated, it is the biographical process of individuation that brings the individual into being –or fails to do so (Ibid, p.300).

From this perspective, the forces of commoditisation and those of individuation are intertwined (Kopytoff 1986, 88). The life of a software solution does not end when it is sold; in the same way, its potential remains unremarkable, if it was not turned into a commodity at some point of its life. In a majority of cases, objects 'develop a life of their own' through social dynamics and alliances, like kinship, gifts, etc. They also constantly develop and re-individuate when entrepreneurs and innovators search for customers, competitive values and markets. In this regard, Cawson, Haddon and Miles (1995) assert that the ontology of technology extends its putative relationship with design (Cawson, Haddon, and Miles 1995, 248), and market valuations (Drucker 1959) so as to be part of 'a journey of becoming'[24]. To study technologies and particularly software beyond design and the market industry, the concept of biography thus provides an appropriate 'mind-set'; one that stresses long-term development, and individuation over time.

[24] Simondon illustrates the individuation process in one particularly interesting example, called the Guimbal turbine. In a snapshot, this is a small electric generator to be immersed into a water pipe. In principle, building this machine is similar to building an electric power station. In both cases machines' components, including natural and physical elements are expected to recursively cause each other to move, generate energy and speed through the mechanism of thermal exchanges (see Simondon 1980; 2007, pp-205-206). However, in this case the machine had to be operational inside a water pipe which added a layer of complications. The major challenge is how to refrain the generator from propelling heat that would end up causing the entire structure to explode. Conventional physics suggested that the generator's size should be reduced in order to lower the volume of heat expelled. Yet, even if the size of the generator is smaller, it is not guaranteed that the machine can still bear water pressure and will not explode anyway (Bensaude-Vincent & Guchet 2007). Simondon argues that there is something wrong in how engineers have conceptualised this engineering problem. There is a relation between the design of the machine and its environment that was omitted. Instead engineers strove to reproduce an 'altered' conceptual body of a classical turbine that might work or fail to work under water (Ibid). Accordingly, 'under water' is straightforward part of what should have been an 'immersed generator'; even before engineers started to sort out how to build it (Ibid). Simondon argues that it is necessaru ***to exploit the 'natural' elements of such a milieu into creating emergent capabilities for the 'new' artefact***.

The Guimbal turbine was successfully constructed by setting a container filled with oil that is coupled to the turbine by means of an axis and immersed into the pipe (Bensaude-Vincent & Guchet 2007). In the new configuration, the surrounding water performed 'new' functions that not only resolved the heat 'problem' but also increased the performance of the whole. For example, water supplied power to the turbine, kept the machine working and cooled the heat generated by its rotation. **All the engineered and natural components coalesced to form the turbine's associated milieu**; they made the Guimbal turbine self-conditioning in its functioning and abided by its logic (Simondon 2007, p.207) –in the sense that Guimbal turbine would certainly explode if activated outside the aqueous milieu (Ibid). The Guimbal turbine is thus a 'concrete machine' because it does not exist prior to being in operation; the aqueous milieu is a condition sine qua non for its existence. Each part of this machine was designed independently and has a definite and unique function (Bensaude-Vincent & Guchet 2007). When pulled together on paper, the whole is an 'abstract' entity: a combination of 'applied physical principles' (Ibid). Literally, there is nothing more to the Guimbal Turbine than a conceptual body (Ibid, p.81). Yet, a concrete machine cannot exist prior to being in operation -it must be caught in action inside a social or natural configuration (Simondon 1980). Once a technology 'invents its own environment', it is then undergoing individuation (Stiegler 1998, p.68; 73). This is different from conceptual design; yet the machine is not yet fully individuated.

2.1.2. Biography of Technology

Markets, design, and the socio-politics of software production and use are components of the ontology of software development; the challenge in terms of research is hence to break the rules making researchers move between spheres that are supposed to be insulated from each other. The concept of biography[25] promises actually to do that. In this section, I first introduce the notion of biography in the general case of objects and technology according to the cultural and anthropological studies of objects and technology (2.1.2.1). Then, I elaborate on the idea of software biography, as it was first claimed by Neil Pollock and Robin Williams -2003-2010- (2.1.2.2) focusing on elements of synergy with Simondon's notion of individuation (2.1.2.3) –my objective being to extend and rethink the concept of software biography in the context of open source software (OSS) (2.2).

2.1.2.1. A History of Biograph(ies)

Biography first appeared in Studies of History of Technology. It was used to study the development of new industrial arts and contributed to our understanding of pre-modern techniques (Mitcham 1994, 114). Often, scholars from this tradition reconstituted event chronologies like the history of craftsmanship and technical innovation. They typically classified tools and artefacts according to their conceptual attributes and their functional purposes (ibid). Their aim was to show that technologies are progressive and inherently beneficial (Simondon 1980). They were critiqued for having embraced a narrow technicist lens. So, it was claimed that they restricted technological change to a phenomenon internal to the technical realm exclusively[26] (Mitcham 1994, 114).

Going one step beyond, Cultural Studies of Technology adopted a more 'culturally-embedded' notion of biography and revealed intrinsic layers of social meanings. Anthropologists like Mauss (1924/1954) and Malinowski (1922) studied the biography of objects from archaeological diggings and revealed how relations between people and things are culturally variable (Hopkins 2006, 74); persons sometimes seem to take on the attributes of things and things act in other times, almost like persons (Ibid).

[25] I decided to opt in this thesis to using the notion of biography. According to Simondon, biography accentuates variation between actuality and potentiality in technological change. It stresses the process through which a technology becomes 'concretised in its social milieu in opposition to when it was still a conceptual design or abstracted from it (Simondon 1980). I expect that the concept of individuation might be criticised for its biologic-like and evolutionist connotations. In this regard, I note that individuation is an epistemic concept. It asserts that technologies are derived from human knowledge of the world and through people cognitive skills (See Metaphysics 1.1.980b25 ff. cited in Mitcham 1994, p120); hence, the individuation of technical beings stems from rational and scientific principles and does not describe arbitrary, and natural processes (See Mahoney 2002). Individuation is therefore faraway form biological evolutionism. As it still conceals a naturalistic resemblance though, and as Simondon employed both concepts (biography and individuation) alternatively, I prefer to stress the biography concept as it makes visible the social loafing in technological development. Biography also presumes a method, which should unpack how a technology progressively and contextually perfects itself or fails to so (Barthélémy 2008).

[26] This equals to saying that the historical approach exacerbates technological determinism by overlooking the real performance of cultural objects in societies when traded and used by people.

Building on that, authors from anthropology (Appadurai 1986; Kopytoff 1986; Thomas 1991; Pantzar 1997), archaeology (Gosden & Marshall 1999; Holtorf 2002; Schiffer & Miller 1999, p.22; Shanks 1998; Tilley 1996, p.316) and sociology (Hughes 1983; Pinch & Bijker 1987; Strum & Latour 1987; Callon & Latour 1981) have agreed that objects are not merely 'functional items', but have a role as 'informants' of cultural change. Therefore some of them have used notions such as 'paths', or 'life history' (see Schiffer & Miller 1999, p.22), which they argued best capture how objects pass through many contextual changes in status and varying degrees of agency (Thomas 1991).

Particularly the concepts of 'biography of things' (Kopytoff 1986; Appadurai 1986) and 'biography of objects' (Gosden and Marshall 1999) described how meanings and values are accumulated and transformed (Gosden and Marshall 1999, 172). Kopytoff recounts how W.H.R. Rivers (1910) suggested tracing the dynamics of kinship relationships by following the movement of particular objects, like mapping how a plot of land passed from hand to hand (Kopytoff 1986, 66); he writes that "what Rivers proposed was a kind of biography of things in terms of ownership" (Ibid). Kopytoff adds that Rivers has ascertained a role to a non-human (land) in unveiling the transformations accompanying ownership and the rules of inheritance, in respect of their relations to kinship and the consequences thereof on the development of their social meaning (Ibid).

However, critics of the Cultural Studies argue that there is a need to go beyond the 'old-style' biography. Carrier (2002) claims that such studies see objects as bearers of meaning and ignore their materiality (Carrier 2002). Hence, the 'biography of things' equals 'machine fetishism' (Hornborg 2001) or 'methodological fetishism' (Hopkins 2006, 75). It focuses on the functional characteristics of an object insofar as to reveal how it came to be invested with social meaning. By doing so, the biography of things infers from the life histories of things the various social meanings in their subsequent depositions (Holtorf 2002, 54); it makes objects look like subdued, inert material upon which action is enforced (Gosden and Marshall 1999, 169).

Objects are isolated from their performance inside the cultural assemblage; therefore their contribution in co-constructing its social meanings is weak. For example, River's study restricts the land to a symbol: a one-way-association to kinship relations from the signifier (kinship) to the signified (land), as this is reflected through practices of ownership and inheritance. In contrast, the land itself is still part of a broader frame of political, ecological and historical associations that are overlooked.

Today the 'biography of things', à la Culture Studies is very much the standard in ethnography where it has rooted an understanding of technologies, as pipes for flowing social meaning. Because of that such a concept remains no more than a truism; The multi-layered sociality of objects does not imply that objects' properties are arbitrary, or that they are less material (Orlikowski and Robey 1991; Orlikowski and Scott 2008). As a result such a concept falls short to explain the role of things –that is co-production and the transforming of material elements and technologies into the making of social order (Jasanoff 2004, 1–12).

STS embraced the challenge. They re-adopted such concept to describe in their studies of technology and scientific production the mangle between the social and the technical in past and present cultural mediation (Jones 1999; Jones and others in the Special Issue of the Scandinavian Journal of IS 2005); so they revealed concealed political processes in command of innovation and technical design and how they shaped society and public opinion generally (Callon and Latour 1981; Hughes 1983; Strum and Latour 1987; Pinch and Bijker 1987; Latour 1988; Mol and Law 1994; MacKenzie and Wajcman 1999; Collins and Yearly 1992; Law 1991; Pickering 1992; Bijker 2001; Sismondo 2007; Law 2002; Waltz 2004; MacKenzie 2005; MacKenzie 2006; Pickering 2011).

2.1.2.2. Software Biography

For instance, Pollock and Williams applied the notion of biography to software, in particular (Pollock et al. 2003; Pollock & Cornford 2004; Pollock et al. 2007; Pollock & Williams 2009; Pollock & Williams 2010). They used this concept to study ERPs (Enterprise Resource Planning); but they also encouraged its extension to study large scale software e-infrastructures (Pollock & Williams 2010). In line with the STS tradition, their aim was to focus on software global performance, particularly when production and use extend the boundaries of one organisation (Pollock & Williams 2009; Pollock & Williams 2010). The very notion of 'biography' meant for them that software can only be studied in **a spatiotemporal locus** that goes **beyond single momentums and spaces**, focusing instead on incremental practices and long-term development (Pollock et al. 2003; Pollock & Williams 2009, p.59).

Such an approach is supported by the idea that code development is in itself part of a distributed information system that is constantly undergoing transformations. By arguing so, Pollock and Williams (2009) reconcile through the notion of software biography, the insights of both Social Studies of Software (SSoS), and Studies of Code Design (SoCD). First, they break with an SSoS tradition that focuses on local sites and dives in the details of political influences behind design and implementation decisions – thus voicing the perspective of idiosyncratic users who are also portrayed as having little knowledge about code. In the same way, they go beyond SoCD studies to the extent that a biographical study intrinsically reforms the use of a code vocabulary that is uprooted from social realities and which is mainly published for code developers.

In fact, both SoCD and SSoS purport an epistemological bias to the study of software due mainly to little criss-crossing. How scholars strive to present the others' perspective as diametrically opposed to their objectives does not reinforce software knowledge specialisation, but leads to a paradox where software code is seen as relentlessly unfit for organisational routines –according to extreme SSoS views-, or that its mechanics are beyond users' understanding –according to extreme SoCD views. The polarisation of software literature prevents the rapprochement of users and developers and so contributes to black-boxing economical, institutional and historical dimensions intertwined into software performance (2009, p.12).

Pollock and Williams's software biography is thus an alternative method that reunites design and use in the same research setting and reconciles time and space (2009, p.12). It allows scholars to unravel the long-term performance of a software solution or class of software, among the agents who trade their influences, the organising of markets, the contexts of use and the uncertainty of technical progress. Such a perspective of software is implicitly aligned with Simondon's views and his thesis on the individuation of technical beings. If Simondon was to comment on Pollock and William's work, he would claim that software biography allows the researcher to go beyond '*the actual artefact'* (Simondon 1992, p.300), and to show instead software as what it is: a *partially captured*' (Simondon 1980), and so a '*partially finished'* product (Pollock & Williams 2009, p.59).

2.1.2.1. Simondon and the Software Biography

Pollock, Williams and Simondon therefore agree that the ontology of technology is constantly depending on machines' '*future performance in their associated milieu*' (Simondon 1980) – in the context of software, this is to say that software systems are "… tested, contested and worked out at a number of different levels and crucially, at different historical tempi" (Pollock & Williams 2009, p.76). In other words, they do not stop at "initial research and development, but extend ... through implementation to use and continues over multiple product cycles" (Pollock & Williams 2009, p.76); the reason is that they only "…become 'alive' as information systems when they operate" (Pollock & Williams 2009, p.12).

In the same line, Simondon (1980) argues, a conceptual body and a design on paper are both actual, but they do not make a machine concrete (pp.299). Design processes have a referential of legitimacy of their own that serve different purposes, such as writing a business proposal, making a sale pitch, estimating future production costs, etc. (Ibid). "Entrepreneurs draw paper-based sketches, conceive formula, build prototypes and yet there is no 'real' innovation" (Simondon 1980). In fact, each time a machine reaches a new development stage; there is a transition in its life-history. It demarcates the passage from a "separate analytical order" to a "unified synthetic order" (Stiegler 1998, 1:73) and expands into new modes of existence[27] (Simondon 1989).

From this view, a non-operating code is still material (text, CD, exe file, etc.); yet major software scholars, like Simon (1996), and Wegner (1997), and Mackenzie (2006) argue that code design is different from an operating package; this is so, as programs start to perform when they build unique configurations of interactions within themselves and with other code objects across interconnected utility domains and social settings –and not before (Simon 1996; Fleck 1988; Wegner 1997; Jørgensen 2001; Gasser et al. 2003; Garud, Jain, and Tuertscher 2008; Goldin and Wegner 2008).

[27] Latour (2009, p.5) writes about Simondon's notion of the modes of existence: "…pour Simondon, la saisie du monde n'exige pas que l'on commence par partager les réalités en objet et sujet…C'est la notion même d'une pluralité de modes d'existence dont chacun doit être respecté pour lui même, qui fait toute l'originalité de cette aventure intellectuelle."

In fact, it is the biographical process of individuation that brings a code into being. It enables researchers to retrospectively re-constitute the footprints of ***persons and things as they move through space and time, by emphasising external constraints over in-situ configurations, keeping with a broader disciplinary change from 'local' levels to 'global' ones, and from single-sited field projects to multi-sited ones*** (Pollock and Williams 2009, Ibid). The software biography is not thus about predetermining the effects of a software package on social change (technological determinism); it only looks at the long-term coproduction of software as its 'innofuse' (Fleck 1988) with its milieu or fails to do so.

To conclude, this section shows similarities as well as complementarities between Simondon's notion of the individuation of technical beings and Pollock and Williams' software biography. It first argues that transient code features do not exhaust alone the meaning of software advances, as they are a series of interdependencies within a system constantly reconfiguring new interactions with other social systems, and code objects. Second, the software biography adds to Simondon's contribution to the extent that it rethinks the idea of individuation in a methodology (software biography) that enables software scholars to reconcile long-term development and use context. Going a step further, I suggest next extending the notion of software biography to study open source software (OSS). To do that I explore additional dimensions specific to the OSS biography – notably in the context of microfinance.

2.2. OSS Biography: A Framework

As I mentioned before, the concept of biography is particularly concerned about the performance of a software technology[28]. In the case of OSS, I consider there are three analytical concepts related to that, which are also in Simondon terms, intrinsic to 'the open source associated milieu': namely community, participation (2.2.1) and the material arrangements of such an organisation and its outcomes (2.2.2). To situate the OSS biography in the context of microfinance, Subsection 2.2.1 studies community participation in the context of development NGOs, highlighting heterogeneous forms of participation and microprocesses of collaboration that sustain users-developers' social dynamics. Particularly, subsection 2.2.2 explores community participation through the mediation of the OSS code and its information platform online. To conclude this chapter, subsection 2.2.3 examines the outcome thereof, in terms of information sharing, learning and the co-production of software knowledge (2.2.3).

[28] Software performance (Fenton and Pfleeger 1998; Pressman and Roger 2009; Findlater and McGrenere 2010; Mockus, Fielding, and Herbsleb 2002; Rifkin 2001; Raymond 1999) is typically merged with concepts like software quality (Herbsleb et al. 1997; Stamelos et al. 2002), and software evolution (Lehman 1996; Lehman et al. 1997; Godfrey and Tu 2000; Godfrey and Tu 2001; Izquierdo-Cortazar et al. 2009; Succi, Paulson, and Eberlein 2001; Jensen and Scacchi 2004; Robles et al. 2005). A majority of scholars concentrate on measurements and methods; so there is little theoretical framing of performance per se. Besides, these measurements rely heavily on theories of code design, which reflects their view of software performance as mostly determined by design qualities. In contrast this research understands software performance in a Simondon sense, as that what has a potential to act, a mise-en-scene that enables the unfolding of a social setting.

2.2.1. Community and Participation

2.2.1.1. Open Innovation and the User

In Simondon thesis, the technology associated milieu is the social, technical, or/and the natural assemblage in which it is embedded. Simondon defines the associated milieu of a technology as what is formed through the reunion of several 'material' elements which must be organised in relation to each other for it to operate (Simondon 2007, 205–207). A component of technology associated milieu might be anything that requires both an activation of its own capacity to act on the actual object and be acted upon by it recursively (Simondon 1980). Based on this view, OSS communities are parts of code associated milieu insofar that their internal dynamics unravel how code is produced, maintained and upgraded. So, open code is here recast in a collective embodiment; this includes users and developers who input their material, exchange mutual support and collaborate in order to commit, use, and continue to develop code[29].

In respect to OSS and users' participation, the literature is controversial; on the one hand, some believe that users with lay expertise are strongly involved in the production of open code and innovation (Kollock 1999; Von Hippel 2005; Chesbrough et al. 2006; Bollier 2008; Benkler 2006; Benkler and Nissenbaum 2006; Maxwell 2006). For instance, some gurus of the Internet pinpoint a cyber-democracy; they often try to persuade others that it is taking place through such forms of open intellectual production (Calhoun 1998). Accordingly, successful open innovations, like Linux and Wikipedia, are deemed to be alternatives to capitalistic modes of knowledge production (Berry 2002), and solutions against the flaw of digital exclusion (Weber & Bussell 2005) etc.

On the other hand, software scholars typically show OSS as the outcome of developers' communities solely (Succi et al. 2001; Godfrey & Tu 2000; 2001; Scacchi 2003; Paulson et al. 2004; Mockus et al. 2002; Koch 2007). In the major OSS cases studied, like Debian, Mozilla, the Linux Kernel, etc., the developers are themselves users of the code. There, community members must possess advanced coding skills in order to belong to the core contributors (Ibid). Furthermore, mainstream software industry and research is very much convinced that users are and will always be consumers who rely on developers to produce code. As a result, it is necessary to prevent the epistemological fallacy of taking users' participation in code development for granted, or to presume simply that under the realm of the OSS, users have broken free from the dictatorship of software companies.

[29] Community-based software development is very much the current paradigm in the software industry given the increasingly distributed and dislocated organising of software production and use globally. It was mainly associated with open innovation and OSS, through labels like 'innovation communities' (Von Hippel 2005a), 'community software' (O'Mahoney 2006), 'community development' (O'Reilly 1999), and 'community informatics' (Gurstein 2000). Yet, software communities are not restricted to open innovation (Shaikh & Cornford 2009b). Pollock and Williams have also used the concept of community to describe a distributed ecosystem that consists of organisational clients and SAP, including its network of regional delegates and representatives (Pollock & Williams 2009).

In fact, users' participation in code development was already established even before the advent of OSS. Users take part in open code development where their action can be directly participatory or indirectly –through intermediaries and IT partners. Braa and others argue that users mediate the integration of code objects within a given domain of knowledge, enabling local learning processes (Braa et al. 2004). In this respect OSS communities cannot be led –contrary to the general view- by the rules of meritocracy[30] alone, as such statement would imply that the rules of programming are intrinsic to the fabric of software, confirming thus the hegemony of a design-dominated thinking that overlooks important socio-political factors, which shape code long-term development.

Moving the discussion on users' participation a step further, STS tries to address what is the nature of users' participation[31] (Collins & Evans 2002; Collins & Evans 2003; Jasanoff 2003) –in that how can we for example, interpret the involvement of 'non-core' computer experts in code production? Collins and Evans (2002) differentiate between two types of expertise: **interactional** and **contributory**. The first is fuelled by participants' interactions and exchanges, while the second requires strong enough knowledge to contribute to the object itself (Collins and Evans 2002). The authors also introduce a third type of expertise, the **referred** expertise that is expertise possessed by project leaders who cannot possess contributory expertise as such, but have experience of managing team work.

Based on this classification, Collins and Evans argue that interactional participation in decision making improves the public value of technological progress[32] (Yearley 1999; Bijker and Law 1992; Bijker 2001; Collins and Evans 2002; Sismondo 2007). In the same way, Simondon adds "users are not merely owners of the machine, but those who choose, maintain and improve it" (Simondon 2005, p. 252; Toscano 2007, p.203). Users' involvement in science and technology production does not obviously mean that all citizens should be able to build a nuclear reactor (Bijker 2001). Rather, the argument on users' participation is about inclusion (Collins and Evans 2002) – that is the integration of other 'specialist abilities', representing networks of complementary knowledge, and which are essential to the working of a given technology (Ibid).

[30] Active programmers form the core or elite, and the less active are at the periphery (Scacchi 2007; O'Mahony and Ferraro 2007; O'Mahoney 2006; Mockus, Fielding, and Herbsleb 2005; Von Krogh, Spaeth, and Lakhani 2003; Moon and Sproull 2002; Raymond 2001; Tuomi 2001; Mockus, Fielding, and Herbsleb 2000)

[31] Particularly the Third Wave of STS (See Collins & Evans 2002; and **Symposium on 'The Third Wave of Science Studies':** Collins & Evans 2003; Jasanoff 2003; Rip 2003; Wynne 2003)

[32] Brian Wynne's analysis of the relation between scientists and sheep farmers –after the radioactive fallout from the Chernobyl explosion contaminated the Cumbrian fells in England- is an illustration of this point (Wynne 1992-1994 cited in Yearley 1999). In a snapshot, the authors recount the failure of experiments led by scientists who wanted to change the acidity of the soil in order to trap radioactive material in it. Against farmers' objections, the scientists kept the sheep penned in restricted areas while applying soil-conditioning chemicals to the ground. This caused the decline of the sheep condition on account of their confinement and the experiment was judged inconclusive (Ibid). Steven Yearley concludes that it is the deafness of scientists to the knowledge of others –those who know most about sheep breeding- that was at cause in this failed opportunity for an important scientific advance (Ibid).

First, Collins and Evans' definition of expertise seems strangely de-contextualised; it refers to esoteric sciences in general, "as if the nature of expertise and the rights that might accrue can be discussed independent of the context in which they are shaped" (Rip 2003). However, the notion of interactional expertise applies well to OSS, to the extent that there are at least two bodies of knowledge involved in code production –as, code as a language inherently encompasses the meaning of its utility in addition to its own (Mackenzie 2006). From this perspective, all community participants must acquire enough quantity of 'unknown-to-them' expertise in order to contribute to code production, maintenance and upgrades. The very fact that community members develop capabilities to sustain their interactions means that there is something in the nature of software knowledge that can be transferred and acquired (Mau and Leonard 2004, 11).

2.2.1.2. Participation/Participatory Development

To situate users' participation in the context of microfinance, it is also important to rethink what it means to participate for welfare NGOs and MFIs. MFIs and grassroots in developing countries often use package software that donors or Western partners provide as 'gift'. By using such technologies, they reproduce a longstanding bias placing them –as local populations or 'insiders'- at the receiving end of a development process designed by powerful 'outside' developers (Mohan and Stokke 2000) –encouraging their social constructs to be absorbed locally (Avgerou & Walsham 2000; Heeks 2002; Braa & Hedberg 2002; Bada 2002; Powell 2006).

The situation of development grassroots raises hence a problem of inclusion (Madon et al. 2009; Warschauer 2004) –which participatory development[33] seeks to address, by involving locals, who are politically and socially excluded (Eversole 2003). From this perspective, both STS and participatory development promote ways to reverse existing social arrangements, whereby the passive locals become active subjects of their own development and empowered (Mohan 1998). They aim to transform the public, the users, and more generally the 'subjects' of development, from those who passively await change, to those who can influence it through processes of communicative action[34] (Habermas 1981). However, designing 'participatory' programmes has shown to be a sort of 'cliché' (Bailur 2007).

Many IT implementation projects with high-level participation among national actors have provided examples of "how to alienate, rather than include" the locals in community work (Loker 2000 cited in Eversole 2003), thus failing to leverage local

[33] First as a tool: Participatory Rural Appraisal (Chambers 1994, 1997) and a philosophy: Development as Freedom (Sen 1999)
[34] In Communicative Action, Habermas (1984, 1987) describes two archetypes of social action, namely purposive rational action and communicative action. The first refers to actions that are governed mainly by rational decision-making and instrumentally efficient implementation of technical knowledge (Heng & de Moor 2003). In contrast communicative action is based on an analysis of the social use of language oriented to reaching common understanding when action is co-ordinated by the validity claims offered in speech acts (Habermas, 1981). Users of OSS must thus understand the social and non-social contexts of their action in order to reach common understanding with other community members

capabilities (Puri and Sahay 2007a). For instance, many software implementation projects for microfinance NGOs have increased their lock-in under dominant software companies (Augsburg & Schmidt 2006). Also, papers on OSS in developing countries report challenges with regard to ownership – as to whose project it is and whose input is tolerated/required (Puri & Sahay 2007; Byrne & Sahay 2007). Most of the devices and methods to 'plan' participation have been designed to improve software delivery and reduce cost; however it is still not clear how they will also cater to users' needs and align with their local capabilities (Puri and Sahay 2007).

2.2.1.3. Mobilisation and Participation

To understand why some of these projects failed, it is necessary to rethink what is meant by local or users' participation. In fact, participation in OSS is confused with mobilisation; hence I argue, it does not allow understanding the role of personal expertise and how it is shaped by collective decision processes. Indeed, OSS scholars have devoted a lot of interest to community participation; they though see it as the outcome of individual motives, as well as social and economic incentives (Lerner & Tirole 2000; Ye & Kishida 2003; Lakhani & Wolf 2005; Ghosh 2005; Nov & Kuk 2008). Accordingly, they equate participation and mobilisation and assume that the continuity of developers' involvement in an OSS project is merely an extension of their original motives and incentives –which is not necessarily the case.

Resource Mobilisation Theory (RMT) (McCarthy and Zald 1977) introduces mobilisation as individual utility and incentive selection; it exposes what kind of cost-reducing mechanisms and career benefits might justify why few individuals will "on their own" bear the cost of collective action[35] (Olson 1965). RMT also includes value-driven motives, like the grievance and shared beliefs of an 'oppressed' community who is 'emotionally' driven to action –this shows the source of influence on OSS activists' thinking like Stallman and others (2002); as they too see OSS as a collective movement that is geared by the values of freedom of speech and free access.

Going a step further, STS scholars have also associated public participation in scientific decisions with a broader concept of mobilisation. Yearley (1999) argues that there are three factors that influence public participation in science and technology; first, the trustworthiness of the legitimate institution, second, the technical knowledge possessed by the scientific community, and finally the project's social assumptions (Yearley 1999). These factors reveal embedded social, institutional and knowledge-related dimensions underlying participation, which extend the utility-based motives presented by RMT. In the OSS case, it is typical that members must share the legitimacy of the

[35] Developers are said to contribute in OSS to improve their career prospects and acquire reputation (Lerner & Tirole 2000; Lerner & Tirole 2002; Lerner & Tirole 2005; Ghosh 2005). Building on that, Spaeth et al. (2008) argue that it is necessary that someone or some organisation bears the cost of participants' incentives in order to solve the dilemma of collective action (Spaeth et al. 2008) –that is the idea that the source code is a common good and that there is a measurable probability that members of the community refrain from contributing, waiting for someone else to do so instead (Olson 1965).

project when they join in; project administrators sell their credence to members, who are led to interpret projects’ assumptions in line with their own. Participants must also see that there is an opportunity to learn from peers or the project.

However, both these two stances (RMT and STS) bear a strong emphasis on individuals’ rational choice to explain participation; there is hence little emphasis on the collective, its interactional agency and its knowledge productive nature. Elster (1986) calls this the deficiency of the economics of collective action. He argues that collective action ceases to be a prisoner’s dilemma (a cost-benefit equation), once the act of participating is beneficial in itself (Ibid p.132); for example, once participation answers OSS members' own needs (Hertel et al. 2003; Lakhani & Wolf 2005).

From this perspective, Lakhani and Von Hippel (2003) show that 'answer persons' in OSS mailing lists (MLs) often acquire knowledge and learn when they provide peer-support (Lakhani and Von Hippel 2003). The cost of delivering help is thus low, as there is benefit resulting from the very action of helping peers (Lerner and Tirole 2000). Fang and Neufeld (2009) also argue that OSS projects are about sustained participation and not only mobilisation and incentives –so the mechanisms encouraging participation are intertwined with OSS long-term development. Community participation is accordingly knowledge productive; it does not stop at mobilisation but it includes collective negotiation –how the whole gradually recombines and moves forward (Ibid).

Accordingly, OSS communities were compared to communities of practice (Brown & Duguid 1991) in the sense that they are knowledge domains, serving as repositories of expertise (Von Hippel 2005, p.96). Von Hippel argues that OSS participants can, but need not, exist within the boundaries of membership groups; but their interconnection incorporates the qualities of communities that provide information and a sense of sociability, support and belonging (Von Hippel 2005, p.96).

Ruggie (1975) defines epistemic communities as a collective sharing a dominant way of looking at social reality through shared symbols and references (Ibid). He adds that such communities have interrelated roles which grow around an episteme, delimiting the domain of their social reality (Ibid). In the case of OSS, Ruggie’s definition is though restrictive; it emphasises cognition, individual values and social membership at the expense of material practices and information infrastructure. Indeed OSS participants socialise and produce code through online tools, data repositories and computer-mediated communication (Von Hippel 2005, p.96; Kollock and Smith 1999; Turner et al. 2005; Sack et al. 2006). In this respect, Haas (1992) suggests a practice-based of epistemic communities; he argues that the latter interweave their domain of knowledge through practices and technologies; these foster members’ exposure to new practices and constructs, thus making the probability of individuals’ discovery of novel insights more intense and focused (Haas 1992).

To recap this section, code and knowledge production are both means and objectives in OSS communities (Spaeth et al. 2008) –which recentralises knowledge building and learning as the primary focus of community participation (Fang and Neufeld 2009). The idea of participation as empowerment goes thus beyond development experts' discourse. It implies gradual transformation (White 1996). In OSS terms, gradual transformation occurs when participants contribute to problem-solving practices, report errors, and learn from peer-support. Thus, they build incremental knowledge and move beyond mere mobilisation (Von Hippel 2001a; Shaikh & Cornford 2003; Von Krogh et al. 2003; Détienne et al. 2005; Kuk 2006; Sack et al. 2006; Sowe et al. 2008; Fang & Neufeld 2009; Ibrahim et al. 2010). OSS community participation is thus material and focuses on the technical arrangements that support it.

2.2.2. OSS: A Material Assemblage

2.2.2.1. Open Code

When it is on-going development code is generally presented as series of code commits and changes in code scripts. This format – which is the result of code versioning systems - makes code appear as a genealogy of code versions, which gradually grow over time through continuous redesign (Gasser et al. 2003). From this perspective, there is not such a thing as complete code[36]. There are only partial specification of interfaces, incomplete code, and imperfect modes of use (Wegner 1997; Gasser et al. 2003; Garud, Jain, and Tuertscher 2008). Code is also interactive[37]. It interacts with an external environment that it cannot control, which makes it better at delegation and coordination between external resources and built-in algorithms, like modules or components of an emerging and constantly changing whole[38].

Code objects are thus inherently open and 'raw' (Pollock & Williams 2009, p.20). They span the boundaries of software packages connecting to a larger web of code, interfaces, and to a new web of semantics inscribed in software pieces. They are globally re-used, i.e. recycled over a large user base to keep their development cost low. Like primitive building blocks, they express limited and transient modes of use, which do not seek to represent the reality with completeness and soundness (Wegner 1997). The repertoire of

[36] The 'laws of software evolution' (Lehman 1980; Lehman 1996; Cook et al. 2006) can provide a first approach to understanding that code change is inevitable and that there are limits to further adaptations in terms of safely implementing changes and adding new functionalities.

[37] According to Wegner (1997), interactive systems were the cornerstone of a new paradigm for computing technology that marks a shift from mainframes to workstations, from number-crunching to embedded systems and graphical user interfaces (GUIs). Also code interoperability is the basis of 'interactive systems' (Wegner 1997), that is systems which can provide history-dependent services over time that can learn from users and adapt to their settings (see Wegner 1997; Goldin & Wegner 2008; Goldin et al. 2006). Contrary to algorithm-based systems –whose outputs are completely determined by their inputs- interactive systems use object-oriented programming to design applications and computer programs. [Objects programming is the interaction of data structures consisting of data fields and methods (Wikipedia 2010)]

[38] Examples of interactive systems are airline reservation systems and bank accounts' access points which can also be embedded in other information platforms.

algorithms that supports them also contains different forms of connectable objects, which gradually build meaning through association with possible domains of utility and use (Ibid). Code is therefore concretised only once embedded in social structures and once it is part of a 'performing whole' –that is organisations or information infrastructures (Pollock & Williams 2009, p.20).

To study code, the challenge resides therefore in identifying what particular social mechanisms coalesce with code objects in order to make a software solution self-conditioning in time and space. Answering such a challenge comes to admitting three necessary assumptions about software and code and the relation thereof[39]. The first is about the relation that exists between software and code (1), the second is about the nature of software agency (2) and finally the actuality of the overall assemblage (3).

(1) First, it is necessary to acknowledge that software and code are tightly coupled. Together, they extend the limits of code as text, or a form of expression[40]. This is because "…code is an abstraction that spatiotemporally reorders…whole social fields of action in a cognitive-motor performance" (Mackenzie 2006, p.32).

(2) Second, the property of code as a form of expression is emphasised only to the limits of its operability; that is to the extent that code does something to better articulate its function (Ibid, p.32). This might be apparent through changes in the objects composing the code and in its relations with its environment. For example, code underpins the efficacy of the Linux Operating System. Simultaneously, it facilitates its emergence as a cultural assemblage that elicits affirmative and negative identifications on the part of programmers, users, institutions, organisations and corporations (Ibid, p.71). In this case, both pragmatics (functional validity) and semantics (cultural meaning) are encompassed in code scripts, which replace the formal organisational rules in the coordination of complex activity systems (Lanzara 2005). Thus, Linux source code works as an organiser of programmers' activities[41]. In the same way, its MLs work as a coordinator and enabler of participants' exchanges (Ibid).

(3) Neither the code pragmatics, nor its semantics have any traction without a social framing though; it would be mistaken to think that code is the only thing to act. Both code social and material arrangements coalesce into shaping how the whole software evolves through time (Mackenzie 2006, p.70). So code is merely actual, i.e. transient relations made by participants and the material objects connecting them (Mackenzie 2006, 70). Code provisionally stabilises through code releases; yet, its sub-code features are under constant changes with patches appearing every few days (Ibid). Such a dynamic construction of code exemplifies software collective agency in the process of constituting itself through steady production-use of code (Mackenzie 2006, p.70).

[39] In application of Simondon's ideas on the individuation of technical beings (Simondon 1980).

[40] For examples, when code operates in the workplace, or when it is seen as law that has an associated authoritative and legitimate force (Lessig 1999)

[41] Regardless of participants' motives, they succumb to the relative importance of the means by which collective action (software) is organised (McCarthy & Zald 1977)

For example, the Linux project is cultural by virtue of the dual relations that run through it –Linux code would not exist if it were not sustainably embedded in the values of its community; at the same time, the code itself is performative as the means of its production contribute strongly to its cultural meaning (Mackenzie 2006, p.70). Linux appeared in 1991 as a clone of UNIX. Today Linux flows from hundreds of individuals scattered around the globe, which hardly makes it a unique product. There are as many versions as there are cultural differences (Ibid). Each corresponds to a "*material equilibrium*" moving 'most-of-the-time' in controlled variations[42] (Toscano 2007, 200), so that Linux can never be finished. Instead of being a technology whose ontology is defined by inner attributes, Linux is a vector opening onto a potential. This is held by participation; as continuous participation helps people enact their belonging to the Linux community (Coleman 2004; Fang and Neufeld 2009; Ducheneaut 2005).

As a consequence of the above design actions continuously take place in use and in breakdowns leading to a changed use (Bødker 1991). So, users have their own special knowledge which upholds developers' incomplete conception of social realities (Yearley 1999). On the one hand, users' contributions to software long-term development is essential in order to palliate, the vagueness of code and to ground its objects in social patterns or routines (Gasser et al. 2003; Fang and Neufeld 2009). On the other, users' understanding of their routines and work practices is recast in novel and productive representations through the input of peers (other participants) – which should enhance both the legitimacy of the outcome and its quality (Forrester 1999). Again this brings us to community participation, as it is mediated by another type of code inscribed in online production tools and computer-mediated communication.

2.2.2.2. OSS Platform

When they start to look for an OSS project, participants browse projects portals, which often lead them to other websites, MLs, wikis, production tools, etc. These contain all sorts of information about the project, code and participants, like the project's mission statement, who is who, how to become a 'contributor', what are the tasks available, what is the expertise required, etc. (Scacchi 2007). Such online spaces are interlinked, thus forming a virtual platform; i.e. an assemblage of communication tools, data repositories, and production websites that support and are sustained by a particular code production over time. Similarly to its community, an OSS platform grows and expands as participation increases, gradually registering the traces of code social dynamic, and its development activities, as well as safekeeping its data libraries and related technologies.

MLs are a particularly key component of any OSS platforms (Jensen et al. 2011); participants register in MLs to gather information and ask questions. Later they use them for coordination and to broadcast their own news (O'Mahoney 2006). Thus, membership in MLs is among the first steps in the process of tying individuals to a

[42] Simondon has described this as the relation between **actuality** and **potentiality**, in that a Linux version is an actual element that straddles its present status and represent a partial resolution of what might be latently potential for a new software solution (See Simondon 1992, p.300; Toscano 2007, p.202).

given OSS community. It can also be a way to gather specific knowledge; hence many mature projects have two MLs, or more (Edwards 2001). For instance, User ML is often dedicated to ‘beginners’ –people with compilation/installation issues; it acts like a ‘help line’ and is linked to FAQ pages, and developers’ wikis (Edwards 2001). In contrast, Developers MLs are reserved to those who are already engaged with the code (Ibid).

In addition, MLs’ traffic is constantly administrated in order to eliminate non-active lists and ensure that the project’s structure remains up to date. Sometimes, when new topics are raised, additional lists are created and post traffic is diverted in order to enable the formation of pools of expertise –which help sub-communities to identify each other and locate new areas of common interest (O’Mahoney 2006). Because MLs play a major role in the life of OSS communities, maintaining old lists and enabling new ones is an act of structuration that ensures the durability of the platform, code and the OSS project.

MLs are also important data repositories; substantial quantities of information are generally lost following face-to-face interactions in meetings or in informal discussions in the workplace (Walz et al. 1993). In the case of distributed code development, like OSS, the MLs and other production tools facilitate the archiving of information long after the spark of the interaction is gone; the life expectancy of such information is thus durable, but its longevity still depends on the hosting medium and its policies with regard to data content. Particularly for large and mature projects, participants must still distinguish the signal from peripheral noise. Search and filtering features become the gatekeepers of the platform, as participants rely on them to look for information floating in “a sea of irrelevant data” (Scacchi 2007; Smith 1999). Indexing and searching capabilities have therefore a potential to facilitate collaboration, the resolution of software problems and code advance, affecting by the same token participants’ capabilities and the quality of community participation overall.

To conclude, sub-sections 2.2.1 and 2.2.2 recast our understanding of OSS associated milieu as essentially made of community participation. Building on that, to study an OSS biography implies to examine the dynamics of community participation –which is intrinsically in relation with code development. In summary, community participation enables open code production, maintenance and upgrade over time; this encompasses a continuous act of social production where groups of heterogeneous participants embodying plurality of perspectives interact and co-organise knowledge production via material practices, tools and interactive code. OSS communities are therefore not only a purposeful combination of people who possess different knowledge profiles, personal tastes and priorities (Floyd, Reisin, and Schmidt 1989), but they are a transient instances of collective knowledge negotiation mediated through material arrangements; these shape code development and its future. The final subsection of the OSS biography framework concludes with the outcome of community participation, i.e., the processes of incremental knowledge building.

2.2.1. Knowledge Building and Open Code

Participation in OSS development is deemed a largely 'unknown workforce' (Ågerfalk and Fitzgerald 2008). Typically project owners and administrators do not possess all the knowledge and resources needed to produce and sustain code development over time. It is also difficult to say if participants will do what is required. For these reasons, code long-term development is about sustaining a collective effort, including exchange of comments, code commits, bug fixes, feature enhancements etc. (Shaikh & Cornford 2009). In this respect, the mico-practices of OSS community participation are a constant interactive order that feeds-back knowledge building.

Goffman (1983) viewed the interaction order as a social situation in which two or more individuals are physically in one another's response presence (cited in O'Mahony 2006). However, studies of computer-mediated-communication have proven that the interactive order goes beyond face-to-face interactions, extending to webpages and links, through which people perform their identity based on whom to associate with and whom to expect a response from (Carr 2008, 160; Sack 2000; Smith 1999). As I mentioned earlier OSS code and platform encompass such an interactive order, as they co-produce an ecosystem where participants can share information, learn and improve their capabilities.

In fact, Learning and the processes through which it occurs are necessary mechanisms of adaptation in conditions of ambiguity (March and Olsen 1975). Through online socialisation, i.e., peer-support, and problem solving conversations in the MLs, community members negotiate a better understanding of the subject matter (Jankowicz 1995; Palincsar and Brown 1984) and generate new insights (Piaget 1978). **They also become each other's students as they gradually reflect and contribute to each other's constructs and practices** (Forman and Fyfe 1998, 239). Their expertise is channelled by the broadcasting, filtering and searching capabilities of the MLs; but information provided by others in post threads makes it to a certain extent also transient and changing.

Capabilities Theory (Sen 1992) in Development Studies provides some explanation as to how enabling individuals' capabilities is a form of collective freedom. People possess individual capabilities that are enacted once they participate in a collective project. These exhibit a dual and even a paradoxical nature, showing participants as accepting the responsibility to obey the collective knowledge (to learn) and at the same time as maintaining the necessary authority to carry the consequences of their informed action (to teach) (Ibid). The presence of these two elements is crucial to the functioning of the learning/teaching dynamic and community participation, acting as switchers from knowledge referential to another. Acknowledging the capabilities of participants in community work implies providing them with effective communication enablers to perform their capabilities and learn.

In the context of OSS projects, newcomers are typically the apprentices of project administrators and other peer members who answer their questions and provide them with information and clarification. They talk them through code production tasks, which imply framing and solving code problems and conflicts[43], as well as discussing requirements and addressing use concerns across inter-organisational memberships. Apprentices apply their capabilities to the tasks at hand, making informed decisions with high degrees of autonomy; yet they are also 'tutored' by more experienced members in an ongoing dialectic of post-exchanges and problem solving processes (Ye and Kishida 2003). Thus, learners are able to contribute at learners' levels and at the same time still produce knowledge that can be learnt by others. Participation implies therefore enabling members to recursively act as learners and teachers simultaneously (Lakhani and Wolf 2005; Lakhani and Von Hippel 2003).

From this perspective, participation is not merely a one way interaction. It is a product of members' exchanges. Help given to a person is reciprocated by someone else in the group –not necessarily by the person who was helped in the first place (Lakhani and Von Hippel 2003). Lakhani and Von Hippel (2003) described how members interact, work and solve problems in the case of the Apache Operating System (Lakhani and Von Hippel 2003). They argue that Apache users often post their questions on appropriate Usenet discussion forum. Members read both questions and receive answers; they then add new elements accordingly, making posts grow into discussions. Gradually, apprentices' influence in task processes increases, as they sustain their participation and contributions to the source objects and its platform, their roles and relation to other members also change (Ye and Kishida 2003). Their position in the network is not definitive to the extent that it depends on their future exchanges and interactions.

Conclusion of the Chapter

To conclude this chapter, the OSS biography approach is derived from Simondon's ideas on the individuation of technical beings and Pollock and Williams' software biography. It emphasises a cultural, yet at the same time, technology-oriented understanding of software performance, which takes into account how code is produced and reproduced through use, affecting its performance and the social settings within which it is embedded. To do that the OSS biography approach adopts a long-term, displaced view to exploring software; it scrutinises the micro-historic processes of its development, retrospectively and stresses community participation. Community participation is defined as a heterogeneous assemblage of participants, practices and technologies, which must coalesce into a continuous and collective meaning negotiation, contributing to code gradual concretisation, just as it is used and reused; hence the OSS biography exemplifies how open code matures and crystallises over time or fails to do so.

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[43] Conflicts are interpreted as a form of a dialectic approach which implicitly cultivates reflection and pushes meaning negotiation among participants, and thereby act as a stimulating mechanism which facilitates learning (Walz, Elam, and Curtis 1993).

From this perspective, the OSS biography offers both a holistic view, as well as an emphasis on the microprocesses of open code production and interactive order (via the OSS platform) enabling the documenting of collective knowledge building and continuous redesign. Any modification, bug fix, or patch made to the system versioning not only evolves the code but redefines the roles and responsibilities of its community participants and their future capabilities; so code remains transient and evolving (Ye and Kishida 2003). This approach contrasts with views of software as a deliverable and a product that is defined by its design qualities. It also contrasts with social approaches that see software as a mere cultural token.

Accordingly, the OSS biography answers Pollock and Williams's call for a comprehensive and long-term view of software development. But it also extends it. It goes beyond the holistic focus (the biography), to show that community participation is the stuff OSS is made of; thus its study cannot be disconnected from the transient instances of members' collective knowledge negotiation that co-constitute it. Furthermore, these collective instances are also material arrangements, enabling code development over time and are recursively co-produced by it. From this perspective the OSS biography is not only a global process of code development that is materialised by a history of releases and local implementations. It is also a study of the socio-material arrangements that enable software production, use, maintenance and upgrade over time.

OSS Biography

-**Community Participation**

Community:	Epistemic; plurality of views/practices; heterogeneity
Participation:	Expertise; empowerment; collective meaning; transformation

-**Materiality**

Code:	Incomplete; interactive; re-combinable utility
Platform:	Duality: Interactive/structuring

Learning and Knowledge Production

3. Methodology Chapter

3.1. A Single Case Study Design

3.1.1. Virtual Data and OSS Studies

Online data repositories and related web 2.0 technologies are valuable sources of information to study open source code production. Increasingly, software packages and especially OSS projects in particular, are associated with several host websites, collaborative systems and open online repositories including chat rooms, forums, mailing lists (MLs) and code versioning tools (Jensen & Scacchi 2004; Koch 2007; Paulson et al. 2004). Through hyperlinks and cross references, such online spaces gradually interwove into forming virtual platforms, hosting and enabling the on-going development of open software solutions and supporting their maintenance over time (Frécon et al. 2001).

Virtual data in OSS platforms are though a double-edge sword. On the one hand, it is a substantial mass of accessible open data, which creates a motive for research in itself, requiring no prior hypothesis. It is increasingly approached in the social sciences through data mining techniques and analytical algorithms, like R (Mackenzie 2012) – including OSS scholars (Koch 2007; Mockus et al. 2002; Robles et al. 2005; Jensen & Scacchi 2004; Succi et al. 2001). On the other, online data artefacts are versatile objects whose meaning can elude the analyst if de-contextualised; their amalgamation in datasets and log aggregates is controversial, particularly with regard to informing the long-term development of open code[44].

Many scholars studied open code by documenting code logs and commits -looking at code change and its performance evolution (Fenton and Pfleeger 1998; Pressman and Roger 2009; Findlater and McGrenere 2010; Mockus, Fielding, and Herbsleb 2002; Rifkin 2001; Raymond 1999). Code logs automatically generate records/posts which are amassed in multiple web archives and indexed according to their dates, size, developers' login, number of modified files, download rates, lines of code, etc. Based on these indexes, analysts have designed increasingly elaborate data mining programmes to retrieve, compile, run statistical tests and identify criteria of code success, its quality and its growth (Robles et al. 2005; Succi, Paulson, and Eberlein 2001; Scacchi 2003; Godfrey and Tu 2001; Jensen and Scacchi 2005; Paulson, Succi, and Eberlein 2004).

[44] Different web repositories yield different types of data requiring different data collection techniques and underlying epistemologies (Jensen & Scacchi 2004). Analysts must achieve informed choices as to what type of online data to go for and what data artefacts best capture interesting aspects of the development process. The scope and the approach required also need to be framed, depending on the age, size and complexity of the virtual platform and its related software code and solutions (Ibid).

One problem with data mining is that it can eventually lead analysts to relax their research standards in order to collect comparable data across hundreds of OSS projects (Hovy et al. 2001). Data mining also encapsulates a certain degree of arbitrariness because of lexicographical differences between communities and projects and clustering issues (Ibid). These reasons notably explain why certain studies kept a certain degree of generality, overlooking the complexity of the OSS long-term development processes. Besides, code logs measures are a type of data that can easily lead the researcher to believe in its 'objectivity' reasserting a somewhat blunt code materiality over other aspects of its social production. In this sense, it is not clear how a statistical analysis of code log measures can provide insight into the social dynamics of software development and participants' participation over time.

In fact, scholars have often represented OSS projects as exclusive communities of programmers, whose number (Krishnamurthy 2002) , individual qualities (Lerner and Tirole 2002; Lerner and Tirole 2000) or/and code (Mockus, Fielding, and Herbsleb 2002; Robles et al. 2005) determine code performance. Methodologically, their focus was therefore centred on code and its intrinsic properties, paying little attention to interactions between users and developers and the interplay between different pools of software expertise. I argue that such approaches encourage researchers to understand code as design, shying away from integrative approaches that conceptualise software as a mangle between use and continuous design and inherently social (Mackenzie 2006). Thus, this thesis design suggests a methodological approach that breaks with a tradition of studies which conceptualises code as the sum of its features and nothing more.

3.1.2. Research Scope

This thesis studies the long-term development of open source software based on a unique case study design that underlies an Interpretive IS tradition. First, similarly to many OSS studies, this thesis' selects as site of observation the virtual platform of an open source project, named Mifos. A virtual platform is the associated social 'milieu' of open source code (see previous chapter). It is an online habitat, where OSS community members interact, input code, exchange opinions and generate contributions, and where they can exchange mutual assistance through cycles of 'try it, and let me know how it works for you'.

Gradually OSS virtual platforms start to amass more and more process-based data, i.e., code logs, newsgroups archives, chats and discussions threads. These reveal community dynamics and a continuous flow of updated use patterns (Jensen & Scacchi 2004). As data builds up, the software virtual platform becomes a major source of local knowledge for the software community, enabling participants to search, emulate and integrate their own contributions (Von Hippel 2005a, p.96). Because of its vital social role, it is hard to disentangle the virtual platform from the on-going production of code; code is an extension and outcome of the virtual platform and so it is also a key component of its long term performance that must be studied in its biography.

In this case study, the Mifos platform is also a lively and mature cultural habitat for the code which has been running for many years (since 2005). It has saved the traces of real time exchanges between Mifos participants, making a point of encounter between the online and the offline, and rendering it visible for us and textually meaningful (Hine 2000, 83). For this reason, I selected Mifos mailing lists (MLs) as a proxy to study Mifos[45]. Mifos MLs are an important communication hub in Mifos platform that reflect a substantial part of the 'capillary' waves triggered by members' code commits, social events, and other production practices. Posts are hence 'data ripples' that contain elements of the gradual concretisation of the source code and provide analysts with a 'retrospective' road map to study software long-term development.

My approach to study Mifos encapsulates three stages. First, it aims at "mapping" Mifos MLs i.e. providing a visual image of its interpersonal communication networks (node-ties configurations) and studying its structural aspects (Smith & Wesley 2004; Sack 2000; Sack 2001). Second, it creates a longitudinal narrative that describes major steps in Mifos life performance and connects them with changes in the MLs over time. The third and final stage studies the content of selected posts and conversations across the project's MLs in order to inform some of the mechanisms underlying members' participation and contributions to the Mifos project.

Several decisions about this research design as to the type of online data collected and its time scope, the choice of a single case study design, as well as the blend between qualitative and quantitative methods combine to make it contribute to a more comprehensive and long-term view of software development. In the remaining of this chapter I try to articulate these particularities and highlight dimensions of this study's epistemology, notably as to the utilisation of the three different approaches and their integration into making a three-stage Mifos biography as well as the rationale for using this methodological scaffolding.

3.1.3. Case Study and Interpretive IS Research

Views that describe what a case study is are frequent in the social sciences and particularly in IS Studies. Many scholars agree that case studies are the preferred research strategy to answer 'why' and 'how' questions (Walsham 1995) – for examples: (Benbasat, Goldstein, and Mead 1987; Eisenhardt 1989; Klein and Myers 1999; Yin 2003a; Yin 2003b; Myers and Avison 2002). In this regard, this thesis seeks to document 'how' Mifos production and use co-develop over time and 'how' sustained community participation influences the becoming of code objects.

[45] MLs are also called newsgroups: A terminology that is used by the Computer-Mediated-Communication (CMC) scholarship which has studied all sorts of online newsgroups on all sorts of topics, including users' MLs and developers' newsgroups.

This thesis also argues that the use of quantitative, visualisation and qualitative tools in case study design is not only possible, but it is in this case highly synergetic[46] (Eisenhardt 1989). Particularly, the use of sociograms –as visualisation tools- does not conflict with this research epistemological underpinning; rather it provides additional capabilities to enable an in-depth examination of Mifos production processes in order to unearth embedded and contextualised social meanings. Based on that, the Mifos biography adopts many of the considerations underpinning the philosophical basis of Interpretive Case Studies[47].

First what I call **data** in this study is my own construction of people's opinions, views and their online records of their practices and routines (content of posts, blogs, social network profiles etc.) as they were expressed by them and systematically stored by Internet-enabled tools on a routine basis. A part of this research data has also emerged from momentums of interactions between me and certain research participants (interviews) and so they encapsulate a first layer of a negotiated and constructed exercise of sense making that is specifically established by the setting of this research.

For example, the network-maps, or sociograms that I illustrate in Analysis Chapter I are somewhat a second-order construction (Van Maanen 1979). These are based on collected data from Mifos MLs online (first-order data). Yet their reading and interpretation rely on the theory of Social Networks Analysis ('SNA'), its measures and related-concepts. Its purpose is to describe the posting activities of Mifos and provide a synthetic overview of the MLs' content and actors' positions and relations –see next section of this chapter.

Along the same line, Mifos subscribers' illustrations in Appendix 5 –which underpin my qualitative examination in Analysis Chapter III - are a second-order construction that is based on the content of selected posts and message threads (first-order data). Similarly to sociograms they are infused by theoretical concepts, which aim to make their reading more insightful and relevant to the research's objectives.

Another major feature of the anthropological tradition and interpretive IS research is their concern with '**thick descriptions**' (Walsham 1995). Analysis Chapter II is in this sense a heavily detailed narrative that traces the genealogy of Mifos. It pulls together several actors and their individual stories from various data types like online data, interviews, and message snapshots, making Mifos it a global, and inter-organisation narrative, which looks simply like Mifos life itself (Czarniawska 2004, p.3 citing Barthes 1977 p.79). Yet, the impression of richness and dynamism is the product of the combination between the three analysis chapters, insomuch that the two other methods

[46] "the qualitative data are useful for understanding the rationale or theory underlying relationships revealed in the quantitative data or may suggest directly theory which can be strengthened by qualitative support" (Eisenhardt 1989, citing Jick, 1979)

[47] I rely here on Klein and Myers' understanding of Interpretive Research (1999) that is research which assumes inherently that our knowledge of reality is gained through social constructions, such as language, shared meanings, documents and technologies and does not predefine dependent and independent variables (Klein and Myers 1999).

(in Analysis Chapters I and III) complement Mifos narrative by adding the global overview of its community and a glimpse on members' exchanges and activity in the MLs. Together, they contribute to reinforcing an impression of a dislocated (not space bound), longitudinal, and inter-subjective exploration of the Mifos biography (Pollock & Williams 2009).

Often organisational studies narratives provide situated details about participants, their roles and their practices, which the same level of granularity, for example the study of routines (Pentland and Feldman 2005) or interviews (Bauer & Gaskell 2000, p.38; 57; Flick 2006, p.149). Instead, this thesis' three Analysis Chapters move between different angles, constructing each time a new method with a different unit of analysis, so in the end they look like different analytical cuts, which are yet part of the same long-term view.

By so doing, the three-stages scaffolding of this thesis "translate" this phenomenon's multiple and complex social structures that are superimposed upon and knotted into one another following the same objective pursued by the authors of organisational narratives. It also seeks to reveal their negotiated and emergent meaning making them more intelligible and easier to read for others (Walsham 1995).

Finally, what makes this research interpretive in the first place is its **epistemological stance**, concerned by the way knowledge is constructed and conceptualising the ontology of knowledge objects –OSS, its platform and code objects- as the emerging and gradual outcomes of a collective negotiation of their meaning –including by the same token the researcher's retrospective assemblage (Hacking 1999; Hacking 2002; Czarniawska 2004).

In fact, the OSS biography framework acts like a 'theoretical' infrastructure for this study (Walsham 1995) –which is supported by this three-stage approach. The latter provides a long-term scope of software code production (through sociograms and time intervals), emphasising negotiation and emergent micro-historic development processes (particularly in analysis chapter III). Second, the OSS biography dimensions (code, community and participation) are empirically grounded through the construction of the Mifos virtual platform (in Analysis Chapter I), the stories of its participants (Analysis Chapters I, II and III), and the gradual transformation of its code objects (Analysis Chapters II and III).

This thesis' conceptual framework is though, only an underpinning; it is on purpose loosely coupled with the Analysis Chapters, preserving a considerable degree of openness in the reading of data (Walsham 1995). I also tried to refrain from imposing ready-made concepts and encouraging methodological originality –in terms of visualisation, triangulation and the design of the dislocated and long-term effects. Gradually, the analysis and overall discussion are refined, incrementally focusing on particular aspects of community participation as they became clearer and crystallise.

From this perspective, the analysis process is bound to evolve through multiple and successive interplays between the parts and the whole, slowly tuning competing meanings according to the global context of the study (Heidegger 1962, 191–195). It can be said, that the design of this case study is sympathetic with the case's spirit; the analysis process relies on the researcher’s methods, incremental advances and her journey towards its concretisation thereby avoiding an instrumental (and taken-for-granted) conceptualisation of what this thesis is and what it is not –although there is a clear effort at conceptualising the OSS biography. This demarcates it also from Grounded Theory and its principle of the researchers starting field work with a minimum of theoretical luggage (Strauss 1998).

3.1.4. Objectivity, Validity and Ethical Considerations

3.1.4.1. On Objectivity

Participants’ virtual traces on OSS platforms are a primary source of data for this thesis. This data is generated by web 2.0 technologies and communication tools that are associated with code production, enabling participants to manipulate code commits, collaborate and share; this data is also routine-based; as it is recorded daily and stored in online repositories, it is often available in large and uniform datasets. In this case, I particularly examined post exchanges in combination with additional empirical material like interview transcripts, online news, personal notes, and internal documents in order to recreate context (Hine 2000, 8–13) and justify a qualitative examination (Mason 2002, 3–5) of Mifos long-term development. Such a combination is important to “develop an enriched sense of the meanings of the technology and the cultures which enable it and are enabled by it” (Hine 2000, 8).

Choices about the nature of the data sources selected and how the methods were conducted are partly explained in the next section of this Chapter and partly in the three Analysis Chapters. Here, I would like rather to open a parenthesis on the epistemology of posts and examine it with regard to that of interviews[48]. Posts enable community members to socialise, exchange information and collaborate (Diani & McAdam 2002; 2003; Monge et al. 1998; O’Mahony & Ferraro 2007; Mockus et al. 2002). They thus contain information about, the software and its code objects, as well as community dynamic.

Typically, a post stands for its sender and holds its individual and differential stamp (Turner et al. 2005); it expresses her views and perceptions of her action in relation to others and to the social structures where she is embedded. Posts that are sent in reply contain in their headers the reference to the ‘father’ post and its related parent(s); hence posts often pinpoint a series of connections, or opinions that are inter-associated; these are also called "conversational threads" (Turner et al. 2005).

[48] Interviews are the main source of data in qualitative approaches, hence my motivation to explain why interviews are only a secondary data source in this thesis and a complement to MLs’ posts.

Conversational threads and posts reflect instances of collective meaning negotiation; they are inter-subjective representations of subscribers' communicative actions and embody their collective understanding (Habermas 1981, 1:309–310) –Analysis Chapter III articulates this idea and goes a step further in showing how post-exchanging is knowledge generative and transformative of social interactions. Also, mapping inter-personal connections among Mifos subscribers based on their post-exchanges patterns endows the community with substance, showing them as materially bound and interconnected (Monge and Contractor 2003, 44).

By contrast, interviews are a proxy, which enable researchers to access the meaning that participants assign to what they do and how they do it. From this perspective meaning is changing as participants often have emergent interpretations of their roles and actions in social systems (Heidegger 1962, 41). Interviews do not provide though, "free" access to participants' minds. They create a communication interface between the researcher and the participant that influences their mutual perceptions and what they say. In this regard, participants and researchers are "**a common enterprise in knowledge production**" (Czarniawska 2004, 47) in which interviews are a product of the interaction – that is dependent on the circumstances of their production (Mason 2002, 40–41; 68).

Both interviews and posts are thus inter-subjective semantic devices that convey emergent and negotiated social meanings. Interviews build meaning as participants develop collective understanding of their social structure and a punctual co-understanding with the researcher. In contrast, posts reveal meaning once participants exchange with their peers. They are infused by their authors' expertise and affected by prior conversations. Thus posts are the outputs of situated interactions, whose existence is not solely influenced by the researcher's persona. However, studying posts implies tweaking and processing; this means that such a data is also dependent on the circumstances of its production.

From this view point data can hardly be factual; it is not reportable in any 'objective' or 'neutral' way; yet degrees of subjectivity and individual bias vary according to how the researcher has influenced what is happening in the domain of action. In this case, I 'interfered' with the content of the interviews –if only by the sharing of concepts and interpretations with the interviewees (Walsham 1995). In contrast, only the act of the visualising subscribers' interpersonal connections (Analysis Chapter I and II) and analysing posts (Analysis Chapter III) has affected my analysis of post messages.

Accordingly, I consider interviews as a second-order data (Van Maanen 1979) whereas posts are first-order data, because less 'subjective'. Whether posts or interview transcripts, the way we process data is though influenced by our lived experiences and interests (Mason 2002, 68); we do not face pure facts, but interpret them and co-shape their meanings. This meaning gradually crystallises (fact-like) as we build our chains of evidence[49] (Latour 1999, 24–79), publish, and align with a legitimate order (Walsham 2006); hence the importance of scientific validity.

3.1.4.2. Scientific validity and Combining Quantitative and Qualitative

> *"By combining multiple observers, theories, methods, and data sources, sociologists can hope to overcome the intrinsic bias that comes from single method, single-observer- single theory studies."*
>
> Norman K. Denzin (1970, p.313)

Proponents of merging methods subscribe to the idea that quantitative and qualitative should not be viewed as polar methods (Van Maanen 1983). For instance, Fry and others (1981) argue that merging quantitative and qualitative methods leads to a more complex, costly, and time-consuming research design. Yet they also say that such a combination promises 'excellent possibilities', as it is expected to unravel deeper and more articulated research objects (Ibid). In a way, the authors seem to encourage such a combination; knowing there will be an extra cost, researchers are still better of with the best of two worlds –the precision and rigour of measures, methods, and context (Fry, et al. 1981; Kaplan and Duchon 1988).

Traditionally, combined methods studies first start with qualitative research to explore and develop a general understanding of the field study (Kaplan and Duchon 1988). Then they add a quantitative dimension to their questions; they refine their conceptualisation and reduce overdependence on too many variables, trying to be more precise about the extent or spread of a given phenomenon in a particular context. So, the two approaches remain completely separate, yet their conclusions are complementary; the first (qualitative) is used to supplement and leverage the results of the second (quantitative).

However, my experience in this thesis is different; my use of SNA measures in analysis chapter I was essentially descriptive –as data filters; it meant to enhance sociograms' layout and make their social divisions clearer. Second, I made the sociograms' analysis (based on SNA), coalesce with the longitudinal narrative and message content analysis, following an interpretive epistemology. This thesis therefore remains essentially qualitative[50], in terms of its conception, underpinnings and philosophy. By articulating and looking at the concept of community participation from different perspectives, it emphasised the inter-subjective meanings held by actors and documented how they shaped their behaviour ordinarily (Kaplan and Duchon 1988). The combination of quantitative and qualitative methods hence only aims to increase the robustness of results and guarantee triangulation (Denzin 1970, 297).

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[49] Circulating Reference (Latour 1999) describes the process through which empirical evidence is gradually transformed into text, symbols and figures, then again transformed into a publication.

[50] In a way, it could also be said that I limited on purpose an extensive statistical approach based on SNA in order to remain essentially descriptive and exploratory

- *On Research Validity*

This research adopts three methodological approaches that abide by their own production rules, which will be explained in detail in section 3.2. What I want to do here is provide some clarifications about the research's overall validity –as an integrated three-level design, which is based on a unique case study and abiding by its validity criteria (Klein and Myers 1999; Myers and Avison 2002; Yin 2003b). In this regard, Van Maanen (1989) reminds us that establishing validity in the eyes of a reader is part of the art of persuasion, and is as much a matter of rhetorical style and flair as it is of accuracy and care in matters of theory and methods (Walsham 1995). From this point of view, the first aspect of validity remains very much a matter of individual skill; yet this is co-shaped by the process of reading, which itself, depends on many exogenous criteria that the researcher cannot entirely account for. The second part of Van Maanen's argument is though more 'transparent' and I believe it is relevant in this research case in particular.

In qualitative research validity is a sound, and consistent relation between data and theory (Mason 2002, p.39; Klein & Myers 1999; Lee & Baskerville 2003; Bauer & Gaskell 2000, p.336; Yin 2003b, p.36). This can also be assessed[51]. Research validity can be for instance examined on the basis of how researchers build chains of evidence (Latour 1999, 24–79) –that is the methods and constructs that the researchers associate through the empirical study. It can be tested on the basis of how thoroughly it is documented and the extent to which it makes the research 'reproducible[52]' (Klein and Myers 1999; Yin 2003b, 38). Also the choice of the data, its nature, accuracy and consistency strongly influence this link (between research and method) and the extent to which the chain of evidence sounds consistent and valid to the reader.

To answer potential concern about this research validity, I would like to share some of my decisions with regard to data collection and interpretation. First, with regard to interviews, I would like to note that I tried to 'protect' interviews' validity, by reducing 'the researcher's bias' in interview settings. I would for example, briefly introduce the objective of the research and ask questions at the beginning of the session, keeping the idea loose and non-articulated; I would also minimise my comments during interviews, to induce informants into monologue. This was particularly the case for interviews during my pilot study, as I tried to glean as much information as possible –with regard to informants' roles, background knowledge and IT capacities. Sometimes, I also asked focused questions to double-check information or to contrast other participants' arguments; also when I interviewed the same person more than once over a long period of time, my questions would gradually become fine-tuned.

[51] Quality Qualitative Research is important, although quality criteria must not be applied in a deterministic, and mechanical way because of the emergent and negotiated nature of interpretive research (Klein and Myers 1999)

[52] Replicability is not to be understood as in quantitative research; a research setting is unique and defined by the qualities of its production process, interview settings, etc. But, constructing a valid and reproducible research is a matter of being accountable and rigorous in terms of research methods used.

Another important decision with regard to research validity is about triangulation (Cox and Hassard 2005) and my choice of methods and various data sources. Triangulation enables researchers to contrast methods and data types so as to reflect emerging findings and double-check ambiguities and unclear information (Ibid). Throughout this analysis, I tried that the same construct (community participation) is examined again and again and rearticulated through different perspectives, methods and data types –at the same time, these remain connected as they contribute to the same final objective and aim to develop a long-term view of software development and the Mifos biography in particular.

Although the terminology of triangulation is not sympathetic with interpretive qualitative research[53]; it is I believe an important concept. Walsham (2001, p.7) argues that interpretive research is open to a multiplicity of views and social meanings, as it does not seek to establish 'the truth' about what participants ought to perceive or say – which might contrast with the idea of triangulating. However, triangulation should not be understood as a method for 'fixing position' and overcoming problems of researchers' bias (Cox and Hassard 2005). It is about capturing a more holistic and contextual portrayal of the unit(s) under study (Cox & Hassard 2005, citing Jick 1984, pp.365) and a way to strongly substantiate constructs and theory (Eisenhardt 1989) – which is what I seek to achieve in this thesis.

In this sense, the findings of my three Analysis Chapters triangulate each other, because they are analytically complementary (Eisenhardt 1989); their different perspectives increase the likelihood of capitalising on any new insight in the data (Ibid). Ambiguities that might result in certain data types are also clarified and cross-checked by different informants, other sources of data, or different data artefacts (Mason 2002, 25). Throughout the analysis, the analysis is substantiated by data that represents a plurality of views and a longitudinal scope. Particularly, in Analysis Chapter II, data stems from different sources and bears different textual and graphical representations that give a sense of the richness, the maturity and the diversity of the ecosystem that is under study, and grounds the biography of Mifos in an ethnographic-like, thick narrative.

A final point in relation to this research validity deals with the intrinsic nature of qualitative research that is of being primarily a contextualised study. Context is about resituating phenomena in their social and historical contexts and documenting how they emerged, transformed and persisted (Klein and Myers 1999). In so far as the 'subject matter' is treated as a unique historical occurrence –which gradually acquires situated and contingent properties- the interpretive researcher must constantly journey from the particular to the general, from concepts and ideas to particular situations (empirical descriptions) (Klein and Myers 1999). The key point here is that interpretive narratives are always designed with the intention to provide theoretical insight –demarking them from simple anecdotes.

[53] Klein and Myers (1999) replace it with the notion of suspicion, and I find this meaning close to that of triangulation here. The authors write "…what is at stake here is not the truth or untruth of the claims"…[but] "the effects of socially created distortions…" [that these cause].

From this perspective, the illustrations that I provide in Appendix 5 and their associated analysis in Analysis Chapter III, the MFIs' cases and the socio-political context of their countries in Appendix 1, as well as the sociogram-text montage in Analysis Chapter II, contribute to deepening the reader's understanding of the Mifos project's context and community participation over time. They also produce a longitudinal view of the development of open source code objects and an interplay with dislocated settings of production and use, providing an alternative view of open source software, which also conceptualises OSS' 'potential' and extends OSS design-based definitions.

To conclude this section I would like to note that 'context-driven' research necessarily triggers an interrogation about "generalisability" (Lee & Baskerville 2003) and the scale of the insights provided. Yin's answer suggests for example that case-study-based research aims at the development of concepts, the generation of theory, the drawing of specific implications and the contribution with rich insight (Yin 2003b, 10). He writes, "case studies like experiments are "generalisable" to theoretical propositions and not to populations or universes" –analytical generalisation (Ibid). From this view, the Mifos biography although, inherently contextual, aims at the same time to make some insights 'transportable' to other settings. More importantly, it provides ground for a reflective, long-term view of software development that deepens our understanding of code and software (Eisenhardt 1989). It thus creates a construct that is necessarily alternative[54].

3.1.4.3. Ethical Considerations

- *Informed consent*

I strictly conformed to the requirement that interviewees should be informed about the purpose of their interviews, this research's interest and my motivation to include their content partially or entirely as part of this study. Interview data that was not anonymous –notably in Analysis Chapter II- is presented with the consent of their authors –who were also sent a draft of this chapter and reviewed its content; they later emailed me their suggestions which I took into consideration.

This thesis also includes content that is based on a substantial number of interviews that I conducted across five countries in the MENA region –details about the number of interviewees and the informants' types, the context of the interviews, and their details are also documented in Appendix 1. This empirical material is the result of a pilot study, which has framed the context of this research and directed my attention to relevant issues. The participants are not identified individually. The information that I received from them was amalgamated in a narrative that does not contain specific quotations and does not refer to specific persons –see Appendix 1.

The only exception to personal identification of interviewees is situated in an illustration that I present later in this thesis (Discussion Chapter). This is constructed based on my personal notes during a work meeting that I attended in Morocco, as well

[54] By contrast to more deterministic and design driven software conceptualisations.

as the interview transcripts of a group of its participants. These were duly ‘anonymised’ to protect the confidentiality of participants’ answers. The context of these interviews, the research site selection, the reasons for these choices and the number of people interviewed are all detailed in the illustration in the Discussion Chapter. Finally, given the plurality of purposes behind interview transcripts, I explain my approach to interviews in context later, as I move along the three Analysis Chapters.

❖ *Online Data and Anonymity*

Many social scientists recognise the potential of online data, such as social network data, online archives etc.; they are thrilling for researchers, who now can ‘replay’ and lay back to ‘watch’ the ‘ephemeral dynamic of ordinary life’ –as it is recorded online (Kleinberg 2008). For many, this amounts to witnessing “a revolution in the measurement of collective human behaviour” (Ibid). “A measurement revolution is an exciting time”, as Howison et al. (2011) pinpoint, “but it is also a time that calls for reflection…, especially when methods developed in one context are applied in new contexts” (Howison, et al. 2011). One major issue is the ethics of online data, or the extent to which researchers are eligible to reference open data for which no consent is obtained (Ibid). This is particularly relevant here, where a large chunk of my empirical material is available without restrictions in the public domain –open MLs, blogs, social network profiles, and online news.

Academics, like Moor (1985) denounced the policy vacuum with regard to studying online data, stressing that social scientists often find themselves in situations, where there is no proper policy of conduct (Moor 1985). Zimmer (2010) highlighted that ethical concerns include privacy, anonymity vs. identifiability, consent and harm to human subjects (Zimmer 2010). Zimmer’s ethical point of view is legitimate on the basis that teens and students’ profile data collected from their Facebook accounts puts their privacy at risk[55].

Zimmer’s case made headlines and raised difficult issues for scholars; whether public data can be used for research? What are the best ethical practices for researchers? And is there a way to assess the eventuality of individual damage (Boyd and Crawford 2011)? All these issues are relevant and deserve to be acknowledged in this chapter; even though I try to be cautious in this respect, I cannot fully foresee potential negatives that might affect the future personal situation of involved individuals (Ibid).

I note though that the data collected for this research is of a much less sensitive nature to the extent that individuals are identified on the basis of professional attributes –organisational affiliations and involvement in the Mifos project- which they themselves sought to diffuse and make public. Indeed, this data is associated with participation in

[55] The paper describes the case of the T3 research project [‘‘Social Networks and Online Spaces: A Cohort Study of American College Students’’, http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0819400] where an important dataset of Facebook data –which was previously anonymised- was breached and the identity of the university and its students revealed.

open source software production and the idea that volunteer developers release personal information and their involvement in OSS projects on the Internet[56] in order to let their experience, skills, contributions, etc. be known and attract future employers and work opportunities.

From this perspective, I did not seek to 'anonymise' this data, knowing that ‘anonymous’ members can still be traced and identified relatively easily[57]. More importantly, I only kept references to members’ involvement within the facts already disclosed in the public domain to point to structural aspects of their participation and changes in their positions in the sociograms, to make sure that no opinions expressed in this thesis can cause personal damage.

Finally, several members of the Mifos project’s founding team were informed about my research, as I have personally contacted them on many occasions[58]; two were also sent a draft of Analysis Chapter II[59]. In their replies, none of them raised any data anonymity issue. This is also linked –I believe- to the ‘philanthropic’ dimension of this OSS project and their interest in attracting more participants to the ongoing development of Mifos and the ‘cause’ of microfinance NGOs.

3.2. Features of a Three-Stage Methodology

3.2.1. Mapping Sociograms

3.2.1.1. Mailing Lists, How to Make Sense of Them?

Mailing lists (MLs) are a hybrid system, which couples broadcasting and interpersonal communication capabilities (Himelboim et al. 2009). Posts get broadcast to the entire newsgroup, whereas their authors still perform interpersonal connections, replying to one or more subscribers’ posts or addressing them directly. Messages and replies posted collide into conversational threads –i.e. collections of messages associated with one another through a pattern of replies (Smith & Fiore 2001). They are the basis for subsequent and new interactions, which slowly grow into **a large scale persistent conversation** (Donath 2002; Erickson and Herring 2005). Post-threads are transportable, re-combinable and searchable. Once downloaded by newsreaders they are stored as files that can be accessed later. Thus, MLs convert fleeting interactions into durable and interconnected threads informing the OSS development process overall. They answer who is talking with who; who are the central players in the OSS community; what are the key discussants and conversations, etc. (Sack 2001).

[56] Through general professional websites like LinkedIn, or specialised social networking websites for OSS developers, like *www.**ohlo**h.net or the https://github.com/diaspora/diaspora*

[57] Mifos MLs are public archives that can be consulted by anyone. References to posts’ topic, date, or key words from posts’ content in this thesis should enable anyone to retrieve the post, and identify its senders through a simple Google search.

[58] By email, Skype or face-to face.

[59] The first person is the initial Mifos technical director and the concept founder; the second is the actual Mifos community leader after the Mifos transition in 2011 –see Analysis Chapter II.

However, newsgroups are also vociferous places that are difficult to read (Viegas & Smith 2004; Welser et al. 2007; Turner et al. 2005; Donath 2002; Sack 2001). The textual medium, the newsreader, that makes news messages so accessible, also makes many useful and communicative social patterns invisible, hence the question of how to make such data legible and visually meaningful. Indeed, newsreaders show limited visual capacity; they do not include valuable information about the authors of messages, their interpersonal relations and the patterns of their participation (Viegas & Smith 2004). Hence they hide the cues that aid social interactions (Viegas & Smith 2004; Welser et al. 2007; Turner et al. 2005; Donath 2002; Sack 2001; Boyd et al. 2002).

In addition, CMC scholars have argued that newsreaders not only fail analysts who seek to make sense of group dynamics and post-exchanges in and across newsgroups; but they also provide the discussants limited interfaces to monitor and visualise their participation while they post-exchange[60] (Donath 2002; Smith & Fiore 2001). Accordingly, CMC scholars encourage MLs' administrators and analysts to construct maps of the community conversational threads in order to render such online data legible. Also, maps bring to thousands of individual interactions, a visual and actual shape with a **clear sense of the collective** that would be less material otherwise.

3.2.1.2. Networks as Infrastructure for Exploration

Statistical analysis is a major method in the Social Sciences; people feel better analysing complex data with images rather than numbers[61] (Perer and Shneiderman 2008a). Data visualisation sometimes transforms abstract relationships into spatialised images, making interactions visible, whilst also representing numbers accurately (Boyd et al. 2002; Donath 2002). Visualisation creates a locus for storytelling based on an integrated geography of positions, roles and information (Fisher 2005). In this sense, visualisation is more than a picture; it generates a learning situation in which the image is used to provide insights for peers (Viegas and Donath 2004).

One common visualisation method, presents relations among participants using node-tie diagrams (Dunne & Shneiderman 2009). This is a classical network visualisation that is in use since the 1930s (Heer & Boyd 2005; Freeman 2000). A node in an SNA library is a representation of an entity (Hansen et al. 2011) –here an individual. Ties represent relations between nodes –in this case interpersonal posts. The substance of a tie is determined by its weight –i.e., the number of times A and B exchanged messages over a time interval. In SNA terms, this is referred as the strength of the tie (Granovetter 1985). Node-tie configurations capture post-exchange patterns.

[60] It is important to design visualisation tools for participants, because they allow users to see their own posting behaviour, providing incentives for more participation (Smith & Fiore 2001). They help users and newsgroup organisers build reputation systems which identify helpful/deleterious users and act accordingly (Welser et al. 2007).

[61] Kilduff and Tsai (2003) have argued that sociograms enable the researcher to stay close to the data, more than statistics can do. They cite Barley's study (1990) of a technology implementation in two hospitals and Mehra et al. paper's (1998) of marginality in underrepresented groups; they show that the second study gained from including the network pictures. These "… added a degree of realism largely lacking in the regression tables of the typical journal article" (Kilduff and Tsai 2003).

Node-ties visualisations are also called sociograms (Hansen et al. 2011). To build a sociogram, the researcher needs to translate users' posts into statistics of activity and encode them visually. This implies that posts must first be transformed into a dataset containing post frequencies and the identity of their senders and receivers –see Figure 11 in Analysis Chapter I. Also, a sociogram is a map that stresses the relational aspect of social systems. It is particularly suited for communication networks, emphasising the patterns of contact that are created by the flow of messages (Monge and Contractor 2003, 3). These appear as the result of performative structures, which are enacted by individuals and flows of information.

Drawing network graphs is a very time consuming task; it draws on prior knowledge of mathematics and graph theory[62] (Cartwright & Harray 1956). Recently, several scientists have designed software-based visualization tools and algorithms that would make visualisation a more approachable technique for social scientists (Perer & Shneiderman 2009). Many examples can be cited[63], such as the Newsgroup Crowds project, AuthorLines, People Garden, Treemap and Loom[64].

Many programmes have been used to plot the activity of authors and derive salient aspects of their authorship. For example, some projects differentiate between initiated and answered messages, establishing answer profiles and determining measures with regard to the number of participants' contribution, the intensity of their participation, the distribution of messages in time etc. In other cases, like the Netscan project (Smith, 1999) meta-statistics about newsgroups and authors are generated to facilitate comparison between newsgroups.

Innovation in visualisation approaches is a sign of pluralism in theoretical concerns and different research interests (Freeman 2000). Thus, visualisation projects often harbour substantial epistemological and conceptual differences, as they are seldom linear 'descriptions' of the ML's activity. Such visualisations are sometimes also complicated and abide by researchers' specific agenda[65].

A visualisation is packaged information that is based on choices that researchers make regarding research design, measurements and results (Hanneman and Riddle 2005; Dunne and Shneiderman 2009). In this study in particular, it is about exemplifying the posting behaviour and strategies of subscribers through their position in the network and the nature of their ties with other members.

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[62]Kilduff & Tsai argue that the use of sociograms in Social Sciences was first seen among social network theorists (Kilduff and Tsai 2003, 56). It is also known that it was influenced by three main sources: physics (Heider during the 1920s and 1930s), mathematics and anthropology of organisations (The Hawthorne studies in the 1920s).

[63] Websites such as INSNA and SMRF provide the state of the art technologies and guidance for researchers. http://www.insna.org/software/index.html; http://www.smrfoundation.org/category/technology/cultural-representations/

[64] (Donath 2002; Viegas & Smith 2004)

[65] Many of the visualisation projects mentioned pay little attention to nodes' interpersonal relations inside the same newsgroup; this is best captured by classical and in a way 'simpler' node-tie configurations, or sociograms.

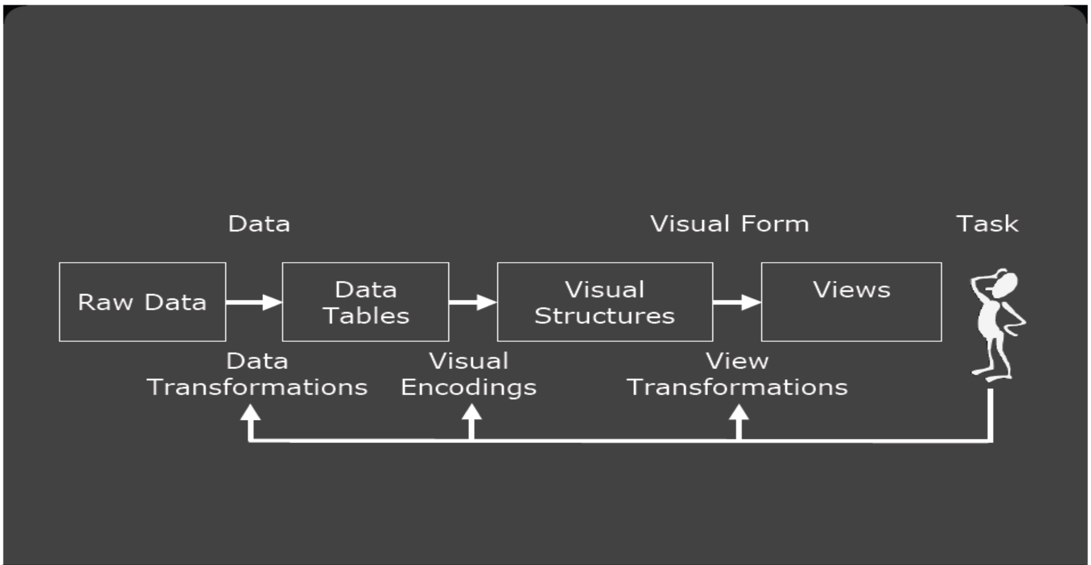
Indeed, studying sociograms is about examining the behaviour of subscribers and their relations; while some quickly reply, answer people, stir conversations and so build a reputation as moderators; others are less virtually present, post few messages or might only write to throw in a question. Visualisation thus enables analysts to get a sense of network divisions, people roles and strategies from the sociogram, amplifying the visibility of the social cues that make the network (Himelboim et al. 2009).

Sociograms put forward an overview of the whole collective, a synthetic view of subscribers and their posts that cannot be properly visualized otherwise. From this perspective, network visualisations are an **infrastructure for exploration**. They prelude and facilitate an in-depth qualitative investigation, although they do not aim to explain community participation and software projects long-term development; in this sense they lay down potential paths for further examination (Diani 2002, 174)

3.2.1.3. Epistemological Considerations

Hermeneutics and Mapping Characterisation

Mapping interpersonal connections between subscribers is just a starting point in the analysis; it opens a point of access in the data by creating landmarks, and amplifying divisions or groups that hence become visible. Before I move on to the other two stages of this research design, I would like to describe the characterisation of the MLs' mapping process, reflect on its epistemology and that of the mapping tool that I used. The characterisation of MLs' mapping is about creating a road map for the analyst; this is captured by the figure below –see Figure 5.



Source: **A Brief History of Data Visualization** - Stanford University 2010 -by Jeffrey Heer

Figure 5

Despite the linearity of the mapping process in Figure 5, the tasks necessary to create and interpret sociograms are not necessarily sequential (Perer and Shneiderman 2008b). Building sociograms often implies having to alter the dataset, adjust visual properties, refine filters and modify network layouts, constantly modifying goals and questions (Ibid); in many ways it is a learning curve, going through circles of trial and error, which gradually refine the output, provide clarity, and facilitate interpretation. In this respect sociograms' characterisation entails a hermeneutic[66] circle. It is similar to qualitative methods to the extent that it emphasises the exploratory and gradually constructed nature of this process.

Accordingly studying sociograms moves the researcher from "a precursory understanding of the parts to the whole and from the global understanding of the context back to an improved understanding of each part" (Klein and Myers 1999). Following this line of thought, papers that studied the behaviour of social scientists –who use sociograms and SNA tools - have reported frequent switching between tasks and data interfaces such as statistics tables and network pictures. They believe that this shows the uncertainty of the characterisation process and the analyst(s)' constant efforts to make sense of the parts through the whole and vice versa (Bonsignore et al. 2009; Viegas & Donath 2004; Hansen et al. 2009) –see Figure 6.

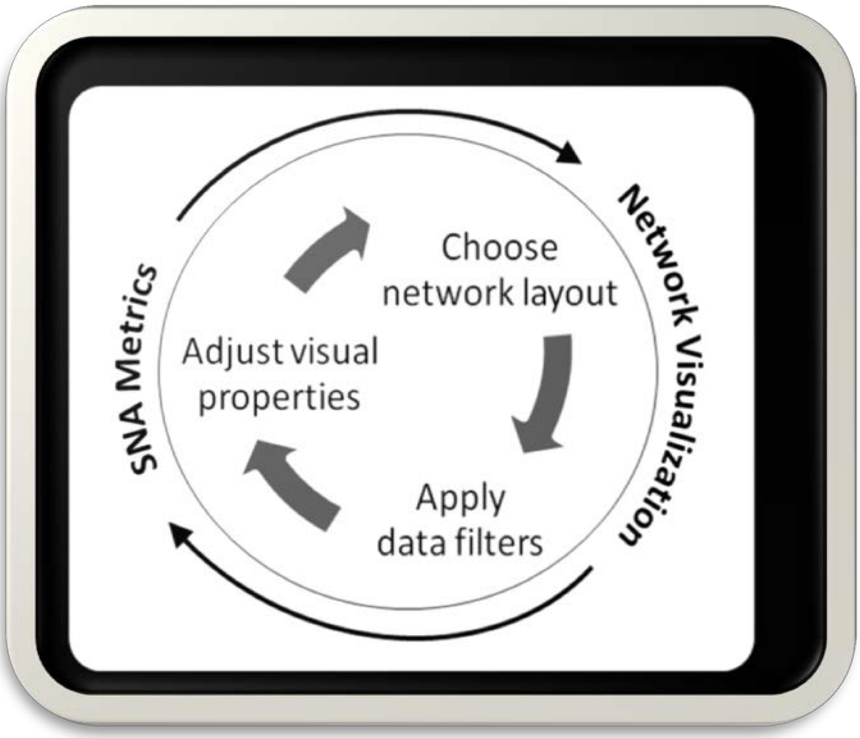


Figure 6
Source: Hansel et al. (2008)

Epistemology of a Network Visualisation Tool: NodeXL

[66] This notion refers to Klein and Myers's definition of hermeneutics that they relate to Gadamar's (1976) in "the Historicity of Understanding." The authors argue that we understand complex whole things from 'preconceptions about the meanings of their parts and their interrelationships'.

This study is supported by NodeXL, an open source network visualisation add-in for Microsoft Excel. It allows existing users of Excel to take advantage of enhanced graphical capabilities on top of its common features –without any programming involved. It extends the Excel spreadsheet file into a network analysis and visualisation tool by inscribing a library of basic network metrics, such as centrality measures and elementary clustering (Bonsignore et al. 2009).

NodeXL has four combined interfaces: three worksheets on the left –serving respectively as 'edge list', 'node list' and 'clusters'- and a graph panel on the right (Hansen et al. 2009). The edge list contains all pairs of vertices that are connected in the network. The node list displays information about the nodes, both based on the properties of relations and intrinsic features. Finally the cluster worksheet contains information about the visual display of the groups in the sociogram. NodeXl layout offers analysts the advantage of dynamically linking the data spreadsheet view and the graphic layout view. Clicking and changing one object in the graph will thus select and automatically change related data rows in the spreadsheet, (Bonsignore et al. 2009).

NodeXL is the outcome of an extensive research project[67] which aims to address the need for non-programmatic interfaces that can be used with less computational skills to build and explore visual networks (Hansen et al. 2011). It enables automated graph layouts that run optimal configurations for individual pairs of relations within a dataset, often based on a set of measures that are referred to as readability metrics (Dunne and Shneiderman 2009).

The choice of which aspects to show in a sociogram –at the expense of others- is in itself an attempt at solving the social cues that explain how a network of individual and their interpersonal ties work. In this case, network layouts (node-ties views) in NodeXL stress relationships instead of individual entities; this design implicitly assumes that the way elements are put together is as important as the elements themselves (Perer and Shneiderman 2008b).

If a sociogram is poorly laid out, it will certainly prevent analysts from focusing on the social facets of nodes' behaviour (how individuals interact and influence each other) and only consider their inherent attributes or properties (Perer and Shneiderman 2008b). Thus a fair assessment of layout quality is part of the choice of a network tool and implies paying attention among other things to the readability of the network layout.

NodeXL includes display options that allow the user to decide the shape, the colour, transparency or size of the node. Colour, size and shape give the network image additional visual dimensions used to encode both topological and non-topological properties such as centrality, categorisation and gender (Heer and Boyd 2005). In the same way, the thickness, level of opacity, and colour of the edges can be manipulated by users directly – NodeXL includes also options to automate the calculations of centrality metrics and auto-fill the graph.

[67] See http://nodexl.codeplex.com/; http://research.microsoft.com/en-us/projects/nodexl/

The problem with sociograms is that they become complex and difficult to decipher when their dataset size is very high, or when they include multiple types of relations (ties), different node topologies, etc. (Perer 2006; Perer and Shneiderman 2008a; Perer and Shneiderman 2009). Typically, clusters become so dense that nodes end up displayed on top of each other (Viegas and Donath 2004) - This situation is also referred to as node occlusion (Perer and Shneiderman 2009).

Perer and Shneiderman recognise that there are many layout algorithms that place nodes and links such to minimise link crossing. However network size is always challenging (Perer and Shneiderman 2008a; Perer and Shneiderman 2009). In the software visualisation world much attention has been devoted to 'network aesthetics' (Dunne and Shneiderman 2009; Batini, Furlani, and Nardelli 1985; Perer 2006). These mean mainly that nodes remain visible, edges traceable and that the reader will not find it hard overall to make sense of the representation[68].

NodeXL is not really aesthetic-driven. Its layouts are computed using a spring-embedding (force-directed) algorithm: nodes exert anti-gravity upon each other to enforce space for each node (like springs). Ties act also as springs pulling connected nodes close to one another, and drag forces are used to prevent objects from flying wildly about (Heer 2004). NodeXL underlying algorithm has the advantage of avoiding node occlusion (or overlapping), which makes it easy to break the newsgroups' populations into groups (Heer and Boyd 2005). This also allows the reader to get a sense of scale (Dunne and Shneiderman 2009).

Finally, once data is captured in a sociogram, it requires SNA statistics to be read. For example, one SNA measure is density. Density reveals the percentage of connectivity in a network or its potential to achieve saturation (Hanneman and Riddle 2005, 30–37; Kilduff and Tsai 2003, 30). Such an indicator enables the analyst to make sense of the crowdedness of the network as it appears in the sociogram. A network picture without its measure of density is incomplete; in the same way, a number like density provides little meaning in the absence of the network picture. The visualisation gives the user a sense of the structure and depth of the network, while the statistics provide a way to both confirm and qualify the visual findings (Perer and Shneiderman 2008b).

Table 1 explains some of the measures that are often used in SNA and used particularly in Analysis Chapter I.

[68] When it comes to visualisation outputs, researchers have shown creative skills. Design aesthetics has played an important role in justifying research goals. One particular project represents message boards as gardens, and users' participation as flowers. The longer members have been involved the longer the stem, the more they have posted the more there are petals -People Garden, Donath (2002).

Network Measures	Ties	Nodes	Structure
Directionality	The direction of a tie implies that a relation is conditioned by an origin and a destination	N/A	N/A
Strength/frequency of the link	Indicates the intensity of a relation between dyads (pairs of nodes). It is measured based on the count of links between each dyads.	N/A	N/A
Reciprocity	Ties are said to be strong once they are highly reciprocated.	N/A	N/A
Reachability	Indicates the shortest path that links two nodes in the network	N/A	N/A
Centrality/Power: Degrees (in & out); closeness; betweeness	N/A	Indegree defines a node based on how many nodes it is connected to. Outdegree refers to the number of nodes which have reciprocated these relations at least once. Betweeness measures the extent to which a node is intermediating other nodes A high closeness score would depend on the degrees' of its direct and indirect connections	A centralised network is dominated by a small number of central nodes. Network centrality tracks variability in nodes' centrality. A few highly central nodes can cause the failure of the network if abruptly damaged or removed (Hanneman 2005).
Density	N/A	N/A	Measures the potential of a network to realise full connectivity (proportion of the present ties compared to the maximum possible).

Table 1

3.2.2. Assembling Mifos Genealogy

3.2.2.1. Time Waves

In the Analysis Chapter I, I study members' behaviour through their positions in the network; this is measured in classical SNA terms through a node's relational properties: the count of nodes with whom a node is connected –sent posts to (outdegrees) and received posts from (indegrees). These properties are called endogenous, as they are a product of the network and post-exchange patterns; they allow the analyst to make sense of nodes' activity and of some structural aspects of their participation in the MLs.

Individuals' endogenous properties also reveal subtle differences in their attitudes and perceptions; for example outdegree counts are measures of expansiveness (Hanneman and Riddle 2005); they emphasise the effort of a subscriber to reach out to a maximum of people. In contrast, indegree counts reveal a person's popularity, stressing the prominence of certain authors (Ibid), and revealing why several people (nodes) have directed their attention (posts) to them in particular.

Traditionally, analysis of nodes' positions and relations have enabled newsgroup scholars to identify generic patterns of contributions and authorship profiles, such as the 'answer person' (Viegas & Smith 2004; Welser et al. 2007), the 'discussion catalyst' (Himelboim et al. 2009), the 'expert' (Welser et al. 2009), the 'spammer', and the 'flame', etc. (Turner et al. 2005; Viegas & Smith 2004; Welser et al. 2007).

However, building a study of community participation on the basis of nodes' relational properties in the MLs alone is limited and also creates blind spots. First, it separates members' post-exchange patterns from their roles and contributions in the project itself, whereas the MLs' activity is necessarily co-shaped by the broader dynamic of their membership in the project and is embedded in the larger social structure of the Mifos project[69]. Second sociograms in Analysis Chapter I are static; they make members' changes and shifting positions appear like a product of the network, occulting the passage of time, and hiding the gradual and incremental building of the Mifos community. From this perspective, results in Analysis Chapter I seem to conclude that community participation is equated with members' posting strategies in and across MLs at a given point of time–which is not my objective.

Building on that, Analysis Chapter II reasserts the function of the MLs as a major support to the code production and interprets nodes' transient positions and their related changes as part of the project's broader dynamics –that is of Mifos life performance and members' stories online and offline. By doing so, this chapter provides in-depth and contextual interpretations of users' post-exchanges.

[69] In Analysis Chapter III, I also show how post-exchanges recursively shape members' roles and positions in the Mifos project, overall.

Section 3.4 in Analysis Chapter I first attempts to make the relation between MLs and the project's attributes more visible and concrete. It introduces exogenous properties of certain nodes, like their organisational affiliation, and job positions, etc.; these are inserted into the static sociograms as visual enhancements, revealing new insights as to members' positions and relations.

In a second stage of the analysis –that is Analysis Chapter II- I start to add the time dimension; I reconstruct node-ties configurations following a chronological series of sociograms, called time waves. Nodes in time waves contain the visual features based on their exogenous traits (knowledge profile) and endogenous properties (outdegrees). Also their relations and the configuration of their network are temporary and transient. Members' behaviour and strategies are constantly changing, as new members join, others leave and others intensify their activity or slowly fade away –see Analysis Chapter II.

Time waves are positioned in Analysis Chapter II as visual signals. They are interwoven into a thick narrative that links nodes' positions in the MLs and specific events, happenings and actors' achievements online and offline. This narrative documents the history of the project, including various participants' views, descriptions of events happening in dislocated organisational settings, and stories of inter-organisational partnerships and alliances. The Mifos genealogy emerges gradually; it is substantiated by different types of data collected from various sources and including pictures, post snapshots, screen captures, as well as quotations from interviews.

Analysis Chapter II is thus inherently hybrid. It relies on the same characterisation process, method and rules that I followed to conduct the previous analysis (static sociograms). Yet, crafting the narrative is also a matter of literary skill; it is written to look as the most 'natural' form of social life (Czarniawska 2004, 11), with a profusion of actors, their achievements, a density of events, failures, and a relentless sense of moving through time and spaces.

From this perspective, Analysis Chapter II has a 'virtual ethnographic-like' character (Hine 2000). It grounds the Mifos case in an enriched sense of the meanings of the technologies and the tools it uses and produces, as well as its members' culture that is recursively formed and reformed over time (Ibid, p.9). To speak of Mifos as a cultural artefact is to suggest that it could have been otherwise, and that what it is and what it does are the product of negotiated, emergent and changing understandings –which are described here by a plurality of views and interwoven into an assemblage of anecdotes, events and stories.

3.2.2.2. Inspirations from Virtual Ethnography

Hammersley and Atkinson (1995) argue that 'ethnography' does not have a standard meaning; as this concept has travelled across disciplines, it has been reinterpreted and re-contextualised in various ways (Hammersley and Atkinson 1995, 2). Yet, it is commonly known that ethnography is a study where a researcher shares a group of people's daily lives for an extended period of time, "watching what happens, listening to what is said, asking questions –in fact, collecting whatever data are available to throw light on the issues that are the focus of the research" (Hammersley and Atkinson 1995, 3).

Authentic ethnographies involve also face-to-face interactions and a strong rhetoric of having travelled to a remote field-study (Hine 2000, 41). Hine (2000) asserts that 'travelling' is fundamental in ethnography (Ibid, p.45); the experience of having come to the research site from somewhere different, of 'negotiating' access, of observing interactions and communicating with participants; these experiences set up the researcher's relationship with the field study (Ibid, P.46). However Hine observes that the lack of physical travel does not mean that the relationship between the researcher, her field study and the reader is collapsed; she writes,

> *"[This methodology chapter] is there not just to tell you what I did, but to convince you that I did something that authorises me to speak… Whether physical travel is involved or not, the relationship between ethnographer, reader and research subjects is still* ***inscribed in the ethnographic text****" [emphasis added] (Hine, 2000,p.46)*

In this case, I barely left the vicinity of my computer –actually I took it everywhere I went[70]; yet I believe that studying Mifos has been a 'long' voyage; it allowed me to gain a developed sense of the technology's context both offline and online, its history and a reflexive understanding of its long-term code production, its use and the interplay between the two.

Accordingly, Analysis Chapter II attempts to reunite Mifos offline and online worlds, framing this technology as both the circumstances that prefigure and postlude its development (offline) and the social space that is produced by it (online). Stone (1991) describes the offline and online as both being 'consensual loci', each with their own locally defined version of 'reality' (cited in Hine 2000, p.39) –which is also transient and changing.

Indeed, Mifos is first of all an interlinked online space (or platform) that community members join to search for information, consult documents, interact with other members, contribute with code or commit fixes, and extend its domain of capabilities overall; most of its social production and dynamics are therefore computer-mediated and internet-enabled, although they are also embedded in the offline as part of individuals' work processes and daily routines.

From this perspective, I am a long-term Mifos member and a participant too. I walked its arcane world hundreds of times during the past six years, searching its web

[70]Having based my analysis mainly on the MLs and other online data types, I was therefore immersed in my computer and plugged into the Internet. However, I did travel physically for an extensive period of time (3 months) during the pilot study (see Appendix 1) to five Mena countries. I also travelled when I interviewed some of the participants that I reference in Analysis Chapter II.

repositories, newspages, registering in related websites, taking part in virtual meetings and text-communicating with its members. On a few occasions, I also interviewed some of them face-to-face and visited two implementation sites (Microfinance NGOs).

Although, I did not personally contribute code to Mifos source, I recorded the changes in its structure, features, community members' perceptions, etc. and noted how their cultural meaning changed as they grew more complex and sophisticated over time. In this sense, I am a 'silent witness' too (Nonnecke & Preece 2000) –see Analysis Chapter III. I did not personally actively participate in its development; yet, my familiarity with Mifos code and its platform are materialised by the diversity of information sources that I use in this chapter, the multiplicity of views I draw from the longitudinal character of my narrative.

This empirical material also formed the basis of a constructed narrative that is shaped by my silent and reflective engagement with Mifos different knowledge objects (posts, sociograms, websites, online documents etc.), but also by the outcome of specific face-to-face encounters (interviews) and authentic mediated communication with its members (emails, Skype-conferences) –these are detailed in Analysis Chapter II.

3.2.2.3. The Making of Narrative

My narrative is a 'text-picture-sociogram' construction of reality. The account it provides of the Mifos project is 'sincere'; yet it is crafted on the basis of my personal experience, a selection of stories and viewpoints, and on the conventions used to make them 'assertive' and 'engaging' (Van Maanen 1979).

Revisiting the work of renown anthropologists and documenting the construction of the narrative in studies of science and technology, Czarniawska (2004) reflects on the 'structural' crafting of narratives (Czarniawska 2004, 76–86). She notes that characters can perform different actions; some of them have different meanings according to when and where in the narrative they take place, while others always have the same meaning (Ibid, p.77).

Accordingly characters are defined as 'actants' which accomplish or undergo an act (Latour 1991, 121). "Thus the hero will be the hero only in certain parts of the narrative" (Czarniawska 2004, 80); in the same way other characters may suddenly rise to be heroes, for them to become again non-individuated afterwards –objects of someone else's action (Ibid).

Thus, argues Czarniawska, the conclusions of Misia Landau (1984; 1991), a palaeontologist, are that "scientists have much to gain from awareness that they are tellers of stories, and that an understanding of narrative can provide tools for creating new scientific theories and analysing old ones" (Ibid, p.79).

In my case, the narrative does not necessarily seek to construct the character of the ‘evolving hero[71]’; instead it aims to build ephemeral equilibriums over intervals of time (I call them Mifos "development stages"); these are grounded in various stories by individuals and organisations in different places, and reflect how actors create and legitimate their own purpose and action, sometimes triggering conflicting views.

Analysis Chapter II shows that Mifos long-term development is more than ‘one purposeful, and coherent action’: each time an ‘actant’ introduced a programme, other characters aligned or introduced other programmes of their own, so ‘change’ became a condition sine qua non for all actors to pursue their programmes. Mifos code objects and platform matured; their potential to create opportunities for local IT vendors and MFIs also increased, as well as the chance for a larger and more open network of Mifos service providers –but only at the end of the story.

In fact, ethnographies are difficult to structure –in comparison to surveys and other quantitative approaches; their results are typically difficult to judge, and are generally object to more criticism with regard to validity and objectivity (Hine 2000, 41).

Their strength though, is that they can be very convincing once they address appropriately the richness and complexity of the phenomenon under study; they then succeed in communicating a holistic emphasis, while endowing the narrative with an emergent, nature-like-feel implied by the thick descriptions (Ibid, p.42).

3.2.3. Content Analysis

In Analysis Chapter II, I document Mifos development stages and describe the various aspects of their participations in its long-term development. In Analysis Chapter III, I pursue my exploration of the Mifos biography, using this time a content analysis approach to provide in-depth understanding of subscribers’ interactions and their posting practices. In fact, this chapter adds a new dimension to my exploration to the extent that it seeks to capture the quality and nature of subscribers’ posts and how they influence their behaviour, and roles in the MLs and in the Mifos project overall.

In many ways, Analysis Chapter continues this research’s investigation beyond the structural properties of nodes and ties in sociograms. It extends through the text that Mifos members exchange and which materialises their interactions. It is also an extension of the qualitative approach of Analysis Chapter II in the researcher here too is confronted with text material that embodies its authors’ understanding of the reality which they inhabit, as well as documents the processes of their collective negotiation.

In fact, content analysis is a process of reading and writing texts, and the researcher’s job is to develop an understanding of the meanings which underlie and are enacted

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[71] Referring to Misia Landau (1984; 1991), Czarniawska argues that the various theories of human evolution can be seen as versions of the tale of the universal hero in folklore and myth. Typically, heroes would depart on a journey, receive essential aid or equipment from a donor figure, go through tests and perform different actions until finally reaching a higher state (Czarniawska 2004, 78)

through these textual practices. Particularly my task here consists of analysing the content of a selection of messages that serve as illustrations for knowledge transfer, learning and building social capital among various community groups and members. This approach aims to reveal some of the mechanisms that enable exchanges and collaboration, by comparing and contrasting among individuals, threads and thread messages, so as to document and back up a series of theoretical categories (Kuk 2006).

Kuk (2006) used a similar approach to study knowledge sharing for the Knowledge Desktop Environment (KDE) developers' mailing list. He identified three types of knowledge sharing, including re-use of public domain knowledge (1); individual learning experiences (2); and re-combinations of new and existing knowledge (3). Here I complement his study, by identifying different learning experiences and different knowledge types according to the MLs' profile groups (1). I also document the social processes through which knowledge is exchanged in the mailing lists (2) and how these are affected by code and platform's capabilities to evolve and assimilate change (3).

3.2.3.1. Message Selection

I decided to select posts and message threads in Analysis Chapter III that were informative of knowledge transfer/learning or of the code and the platform's flexibility –individuals' perceptions and evaluation of code and platform's features. I call this sampling an informed selection aiming to explore **how** these interactions are constructed. This chapter is built on top of the initial tasks of processing newsgroups' messages and the first two exploratory phases of the analysis (Analysis Chapters I and II), which have allowed me to identify landmarks in the data.

Sometimes, names of senders, email topics or critical dates have also guided my selection. Yet, to add a certain amount of randomness in my selection process; I included at least one of the peripheral subscribers from every profile group, including those who only had rare and marginal exchanges and so are not identifiable per se. Finally, the periodicity of emails creates a sense of movement or change, which is necessary if one is to demonstrate knowledge transfer or individual learning experiences in the emails' content. Hence, I made sure that the 'sample' of messages I selected covers the entire period of observation.

3.2.3.2. Unit of analysis

One scenario is to consider sentences as units of analysis (De Wever et al. 2006). A second option is to identify a consistent theme or idea in a message and to approach this as the unit of analysis (Henri 1992). A third option is to take the entire message as unit of analysis (Rourke 2001). I use message content as unit of analysis, rather than the topic of messages. Traditionally, message topics were believed to be a substitute for a message's main theme –which I do not agree with.

In fact, MLs' topics decay rapidly and conversations drift (Barcellini et al. 2008), as threads include parasite messages that do not fit with the general direction of conversations[72]. Often, subscribers –especially newcomers- use threads, or other non-related messages to introduce themselves. Hence they break the coherence and consistency of the thread. Relying on the analysis of topics becomes thus arbitrary and insufficient.

Furthermore, messages' content is a richer source of data. Indeed the way a message is written has a lexicological and discursive insight. This reveals important aspects of subscribers' communicative strategies, which are as important as the themes contained in topics or body messages. Therefore the entire message content should be documented and analysed.

In this thesis, I also treat message bodies as 'mobile' entities that travel from the settings of their authors to those of their readers (Thompson 1995, p.82). Although it is difficult to capture the situated practices of readers, it is important to address how the semiotic construction of these texts is 'designed' to instil a collective meaning.

"A textual focus places emphasis on the ways in which contributions are justified and rendered authoritative, and on the identities which authors construct and perform through their posting" (Hine 2000, 53). When analysing posts, I therefore take into account their context (Hine 2000, 52) –including the identity and profile of their authors- and their material capabilities –as written and asynchronous messages embedded in MLs- in order to study how posts contribute to socialisation and the building and sharing of information in particular –(see Analysis Chapter III).

[72] Most email browsers allow participants to refer to previous emails or extracts of emails by linking messages through quotation marks. The latter are compensatory conversational links, creating thematically chained messages while maintaining context in the isolated messages (Barcellini et al. 2008; Herring 1999), hence supporting understanding.

Conclusion: Quantity versus Quality

The tension between Quantity and Quality has a long history in social sciences and has always been regarded as a decision that a researcher has to take individually. Yet, researchers are increasingly lured to study tantalising quantities of data, which comes out of billions of clicks and key presses every day, across vast and interconnected networks, bundling people, locations, objects and ideas in ever growing combinations of social meaning (Hansen et al. 2011, p.3). They are equipped with apparatuses of tools and algorithms to make visible the Meta structures underlying the daily processes and recreate a global overview of the social media forest, instead of just trees, branches and leaves. Although this research subscribes to the idea that it is important to visualise the 'big forest', it also argues that the only possible way to make sense of its wholeness –crystallised and already there- is by traversing back and fro the macro structure of the forest, linking its growth and long-term concretisation with the daily practices, routines and micro processes of its inhabitants (Latour 2005, 5).

To conclude this chapter, this section reveals, how the thesis three-level scaffolding brings an answer to such an epistemological challenge –which is also implicit in the OSS biography framework. It explains how it has conciliated the macro and holistic view of the biography, with the study of situated interactions and negotiated practices that are necessary to produce code maintain and upgrade it. This conclusion also situates such an endeavour within the context of the research case study, Mifos. Mifos code is an on-going open source project; its development continues while Mifos solution is in use and implemented in several locations worldwide. The Mifos code also inhabits a mature online platform; it contains a dozen of data repositories and web 2.0 tools, which are activated by its community members, a distributed and inter-organisational collective with hundreds of individuals who progressively joined over time. As they committed code, reported bugs, translated interfaces, or simply exchanged posts, they left their digital footprints, which stood in front of me as the vivid token of their transient membership, participation and socialisation.

Mifos has been active for many years; the sheer quantity of accumulated code logs, posts, links, chat lines, wikis and online documents were a methodological challenge. First, I needed to make sense of the community as a whole, see what it looked like, and outline its scope. I decided thus to focus on the MLs, being the gates and the social hub of the platform; they contain thousands of post exchanges among all types of Mifos members and reflect the activity of the platform and Mifos code over time. Yet, I still had to account for the tension between quality, and quantity. On the one hand, such a substantial volume of data –I recorded 20000 posts exchanged over five years- captures the longevity and the maturity of the code, which is pivotal for the study of a biography. On the other, this data is textual and inherently qualitative (problem solving discussions, task allocation, news broadcasting, etc.); aggregating it will only capture frequencies and black-box what these interactions are about.

I reached a compromise by combining quantitative and qualitative approaches into a multi-stage methodology using both methods in a synergetic way so as to complement and reflect on the limits of each other (triangulation). (1) First, I resorted to mapping the MLs. Visualisations use the power of the image where words can fail to convey a sense of togetherness or materiality. I then illustrated the content of the MLs by using synthetic node-tie overviews, also called sociograms –where nodes refer to subscribers and ties to messages sent or received by them. Sociograms convey the plurality of interactions and at the same time provide a bird's-eye view of the MLs' activity, making them look like a platform or part of a platform that supports people's collaboration and exchanges of opinions.

Sociograms are though static –that is they represent the gradual building of the MLs' activity and their members' ties, as if they are the outcome of one single snapshot. They are to be seen as retrospective maps. They so guided me to find my way around the data, but did not really lead the study of the Mifos biography down an explanatory path. Indeed, looking at the structural properties of subscribers, their posts and Mifos MLs is important but not sufficient; I also needed contextual and textual data to inform the behaviour and strategies of posters with regard to the broader dynamics of the Mifos community and its changes over time. Also, time is indispensable in order for this analysis to account for changes in community participation and how they affect Mifos long-term development. This does not necessarily mean not using sociograms; time can also be translated through the dynamism of some visually enhanced diagrams, or more simply through changes in sociograms' configurations.

(2) I then reworked the sociograms into time intervals –time waves- following a chronological sequence, from the creation date of the MLs until 31/12/2010. I looked at nodes' positions across time waves and interpreted them according to changes in the community (as new people join and others leave) and in relation with the dynamic of the project as awhole. To do that, I compiled additional material over the research period of observation, including interviews, online news, members' blogs, etc. This dataset was the basis for a qualitative and thick narrative, which re-positioned the footprints left by MLs participants within the project. It fused together with the time waves –which I also added- into a text-sociogram montage that documents the history of the project, and informs the participation of key actors.

However, nodes' posting strategies in the MLs are only an aspect of their activity and roles in the project. The context of actors and their stories necessarily influence their posting; nodes' positions change in relation to changes at the level of the community. Yet, how conversations develop and how actors interconnect with others is also contingent on the content of their posts and on their interest in the topics; as answers get posted, information is shared and actors start to develop local knowledge. Members' positions in the MLs' network change and so their network configurations. Slowly, members enact their presence through intensive posting, while others are dissatisfied with the quality of the exchanges, and so gradually fade away, or stop posting.

As a result, the text-sociogram montage reflects the emergent nature of Mifos long-term development; Mifos code is gradually built and change through the action of separate and not necessarily directly connected actors, such as MFIs (users), administrators, institutional contractors and freelance developers, etc. –making Mifos biography the result of a multitude of actors separated in time and space and which do not necessarily pursue the same objective. This result confirms Pollock and Williams thesis that they describe in the software biography (Pollock & Williams 2009).

In addition, the text-sociogram montage approach has also emphasised the MLs, as a proxy (Mockus, Fielding, and Herbsleb 2000; O'Mahoney 2006; Scacchi 2007). Building on the results of the mapping (1), it qualitatively complements measures of community participation, such as posts' frequencies and counts of nodes' ties (Degrees), by including other aspects of participants' involvement that are based on multiple data sources. As a 'qualitative' and 'longitudinal' extension of the first method, this approach went beyond the blind spots created by nodes' activity measures. It reasserted the dynamic aspect of nodes' post-exchanges and the gradual construction of social relations in the Mifos community over time. Both mapping and the photo-text-sociogram montage focused on the scope and the structural aspects of community participation; yet neither method provided an explanation to what it means for subscribers to participate in the long-term development of Mifos.

(3) Finally, moving one step further, I focused my attention on the content of selected conversations and posts in order to inform how members socialise, collaborate, share information and learn. To do that, I applied a simple open code analysis of test messages. This approach revealed that post exchanges goes beyond socialisation, enabling participants to co-produce local knowledge as an act of structuration. Members' discursive strategies and content quality have acted reclusively with the capabilities of the MLs –in terms of archiving, organising and searching information- as a lever for knowledge dissemination and learning. By so doing, the dynamic of conversations in the MLs (peer-support, collaboration, problem solving etc.) facilitated a gradual appropriation of code in use patterns and its domain of utility overall, which has enabled code continuous redesign and reuse.

In terms of validity (Klein and Myers 1999), this method (3) can be criticised for its lack of representation; it is based on a selection of illustrations that do not cover the content of all the 20000 posts within the period of observation. However, this method is still consistent with the overall structure of the research design insomuch that it is just a complementary module; it relies on the findings of the mapping and the text-sociogram montage to select members, posts, and conversations; as well as for the interpretation of message stories. By so doing, I conceptualised the MLs and posts' content as embedded material artefacts that recursively shape and are co-shaped by Mifos biography –that is actors' efforts to exchange information, gradually building incremental knowledge and new opportunities for design and reuse.

The Mifos biography is not a history of technology. It operates through analytical cuts, a three-stage methodology that creates an analytical interplay between the macro view of code long-term development and participation –micro-practices and community interactions, creating a point of encounter between quality and quantity. Metaphorically, Mifos biography design reminds me of Miro's ladder –the Ladder of Escape- which is found in several of the artist's work, from his first figurative paintings to his later surrealist work; a symbolic imagery of humans' hope to reach to the skies in the middle of a crowded earthly existence (The Observer, Sunday 17 April 2011)[73]. Yet, I believe the ladder goes both ways; it is similarly an escape from an empty and crystallised sky (Mifos) to a crowded detailed and earthly existence (community participation).

Detail from The Farm, 1921-22
By Joan Miró: 'Everything is in the ascendant, reaching up to the brilliant cobalt sky.'
Photograph: © Successió Miró/ADAGP, Paris and DACS, London 2011
Source: Google Image

Joan Miró. *The Escape Ladder,* 1940.
Gouache, watercolour and ink on paper, 40 x 47.6 cm. Museum of Modern Art, New York. © Joan Miró and Fundació Joan Miró, Barcelona.
Source: Google Image

[73] Tate Modern– London 2011, organised a fabulous exhibition that contained a large collection of Joan Miro is work –the most iconic of modern Spanish artists- including his early and late paintings, and a number of sculptures.

Case Study

4. Overview of the Case Study

4.1. Mifos Context

Mifos is an open source information management platform for microfinance institutions (MFIs[74]) that is governed by the Apache 2.0 licence (Mifos.org, last accessed 08/12/2011). It has been designed to manage and track MFIs' operations and their financial transactions (Mifos.org, last accessed 08/12/2011). Mifos core functionalities and code architecture have gradually evolved through a series of code releases (see Analysis Chapter II). The Mifos initiative was launched by Grameen Foundation's Technology Centre (GF-Tech) in 2006. Using the open source framework, it slowly developed into a global community including the GF-Tech team, microfinance specialists, local IT intermediaries, volunteer software designers and MFIs. Under the leadership of GF-Tech, this community gradually contributes to developing the Mifos platform and its code source. In 2011, GF-Tech ceased its leadership of the project and supported its transition to a fully community-led initiative.

4.2. Who is Who?

- *GF-Tech*

GF-Tech is the Information Technology Department of Grameen Foundation USA. This organisation is based in Seattle and has regional delegates globally. Its goal is to drive industry-wide technology innovations that help MFIs to operate more efficiently and effectively (Mifos website, last accessed 08/12/2011). Grameen Foundation's microfinance expertise is well known, competing in fame with other microfinance northern NGOs such as the Consultative Group to Assist the Poor (CGAP); USAID; the SEEP Network, Planet Finance, etc. GF-Tech has also taken ownership of many innovation projects for the microfinance industry among which Village Mobile Banking and Mifos are the most known. Initially, GF-Tech sponsored Mifos and acted as its incubator, and the main kernel developer and administrator; In 2011 Mifos was transitioned into a community-led initiative.

- *Mifos Community*

Mifos team at GF-Tech use 'Mifos community' to describe a hybrid ecosystem of developers, users and IT intermediaries who have registered in the project directory. I so should continue to use this term to refer to Mifos participants. Gradually GF-Tech mobilised participation, inviting open source(rs) –that is software volunteers, and other IT professionals to take part; GF-Tech believed that it was necessary for Mifos global growth to partner and collaborate with local resources: "train and instil the knowledge

[74] MFIs are organisations that provide micro financial services for low income populations in developing countries. A majority of MFIs are small and adhoc NGOs that have specialised in microcredit delivery exclusively –or sometimes of social welfare services package.

and technical capacity to use, maintain, and extend Mifos at the local level" (Mifos.org, last accessed 08/12/2011). For this reason, it has also partnered with MFIs and other local IT intermediaries in order to leverage Mifos adoption industry-wide. Mifos community continued to grow, attracting more people who are interested to use or modify the source code and contribute to its online documents and wikis. They include MFIs and their local IT partners who have implemented Mifos source code or plan to use it; they also include other IT professionals, like volunteer developers and IT contractors who modified the source code and contribute to its continuous enhancement. Some of those are today responsible for Mifos recent code releases after GF-Tech ceased its involvement (see Analysis Chapter II).

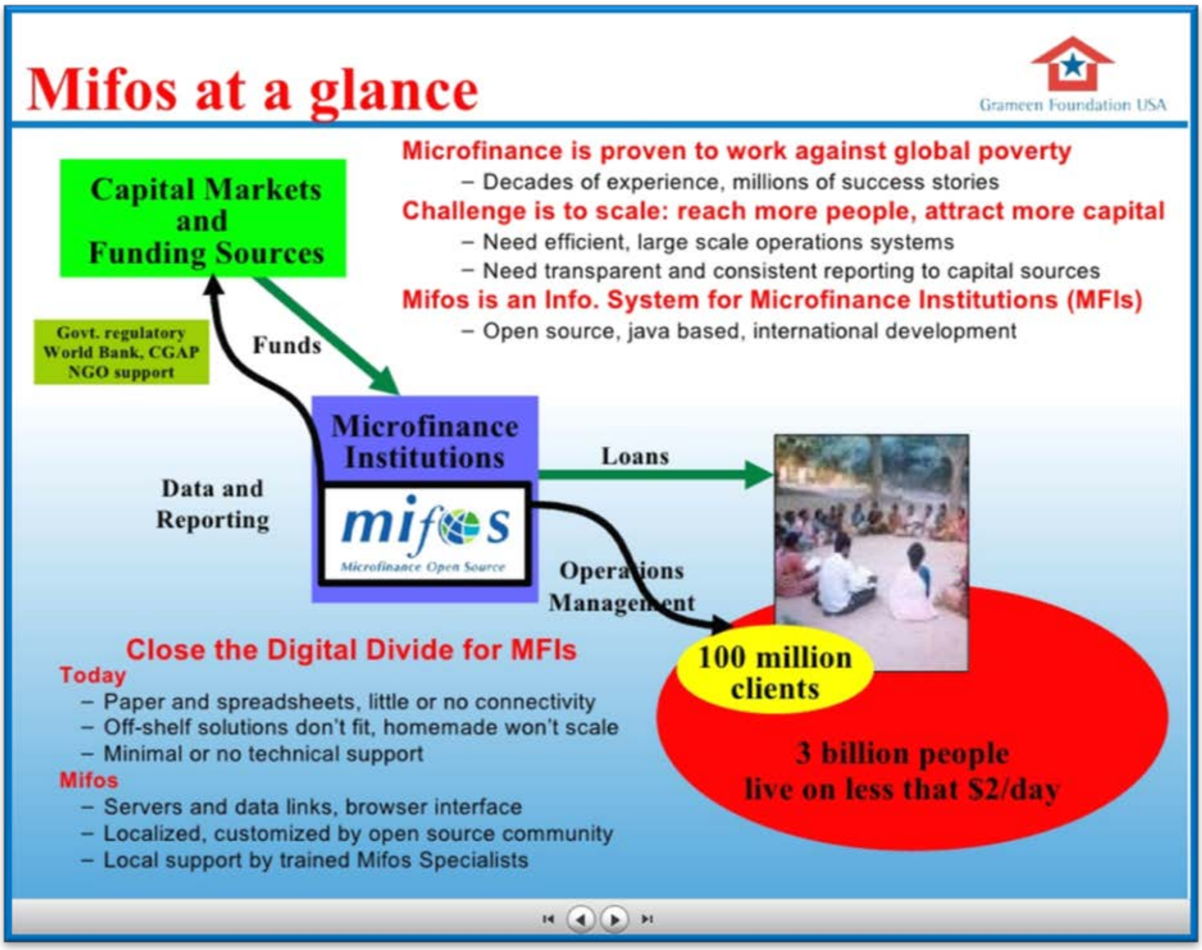

Figure 7
Mifos at a glance, published by Vinodh Nandakumar on Mar 26, 2007
Source: Slideshare

4.3. Mifos Vision

Mifos is the product of a vision; it was first articulated by GF-Tech, which claims that Mifos' value proposition offers more than a simple open-MIS (GF Technology Center 2008). Mifos.org[75] adds that Mifos addresses one of the most significant barriers to sustainable growth for the microfinance industry (see Figure **7**). It is also said, it is an affordable, flexible and scalable technology, which is designed according to the evolving needs of MFIs (GF Technology Center 2009). In the former versions of Mifos website, it was also stated that Mifos solution should help MFIs streamline their operations more efficiently, driving a broader and deeper outreach to the poor. According to the 'Mifos one pager' published online by Grameen in 2006 (in the Mifos section of their website) (GF Technology Center 2006).

However, the focus of Mifos value proposition –as it appears in its website and other online resources- has shifted slowly over time –from being directly centred on MFIs' organisational efficiency/transparency to being centred on MFIs' involvement in Mifos long-term development and the sustainability of this technology overall. Recent online documents[76] published by GF-Tech stress the role of Mifos community. It puts forward community participation as 'the engine of Mifos development'. For example, the Mifos Initiative Fact Sheet 2009 claims that Mifos is

> "*A new approach to technology –a common platform, uniting the microfinance industry around technology and giving MFIs the flexibility and ownership of technology they demand. Free and open access to the Mifos software source code, takes the industry away from the MFI and vendor relationship, allowing multiple parties to access and modify the software. With Mifos, the microfinance industry not only benefits from the technology, it contributes to it, improves it and owns it*" (GF Technology Center 2009).

I see these changes in GF-Tech's discourse as an outcome of GT-Tech's long-term involvement with Mifos community. Thus, it is relevant to understand community participation as a flow grounded in daily practices, which are continuously performed and changing. The rest of this chapter introduces Mifos online platform, as well as some of the tools and data repositories that mediate software production, and use. They show Mifos integrated apparatus of technologies, which act a setting for community participation and enable its social dynamic over time.

[75] Mifos.org was first by GF-Tech; its property changed once Mifos was transited to the community.
[76] including Mifos Initiative Fact Sheets, the developers' Mifos overview brochure, Quick Facts pages and other overview presentations on Slideshare

4.4. Mifos Online Platform

Access to the world of Mifos online is gained through the project's official website, Mifos.org[77]. Mifos.org is a substantial and mature website, containing hundreds of pages, wikis and updates. These are organised around five main sections: product, community, support, contribution, and vision. A major part of Mifos data is also contained in different web servers, open data repositories, social networks and host sites, which are all interlinked and connected with Mifos.org. Among these are Mifos newsgroups, Mifos Wikis, Mifos online manual, Mifos issue tracker and Mifos in the SourceForge portal[78]. Together, they constitute the platform's main production pipeline (the grey area in Figure 8), enabling and directing community members across an entire digital apparatus, of associated websites and data repositories.

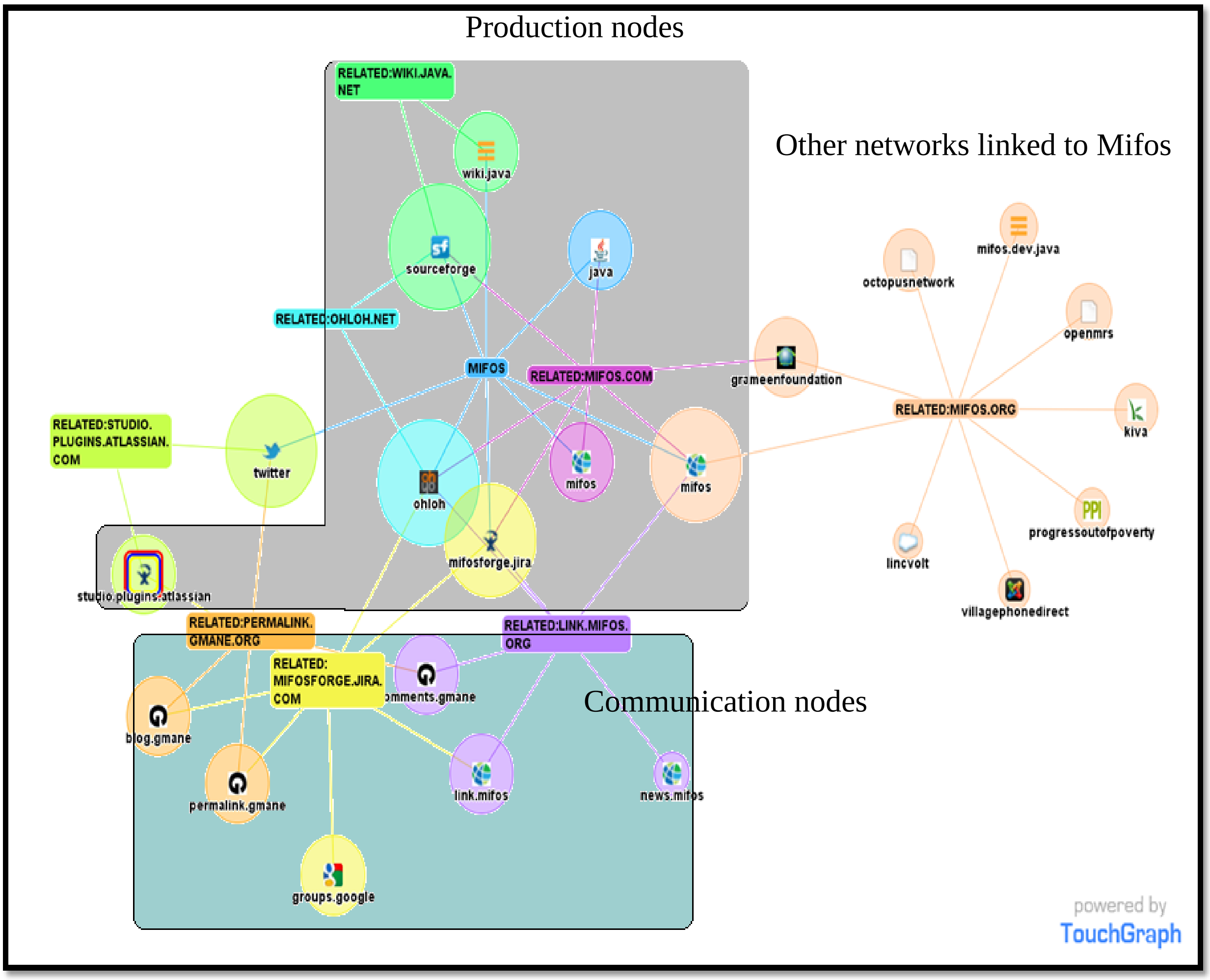

Figure 8
Mifos Online Platform -Snapshot captured May 2011

[77] Mifos.org was created by GF-Tech. But it remains the project official website after the Grameen Foundation withdrew in 2011.
[78] For example the Issue Tracker facilitates the access and browsing of sections of Mifos code and bugs. The Developers' Wiki, the SourceForge website, and the Mifos code repository are used for code and bug commits, designing features, etc.

4.4.1. MLs: The Gateway of Mifos Platform

The second group of interconnected websites (blue area in Figure 8) is the Mifos communication space. This contains a set of Mifos asynchronous communication tools such as mailing lists (MLs), newsletters and blogs. The websites that are represented in Figure 8, such as Gmame, Google, Mifos blogs and Mifos news, are data repositories that contain archival data. The Mifos platform also comprises online tools that enable real-time exchanges between members (synchronous communication) through popular chatting mediums and IRC clients, such as Chatzilla, Pidgin, etc. Their data can also be archived, searched for and retrieved by users.

Participants become part of Mifos community when they subscribe to its MLs. At the same time, they also register in Mifos production artefacts, in order to commit code etc.[79]. This way they are both informed about the project's news, interact (or socialise) and contribute with code. First Mifos members need to get familiar with Mifos platform. Typically, members post queries to seek information and directions from 'old' subscribers. New volunteers also take advantage of the MLs to introduce themselves and 'offer their services'.

From this perspective, the MLs are very much a gateway of the Mifos platform, whereas other production websites point to them in order to facilitate collaboration and communication. MLs must therefore remain updated; posts are co-linked to tools, documents and wikis. This way, the whole platform remains integrated, forming a compressed work space for software production and use.

4.4.2. MLs: A Living Memory

Despite the absence of corridors, walls and meeting rooms the Mifos production platform is very tangible. Participants leave landmarks and relatively traceable footprints whenever they 'act online', posting messages and commits, or fixing bugs, etc. Such traces are a living memory, making Mifos platform an associated social milieu with palpable and material social substance. Mifos online data can disappear, though[80]. It is temporally limited by the websites' archive policy, and by the nature of its content. This is due in part to the actuality of such data –that is it only means something in respect of the task that it allows to perform. Many Mifos repositories have become fragmented, partially duplicated, or unused. Usually, this occurs because of changes in host sites after staff turnover, accidents, etc[81].

[79] By contributing I mean all types of activities, which generate some value for Mifos code objects, its platform and community, such as chatting, blog posting, testing, bug fixing etc.

[80] For retrospective use of OSS data, this means that researchers must check data first and contrast it across projects' multiple mirrors and data repositories. Most of the time, the greater bulk of data is saved somewhere online and can be recovered.

[81] For instance Mifos production has moved –three years after Mifos launch- from Java.net to SourceForge. When Java went down, it caused a significant interruption to the project's activity. See,

While the eventual disappearance of data might limit a retrospective look at Mifos platform, the ephemeral character of news, logs and posts acts paradoxically as a booster for its vitality and dynamism. In fact, the nature of this data is to have a short term life-expectancy. In this sense, the Mifos platform exhibits biogenic-like traits that very much shape its ontology, keeping it and Mifos code objects alive. The Mifos platform is thus a public statement to the world; a tangible proof that Mifos community and product are alive and kicking.

The Mifos platform is also self-organised. Despite the many landmarks, instructions that administrators leave to orient and direct community members, the majority of users are left alone to work out the particularities of hyperlinks and websites and decide the form of their participation. They must also learn how to use them, in order to expand their virtual presence and thus push their batches, posts and ideas. As a result, participation in the platform's dynamic is very much shaped by members' background knowledge, and by the organising of such a distributed, exchange-based community.

In this research, I am particularly interested in looking at mailing lists and the social dynamic of post exchanges. As the platform's gateway, the MLs are the place to start with. In fact, they constitute a terrain of encounter between the technical and social 'stuff' that software is made of. This is unpacked in the various snapshots of interactions, processes and ongoing practices, which are discussed in post exchanges or reflected through the MLs' structure. I believe that their study can unearth important community dynamics and how they are associated to Mifos development over time.

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http://gsoc-wiki.osuosl.org/index.php/Saturday_Sessions_2009/Project_Hosting_Horrors Last accessed 19/02/2010

5. Analysis Chapter I: A Structural Analysis of Mifos Communication Networks

This chapter follows the analytical process characterisation that I describe in the methodology chapter. In a nutshell, this process conceptualises my approach to study Mifos MLs; i.e. how I delimit the research scope, the tools and techniques that I use to process and analyse the data, as well as my epistemological position and how it affects my study of the phenomenon under scrutiny (see Chapter 3).

This chapter contains two sections. The first describes the task of constructing sociograms, based on the patterns of post-exchanging in and across Mifos MLs. It answers questions about the analytical aspects of this endeavour (what is the relevant data set?) as well as explains decisions about sociograms' interpretation (what do patterns mean? How can they be related to messages bodies and interviews?).

The second section is an attempt to analyse and interpret the emergent results from the sociograms. This is pursued based on a grounded, exploratory approach that aims at constructing landmarks in the data –rather than theorising actual findings- and will be followed by further data processing and analysis in the next two chapters of this multi-stages analysis.

5.1. A Procedure for Creating Sociograms

5.1.1. Data Selection

As I mentioned in the first chapter of the case study, Mifos Mailing Lists[82] (MLs) contain links to six active news channels (See Appendix 7). I had to look for a data source, which is complete, non-truncated, and exportable into a common email client. Fortunately, I was able to find full archives –that went back to the MLs' dates of creation- so I did not have to patch data from different sources as is often the case in studies of newsgroups. Gmane Archives[83] were my data source. They were used by Mifos administrators to broadcast posts as if they were Usenet messages, allowing my email client[84] to download posts dating prior to this study. Below is a picture of Thunderbird email client with Mifos newsgroups and messages –see Figure 9.

[82] Accessed last in Feb. 2010. The number of Mifos MLs has increased more recently.

[83] Gmane services allow anyone to access messages from the server. Gmane (pronounced "mane") is an e-mail to news gateway. It is an archive; so messages never expire (Wikipedia, last accessed 04/02/2011) http://dir.gmane.org/index.php?prefix=gmane.comp.finance.mifos

[84] I used NNTP(Network News Transfer Protocol) newsreaders to access, and read messages . Particularly, Outlook Express, Windows Live Mail and Thunderbird allowed me to access Mifos newsgroups. Thunderbird is an Open Source email client. It can be configured to read NNTP and store posts as email files. Trying more than one newsreader is justified by the importance of having more than one input data format for mapping.

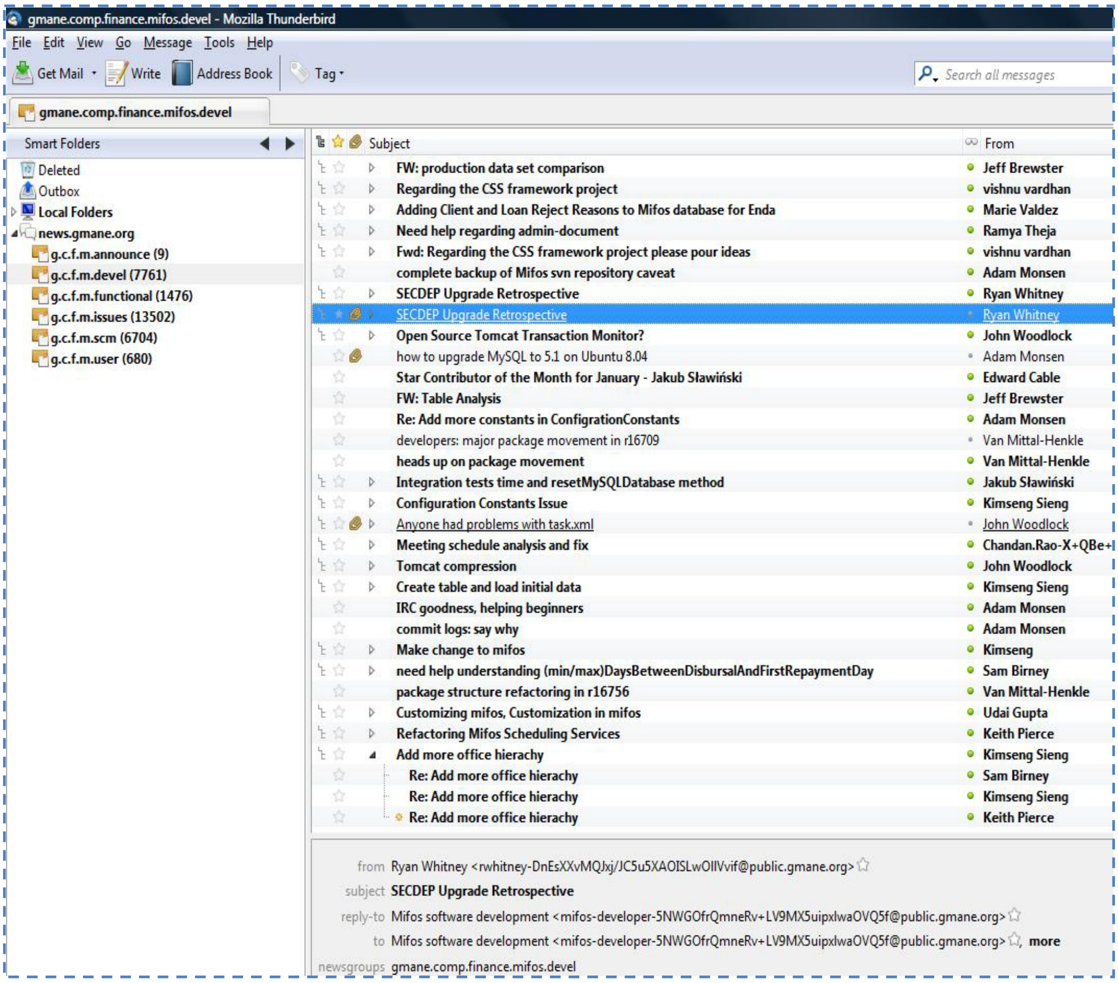

Figure 9

Mifos News.gmane.org –Last accessed Feb. 2010

The total newsgroup messages collected span a period of five years starting from January 2006 until December 2010. Mifos used six mailing lists containing around 50500 messages in total until the 30th of December 2010 –when I started data processing. Table 2 above provides a view of the number of messages in every mailing list. The graph[85] below shows the distribution of posts for each Mifos mailing list over the total duration of the study.

[85] There is a difference in posts' count between Table 2 and Figure 11. The graph is plotted based on the figures in column three of Table 2 –that is data as per Feb 2010: Almost a year before I wrote this chapter. However, this difference does not affect the reading of this Figure 11; this shows the discrepancy between the posting activities of each newsgroup, which has grown proportionally over 2010.

Mailing lists	MLs Start date	MLs Closing date	Number messages Feb 2010	Number messages Dec 2010	Growth Rate
Announce ML	14/11/2008	17/12/2009	11	11	0%
Functional ML	30/10/2007	09/02/2010	1476	1494	1%
Developers ML	20/1/2006	Active	7769	10796	**39%**
Issues ML	23/04/2008	Active	13499	30577	**127%**
Users ML	23/10/2008	Active	679	2095	**209%**
SCM[86] ML	22/04/2008	Active	6704	10518	**57%**
Total			30138	55491	

Table 2

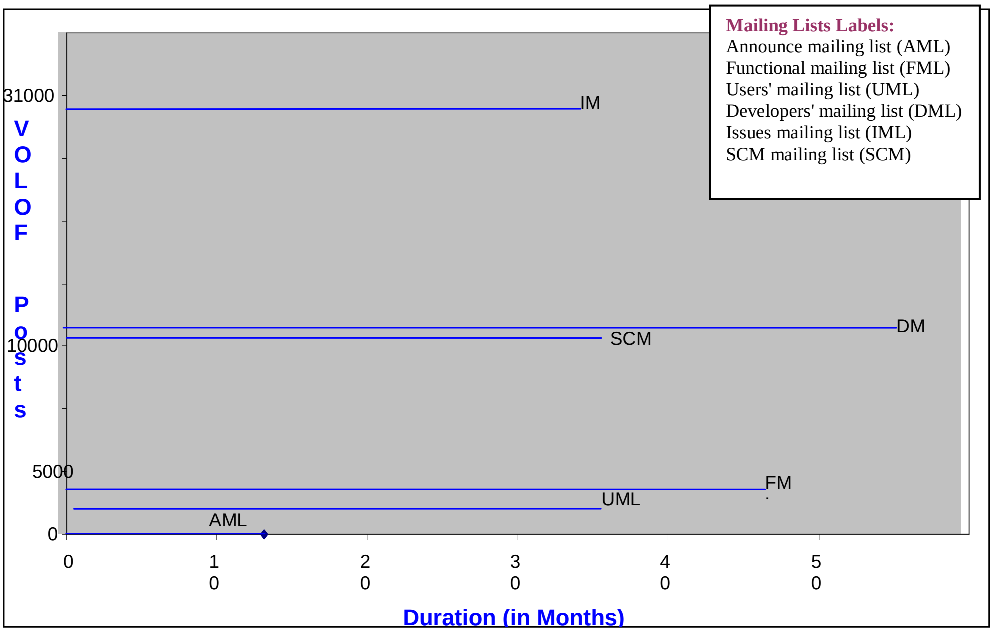

Figure 10

Among Mifos six mailing lists, three were useful for the purpose of this analysis, namely the **functional,** the **users** and the **developers**. The Announce, SCM and Issue Tracker MLs have been discarded, as they are unidirectional; the Announce mailing list is used to broadcast news of major releases/upgrades and does not change much over the years. Besides it includes only 11 messages. The other two mailing lists, SCM, and Issue Tracker are automated delivery systems for code commits and issues. Despite their important increases (respectively by 127% and 57%) over 2010[87], they do not add much to the study of the MLs' social dynamics, given that no subscribers are engaged in post-exchanging. So there is nothing to conclude about their posting behaviour.

[86] SCM (Source Code Management) is a type of code versioning system

[87] The increase in SCM ML is an indicator of the project's growth. More code and bug commits were registered along with the general increase in the post frequency of users and developers' MLs.

I selected the Functional and Users MLs, as they constitute two facets of users' experiences and their involvement in Mifos production. They show users discussing requirements and explaining their business practices in order to get help with issues and code localisation. The Functional ML was active one year after the Mifos launch and was designed to discuss MFIs' practices and requirements. In the meantime, the Users' ML was created (in 2008) and was meant to provide support for MFIs. Slowly, it has developed into a permanent peer-driven help line. In April 2010, the Functional ML was disabled, and the Users ended up replacing it.

I also decided to include the developers' ML, which is a major support of distributed collaboration, and thereby to OSS code building (Mockus, Fielding, and Herbsleb 2000). Developers' ML opens a window into collaborative processes, organisation issues, and technicalities of Mifos production and long-term development. In this sense, it complements the other two lists, as it also reflects interplay between design practices and other social processes, and reveals subscribers' perceptions and attitudes across different stages of Mifos development. Appendix 6 able includes the names of subscribers who I specifically refer to in the Analysis Chapters.

5.1.2. Data Retrieval

The objective of this preliminary retrieval task is to retrieve and transform the selected newsgroups into sociograms. I must add here that the data that I retrieved was geared mainly towards emphasising subscribers' interpersonal ties. Although I counted all the posts that were sent by each node (subscriber) at one time[88], I only show in the sociograms those that were directly addressed to one (or more) nodes. The main reason is that I wanted to capture a picture of the MLs, which is defined by subscribers' effort to connect and create inter-relational networks.

The inclusion of 'ties to all' would have made the sociograms look messier and denser, obscuring rather than displaying their structure. Also, extending interpersonal posts to all would hide nodes' interpersonal relations, making all subscribers' fully interconnected. The way I processed these MLs is in fact, quite similar to how researchers have processed personal emails, except that in this case I did not end up with one 'egocentric' network –but a collection of interconnected ego-networks. Indeed, the ML emphasises subscribers' relations equally. These emerge once a post is broadcast to all, as some decide to reply, while others do not.

Accordingly, my concern in this phase was to retrieve and then move the data from the newsreader into Excel files, which can be more easily queried and plotted. First, I downloaded messages from the Mifos news server. Then, I retrieved data fields about the identity of the receiver and other message properties from the content of posts. Information collected include, Post Date; Sender's Name; Receivers' names; ML's name, Post's Subject, etc. –see Figure 11.

[88] Broadcast posts –that is posts sent to all- are still accounted for and used in the other analysis sections.

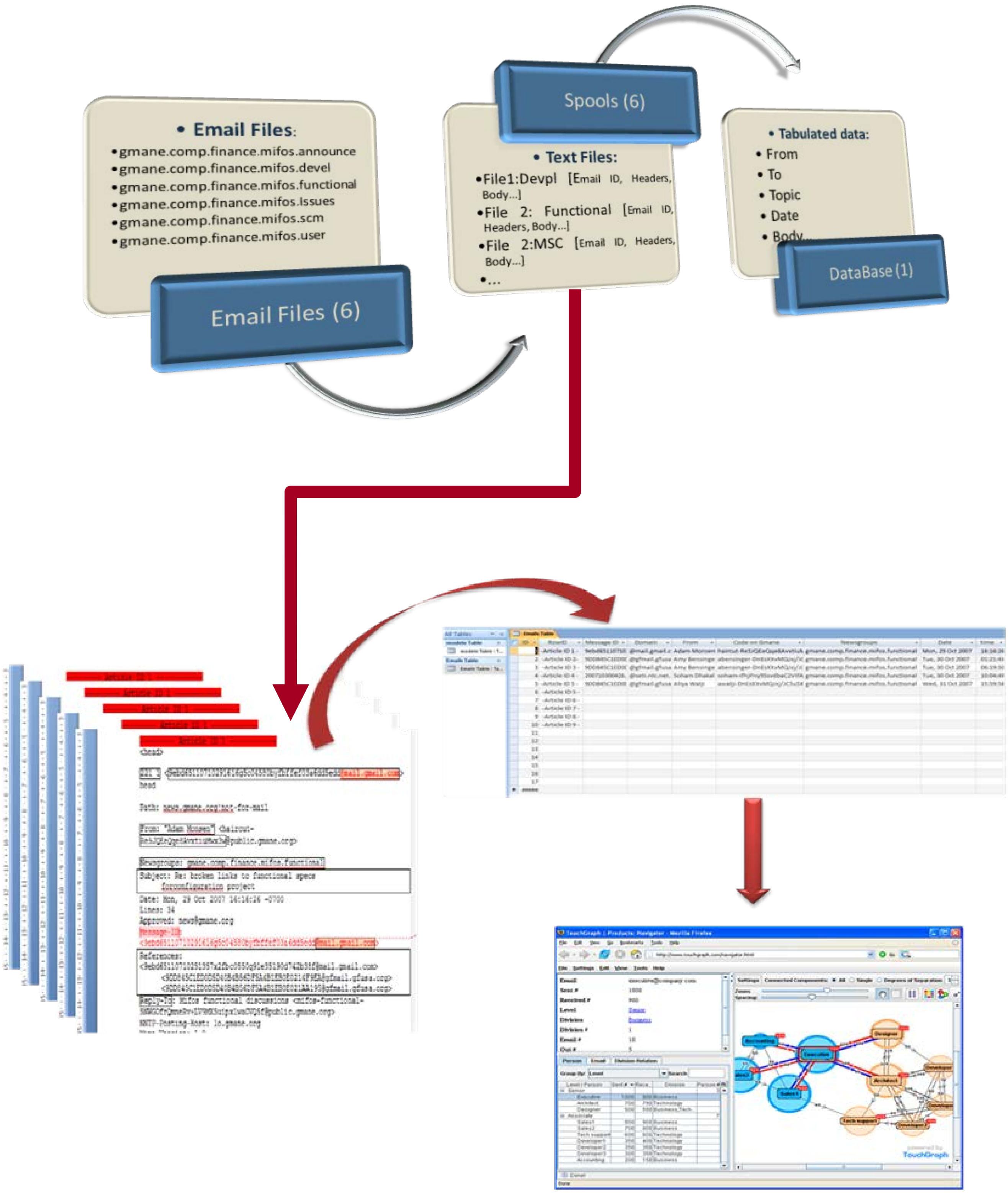

Figure 11
Data Retrieval Process

Often relations of parenthood as they are captured by the newsreader are incomplete. Obviously a message has a unique reference that allows the newsreader to trace back its father (original messages) and to show a conversational thread in the client interface (a tree composed of children messages nested into parent messages). However participants might decide to reply to one specific message while addressing more than one subscriber, including or not the sender of the original message. In fact the reply button provided by the majority of newsreaders is not always used to answer specifically the person who sent the message. As the conversational thread goes on, one might even discover new topics nested into the original (Paolillo 2000).

In terms of tracing interpersonal relations, it becomes thus important to search inside messages for names and evidence of links between the sender and other subscribers in the mailing list. For example, I found that reply messages are hidden in what appears to be broadcast messages, i.e. addressed to all members. Also, reply messages have been extended to one or more individuals who were not attached to the father message. This occurs when a poster replies to a message, referencing older messages and other people. For example, someone answered the sender of a post, by including the names of two other subscribers and instructing them with tasks related to this message content. Often messages generate more interpersonal relations than a one to one email and include different names from those who are referenced in the hierarchy of conversations.

The messages' body remained therefore my prior source of information. It enclosed important information about the identity of recipients, if not their names[89]. They allowed me to retrieve whose messages were cited or quoted (Sack 2001). This sort of analysis is generally referred to as citation indexing in social sciences (Garfield 1979; Garfield 1980). Yet, in this case, there is an additional difficulty to the task, as in many posts recipients' names are hidden, or in extreme cases can only be induced by the tree hierarchy in the browser. Often recipients' names are nested in the post as 2nd and third quotes (Sack 2001). In this case, it is not possible to algorithm the content of posts searching for recipients' names based on their position in the email protocol. Emails do not have a standard format; because they have been sent by different email clients. However, they can still be read, as quotation marks generally demarcate email bodies from extracts of anterior messages inside the text, such as these symbols '>', '>>', '>>>'. All this data was then typed into Excel files.

[89] Contrary to most studies reviewed in the literature (see Mockus et al. 2002 and Hansel et al. 2011), manually extracting data from emails has the advantage of directly spotting the names of the persons committed to a post. Often, researchers cannot avoid the cumbersome task of having to match subscribers' emails with full names, in order to eliminate cases where several emails represent the same person. Generally this task is necessary when a researcher uses a script to algorithm email addresses, instead of searching for the names.

5.1.3. A Circle of Transformations

My input files[90] were Excel spreadsheets[91]. Each one of their rows represented a tie, containing the sender and the receiver's name, as well as other data fields about the post[92]. To process these files, I used NodeXL. It generated SNA metrics and network snapshots[93] -see Figure 12. My first network visualisation was a great tangle of arrows and nodes –notably because of the very large size of my data set (See Figure 14). It felt rather overwhelming…

I was though quickly reassured to know that whole graph visualisations are typically chaotic and illegible (Hansen et al. 2010). After a lot of tweaking, they become gradually readable, as patterns became visible. In this sense, the sociograms that I present and interpret next are more than simple pictures of Mifos MLs. They contain a first layer of social meaning, which stresses some properties in the data that can be 'read' or 'made visible'. They are a first stage in a journey of exploration, rather than final and actual 'findings'.

Before beginning this journey, I would like though to discuss some of the decisions related to building sociograms. First is the network's direction[94]. By default NodeXL displays graphs as undirected. Yet communication networks are generally directed. Particularly, a post represents labour[95] –time and knowledge that the senders have intended to share in order to diffuse information. Thus, the researcher must press the 'directed' button, before the system can calculate the edges[96]. Second is the graph layout. Generally, analysts chose between a force-directed layout –which can be quite effective for spatially grouping connected communities- and a radial layout. The latter representation portrays network distances from a central actor and therefore is good for displaying egocentric networks (Fisher 2005). For this study, I selected a force-directed layout as it gives better balanced proportions to large networks.

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[90] For some reason, I could not work out the import-email function of NodeXL. So, I downloaded and typed in the data, as I mentioned before. Processing manually more than 20000 messages was an important time investment, but I like to think that doing it helped me to get on top of the newsgroups, collect information about authors and identify important landmarks for my next analysis chapters.

[91] Most SNA tools require as inputs quadratic matrixes (actors in rows + columns; posts frequencies in cells). However, NodeXL is able to algorithm a 'to-from spreadsheet', by computing the edges between each pair of vertices and calculating edges' weights.

[92] I had in total ten columns of information fields, including the post's date. Only the first two (sender/receiver) are processed by NodeXL.

[93] The former metrics were used to construct and read the network snapshots (sociograms)

[94] Direction defines the relation between two nodes. An undirected network means that relations between nodes are symmetrical. If individual A is connected to individual B there is then a link between the two nodes regardless of who is the source of the connection.

[95] It has been argued that jokes and non-related content affect the quality of Q&A newsgroups notably in software online help lines, like the Microsoft Netscan archives (Fisher 2005). In comparison, Mifos newsgroups remain very work-oriented and have a serious atmosphere. I report no jokes in the users' newsgroup and one only in the functional newsgroup, but the style of conversations is lighter in the developers' newsgroup.

[96] An edge network is based on at least one post, sent from one individual to one or more people (Fisher 2005). For this reason, an edge's weight is influenced by the number of times the link is reciprocated (Hansen et al. 2011, p.35).

Finally, the last decision is about visualisation and in reference to SNA theory and tools. NodeXL selects and calculates a set of SNA aggregates by default. These improve the readability of sociograms, and capture the underpinnings of network graphs[97] (Turner et al. 2005). They build a socially meaningful picture by describing members' participation in terms of posting frequencies, positions and interpersonal relations (Viegas & Smith 2004). Based on that, a researcher must decide what measure to pick, and what measure to leave. This is crucial, as these choices shape the way one packs and filters the data and the way it is presented (Hansen et al. 2011). Once the visualisation parameters are set on one or more SNA measure, NodeXL algorithms plot the data accordingly, allowing for example nodes with the highest indegrees to be visually enhanced while all other nodes and associated edges are greyed, or filtered out (Hansen et al. 2011).

[97] See Graph Theory (Monge and Contractor 2003)

From	To	Date	User	Func	Dev	Topic
Carlo Romero	Emily Tucker	23/01/2007	0	1	1	[Mifos-developer] Shares Product
Emily Tucker	Carlo Romero	23/01/2007	0	1	1	[Mifos-developer] Shares Product
Lassaad Ben Hadj	Emily Tucker	23/01/2007	0	1	1	New feature released-- Loan reversal
Lassaad Ben Hadj	Emily Tucker	25/01/2007	0	1	1	New feature released-- Loan reversal
Emily Tucker	Lassaad Ben Hadj	25/01/2007	0	1	1	New feature released--Loan reversal
Lassaad Ben Hadj	Emily Tucker	25/01/2007	0	1	1	New feature released--Loan reversal
Emily Tucker	Swati Rathi	08/02/2007	0	1	0	Individual clients in Mifos
Nesrine Madhkour	Emily Tucker	13/02/2007	0	1	0	Individual clients in Mifos
Jim Kingdom	David Fono	13/02/2007	0	1	0	Newb Questions
Nesrine Madhkour	Emily Tucker	16/03/2007	0	1	0	ENDA-MIFOS:Desired features
Emily Tucker	Nesrine Madhkour	16/03/2007	0	1	0	ENDA-MIFOS:Desired features
Vinodh Nandakumar	Nesrine Madhkour	16/03/2007	0	1	0	ENDA-MIFOS:Desired features
Gabriel Metz	Emily Tucker	22/03/2007	0	1	0	Question on Loan re-scheduling r
Gabriel Metz	Nesrine Madhkour	22/03/2007	0	1	0	Question on Loan re-scheduling r

	Gabriel Metz	Nesrine Madhkour	Emily Tucker	Vinodh Nandakumar	Jim Kingdom	David Fono	Swati Rathi	Lassaad Ben Hadj	Carlo Romero
Gabriel Metz	0	1	1	0	0	0	0	0	0
Nesrine Madhkour	1	0	3	1	0	0	0	0	0
Emily Tucker	1	3	0	0	0	0	1	4	2
Vinodh Nandakumar	0	1	0	0	0	0	0	0	0
Jim Kingdom	0	0	0	0	0	1	0	0	0
David Fono	0	0	0	0	1	0	0	0	0
Swati Rathi	0	0	1	0	0	0	0	0	0
Lassaad Ben Hadj	0	0	4	0	0	0	0	0	0
Carlo Romero	0	0	2	0	0	0	0	0	0

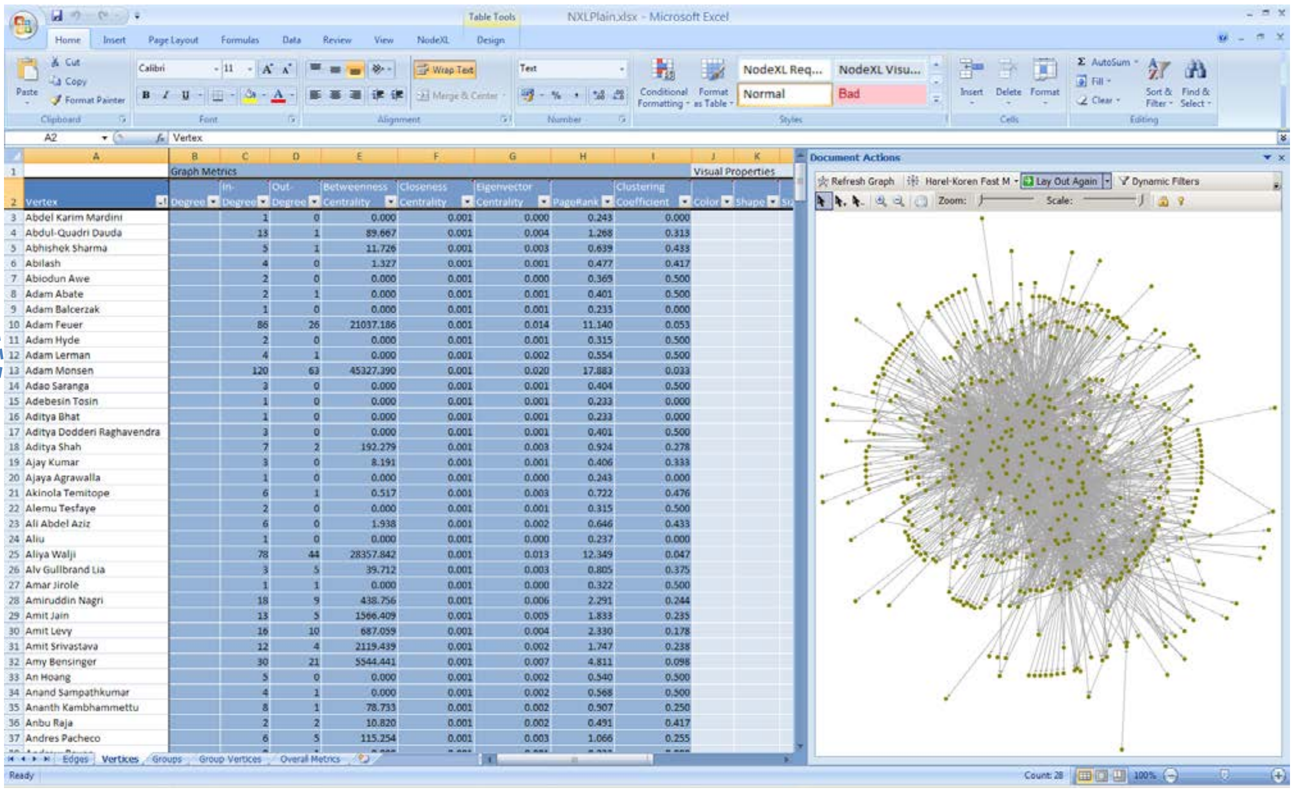


Figure 12
NodeXL: Input -> Output

5.2. Community Participation: Multiple Views and Measures

5.2.1. Overview of Mifos MLs

The sociograms in Figure 15; Figure 13; Figure 14 and Figure 16- show Mifos the 3 newsgroups (functionalities, users and developers), as well as a fourth compiled network. Each sociogram is a directed network, capturing interpersonal email exchanges between newsgroup subscribers. These graphs show Mifos authors as nodes; each node is linked to the other by an arrow pointing in the direction of the post. This way, I condensed newsgroups' posting traffic and created a bi-dimensional picture of members' participation, covering a five year span. These images constitute a 'bird eye' overview of the Mifos email platform, capturing a snapshot of its history. They are also material structures made of participants' exchanges. To help read them, the following table provides key structural numbers –see Table 3 below.

	Funct.	Users	Devel.	Compiled
Graph Type	Directed			
Graph Density*	3.1%	3.6%	1.8%	1.47%
Tot. Interpersonal posts	1180	1800	10000	12079
Tot. Broadcast posts	460	555	3280	4297
Tot. Nodes	131	149	399	499
Tot. Edges	529	784	2822	3652

Numbers are rounded *

Table 3

The three graph networks are centralised, as shown through graph density numbers in Table 3. Despite variations, all four networks have a density measure under the threshold of 5%, which is relatively low. Density indicates the crowdedness of a network and stresses its potential to achieve full connectivity and communality (Kilduff and Tsai 2003; Monge et al. 1998).

The centrality of Mifos newsgroups can also be observed clearly from the graphs, as sharp differences exist between nodes' populations. A few nodes are clouded in the centre, which are connected to a majority of nodes scattered in a sort of fan shape. This suggests that distribution of posts is skewed towards central points. These points diffuse information globally and channel communication to the periphery. As the network grows, it is also more likely to have preferential attachment links (Himelboim 2008). Newcomers interlink with already well connected individuals, who increasingly mediate between subscribers, resulting in both wider and extensive linkages for sharing information (Monge and Contractor 2003, 423).

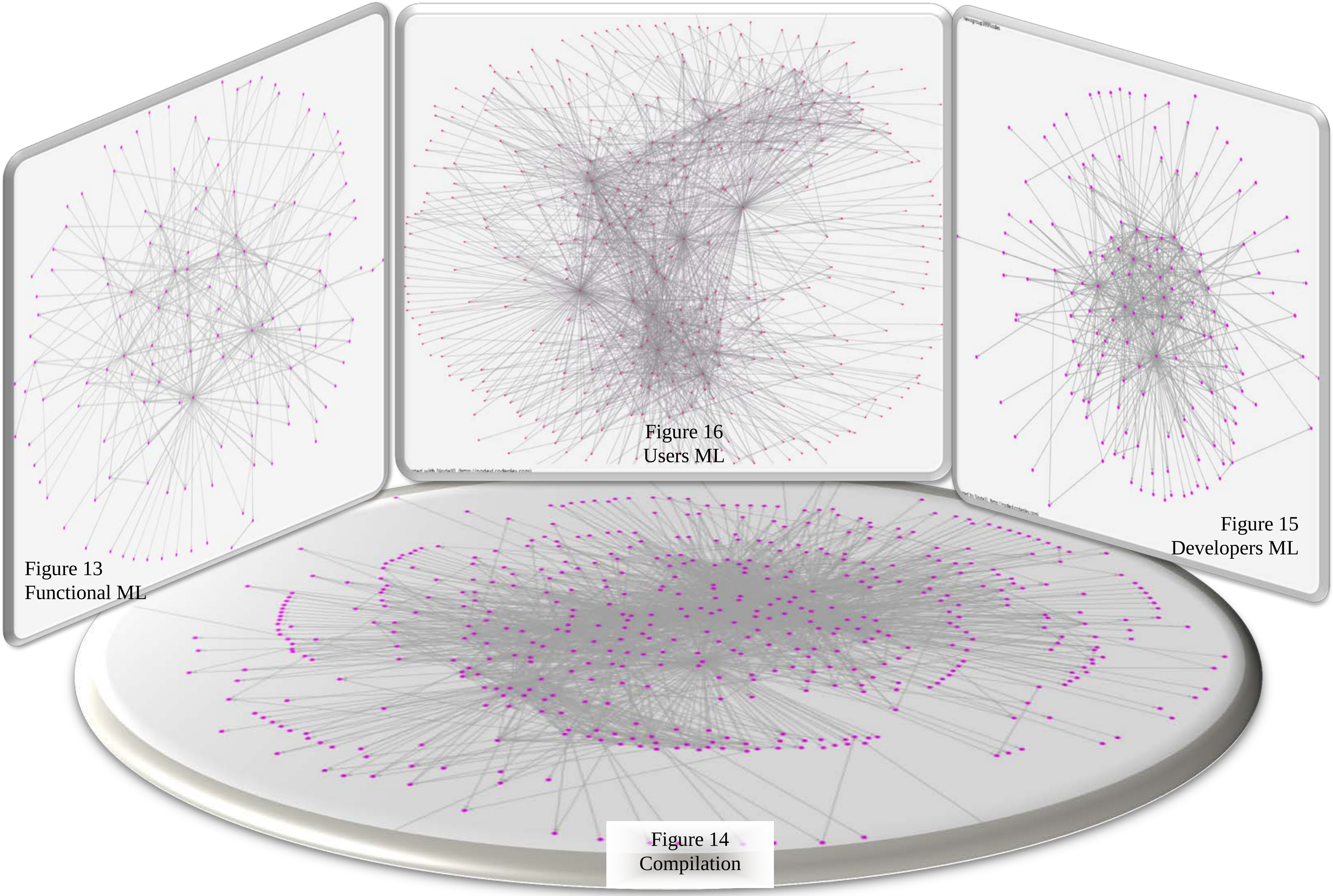


Figure 13
Functional ML

Figure 16
Users ML

Figure 15
Developers ML

Figure 14
Compilation

The three Mifos newsgroups have different graph configurations. The reason is that the larger a network is (number of nodes and posts), the more skewed the distribution of attention is, because a few highly connected participants become even more connected (Himelboim 2008). The Mifos developers' network in Figure 13 is almost three times larger than the other two. Its subscribers are therefore expected to have higher participation, but also higher disproportional distribution of ties, or centralisation (Ibid). By contrast, the users and functional MLs are more equal in terms of posting frequency, node number and time span so are 'better' connected.

In fact large networks are expected to be less densely connected (Hanneman and Riddle 2005). For this reason it is difficult to compare the density and connectivity of the three networks, just based on these pictures. Community participation in the three sociograms is studied next in more detail, examining the behaviour of nodes in general and in each newsgroup.

5.2.2. Participation and Posting Frequencies

In online groups like chat rooms and newsgroups, community participation means generating messages, responding to messages, organising discussions and conversations (Butler et al. 2001). In sociograms, such activities are captured through nodes' positions and their relations to other members (Diani 2002, 186) highlighting individuals' involvement in knowledge dissemination, production and use. From this perspective, one major indicator that is typically used to measure nodes' participation is posting frequency, i.e. nodes' count of posts sent to all[98], as well as one-to-one posts. To visualise Mifos subscribers' participation, the rest of this section and its selection of sociograms are particularly based on calculations of nodes' posting frequencies.

The following graph (Figure 17) builds on the first three graphs above, and attempts to introduce a homogeneous and integrated picture of the entire Mifos newsgroup space. It shows Mifos MLs in the square boxes and their subscribers as nodes scattered around in a fan shape. The MLs are interconnected given the overlap between some of the nodes. 75% of the Functional ML population is also registered in the developers ML. Users and Functional share 32 participants –about a third of each population. Another 30 individuals are registered in all three, and include Mifos administrators (the group of green nodes with names). The thickness of lines shows the number of times a subscriber posted to a particular newsgroup, visualising the strength of her participation and the role[99] that she occupies in the ML.

[98] Broadcast posts (sent to all) are only visually captured in Figure 17. These represent ties to all subscribers, without necessarily meaning that they are actually connected.
[99] Generally answer-persons or newsgroups' facilitators have high posting frequencies.

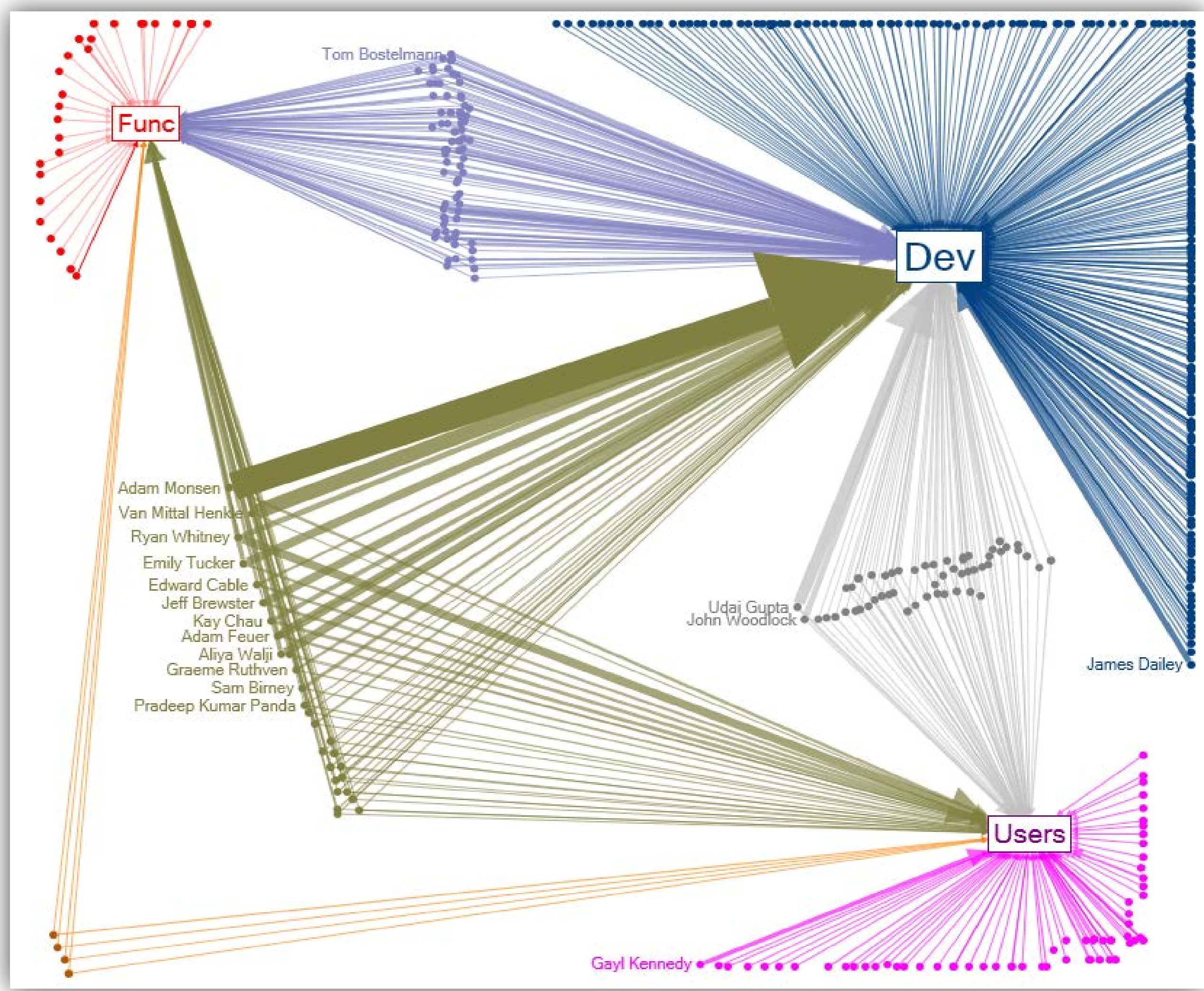


Figure 17
Integrated Newsgroup Space

To deepen this overview of community participation, Figure 19, Figure 18, and Figure 20 go one step further, looking at the dynamic of the nodes and their positions. These sociograms zoom in inside the MLs, so as to stress out nodes' posting frequencies and the strength of their ties (thick lines). Here, the sizes of the nodes reflect their posting frequency. Links between nodes capture the strength of a node's connections to another –again based on posting frequency. The table at the bottom Table 4 classifies some of the central posters that can be seen in the sociograms, highlighting differences in posting frequencies and allowing comparison between nodes.

Figure 18
Functional ML

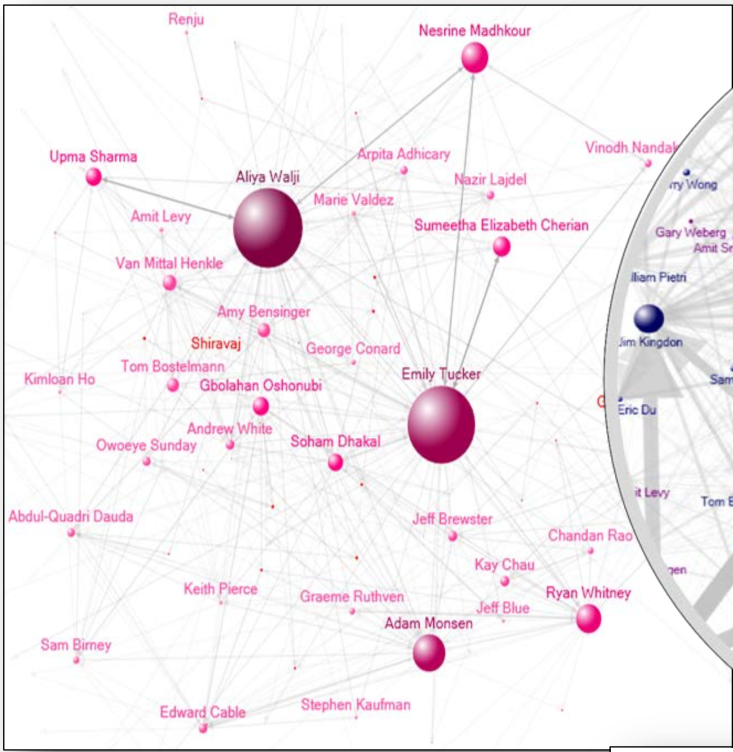
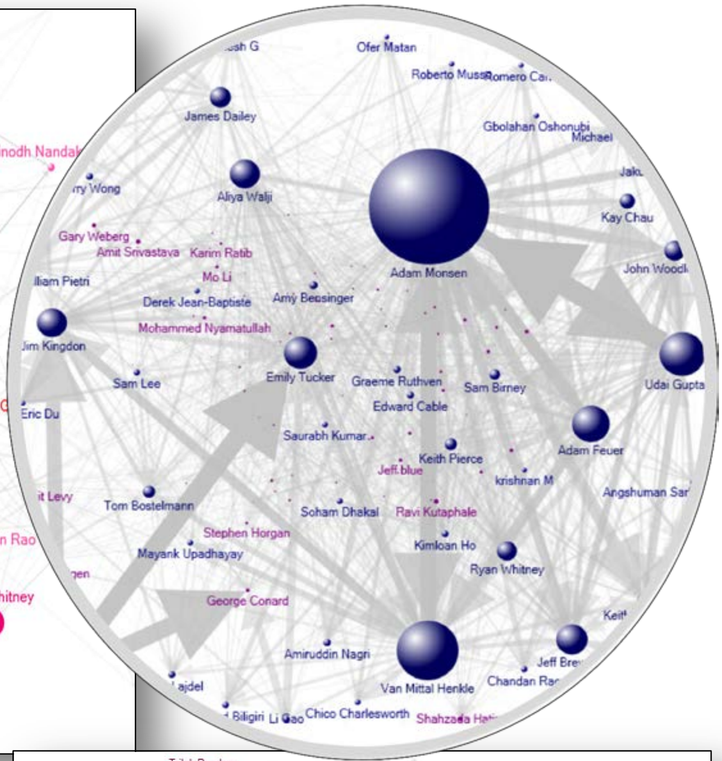


Figure 19
Developers ML



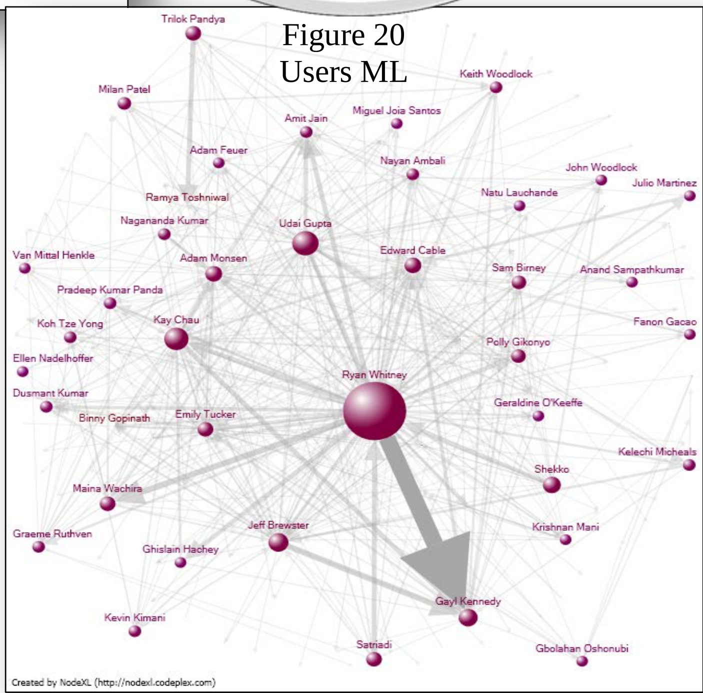


Table 4

	Functionalities	Posts		Developers	Posts		Users	Posts
1	Aliya Walji	202	1	Adam Monsen	1532	1	Ryan Whitney	581
2	Emily Tucker	197	2	Van Mittal Henkle	788	2	Udai Gupta	174
3	Adam Monsen	95	3	Udai Gupta	578	3	Kay Chau	146
4	Nesrine Madhkour	79	5	Emily Tucker	422	4	Jeff Brewster	107
5	Ryan Whitney	74	6	Jeff Brewster	398	5	Gayl Kennedy	92
6	Sumeetha Elizabeth Cherian	52	7	Aliya Walji	379	7	Adam Monsen	65
7	Gbolahan Oshonubi	48	9	James Dailey	270	8	Edward Cable	64
10	Van Mittal Henkle	45	10	John Woodlock	267	9	Emily Tucker	62
13	Jeff Brewster	37	11	Ryan Whitney	253	19	Graeme Ruthven	25
14	Kay Chau	27	12	Kay Chau	197	27	Van Mittal Henkle	17
16	Edward Cable	26	20	Graeme Ruthven	96	28	Gbolahan Oshonubi	16
25	Graeme Ruthven	17	22	Edward Cable	90	78	Aliya Walji	2
26	George Conard	14	57	George Conard	48	78	George Conard	2

The ten first names in each column of Table 4 are intensive posters and central nodes in their MLs. They are responsible respectively for 50% of email traffic in the functional ML; 60% in the users ML; and 45% in the developers ML. Their posting frequencies are also high, in contrast with the rest of subscribers. For example, Tucker, Monsen, and Ryan Whitney, three nodes in Figure 19, Figure 18 and Figure 20are proliferate authors across all three MLs. Ryan Whitney stands for 25% of post exchanges in the users' ML, while more than 90% of this list's subscribers have contributed less than 1%. This is the same in the functional ML, where the difference in posting frequency between the second node (Emily) and the last one is 16 times this newsgroup's average. In the developers' ML, the difference between the first and the last node is 50 times the average. In this sense all three MLs are highly centralised.

These results conform to what has often been reported in newsgroup studies; they show mainly three types of participants: a few core members strongly contributing to the newsgroups' content, many peripheral members with less regular involvement (Preece & Ghozati 1998; Sack 2000; Smith & Wesley 2004; Erickson & Herring 2005; Hansen 2009; Himelboim et al. 2009; Gleave et al. 2009; Hansen et al. 2011), and finally the lurkers (who do not show up in the graphs).

In fact, goal-driven networks are highly structured around a leader (or leaders) (Kilduff and Tsai 2003, 95). They are likely to exhibit a centre-periphery structure and to grow from the centre outwards adding more members to the periphery, thus demarcating the separation between these two categories of participants (Ibid). This is also the case for Mifos, as MLs are mainly used for coordination purposes and to enable collective code production. Thus, centralisation and participation inequalities can also be interpreted as an outcome of knowledge specialisation and task division in software communities (O'Mahoney and Ferraro 2004), and OSS communities (Mockus, Fielding, and Herbsleb 2000; Mockus, Fielding, and Herbsleb 2002; Scacchi 2002a).

To a certain degree, one might expect to see ripples of email exchanges forming around few subscribers, who are perceived as gatekeepers of code and platform knowledge (Hansen et al. 2011). Once they interact (dyads), they also broadcast information and news to the entire ML, thus attracting more experts (or/and interested members). Conversations within the MLs' space become 'specialised', pushing other subscribers to participate in the social dynamic of post exchanges (Smith 1999; Lerner & Tirole 2000). Gradually, MLs end up looking like interfaces between major technological subsystems, or modules in the project (Fleming and Waguespack 2007).

However, node overlap –see Figure 17- suggests that Mifos newsgroups are more inclusive knowledge spheres than one would expect. Nodes' overlap means that some nodes have posted in other MLs, making them boundary spanners or 'bridges' (Burt 1992). Bridges are subscribers who facilitate communication across newsgroups and leverage participants' exposure to other knowledge circles (Diani and McAdam 2003; Constant, Sproull, and Kiesler 1996).

Bridges are generally intensive posters and can gradually become gatekeepers (Fleming and Waguespack 2007). This is for example, the case of Walji, Tucker, Monsen, Whitney, Chaw and Cable (see Table 4), who can be seen as boundary-spanners. They have permeated participation inside their newsgroup, by monitoring changes across all three MLs and by channelling support. As their reputation has travelled across newsgroups, they became gradually known and more people have connected to them, which has reinforced their role as leaders and obligatory passage points.

A high number of boundary-spanning nodes is also a sign of Interpenetrability and high integration between knowledge domains (Provan and Lemaire 2011). In this sense the three MLs are interconnected, given that subscribers use them also to organise software production and collaborate. Interpenetrability is not a feature that is generally incorporated in MLs' design though. It is dependent on the posting behaviour of the nodes. For this reason, MLs can become messy as subscribers cross-post and forward information across MLs, thus duplicating messages.

This section has revealed high centralisation, participation inequalities and the existence of boundary-spanners among central nodes, showing how community subscribers have integrated Mifos newsgroups in their daily activities and software production/use processes. So these communication spaces formed a backstage social dynamic that run simultaneously to software development. From this perspective, community participation looks like an outcome of posting frequencies, measuring subscribers' performance and interpreting their interactions through the count of sent posts. However it is not sufficient to measure participation in terms of posting frequencies. The way actors interlink with others in the ML determines also their position in the network. Therefore it is necessary to include an additional social dimension –which does not depend on actors' 'volume' of labour- in order to understand community participation.

5.2.3. Connectivity

In fact, community participation inherently presupposes a relational dimension (Diani 2002). Participation is an outcome of a collective effort that goes beyond individual contributions. Whilst the mailing list allows anyone to be connected to anyone else, it is only by making an interpersonal connection with one or more subscribers that the boundaries of the network start to form (Diani 2002, 178). In order to study participation, it is thus necessary to account for members' authorship from the perspective of their connections, and in relation to the overall newsgroup's structure.

To do that, SNA provides a series of centrality measures[100] based on nodes' connections and positions. In fact, nodes' positions in the network are influenced by their closest connections, as participants who often share posts are more likely to be situated close to each other. They are also more likely to be closer to the centre of the network if their connection and the connection of their connections are high (Hanneman & Riddle 2005; Diani & McAdam 2003; Hansen et al. 2011).

Particularly, I consider nodes' degrees[101] as an indicator of participation to the extent that it captures subscribers' intent to exchange with other members. This measure also stresses the inter-subjective aspect of participation, as differences between indegree and outdegree[102] point to roles and divisions in the network that are an outcome of subscribers' posting strategies. For example, based on its outdegrees, a node can be an information source, a discussion catalyst, a facilitator, or/and an influential communicator (Smith 1999; Gloor et al. 2003; Viegas & Smith 2004; Smith & Wesley 2004; Turner et al. 2005; Gleave et al. 2009; Himelboim et al. 2009). Yet it still might not be perceived as influential by its peers and thus has lower indegrees (Hanneman and Riddle 2005).

In the series of graphs below, I used some measures of nodes' centrality to alter the sociograms' layouts. Figure 21 shows a table of sociograms, where each ML has been plotted twice, once based on the count of nodes' indegrees and once on their outdegrees. Table 5 shows aggregate SNA figures that support the reading of Figure 20, which I do next. In the first column of networks (Graphs: 1-3-5), the size of the dot is proportional to its outdegree count (number of outgoing connections). The thickness of each connector is proportional to the number of times that one author replied to another, and so to the strength of their connections. In contrast, the second column of graphs (2-4-6) classifies nodes based on the number of people who posted and replied to their posts directly, suggesting that nodes with higher indegrees are perceived as more prominent or more influent (Bonacich 1987; Diani and McAdam 2003, 187–188).

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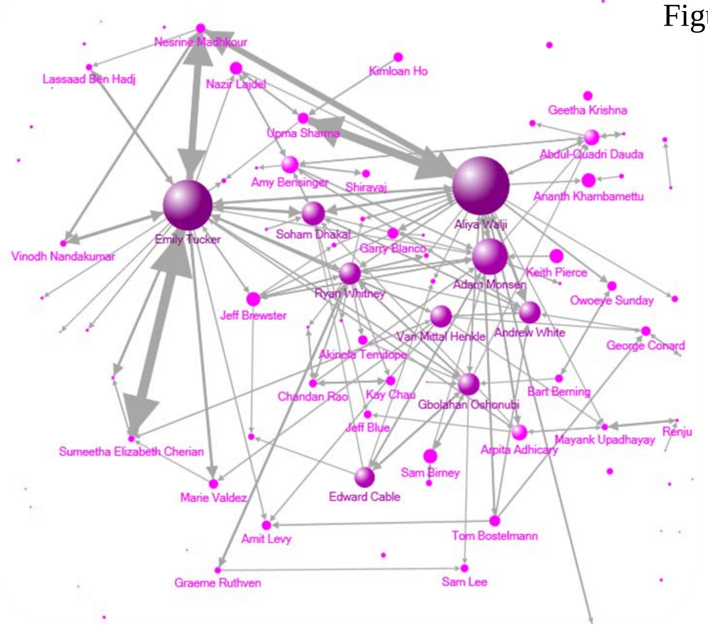
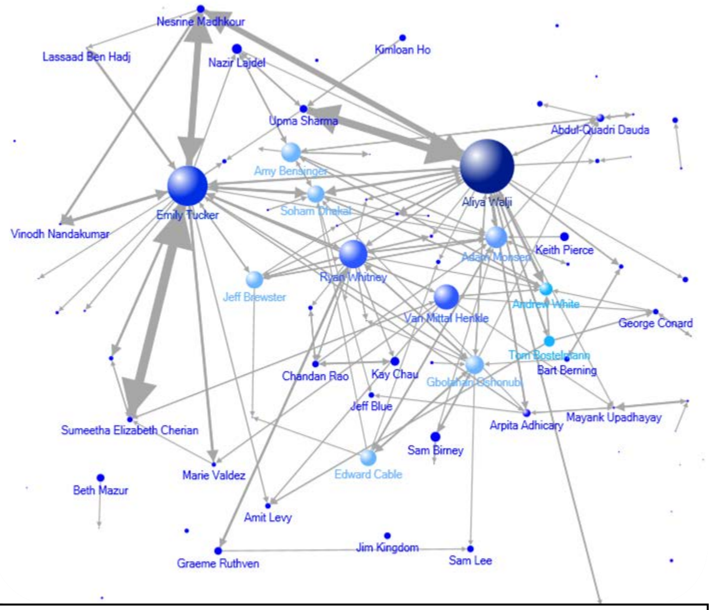
[100] Centrality is paramount in SNA, since sociologist Philip Bonacich, who developed the idea of centrality based on the high value a well connected person can have in contrast to people with few connections (Hansen et al. 2011, p.40).

[101] The number of connections in a node's egocentric network (Hanneman and Riddle 2005)

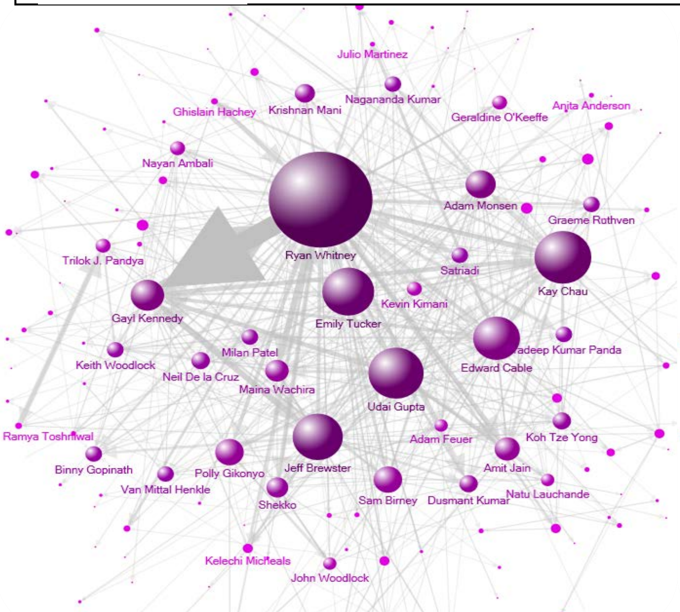
[102] These measures apply in communication networks, where the direction of the tie between two nodes indicate who is posting to who, as well as a sense of reciprocity and exchange.

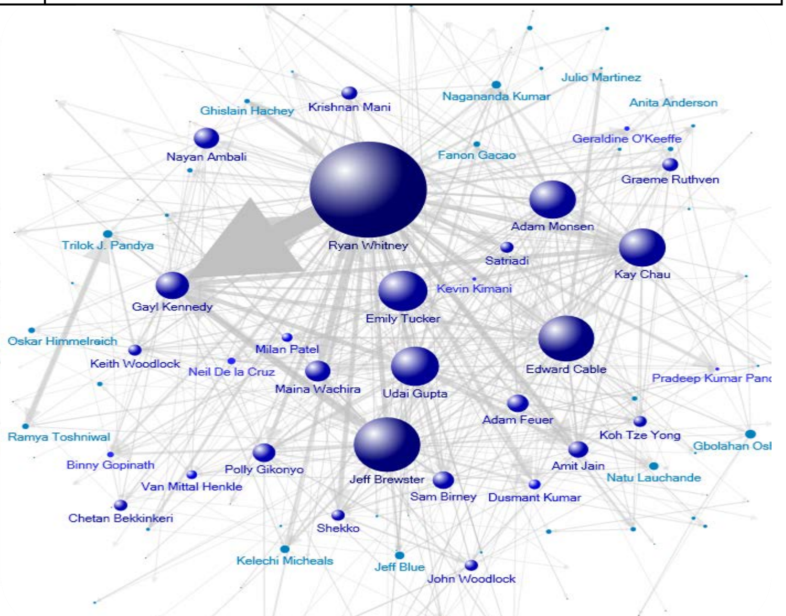
Figure 21



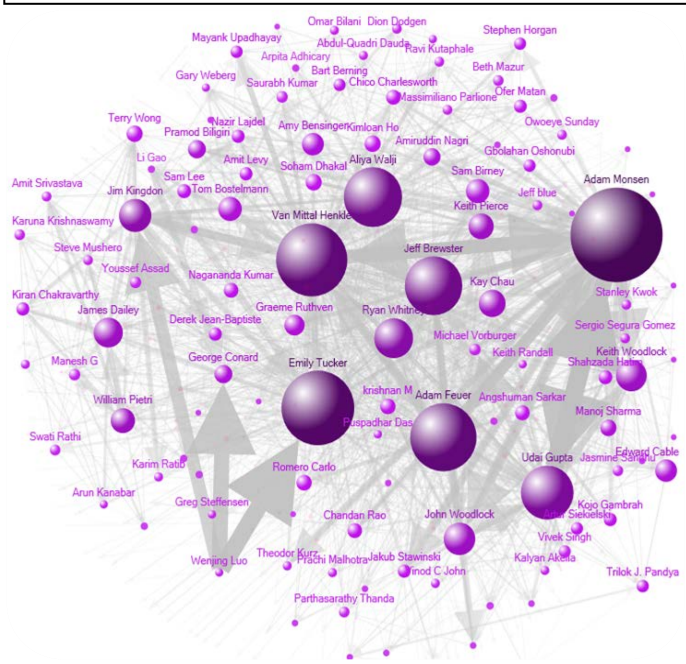


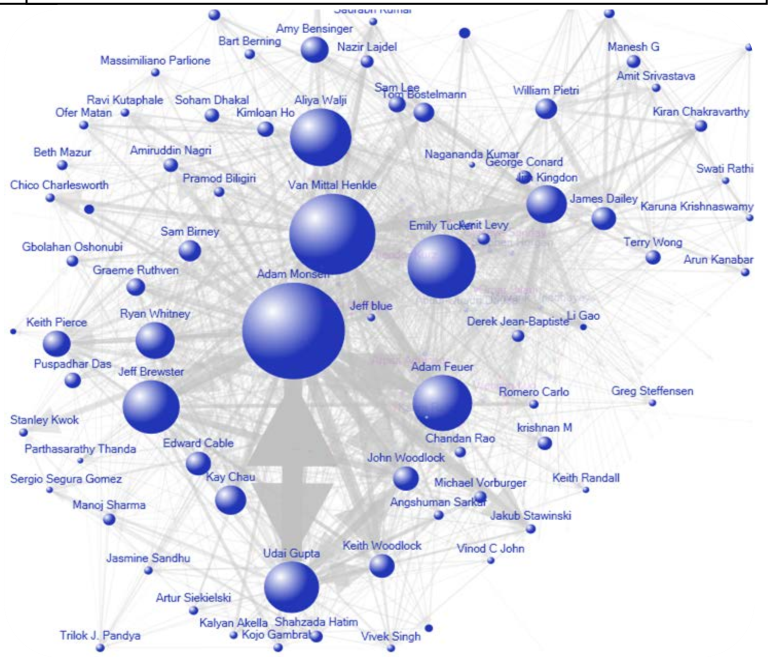
Functionalities Graph- 1	Graph- 2





Users Graph- 3	Graph- 4





Developers Graph- 5	Graph- 6

Looking at Figure 21, one can notice that outdegree sociograms (graphs 1, 3 and 5) and indegree sociograms (graphs 2,4 and 6) have a similar structure; nodes' positions, the direction and the strength of their ties are similar, but for the size of central nodes. For example, nodes like Whitney, Monsen, Tucker and Walji have high outdegrees and relatively lower indegrees.

Lower counts of indegrees imply that fewer connections have reciprocated their posts – this is not surprising if we are to consider that intensive posters typically send several replies to the same topic, intervene frequently in conversations to add information, or comment on some peers' comments, etc. So they do not necessarily expect a systematic answer. Posting is their daily routines, and part of their software production activities.

In contrast, less regular posters have smaller egocentric networks (see difference between average and maximum outdegrees in Table 5). As they post according to their selective interest –are less committed, or have limited involvement-, they are moderately (or sometimes little) interconnected; only maintaining a few connections amongst their peers. Hence, many have also indegrees exceeding their outdegrees, in the sense that central nodes might reply twice or several times to their posts. This also implies that most peripheral posters are connected to central nodes –see Figure 21. Table 5 also shows variations between indegrees and outdegrees across all three MLs, indicating multiple and diverse posting strategies across subscribers.

		Indegrees	Outdegrees	Var. btw. In and Out
Functional	Average	4.04	4.04	-
	Maximum	37	50	<13>
Users	Average	5.3	5.3	-
	Maximum	62	88	<24>
Developers	Average	7.08	7.08	-
	Maximum	114	155	<41>

Table 5

Intensive posters are important to sustain the posting activity of less regular posters. They give insurance to peripheral posters that they are more likely to receive answers if they post, thus increasing the ML's conversational incentive (Welser et al. 2009). Many central nodes across the three Mifos MLs have turned themselves into 'answer people' (Fisher 2005) in order to leverage community participation (Diani 2002, 186). By so doing, they have gradually fostered the conversational potential of Mifos newsgroups, and increased peers' incentive to post, exchange tips, information and experiences[103].

[103] Over 50% of posters have received multiple replies and the average thread depth suggests a typical exchange in excess of three posters. Less than 15% of subscribers have low reply rates.

However, intensive posters do not occupy necessarily the same roles in and across MLs (Hanneman and Riddle 2005). When looking at nodes indegrees and outdegrees, one can notice differences in nodes' relational properties that suggest personal strategies. For example Tucker and Ryan Whitney are strongly interconnected across all three newsgroups. Emily is among the five first in the functional and developers' MLs and among the ten first in the users MLs, suggesting that she is an information catalyst and a leader (Smith & Wesley 2004; Turner et al. 2005). She is also perceived accordingly by her peers. More than 80% of her egocentric network has reciprocated her ties –some of which are very strong, implying collaboration and continuous monitoring (see Figure 21). In contrast, Ryan Whitney's activity is particularly substantial in the users' ML, where he has both the highest count of outgoing posts and the broadest egocentric network. His posting behaviour in this ML indicates a frontline role, a sort of answer-person, providing support to users. His strong position in the developers' ML also implies that he is one of the core developers, which explains his focal position in the users' ML –possibly channelling users' requests to the developers' list.

When reading posts, subscribers come across peers' profiles, such as organisational membership, location, roles in the community, etc. Such details are often enclosed in email bodies, or can be retrieved from Internet. In this sense what we –network analysts- try to understand from nodes' relational properties is known by subscribers and has already shaped their posting behaviour –with whom to connect and whose post to answer, etc[104]. Hence, nodes' position in the networks is a consequence of nodes' posting strategies rather than their cause. From this view, information about peers' identity affects network structures and thereby should be included in the way we study and conceptualises community participation (Matzat 2009).

5.2.4. Knowledge Performativity and Community Participation

Indeed, looking at nodes' degrees alone is not sufficient. Viegas and Smith (2004) reckon it is important to design visualization methods that account for how discussants rely on their personal knowledge of others' behaviour in online environments to guide their choices of who to interact with and who to ignore. To do that requires profiling[105] authors and including this information in NodeXL, so as to enhance nodes' features and the overall layout.

The remaining sociograms in this chapter are thus redesigned to emphasise nodes' endogenous and exogenous traits, using one property of each trait at the time (like geographical location and outdegrees; job titles and closeness centrality, etc.). It is necessary to keep nodes' relational properties and exogenous traits together in the layout, in order to contrast both sides of actors' identity as they participate in post-

[104] Separating between subscribers is necessary in order to set priorities, know whether to reply to a message or not, who to target for help, and whose queries to answer.

[105] Profiling nodes consists in collecting information about subscribers' roles in the community, their organisational affiliations, geographical location, type of contributions, etc.

exchange. This way, one can study Mifos community participation in MLs' post-exchanges as an extension of actors' broader involvement in the Mifos project and as a proxy of their multiple memberships across embedded social systems (Fleming and Waguespack 2007).

5.2.4.1. Organisational Membership

The next three sociograms (Figure 22, Figure 23, and Figure 24) import the organisational affiliation of the most central nodes in Mifos community,[106] showing that intensive posters across the three MLs were mainly Mifos project administrators at GF-Tech. Figure 22 displays their picture profile, while their size is proportional to the count of their nodes' outdegrees. The graph's layout does not respect the geography of centrality, keeping central nodes at the periphery of the graph for visibility purposes. The grey spheres at the centre do not have pictures. The intensity of their colours and their size indicate instead the count of their outdegrees. The black spheres in particular have relatively high outdegrees and posting frequencies. They are also affiliated with GF-Tech, thus their close positions to the central nodes in the picture. This graph explicitly hides the visibility of nodes' ties, as these will be highlighted in the next two graphs.

Indeed, Figure 23 and Figure 24 are complementary, emphasising out central nodes' ties based on a double lens –zoomed- in (16) and a zoomed-out (17). First, Figure 23 substitutes central nodes' names with their job titles. Similarly to Figure 22, this sociogram also displays their pictures, while their size is proportional to the count of their outdegrees. The aim is to show at the same time nodes' job titles and their ties in order to capture how their posting behaviour was influenced by the hierarchy of their job titles. Finally Figure 24 aggregates all central nodes in one meta-node and zooms out their outside group relations to the rest of community members. The size of the simple nodes (the non-central subscribers) in this sociogram is also proportional to their outdegrees and to the strength of their connections.

[106] The remaining sociograms in this chapter are built on the basis of a compiled dataset, in order to avoid nodes' overlap.

Figure 22

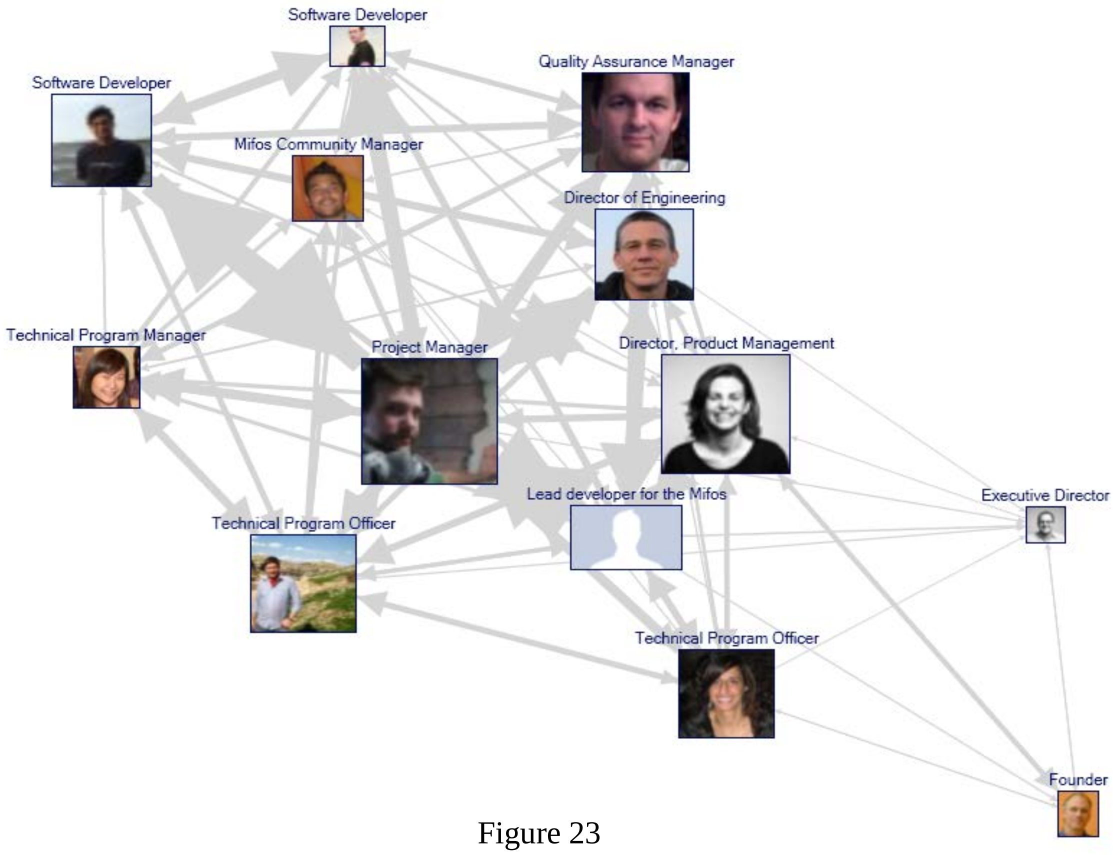


Figure 23

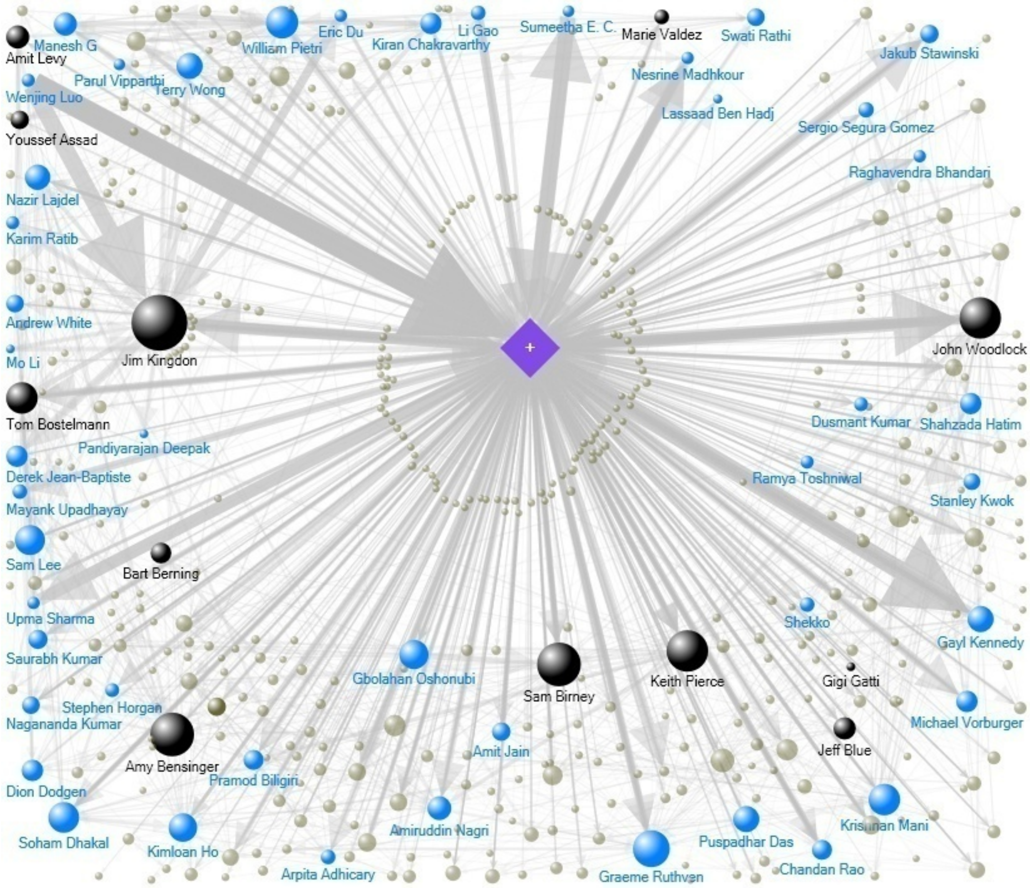


Figure 24

As I mentioned above, nodes with profile pictures are Mifos administrators at GF-Tech (see section 3.4.1). In total, there are fifteen nodes[107], ten of whom have the highest counts of outdegrees[108] in the compiled dataset. Mifos administrators at GF-Tech also represent 3% of the subscribers and cover almost 50% of the total traffic –that is to say one message in two is a post or a reply sent by an administrator. Indeed, as Figure 24 also shows, almost the entire newsgroup space forms their egocentric network –but with relatively thin ties among the other subscribers.

Typically, newsgroups' administrators are the most active members and do function better when they are known as such, and respected by all subscribers (Hansen et al. 2011, p.137; Butler et al. 2001). In newsgroup' scholarship, it is known that administrators' posts are crucial in order to create 'common ground' (Whittaker et al. 1998; Clark and Wilkes-Gibbs 1986). Common ground is a key principle of face to face conversations and refers to the state of mutual acknowledgment among a set of discussants that makes their conversation coherent (Ibid). In virtual spaces, the need for common ground is even more vital as participants do not see each other –which implies that post-exchanging can become messy and unruly. For this reason, administrators are so important; they allow subscribers to become familiar with one another, and they

[107] The sociograms are frozen snapshots that do not account for the effect of time. It is not the case that all these people have been recruited into the Mifos project, or have posted to Mifos MLs at the same time.
[108] This group's average outdegree is 14 times the average outdegree in the whole dataset.

create a common ground for conversations (Butler et al. 2001). Their central position is thus a consequence of their efforts to order and monitor the progress of conversations between peers (Monge and Contractor 2003, 423).

In the Mifos case central nodes have developed beyond facilitation and the nurturing of a common ground between discussants. Their organisational affiliation, i.e. their role as Mifos project administrators at GF-Tech, has superseded their role as newsgroup admins. As project's administrators, they broadcast news, organise collaboration and monitor discussions between subscribers, becoming by the same token the gatekeepers of Mifos knowledge. However, not all GF-Tech administrators are newsgroups' administrators and not all newsgroups' administrators have contributed to code development. The administration of the MLs and facilitation between community members is a separate task which in this case was allocated to one particular ML's administrator.

This can be indeed seen in Figure 23, e.g. for Cable who is Mifos community director at GF-Tech. To study this subscriber's particular posting behaviour, one needs to contrast his relational patterns with those of other members in the administrators' group. Let's for example compare the node Monsen –project manager- to Cable. Figure 23 shows that the former author (Monsen) has strong ties with most of the administrators' group. In OSS projects, MLs are generally used to organise and coordinate processes and tasks; hence a strong tie between a pair of nodes should be interpreted as a sign of collaboration (O'Mahoney and Ferraro 2004). In contrast Cable has a relatively large egocentric network by the count of his outdegrees –but relatively weaker ties, and lower posting frequencies. This implies that he has intervened sparsely in conversations, just posting to greet members, introduce himself and the community, broadcast information, etc. –which does not require several replies and extended posting. His organisational job is thus reflected through his relational patterns (Butler et al. 2001) –that is building the Mifos community.

Other differences in posting patterns among GF-Tech administrators suggest that they have used the MLs to organise software production tasks and processes, but also as to interact with other community members in line with their own roles and organisational responsibilities. Thus organisational divisions inside GF-Tech have been continuously enacted across the newsgroups. Figure 25 plots some indicators of GF-Tech administrators' posting behaviour (posting frequencies graph 1 and 2, indegrees and outdegrees in graph 3) and shows differences that can be compared and contrasted with their job titles in Figure 23.[109]

[109] I stop here at the example of Cable vs. Monsen. But this exercise can be repeated for other nodes.

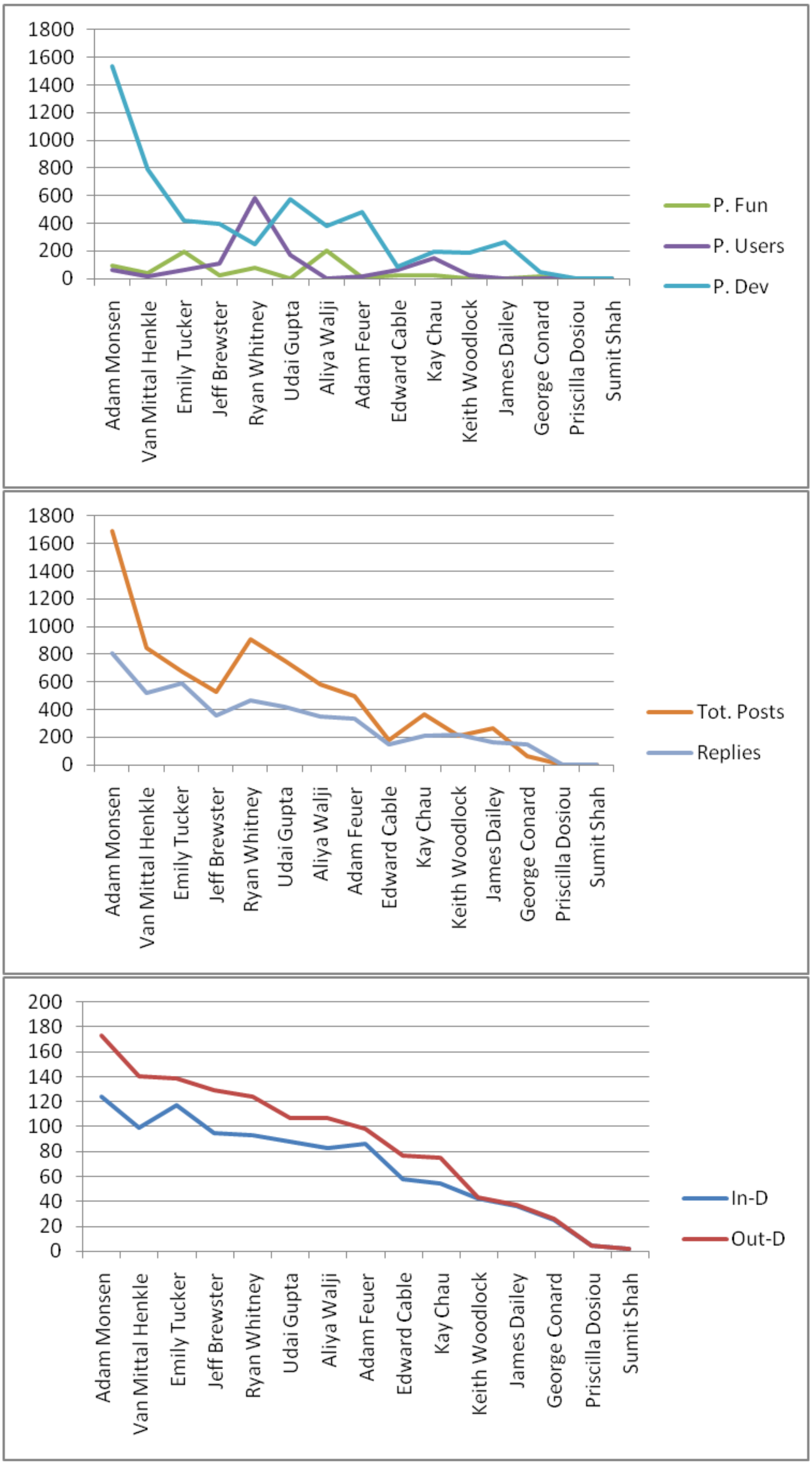

1800
1600
1400
1200
1000
800
600
400
200
0
P. Fun
P. Users
P. Dev
Adam Monsen
Van Mittal Henkle
Emily Tucker
Jeff Brewster
Ryan Whitney
Udai Gupta
Aliya Walji
Adam Feuer
Edward Cable
Kay Chau
Keith Woodlock
James Dailey
George Conard
Priscilla Dosiou
Sumit Shah
Tot. Posts
Replies
200
180
160
140
120
100
80
60
40
20
In-D
Out-D

Figure 25

Often networks of relations are partially embedded in interrelated networks, as actors' performance in one network is co-dependent on their performance in others (Wellman 2001). Unless, we are able to 'see' how they interrelate, we might fail to perceive the link between the global structure and individual performances (Emirbayer & Goodwin 1994). In this sense, using a category (administrators' organisational roles) that most subscribers are aware of when they post-exchanged has put a different light upon the concept of community participation altogether –revealing how central actors' organisational roles influence the structure of post-exchanges.

Going a step further, Figure 23 captures the ties between GF-Tech administrators – which should show organisational hierarchies and divisions based on the strength of the ties between nodes (Granovetter 1973). In this sociogram Tucker –Mifos director- and Monsen – project manager- appear to be the central nodes. Emily's count of betweeness centrality[110] is fifty five times the average of the newsgroup compilation. By contrast, Monsen has a relatively lower betweeness centrality; yet he has stronger ties with all group members –see Figure 23.

However, it is not possible to conclude who is the most central node among GF-Tech administrators[111]. This group is strongly tied[112] and its members' indexes of closeness centrality[113] are almost equal –implying that they are "just a hop away" from each other (Hansen et al. 2011, p.41). This also means that their roles are complementary, so their presence is divided between Mifos MLs according to their knowledge domains and their ongoing work processes[114].

It is now largely proven in the open innovation and software scholarship that OSS projects rely heavily on strong leadership to function (Lerner & Tirole 2000; Lakhani & Wolf 2005; Von Hippel & Von Krogh 2003; Coleman 2004; Mockus et al. 2002). In this case Mifos administrators at GF-tech have performed their leadership notably through the MLs, fully integrating these spaces in Mifos long-term development.

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[110] Betweeness centrality is the frequency with which a node falls between pairs of nodes on the shortest path connecting them (Freeman 1977). In this case, Tucker is 48000 times on the shortest path between all pairs of nodes.

[111] Beauchamp (1965) argues that betweeness centrality captures the efficiency of a given communication system, as "a message originating in a central node would spread throughout the network in a minimum time" (Freeman 1977, citing Beauchamp 1965). The use of this measure seems even more natural in a study of communication networks, where the potential of a central point for binding the network together by coordinating the activities of other points sounds substantially relevant (Freeman 1977 citing Cohen and Marriot 1958). Knowing who has the highest count of betweeness centrality reveals who has control over the network (Diani 2002). Whilst this might be true in classical communication systems, in newsgroups, when a message is posted, it reaches out all subscribers simultaneously. In this sense, betweeness centrality and other measures of influence/control are less relevant.

[112] density is high (>0.7)

[113] Closeness is another measure of centrality. It is the average distance between a node and every other node.

[114] Most GF-Tech administrators' roles are about orchestrating multiple and interconnected code production processes –which implies a higher activity in the developers' ML. Their parallel membership in the other two newsgroups is necessary insomuch as it permeates the transfer of information.

Based on that, my point in this section was to show that Mifos administrators at GF-Tech have become intensive posters in the MLs because of the nature of their tasks and responsibilities inside the Mifos project. The more they were engaged in tasks that require the gradual building of complex knowledge, the more intensively connected to others they became (Bechky 2006; Provan and Lemaire 2011).

There is nothing really exciting about knowing that Mifos administrators at GF-Tech have enacted their own roles and organisational membership in the MLs. As I mentioned earlier, what matters really is to know how their role and performance in the MLs have fostered community participation –to the extent that being a central node in Mifos MLs is about influence or knowledge transfer, rather than control of information (Himelboim, Gleave, and Smith 2009).

In this sense, the OSS administrators –or the ‘benevolent dictators’ as Mochus and others (2002) have called them, still need to ‘earn’ their leadership and gradually build their reputation among newsgroups’ subscribers (Fleming and Waguespack 2007) –through providing support, keeping members posted, broadcasting information, etc. Therefore, it is not enough to ‘transport’ leadership in the open space of the MLs. It is still much important that actors’ status as leaders is acknowledged by other subscribers –this occurs only insomuch as they are perceived as so (able ‘to make a difference’). They must convince peers they are experts and transfer information to others (Ibid).

Accordingly, the duration of a subscriber’s involvement in the project is one aspect of building reputation, allowing her to become well positioned to communicate information about Mifos products, code and the development process (Provan & Lemaire 2011). When looking at the thickness of ties between nodes, it is not always relevant to interpret them as enactments of organisational hierarchies. In this case, they are also a token of subscribers’ time investment.

Indeed, this chapter has built sociograms by aggregating five years of post-exchanges, capturing in one picture the gradual labour of actors who might have left since then, and the continuous efforts of those who kept contributing to the social dynamic of the MLs[115]. Rosenthal and others (1985) have suggested that ties strength pinpoint the possibility of information transfer. Particularly, linkage strength and breadth provide a potential for long lasting relations between members and suggest ongoing collaboration or transfer of complex knowledge (Hansen 1999; Provan & Lemaire 2011).

The time investment of GF-Tech administrators is thus implied in the thickness of their ties –whether among themselves or in relation to the rest of the community. GF-Tech administrators have become the central nodes across MLs progressively as many subscribers have posted to ask for support, report an error or demand clarification. By answering, they have naturally multiplied their connections, and built their reputation as ‘experts’.

[115] I will develop further the limitations of studying static networks in the conclusion of this chapter.

From this view, community participation is not just relational; it is an ongoing flow of nodes' relations. It is seen here as a process through which individuals recognise each other, and acknowledge their peers' roles and responsibilities (Diani 2002, 176). As subscribers post, reference common interests, discuss previous experiences, comment on limitations, etc. they assert by the same token their individual expertise and gradually build a reputation in the newsgroup.

Once a subscriber learns who does what in Mifos network, whose information to channel and whose expertise to rely on, then she is better off than knowing how to do the task by herself (Faraj & Sproull 2000; Hansen et al. 2011, p.32). Thus expertise is knowledge of the perceived most knowledgeable members (Palazzolo et al. 2006), in so far as individuals' perception of others' expertise is closely related to the rate of others' participation in the discussion (Ibid).

Finally, I consider that knowing subscribers' organisational affiliations and their roles is one piece of information that a subscriber also acquires in order to optimise her posting strategy. Uploading this information into the layout of sociogram is therefore not so much an argument in favour of 'embeddedenss' (Wellman 2001), as it is a way of showing the 'performativity' of knowledge in community participation, and how it influences the structure of Mifos MLs.

5.2.4.2. Community Participation and Knowledge Profiles

In this section, I would like to pursue this idea of building expertise and reputation, through posts and posting strategies. To do that, I enlarged the focus of my sociogram so as to include non-administrator subscribers and build a directory of participation. This contains different types of participants depending on their background knowledge, organisational affiliation and interest in posting to the MLs –that is their knowledge profile.

To be able to construct a comprehensive picture of Mifos MLs, I had to extend the task of profiling nodes, so as to collect more exogenous data and construct the knowledge profile of a sample including over 200 nodes[116]. While I do not seek necessarily to create a representative sample, this task has allowed me to remove the anonymity of some nodes, to explore their knowledge profile and the actual knowledge divisions in Mifos MLs[117].

Figure 26 is built to capture the project's knowledge profiles. This figure is based on the additional node profiles that I uploaded. It contains meta-nodes (groups of nodes) that are relatively densely interconnected. The remaining nodes that are not profiled lie at the bottom of the figure –the majority of which are directly connected to GF-Tech administrators.

[116] The compiled dataset of the three Mifos MLs contains 500 nodes in total

[117] My selection is based on nodes' indexes of eigenvector centrality –capturing nodes that explain most of the MLs' traffic. This index classifies participants based not only on how well connected they are but also how well connected their connections are.

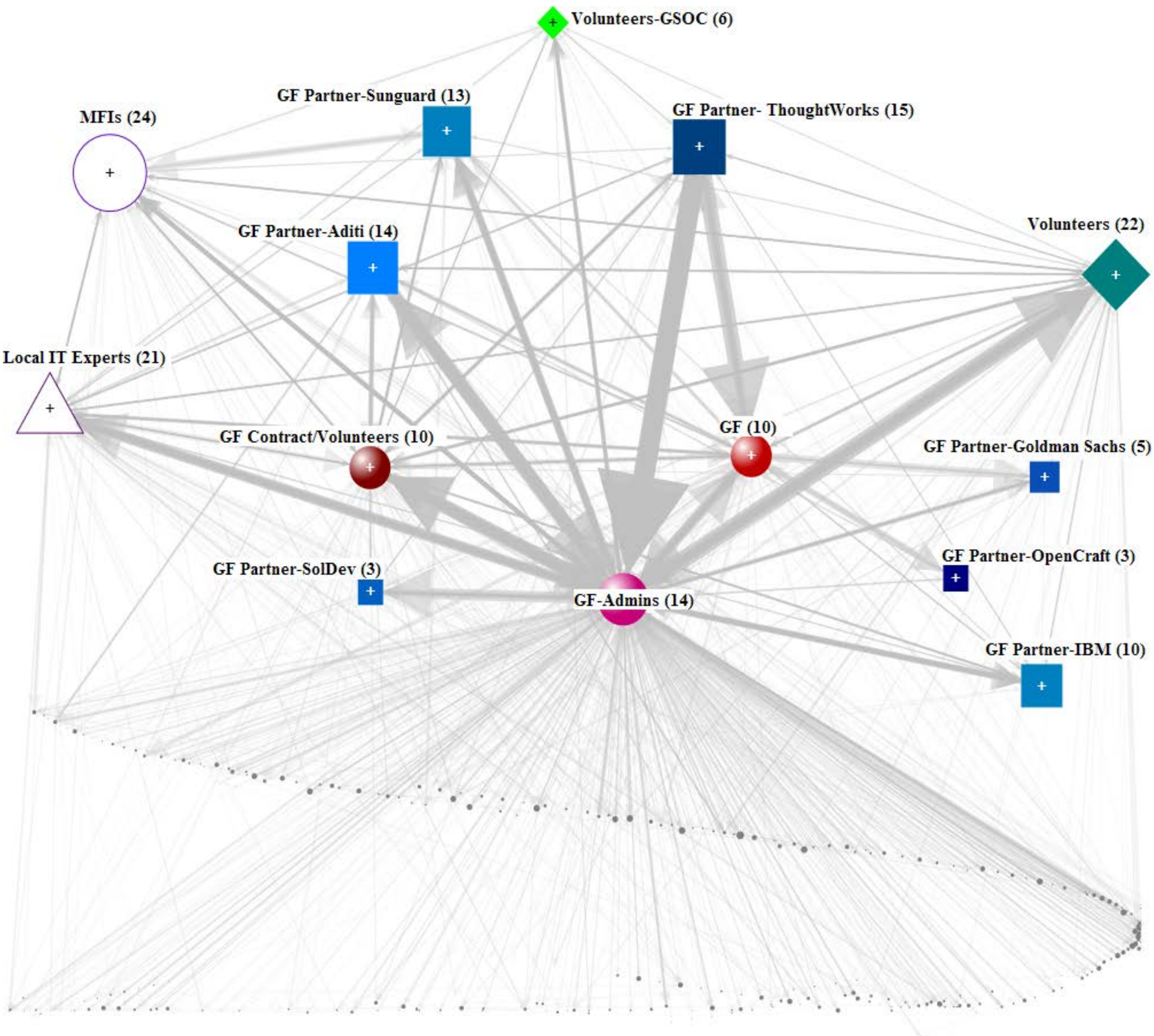

Figure 26

Figure 26 shows 14 categories that represent MFIs, their IT intermediaries (local IT experts) and Mifos developers. Among the developers are volunteers, as well as different groups of individual and institutional contractors. Some are directly affiliated to GF-Tech, for example the nodes that are represented in the red node GF Contract/volunteers –who at some point were GF regional delegates providing field support. By contrast most of the blue nodes are institutional IT partners, which have been recruited to produce and enhance code features voluntarily or on a contract basis[118]. Despite belonging to different knowledge profiles, these individuals are all IT fluent, which explains why they can interact and communicate.

In fact, Figure 26 reflects a hybrid ecosystem containing multiple knowledge profiles, which have collaborated and contributed to code production and software long-term development. Not only that, but this ecosystem is also open and changing (O'Mahoney and Ferraro 2004); there is no single group or set of groups that can ensure Mifos

[118] Analysis Chapter II will provides further details about meta-nodes, explaining their context, duration and the nature of their participation.

development over time on their own –not even the project founders at GF-Tech. This does not mean that there will not be explicit agreements among community members, specific roles and responsibilities allocated, or that a group of people will not commit to some tasks at a moment of time. The point is that there cannot be global mechanisms of coordination, nor a definitive system of governance as one can witness in distributed production of commercial software (Gupta et al. 2009; Provan and Kenis 2008).

In truth, organisations, like GF-Tech do not possess all the knowledge and resources needed to produce and develop software for MFIs over time. For this reason, they seek partnerships and associations with other organisations that have part of the knowledge and resources required (Ågerfalk and Fitzgerald 2008; Fitzgerald 2006); this is how inter-organisational arrangements and communities start to form (Powell et al. 1996). They establish a temporal arrangement within which individuals collaborate and advance the development of core features (Mockus, Fielding, and Herbsleb 2002).

The involved participants and groups of participants might be able to partially produce code, or achieve interesting progress. However, the task-network thus developed may have little to do with their interpersonal abilities and the extent to which they are 'appropriate' for the roles they occupy (Provan and Lemaire 2011). For this reason, they are bound to change as new tasks emerge, newcomers start participating, and new forms of expertise are acquired and required, thus making new network configurations possible.

In this sense, Mifos knowledge circles in the network are emergent. They are formed by people who show interest in Mifos, as they participate to its development by posting news, solutions, questions about things they did and did not understand, as well as by commenting on peers' posts and experiences. Each knowledge group is a network in itself containing the representatives of multiple organisations; yet they all meet within the space of the MLs, as posts transform their interactions into encounter points between various knowledge strata.

As the social dynamic of post exchanges in the MLs intensifies, community participation gains momentum –in terms of intensity of posting and number of connections. More actors are familiar with the product and its platform and so are able to reuse the code and its objects for their own purposes. Potentially, they become perceived as the Mifos 'experts' by the rest of the community, which should then affect in turn the balance of influence within the newsgroup and the community.

So far, I showed that community participation is not only relational, but it is also a continuous flow of labour. Hence GF-Tech administrators could not only rely on their organisational leadership only to occupy their positions across Mifos MLs; they had to construct and sustain ties within an ever growing and changing network –which contains in addition multiple and various knowledge profiles. This was necessary in order to keep collaboration and code development going over time. More importantly, Mifos development is not merely the outcome of a few nodes' work (GF-Tech administrators), as the first and centralised pictures of the MLs would lead us to believe.

Emergent and intermittent (temporally-bound) arrangements of GF-Tech partners, software contractors, volunteers and IT intermediaries have participated and gradually contributed to the crystallisation of Mifos code objects, its products and its platform.

As I mentioned earlier, it is unfortunate that the use of static network snapshots hides the time dimension from subscribers' post-prints. What I explain in this section with regard to knowledge building, reputation and nodes' position in the network are time related; in the sense that they are the outcomes of participants' time investments and continuous efforts. By contrast, the sociograms above lures the analyst to understand community participation as a frozen structure of relations that does not mature and change, obstructing from view the labour and time investment that brings a node to occupy its position in the network and makes it at the same time so fragile and transient.

I try to overcome the limits of static sociograms in the next analysis chapter. But for now, I would like to conclude this chapter by briefly introducing another aspect of community participation that can still be studied through static sociograms. This is about distance and regional concentrations of participants. The point is that this case is a geographically distributed OSS project, which impacts collaboration and code production. Besides, the geographical separation of participants is in fact the first and major reason in making the MLs so instrumental in mediating participation, and in creating an intense social dynamics around the MLs.

5.2.4.3. Geographical map positioning

As mentioned earlier the purpose of importing exogenous data in the sociograms is to emphasise some information that subscribers know and which affects their posting strategies, such as who to exchange with, whose post to answer and what to write. In this case, I used some of the information that I collected earlier to map participants' knowledge profiles, particularly the senders' countries. It was possible to collect this information by reading subscribers posts –whenever the country of origin was mentioned. I also looked at the hosting domain in email addresses[119], to find the origin of the poster or the origin of her organisation. This data was then inputted as exogenous' nodes properties and plotted with NodeXL. Accordingly Figure 27 does not capture the whole Mifos dataset, but only the selection that I have specifically profiled (see Appendix 6). In line with Figure 26, it also shows meta-nodes –that is a group of individual nodes that have the same country. The size of the pink node is proportional to the number of posters in each meta-node. The latter are interconnected by the flows of posts that were sent from a country to another and show their directions.

According to Figure 27, one can notice two large nodes, the USA and India. The node India contains many MFIs and Mifos intermediaries (local IT experts), as well as some of GF-Tech individual and institutional contractors. The USA node contains mainly GF-Tech administrators, GF affiliates, as well as some volunteer developers. The other nodes are divided across North-South. The Southern nodes contain mainly MFIs and

[119] Country name, like * .UK; * .FR, etc.

their IT intermediaries, while the northern nodes contain mostly volunteer developers – apart from for China and Australia. China contains a group of subscribers who work for GF-Tech's institutional contractor ThoughtWorks. Australia only contains volunteer developers.

Communication flows are generally two directional, except for China, where the flow of outgoing posts is much higher. This suggests that Chinese participants have mainly reported to GF-Tech administrators –rather than really collaborated. Most of the thick connectors in Figure 27 point to the USA node or stem from it, which confirms prior results. However, the graph also shows information flows between other countries, like India-Australia, or Tunisia-Lebanon-Egypt, Kenya-Nigeria, etc.

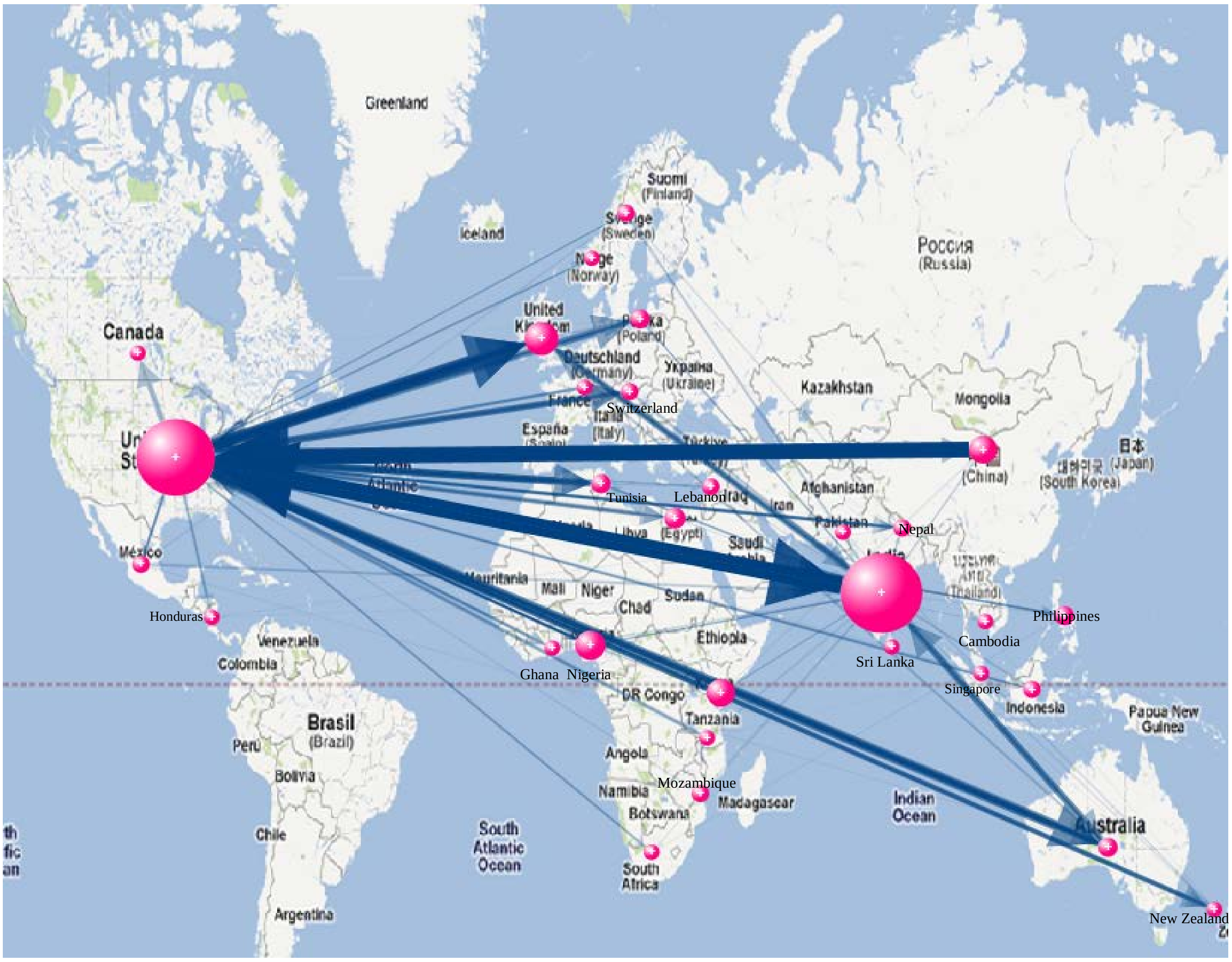

Figure 27

To put this map in perspective I would like to borrow here two other maps[120], which were published by GF-Tech and for many years were displayed prominently on Mifos website. These highlight Mifos global outreach; they focus on GF-Tech network of partners, populating the World map as a way to claim affiliated territories and pinpoint regions where Mifos was downloaded and implemented locally –see Figure 28.

These two maps have some similarities with the sociogram in Figure 27 –so I could have just used them to show how distributed the Mifos project is. However, they overlook the project's directions of information and the connections that non-USA participants have gradually nurtured –also hiding the self-organising and emergent nature of the Mifos network. Figure 28 is a discursive artefact, which situates the Mifos project in the continuity of GF-Tech development policy. Its aim is not to capture Mifos community relations, or to show how it is slowly changing –so we do not see in these maps that the dependency on GF-Tech administrators is less important as, new and potentially key players join to participate.

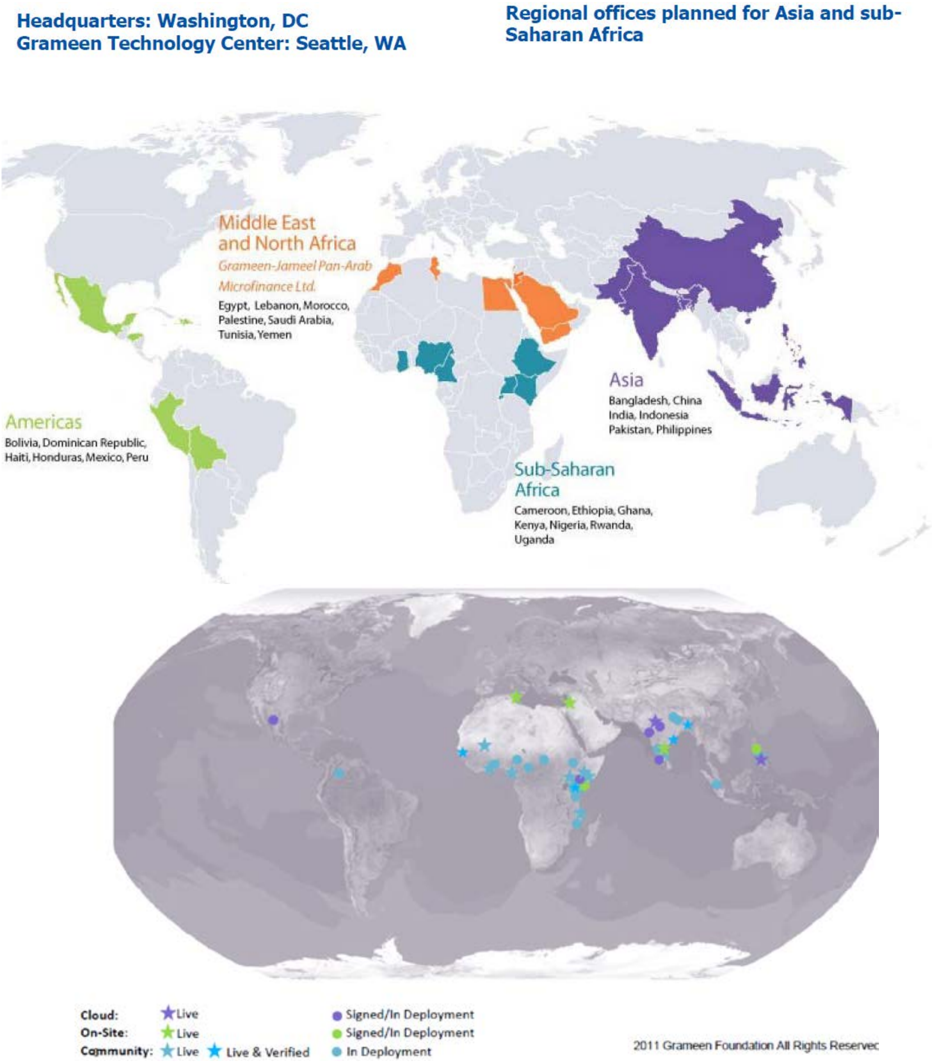

Figure 28

[120] These maps were also part of a presentation given in 2009 by members of GF-Tech, which was entitled 'creating a world without poverty' and then published online.

Geographic analysis is based on the presumption that concentration is associated with homogeneity and that heterogeneity increases with distance (Rothenberg et al. 2005). It is also commonly believed that collaboration in work groups is essentially a “body contact sport” (Kisesler and Cummings 2002, 57). Thus, research in innovation and virtual organisations, which also utilises SNA tools and theory, has found that physical distance has a negative effect on communication (Leenders et al. 2003). The more spread out is a project, the more likely that actors involved are to encounter difficulties communicating because of their differences[121].

From this perspective, OSS belongs to a category of software ventures that are right from the start highly risky, given they are extreme cases of collective action where distributed developers work in arbitrary locations, rarely or never meeting face to face (Mockus, Fielding, and Herbsleb 2002). The Mifos project was thus inherently disadvantaged. On top of this, it was also to be expected that relations between participants inside geographical concentrations would be stronger than those across regions (Kisesler & Cummings 2002, p.66). Hence, the immediate proximity of Mifos administrators at GF-Tech should logically intensify their intra-relations at the expense of their ties with the outsider community. This is to say that GF-Tech’s control over the project should be amplified by their members’ need to establish a local territory, thus overlooking the broader picture of a Mifos community and OSS development.

However, these assumptions ignore the design of the MLs and their potential to enable interactions and collaboration; whereas the effects of proximity and distance can only be assessed in relation to the actual setting that permeates participation and collaboration (Kraut et al. 2002; Walther 2002). Mifos MLs are a component of a larger virtual platform that palliates the absence of physical proximity, by superseding a new way of production and communication. For this reason, collaboration and software production need to be observed with regard to the material agency of the whole assemblage and how it mediates interactions between actors.

Arguably, the study of the sociograms does not allow fully observing the MLs’ capabilities or how they affect members’ participation. Figure 27does show though, that strong ties have been nurtured across geographical concentrations, while Table 6 shows a relatively low density inside them, suggesting low connectivity between the individual nodes inside the geographical meta-nodes. In this sense collaborative links in the Mifos case have been nurtured across countries and at the detriment of internal relations at the level of the countries. This might also imply that the MLs, or the project administrators, or again these together, have leveraged participation globally.

In fact, team cognition research suggests that members of distributed groups gradually learn over time how to coordinate implicitly, because they become more familiar with

[121] In fact, co-located teams collaborate better due to numerous cognitive, behavioural and organisational mechanisms, like direct observation, physical presence and face-to-face interactions (Kisesler and Cummings 2002, 59). Such mechanisms are generally missing in distributed collaboration, which is believed to pose organisational and social conundrums that actors need solve if the purpose of their action is to be fulfilled (Armstrong & Cole 2002; Kiesler & Cummings 2002; Kraut et al. 2002).

each other and can manage their interactions more effectively (Espinosa et al. 2007). Time and long lasting ties are even more necessary when members' tasks show high dependencies on someone else's work (Ibid). The point here is that the importance of time on task coordination and the way members participate and collaborate weighs on the effect space has on their relations (Walther 2002) –which brings us back to the missing time dimension in static sociograms and to what the next chapter aims to do.

Meta-nodes	Density
India	0.05
USA	0.30
Ghana	N/A
Australia	0.33
China	0.04
Lebanon	N/A
Cambodia	N/A
Egypt	0.17
Poland	0.00
Philippines	0.00
Indonesia	0.00
UK	0.11
Nigeria	0.11
Kenya	0.02
Honduras	N/A
Switzerland	0.00
Luxembourg	N/A
Mexico	0.00
Mozambique	0.00
Nepal	0.00
New Zealand	N/A
Norway	N/A
Pakistan	N/A
Singapore	N/A
South Africa	N/A
Sri Lanka	N/A
Sweden	0.00
Tanzania	N/A
Tunisia	0.50
Canada	N/A

Table 6

5.3. Conclusion

This chapter has examined community participation based on the study of MLs' sociograms, and the analysis of their structure and nodes' positions in the graphs. In a nutshell, the findings of this chapter show that Mifos' community was quite centralised, as a few intensive posters (mainly members of GF-Tech) took control of the MLs' activity, channelling news and information between subscribers.

However, it is commonly known that newsgroups often tend to have a few focal nodes, while the majority lay at the periphery. The intensive posting of these nodes is necessary in order to organise post-exchanges and create common ground among discussants. This is also applicable in the Mifos case.

Yet, Mifos MLs went beyond constituting a vehicle for subscribers' idle chatter and news' broadcasting, given that Mifos administrators used the MLs as a major support for code production and long-term development. In this sense, the role that some nodes have player as newsgroup facilitators (or administrators) was superseded by their role in the broader Mifos project, where they led and administered complementary and production-related processes and tasks.

To discover how organisational divisions inside GF-Tech, the project founder, have been continuously enacted across the newsgroups, I go beyond SNA measures of centrality in order to understand nodes' posting behaviour and their underlying posting strategies –whether these measures are based on post frequencies, or connectivity between nodes. I thus uploaded into the sociograms some of the exogenous properties of the nodes in order to enhance their visualisation, relations and exchange patterns.

This exercise shows that subscribers' knowledge about their peers affects their posting strategies and shapes the structure of their exchanges and the sociograms. It also demonstrates that community participation in Mifos MLs is not only inter-subjective and relational, but is an ongoing flow of nodes' relations. Nodes build their positions in the network, by exchanging, transferring knowledge and gradually building their reputation among peers.

It shows that Mifos' MLs are not only about intensive posting of a few central nodes in the network, who are the OSS project sponsors and leaders. More importantly, the sociograms reflect the existence of a hybrid ecosystem containing multiple knowledge profiles, which have gradually collaborated and contributed to code production and software long-tem development.

These knowledge profiles constitute emergent and transient inter-organisational and individual assemblages of volunteers, software contractors, MFIs and local IT intermediaries that are scattered throughout various geographical concentrations globally. Over time these participants have also developed relatively strong ties that suggest ongoing exchanges and collaborations.

However, the study of sociograms has limitations. The network snapshots upon which I have based my analysis are static configurations of exchanges that aggregate the time investment and labour of nodes into figures of post frequencies and connections' counts. These are amalgamated with SNA centrality measures –which are inherently defined through calculations based on the position of a node in relation with its direct egocentric network, its peers, or and the overall structure of the network.

Static sociograms overlook the effect of time on nodes' participation and the way the structure of the network changes once newcomers start posting questions and old participants resign their MLs' subscription and leave the project. As alliances are done and undone, nodes' positions change and new social dynamics arise. They are crucial mechanisms of participation insomuch as they capture the 'processual' unfolding of actors' contributions and a sense of becoming –which is very much necessary to understand software development over time.

To overcome the limitations of the study of static sociograms, the next chapter is a longitudinal study, which captures the major stages in Mifos development over a five years period. This chapter re-constructs the genealogy of the Mifos project and its code objects in combination with a chronological series of sociograms. These are called time-waves, as they capture periodic time intervals in the life of Mifos MLs' subscribers and exhibit changes in the structure of their post-exchanges. The purpose of this approach is to create an encounter point between the activity of the MLs and the different events and happenings in the Mifos project[122], so as to capture a coherent and integrated picture of the changes in its life history and its development stages.

[122] These are based on interviewees' data, and the project's online headlines and news.

6. Analysis Chapter II: Re-constructing Mifos Genealogy

6.1. Mifos Time Line and Time waves

Monge and Contractor (2003) argue that both connectivity –that is the linking of nodes- and "communality" –that is the sharing of collective knowledge and resources- rely on participants’ sustained contributions to the collective good, so that the level of participation at any given time will depend upon the average rate of collective resources contributed (Monge and Contractor 2003, 417).

While I don’t really want to linger on the notion of ‘average rate of collective resources’ –as Monge and Contractor define it- I do think that there is an analogy between the production of common goods (Olson 1965; Ostrom 1990; Melucci 1996; Benkler and Nissenbaum 2006; Bollier 2008) and OSS long-term development. Similarly to the production of a common good, OSS requires that code building and its reuse must be sustained over time in order to ensure its survival (Neff and Stark 2002; Gasser et al. 2003).

For this reason, I believe Mifos MLs are a crucial participant in the production of code objects, given that they channel and leverage members’ participation –whether they are simple users or core code contributors. If an important proportion of these participants stop logging on their newsreader to post or reply to peers’ messages, the platform might run ‘silent’, which would disrupt developers’ ongoing processes in interconnected code production sites and threaten the continuity of software development.

Mature MLs can still be used as archives, but this means that their potential is considerably limited, as they do not generate information anymore. In this sense, there is a strong interpenetrability between the dynamic of post-exchanges in the MLs and the use of the other tools and data repositories of the platform, making Mifos development a series of interdependences between actors, technologies and their potential for extension and regeneration.

On a more individual basis, it is also widely known in network theory that once members exchange and grow a pool of information. Their conduct entices and incites others to participate, earning them more connections and expanding the overall network (Monge & Contractor 2003, p.417). Hansen (2007) has proved this in the context of newsgroups and showed that newcomers are important additions to the MLs not because of their contributions, but because their ongoing questions help motivate long-time members to post answers and clarifications to the MLs (Hansen 2007).

This snow-ball phenomenon is observed in the Mifos project too. The more questions there are, the more information circulates across members, interconnected wikis and online documents. Furthermore, once Mifos code and features are designed and new enhancements and releases are added, the project’s outreach expands as more subscribers see benefits in using the MLs. Members’ interest is sparked, knowing that the ultimate achievement of the whole venture can be higher, and this gradually sustains their incentive to participate (Monge and Contractor 2003, 419).

Change is therefore a major aspect associated with community participation, which strongly affects OSS long-term development (Mockus, Fielding, and Herbsleb 2000). It is also the way to go beyond the structural view of participation in the MLs, as it is measured through posts’ frequencies and nodes’ counts of connections (Ducheneaut 2005).

My previous analysis of Mifos MLs could not convey the emergent and transient nature of post-exchanging, and thereby failed to show how Mifos development consists of unfolding sequences of participation[123]. When participants increase their involvement and posts, and when they extend their egocentric network –as they know new members, build new relations with different knowledge profiles, etc. - they affect the quality of their experience, gradually changing their posting behaviour and strategies –thereby the entire sequence of network configurations.

In order to convey a sense of change, sociograms must then transcend time (Garton, Haythornthwaite, and Wellman 1997). Time waves, or network trajectories –as Kilduf and Tsai (2003) call them- allow the analyst to expose the implications of change on patterns of relations between nodes (Kilduff and Tsai 2003, 95). Once the analyst captures previous network configurations, she is then able to observe the gradual mobilisation of participants, as some active participants continue while others leave.

This chapter uses time waves in order to capture the long-term mobilisation of Mifos community. Sociograms are introduced in combination with events and happenings that I describe through a substantial assemblage of interview quotations, pictures, online news and posts' snapshots. Together, these data artefacts form a longitudinal overview of the Mifos development stages, whereas its underlying narrative is double-checked and built in light of unfolding configurations of nodes and relations in six months intervals over the five years period of observation.

Accordingly, nodes’ positions and changes in network configurations are interpreted in the light of the evidence that I collected from various sources. By weaving the project's major achievements and events into the analysis of the MLs’ time waves, the chapter aims to provide a more qualitative, context-based account of Mifos development. Change seems to be triggered by different actors at different times. Yet the outcomes of their action remain interdependent at the project level –which is also reflected by nodes’ patterns of interconnection in the time waves. Therefore, this approach describes –by reporting participants’ stories and experiences- how and why Mifos cohesion and unity could not be taken for granted at any time.

[123] This contrasts with the frozen structures of post exchanges.

This chapter is divided into five sections, corresponding to five development stages over a total period of ten years (2001-2011). The first four years are though presented briefly. They are meant to be an introduction, so as to anchor a starting date for the Mifos project and set the stage for its next phases. Similarly, the last section (2011+) is an epilogue, which only aims to open a window into Mifos future and free it from its past history.

Transient and emergent, the Mifos assemblage continues to change after my period of observation. This is the reason why I extend this chapter with an epilogue. Whilst I know that this addition does not put an end to the Mifos genealogy, it stresses the extent to which change can happen and transform the map of Mifos relations –as I captured it in the first MLs' pictures.

The first and epilogue sections are not accompanied by MLs' time waves; I did not look at the dynamic of participants' actions, but mainly report anecdotes and events that concern the overall project, which I have turned into a chronology. By contrast, the three middle sections provide a thick description of the major participants' stories and achievements and their reflection in the MLs in terms of their position in the network and ties with peers.

Figure 29 illustrates the project's timeline. It shows major dates in the project's history in a chronological sequence. These landmarks should help the reader follow the account of Mifos genealogy in the subsequent sections. Each section of this chapter is also represented by an interval that lays at the bottom of this figure, and so gives a sense of its associated duration with regard to the other stages and the entire Mifos timeline.

I also include in Appendix 6 a table including subscribers who I specifically refer to in the Analysis Chapters along with information that was available in the public domain regarding their roles in the Mifos community. This should help follow the actors in this chapter.

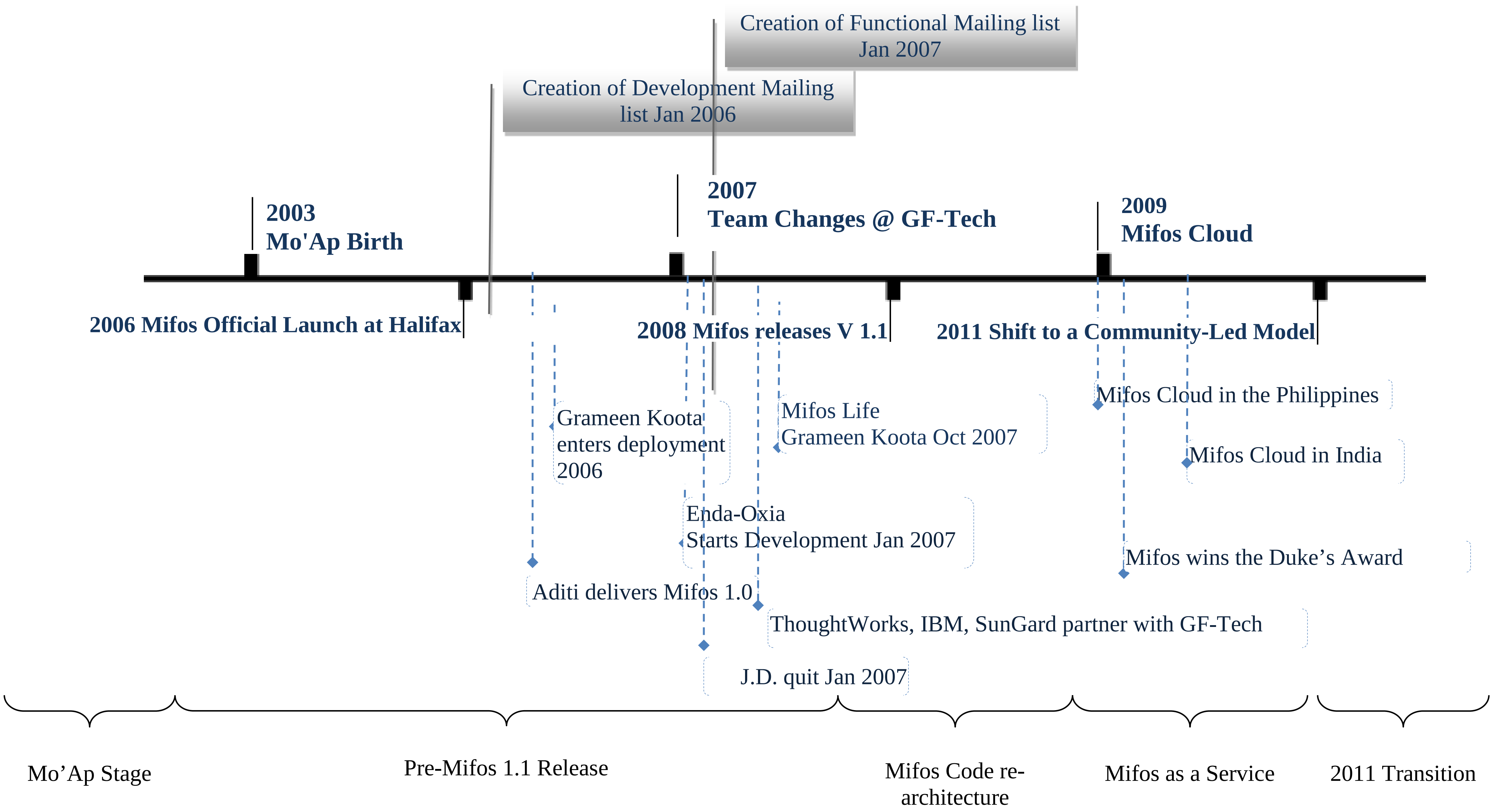

Figure 29
Mifos Timeline

6.2. The Mo'Ap Stage: 2001-2004

> ***"Sitting on the dirt floor of a village community centre in Andrah Pradesh in Nov. 2001…I experienced my first ah-ha moment…"***

These are the first words of J. Dailey's blog, recounting how the Mifos idea has blossomed and developed[124] (jdailey 01 11 2006). I wanted to start this chapter by quoting them, because they are evocative; they allude to the birth of a vision. This started over ten years ago in a remote corner of the world; while today, one can witness a mature and global OSS venture, where over 500 actors[125] are involved in more than 30 countries. Many events, locations and technologies separate these two events; yet they are still connected –they are stations of a same journey, which I describe here.

As J. Dailey writes in his blog, the idea at the heart of Mifos is grounded in the reality of the microfinance industry (jdailey 01 11 2006). At that time it was difficult to get a technology platform going for microfinance grassroots in the absence of a global and inclusive system of standards. The synergy was presented with public domain information, so as to build a flexible and open information platform that would act as backbone for a 'glocal' microfinance MIS (jdailey 01 11 2006). Such a system requires the circulation of an original code, on top of which partners can build improvements, gradually developing the source intellectual property (jdailey 01 11 2006).

In a meeting of Grameen advisors the same year, the seeds of the open source idea were first thrown. Propositions went ahead about developing the concept of an open source beta release that would have a public license and would enable local partners, and MFIs to develop and use the system over time, keeping the code building process dynamic and live (jdailey 02 11 2006).

In the fall of 2004, the project was named Mifos and registered under this name in SourceForge[126] (jdailey 03 11 2006). However, it was not yet clearly articulated –a sort of resolution rather than a goal-driven project. In this regard J. Dailey wrote:

> ***"while I was raring to go on the idea, we decided to proceed with our current plans, which were to get MIS automation working at a few small, but key partners, and to then pause and take a look at the overall strategy"*** (jdailey 02 11 2006).

[124] J. Dailey, Mifos concept creator at GF-Tech, created in Nov 2006, a new entrance in his blog, which he called 'Genesis of Mifos –microfinance open source': http://jdailey.livejournal.com/2006/11/01/. This section is based mainly on this document and recollections (interviews, internal documents, and blog posts) from other protagonists.

[125] The total number of nodes across Mifos three MLs. These people have at least once posted and received a reply in Mifos MLs.

[126] SouceForge is a web portal hosting thousands of open-licensed software projects.

The concept's founder and the growing GF-Tech team were still negotiating what Mifos was about, how to build it and how it could be leveraged for microfinance grassroots (jdailey 02 11 2006). That was very much in the OSS spirit. Propositions and suggestions were collected and debated among open source veterans and well-known microfinance forward-thinkers. Deliberations and decisions were intended to be public and open[127] (Interview Dailey 30-10-2007). This way the founders of Mifos at GF-Tech benefited from knowledge transfer, given that individuals with prior OSS expertise shared insights from their former successes and failures (Interview Dailey 25 10 2007).

Dailey recalls also that the ideas of one particular contributor have strongly influenced the early shaping of the Mifos concept. This is Tapan Parikh, who had already some experience trying to design and implement an OSS for a group of self-help organisations in rural India. As Indian student of Washington University, he reached Dailey through the mailing list to discuss his project (jdailey 02 11 2006). Collaboration between the two men grew, as they were later to co-author a paper on the need for XML standards (See Parikh & Dailey 2005). A series of papers followed soon after, whether jointly or individually (Parikh et al. 2003; 2006; Parikh 2006).

Looking at the beginning of Mifos, from today's vantage point, one might consider discarding this episode from Mifos life history. The events that occurred during 2003-2005 were a sort of backstage pilot; a draft called the Mo'Ap architecture (jdailey 03 11 2006) which bears little resemblance with what is known today as the Mifos project. Still, these events are connected to the “becoming” of Mifos. They are an important element of its genesis, and key to the ongoing tension that this material assemblage holds in order to sustain its agency and future.

6.3. Pre-Mifos 1.1 Release: 2005-2008

Gradually GF-Tech started to believe in Mifos. In 2005 it announced: ***"Mifos is a key innovation for microfinance and part of our*** [Grameen’s] ***strategic plan"*** (jdailey 04 11 2006). Dailey records this period in the final part of his blog. He writes:

> ***“…while that*** [Mifos’ positioning as a key innovation in GF-Tech strategic plan] ***gave the project more resources, and largely freed me up for it; it also led in my view to a way of project development that emphasised a more typical top-down software development effort, which in turn led to being out of synch with distributed, test driven, agile development, more appropriate to open source… Since this period of “top-downess” was only supposed to last 9-12 months, I thought, well we can always get back to the other approach later on – and in that I was wrong”*** (jdailey 04 11 2006).

[127] In particular Dailey said about the process of requirement specification, “in various online discussions, we went around and around on specifications that we were gathering from dozen of MFIs (Skype interview 30-10-2007).

In November 2006, Dailey was Mifos technical director and Conard its director. The Mifos team at GF-Tech also contained a few other members. They all represented Mifos at the Microcredit Summit at Halifax, announcing its official launch (see Figure 30).

Figure 30

(From left: Dailey, Tucker, Conard, Turtel and Dosiou) [128]

A few months later Dailey left GF-Tech; shortly after he was followed too by other members of his team. Over 2007, the Mifos team went through a staff re-shuffle, as new members gradually joined the project.

To understand what Dailey meant by Mifos growing more top-down, let's go back to the two years before its official launch. During this time, GF-Tech run a massive operation for gathering MFIs' requirements (Interview Dailey 30-10-2007). Their priority was specifying the practices of their partners –MFIs- whilst putting on hold proper programming (jdailey 04 11 2006). When I interviewed Cable, Mifos community leader at GF-Tech, he commented on that period as following:

> ***"We [Grameen] wanted to find for ourselves a set of beta customers and learn from the deployment in their organisations: what are their needs, who are the local IT specialists and how can we leverage their support"*** (Skype Interview, summer 2011)**.**

[128] Source: Steve Ketchpel's blog (Last accessed Nov 2011-12-01)

According to Dailey, such a long time investment in requirement specification is contrary to the multi-tasking and agile OSS approach[129]. He writes:

> ***"…this felt like a luxury that I thought did not make sense in the fast paced and pragmatic world of microfinance, nor did it make sense given the mantra "release early, release often"*** (jdailey 04 11 2006).

At the same time, GF-Tech started to receive code batches delivered by Grameen's major institutional contractor, Bangalore-based Aditi. There was not then much community participation (see Figure 31). The developers' ML was created and contained relatively few post-exchanges (less than 5% of the period's total exchanges and only 59 participants). Figure 31 shows several knowledge profiles, including the Mifos team at GF-Tech (pink nodes), volunteers (green nodes), GF-Tech MFI partner, as well as their local IT intermediary (red nodes) and finally institutional contractors, like Aditi (black nodes)[130]. These actors post-exchanged while Mifos founders were trying to release Mifos beta version (1.0).

Furthermore, Figure 31 shows that there were strong ties between some GF-Tech members. The latter were also intensive posters (large nodes) –which suggests collaboration. Most importantly, there are strong ties between several volunteer developers and members of the Mifos team at GF-Tech. This implies that the latter sought the opinion of other professionals in the software field with whom they engaged in discussions. We can see also that some of Aditi members are moderately connected to the local IT intermediaries of GF-Tech microfinance partner Grameen Koota[131] (Mftech –in red in the graph) in India, while there are mainly weak ties between volunteers and the representatives of MFIs (in red).

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[129] J. Dailey took an active part in requirements' specification. It was during one of his visits to MFIs that we met in summer 2005 –I was then the MFI's IT consultant. He has invited Enda, a leading MFI in Tunisia, to be part of a pilot partnership with GF-Tech. This was the beginning of the 'lighthouse' programme (see next), although it was not yet called like that. Enda agreed to join, after securing a foreign grant with the assistance of GF.

[130] Outdegrees are represented by the node' size in the sociogram. Thick lines represent the frequency of posts between pairs of nodes.

[131] Grameen Koota is GF-Tech first microfinance partner. This is a small NGO, which is part of the Grameen Network in India.

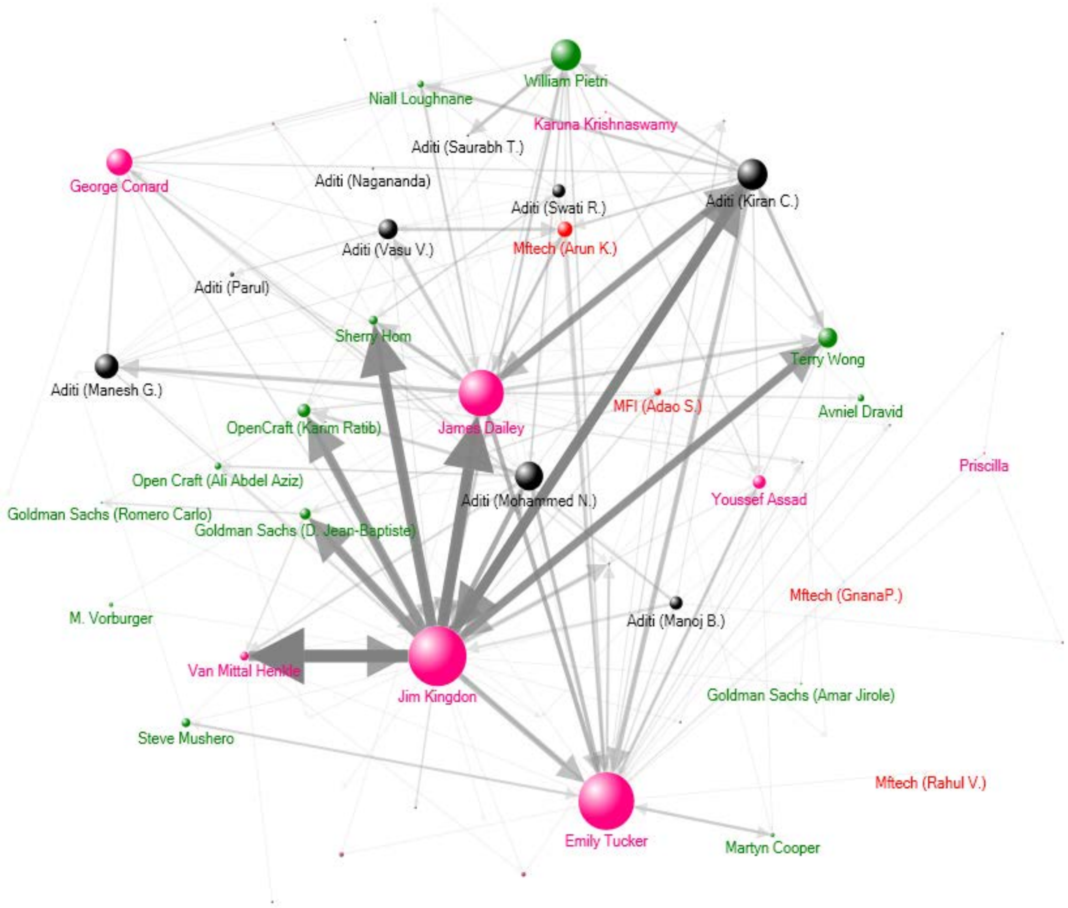

Figure 31
Source: Developers' Mailing List; Period: July to Dec. 2006

One can argue that Figure 31 illustrates what Dailey said in the terms of GF-Tech's central position in the Mifos community and how they strongly mediated interactions between other community members. However, this figure does not only show top-down relations. It is formed by several interconnected tripartite relations, where volunteers, as well as institutional contractors are also directly related –for example, there are many occurrences where green, pink and black nodes are interconnected, although with various tie strengths.

This graph shows only a fraction of Mifos potential community, which is explained by the fact that the project was still at an early development stage. There are only a few nodes who attempted to implement Mifos locally –mainly because the product was still beta. By contrast, participation is strongly skewed towards developers, who then were committing code and at the same time trying to identify appropriate tools and data repositories to host and leverage Mifos open design[132].

[132] Code was tested and evaluated by volunteers, GF-Tech and other members, while issues and potential improvements were presented and discussed collectively in the MLs.

Finally and more importantly, volunteers did contribute to Mifos. Their number and achievements are noteworthy. For example, Steve Mushero[133], Terry Wong, Andrea Zicare[134] and William Pietr made important improvements to Mifos 1.0 –which is also reflected by their size and the strength of their ties in the graph. In this regard Dailey also writes:

> "***With William Pietr help, and a willing Aditi team, we switched to a more test-driven design and agile development process. We also opened the code up for inspection and ridicule; we migrated from CVS to SVN, and moved to a high bandspeed location in the US courtesy of Java.net for our code tree… We tried to pro-actively engage more developers from outside the project. They let us know that it was still too difficult to get a build working, and we went back to the anterior build and re-wrote it until it got us there. Terry Wong contributed throughout this later process as well - and began to take a closer look at our architecture when we sat down together at the Javaone conference in San Francisco***" (jdailey 04 11 2006).

Mifos network as it appears in Figure 31 shows a relatively different dynamic to what has been observed in classical OSS projects –particularly as scholars have emphasised the participation of independent volunteers solely (Mockus et al. 2002; Lanzara & Morner 2003; Ye & Kishida 2003). In this sense Mifos community is hybrid.

Yet the structure of relations that is reflected in Figure 31 is not necessarily in contradiction with the open source spirit. The Aditi team have collaborated openly. They used the collective platform to commit code and interact. Their presence can be seen as an incentive for volunteers, a sort of benevolent audience for new contributors to demonstrate their skills. In addition, once Aditi members used the general ML, they made their work processes and decision open and traceable. As I show in the next chapter, they even accounted to volunteers for their decisions, explaining their reasons and discussing suggestions.

In the fall of 2006, Mifos 1.0[135] was finally online; it was mainly produced by Aditi members. Dailey sent a post, where he extended his acknowledgment to Aditi developers –see Figure 32.

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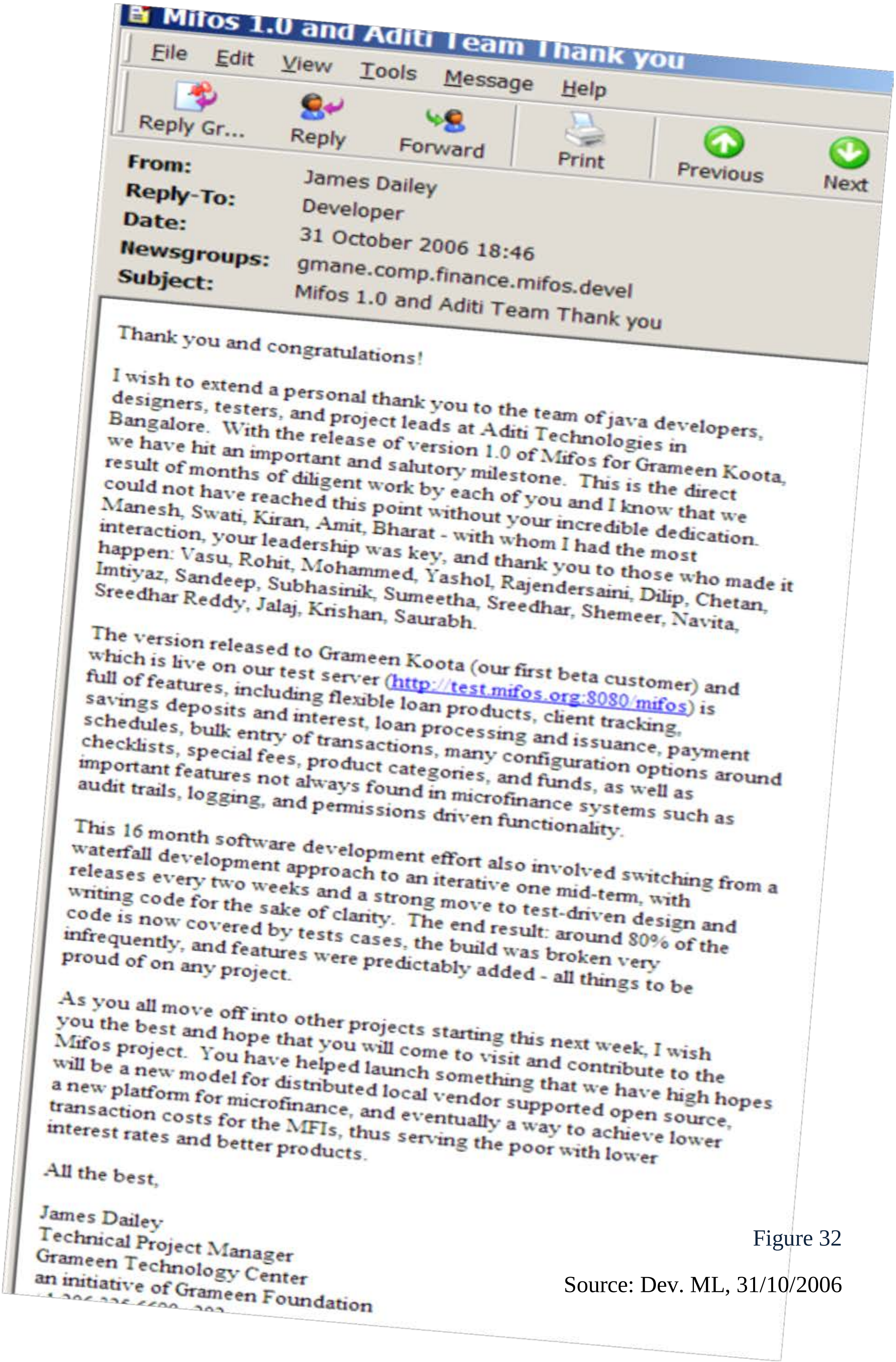
[133] Author of "Offshoring the Middle Class" and based CTO of the largest video online company in China.
[134] An early Mifos contributor who built his own system on open source tools. This was shown at a Grameen board meeting and was an important source of inspiration for the project.
[135] See Appendix 2


Mifos 1.0 and Aditi Team Thank you

File Edit View Tools Message Help

Reply Gr... Reply Forward Print Previous Next

From: James Dailey
Reply-To: Developer
Date: 31 October 2006 18:46
Newsgroups: gmane.comp.finance.mifos.devel
Subject: Mifos 1.0 and Aditi Team Thank you

Thank you and congratulations!

I wish to extend a personal thank you to the team of java developers, designers, testers, and project leads at Aditi Technologies in Bangalore. With the release of version 1.0 of Mifos for Grameen Koota, we have hit an important and salutory milestone. This is the direct result of months of diligent work by each of you and I know that we could not have reached this point without your incredible dedication. Manesh, Swati, Kiran, Amit, Bharat - with whom I had the most interaction, your leadership was key, and thank you to those who made it happen: Vasu, Rohit, Mohammed, Yashol, Rajendersaini, Dilip, Chetan, Imtiyaz, Sandeep, Subhasinik, Sumeetha, Sreedhar, Shemeer, Navita, Sreedhar Reddy, Jalaj, Krishan, Saurabh.

The version released to Grameen Koota (our first beta customer) and which is live on our test server (http://test.mifos.org:8080/mifos) is full of features, including flexible loan products, client tracking, savings deposits and interest, loan processing and issuance, payment schedules, bulk entry of transactions, many configuration options around checklists, special fees, product categories, and funds, as well as important features not always found in microfinance systems such as audit trails, logging, and permissions driven functionality.

This 16 month software development effort also involved switching from a waterfall development approach to an iterative one mid-term, with releases every two weeks and a strong move to test-driven design and writing code for the sake of clarity. The end result: around 80% of the code is now covered by tests cases, the build was broken very infrequently, and features were predictably added - all things to be proud of on any project.

As you all move off into other projects starting this next week, I wish you the best and hope that you will come to visit and contribute to the Mifos project. You have helped launch something that we have high hopes will be a new model for distributed local vendor supported open source, a new platform for microfinance, and eventually a way to achieve lower transaction costs for the MFIs, thus serving the poor with lower interest rates and better products.

All the best,

James Dailey
Technical Project Manager
Grameen Technology Center
an initiative of Grameen Foundation

Figure 32

Source: Dev. ML, 31/10/2006

- *Year 2007*

Despite collective efforts, Mifos 1.0 was too complex –some members called it later the ‘most-hard-to-get-rid-of’ problem of the Mifos built. “There was an abundance of layers and late binding…” making Mifos code lack elegant simplicity –which did not attract volunteers (jdailey 04 11 2006). Code refactoring did not stop and more time was lost fixing bugs and keeping the build working. Besides, Mifos 1.0 had no installation CD, and many subscribers reported difficulties running the build in their computers. In this regard Ketchpel[136] writes:

> ***“…getting to a fully-functional Mifos installation does require a fairly high level of computer savviness: installing MySQL, Jetty, Java; setting environment variables, etc.”*** (Ketchpel’s blog)

Furthermore, Mifos version 1.0 was not ‘complete’. It was missing features, flexibility with business rules and did not allow integration with telling and accounting (Interview Dailey 30-10-2007). The main reason is that features that were endorsed in Mifos 1.0 were tailored to fit the requirements of only one MFI, Grameen Koota –which made it unattractive for MFIs that did not follow the Grameen credit methodology[137]. The 'feature' gap was also too important to be addressed by additional modifications of the source code.

Early in 2007 GF-tech started work on release 1.1. Apart from Dailey’s departure, the development approach in 2007 remained relatively unchanged. The Mifos team at GF-Tech tried to ‘make-do’ within the existing structure of Mifos component coding, “fixing things that are partially broken and palliating to emergencies” (Interview Dailey 30-10-2007).

Based on this time wave sociogram (Figure 33), Kingdon continued in Dailey’s footsteps, taking lead of code development. He appeared as the central node in the developers' mailing list, closely followed by Tucker, who led the program management team. He tried to keep post-exchanges with volunteers (green nodes), while his team inside GF-Tech was expanding (pink nodes) and new contractors were recruited (in blue) –see Figure 33

[136] Steve is an early Mifos volunteer and project contributor; he was involved in the project in the context of the RDVP (The Reuters Digital Vision Program (http://www.rdvp.org/)) fellowship from Cisco. He helped write specs, recruit a team, and run the RFP process for offshore team selection. (Steve’s blog and LinkedIn profile).

[137] A lending methodology that was pioneered by Grameen Bank and well known in the Asia region. It consists of group loans extending to a majority of a village members and frequent payments that are scheduled weekly.

Indeed, this time wave shows GF-Tech's new IT partner, ThoughtWorks[138]. Some of this company's members are also strongly linked to GF-Tech nodes, showing their growing collaboration and role in the new Mifos release[139].

Figure 33 also shows a new type of players, the Goldman Sachs nodes (aqua colour). They represent a combination of volunteers and GF-Tech partners[140]. These developers volunteered their work hours, but they were at the same time committed to the terms of the contract between their employer and GF-Tech. Although some of them are also present in the previous time wave sociogram (Figure 32), their number has substantially increased here.

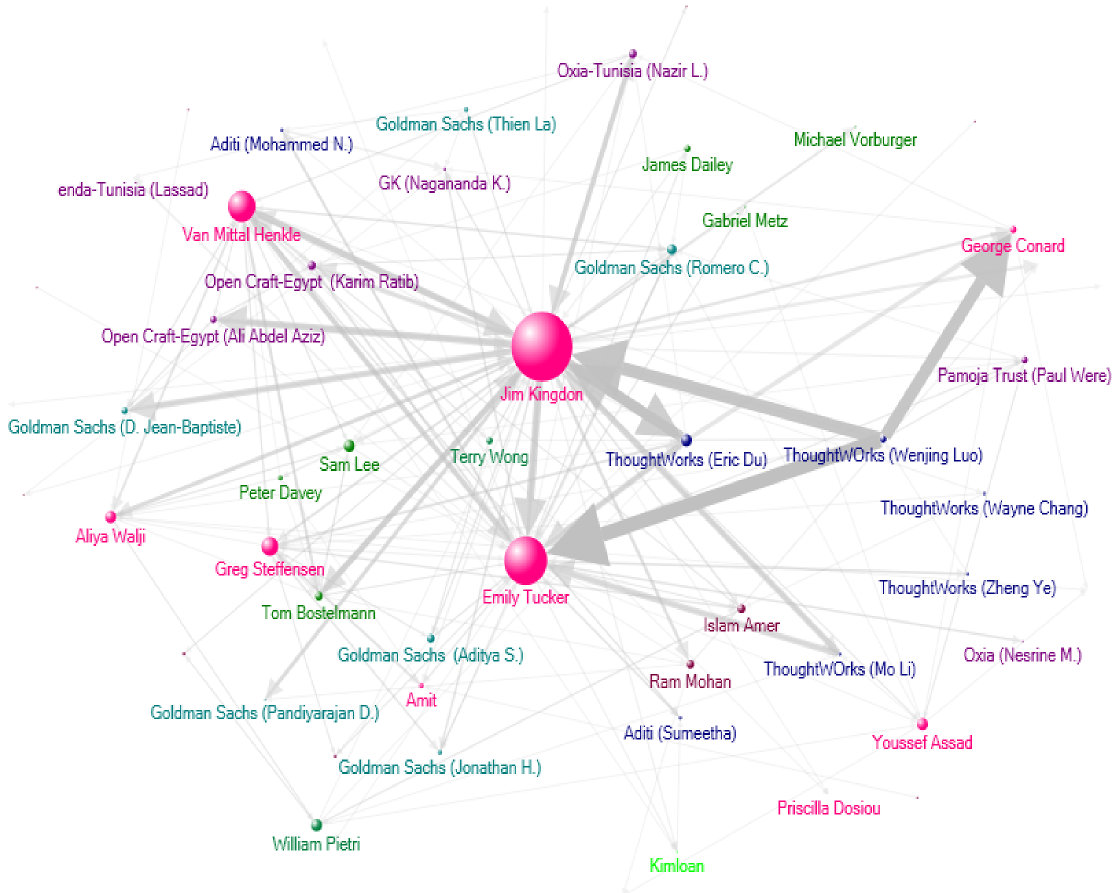


Figure 33
Source: Developers' Mailing List, Period: Jan.-Jun. 2007

In sum, the activity of the MLs was growing. However, this did not mean that more participants were joining the project overall, as the numbers of newcomers and the

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[138] ThoughtWorks, Inc. is a global leader in software agile methods. It contributed to scale up Mifos platform and update its technology architecture using the latest OSS technologies (news.mifos.org; last accessed 2011-11-29).

[139] The small size of these nodes is explained by the low number of their connections, as they kept exchanging mainly with one or two members from GF-Tech.

[140] This organisation is one of GF-Tech major partners and it has dedicated some of its workforce hours to contribute with bug fixes.

numbers of leavers compensate each other. Indeed, on the one hand, Figure 33 shows a growing network of IT contractors both institutional and individual. On the other, turnover among them is high. Many names, which were in the first time waves, have changed, including members of the Aditi group. As a result, version 1.1 turned out to be 'much more than a point release', suffering substantial delays (jdailey 14 05 2008). Work continued though, as participation in the MLs picked up for the following two terms –see Appendix 3.

The main changes in the 2nd half of 2007 are an overall increase in the number of subscribers. The GF-Tech group as it is captured by Figure 34 contains over ten nodes (pink) –hence more than a 50% increase- implying that it is expanding. In fact, GF-Tech has recruited developers with a long and robust open sourcing history –for example Monsen, and Bostelman in Figure 34. They also contracted some volunteers. Their objective was to strengthen the development team inside GF-Tech, but also to build a network of delegates to oversee local deployments on sites: Amy Besinger who was on-site technical consultant for India; Bart Berning who ensured the deployment of Mifos in Nairobi; and Marie Valdez who was in South-East Asia, Kenya.

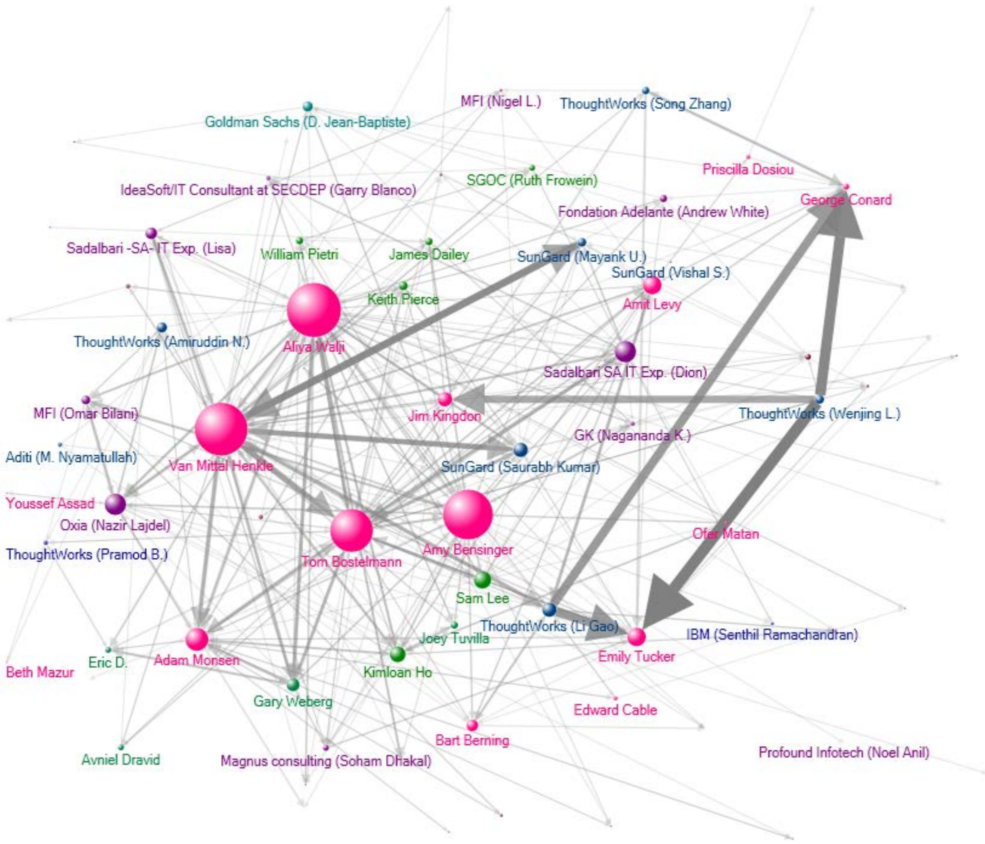

Figure 34
Source Dev. Mailing List 7-12 2007

Among those who contributed to Mifos development over the years, many switched between paid and non-paid hours. This explains how green nodes in previous time waves become pink in the subsequent ones and vice versa. For example, the node

Bostelman in Figure 33 was a volunteer previously. It is pink now. Similarly, Pierce is an active volunteer in this time wave, finding the idea of developing open source MIS for microfinance grassroots worth supporting[141]. From the first half of 2008 onwards, he will be full-time developer for one year. From 2009 to May 2010 he is GF-Tech contractor and becomes again a volunteer from 2011 onwards.

Overall, the number of developers' paid hours had been steadily increasing. The Mifos project director, Conard stated that,

> ***"…As much as Mifos needed the involvement of volunteers, having developers who can earn their living from working on it was probably more effective"*** (Ketchpel blog 03/2007)**.**

This may also be explained by the growing financial support that the Mifos project enjoyed, which had provided GF-Tech with more means to pay for its labour[142]. Along the same lines the boost in GF-Tech financial support also explains the increase in the number of its institutional contractors, implying that more and more code objects and features were being outsourced. Hence, new members from SunGuard[143] are in Figure 34 (blue nodes). Around the same time, IBM, another Grameen partner announced the beginning of its collaboration with Mifos community[144] (IBM newsroom 15 Oct. 2007).

All the institutional contractors are represented as blue nodes in Figure 34. As one can see, most of them have strong ties with GF-Tech's nodes, which stresses their growing role in the community. By contrast, ties between volunteers and GF-Tech appear less strong in this time wave. This change in relations testifies to GF-Tech's urge to catch up on the delays of version 1.1, giving priority to code development; whilst it confirms GF-Tech stronger reliance on its 'own' people, rather than volunteers and the rest of the Mifos community.

At the same time, other types of participants have here become more apparent. Particularly, Figure 34 shows more purple nodes, which represent MFIs and local IT experts that were engaged in localising Mifos. The latter group is referred to as the Mifos intermediaries, as they provided support to local MFIs and mediated between the MLs' volunteers, GF-Tech members and their clients (the MFIs). The purple nodes are

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[141] He was awarded Star volunteer in Feb 2011, recognising his Drupal expertise. Mifos news 2011 announced, ***"Woodlock has been maintaining the face of Mifos, keeping mifos.org and mifos.com sites running smoothly and securely."***(Mifosnews.org)

[142] Donors include the Omidyiar network and the Cisco foundation. The latter allocated Grameen a $611,000 grant in order to support Mifos platform and contribute to the development of new functionalities. By the end of the grant period, it was expected that Mifos deployment would be under way or completed at nine MFIs (Corporate Citizenship Report, Cisco 2007).

[143] Sunguard is also a leading software company. It contributed to the Mifos project by building test environment, procedures and quality assurance. The organisation has also contributed directly in Mifos deployment inside GF-Tech MFIs' partners. Later, it continued to assist other MFIs willing to implement Mifos with data migration, reporting and implementation management

[144] The company accepted to input functionalities into the code.

not all independent users though; among them are also GF-Tech's MFIs partners and their local Mifos intermediaries.

As a result of the surge in the number of users, the functional ML has also become active in 2007. Figure 35 captures a snapshot of its exchanges over the same period, which highlights the newcomers and their new positions in the Mifos network.

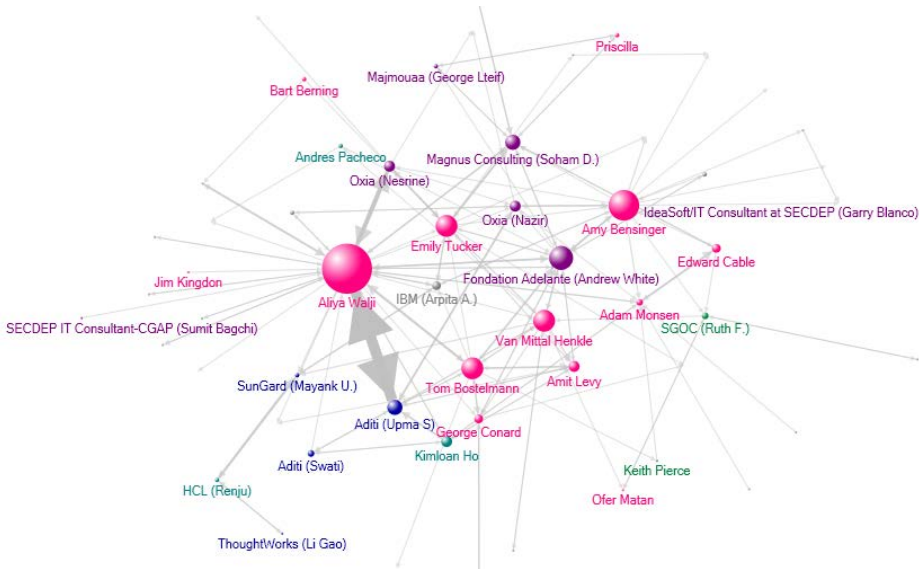


Figure 35
Source: Func. Mailing List, 7-12 2007

Based on this graph, new Mifos intermediaries include for example, Magnus Consulting, a Nepal-based IT firm, which discovered Mifos on Internet and assisted two of its local customers SB Bank and CSD with local deployment and the design of a new interest rate calculation methodology. The company joined Mifos MLs since early 2007 and then added a new feature to Mifos release 1.1. Yet, it was not particularly encouraged by GF-Tech to do so.

Among MFIs and Mifos local intermediaries, some nodes have also partnered with GF-Tech. In Figure 35, these include Grameen Koota (India), Enda Inter-Arabe (Tunisia), Jitegemia (Kenya)[145] and Fundación Adelante (Honduras). These MFIs took part later in the Lighthouse programme around 2007-2008, when beta users and their local IT partners were selected by GF-Tech to create new features and serve as examples of local implementations[146]. Enda Inter-Arabe group is visible in Figure 35. It is represented by the two Oxia nodes (Nesrine and Nazir).

[145] Jitegemia Credit Scheme is a small microfinance NGO based in Nairobi.
[146] In the Enda case, the selection process involved three IT companies, including IT synergy, Open Craft, and Oxia. Oxia is the only Tunisian-based company. The comparative analysis was accomplished by Grameen's representative in the Arab region, Grameen Jameel, which is also Enda's project sponsor.

- *Year 2008*

Arguably, GF-Tech was gradually gaining more control over the project. GF-Tech was gaining momentum, mediating between members and creating new connections with newcomers. Its development strategy also changed; it became more user-centred, as it was increasingly necessary to get Mifos deployed in MFIs. The adoption of Mifos testifies to GF-Tech's efforts to see Mifos outreach expands. But more importantly it fulfils GF-Tech's promises to Mifos sponsors and meets their goals.

Based on the terms of its conventions with sponsors –including Cisco (see footnote 142) - GF-Tech was committed to fix the high priority localization issues as part of version 1.1 (post Conard 29/08/2007). It was also committed to guaranteeing the success of Mifos implementation notably in Enda Inter-Arabe and Fundación Adelante. For these reasons, the organisation was determined to intervene between MFIs and their IT partners, resolve problems on sites, and get Mifos rolled out.

Consequently, GF-Tech focused on Mifos roll out in its MFIs' branches and organised its network of partners and contractors accordingly. At the same time, they worked towards releasing Mifos 1.1 by the end of the first half of 2008. This release was mainly based on feature enhancements to be delivered by Oxia, Enda Inter-Arabe's local Mifos intermediary –which also explains the strong tie between Emily and Oxia in Figure 37.

The overall situation is reflected in Figure 36 . We see here GF-Tech's employees, contractors and affiliates continue to grow –pink nodes have multiplied in comparison with Figure 34. This has happened, while GF-Tech continued to call on volunteers. Birney (pink node) had approached Mifos as a volunteer[147] in the fall of 2007. In 2009, he led the engineering team at GF-Tech (mifos.org/ourpeople last accessed Jan. 2009). Figure 36 also shows strong ties between GF-Tech members and various institutional contractors (blue nodes). By contrast, volunteers and their participation are gradually shrinking from the developers' ML.

[147] Former open-source professional and responsible for the JasperAnalysis product line at JasperSoft.

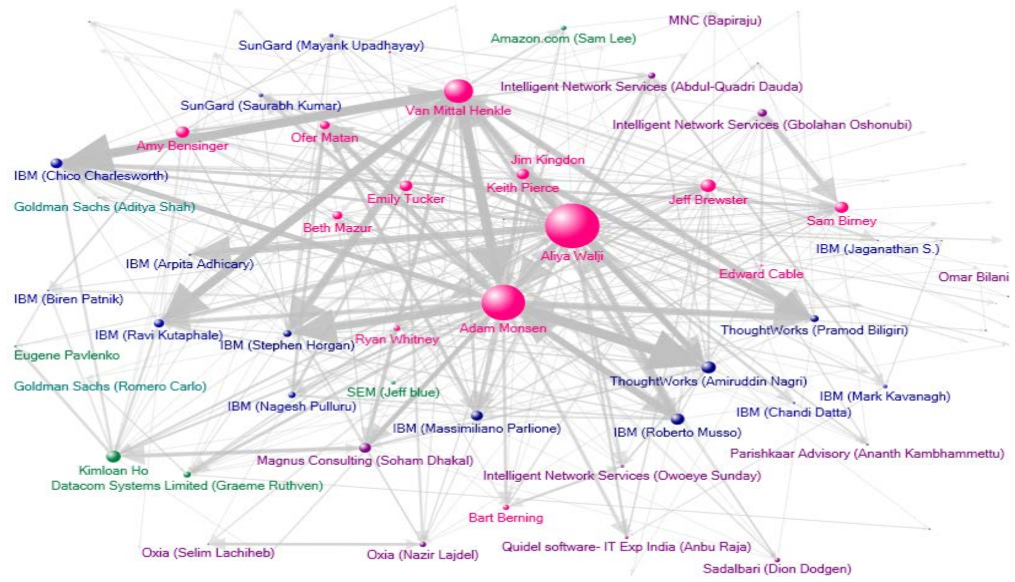


Figure 36
Source: Developers' Mailing List, 1-6 2008

At the same time, new Mifos intermediaries joined, and others like Magnus Consulting were still participating in the MLs' exchanges. Figure 37 shows a new node, Intelligent Network Services (INS) –an Africa-based IT vendor. Apart from managing deployment in local MFIs, INS has worked on integrating Mifos with other OSS accounting applications (email Gbolahan Oshonubi 19/01/2008). INS was present at a Mifos Workshop[148] that GF-Tech held in Nairobi in Oct. 2007. This made it easier for INS to build Mifos competences and consolidate its local reputation among MFIs.

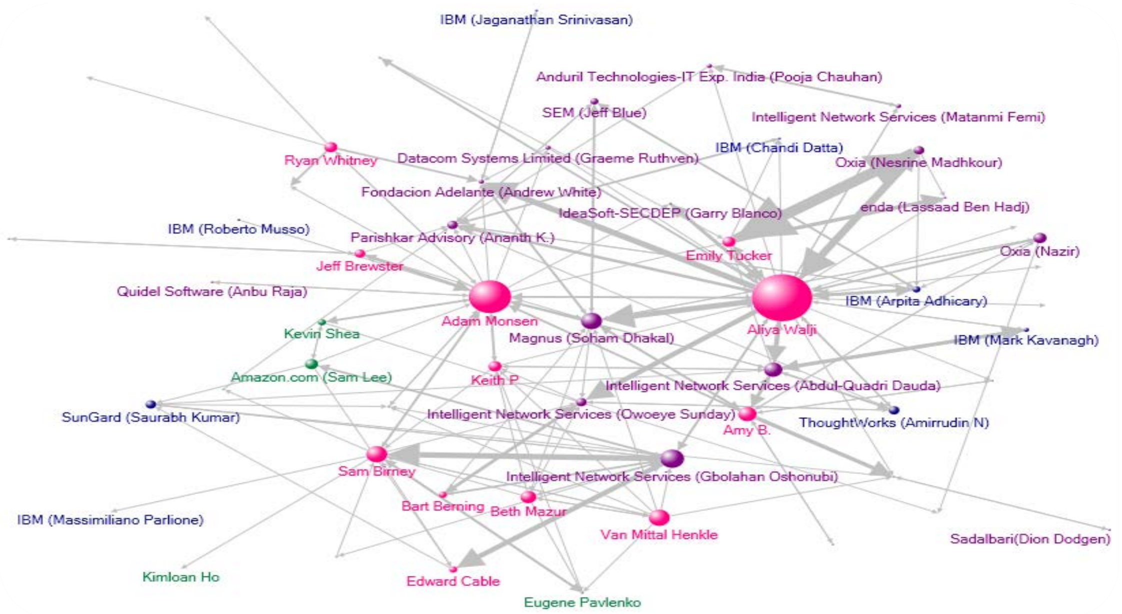


Figure 37
Source: Functional Mailing List, 1-6 2008

[148] This workshop brought together a group of IT companies who had prior knowledge of microfinance software along with several MFIs who were interested in using Mifos (Event list, Mifos.org Oct 2007).

Despite GF-Tech's efforts, deploying Mifos on site did put the organisation to the test. Oxia was Enda Inter-Arabe's Mifos intermediary, i.e. in charge of its localisation, data migration and roll out in branches (Interview Nesrine, 17/07/2007). At the same time, Oxia was supposed to commit new code to the source, on which Mifos 1.1 release was very much dependent –as I mentioned previously. After some time, this tripartite contract (Grameen-Enda Inter-Arabe-Oxia) started to experience difficulties.

The Oxia group was struggling to manage the 'Enda-GF-Community' relationship and beginning to feel that they were on the losing side (Interview Nesrine, 17/07/2007). By contrast, GF-Tech believed that Oxia underestimated the extent and cost of work required and therefore was not able to fulfil its share of the contract[149]. In the end, Oxia left the Mifos project, and GF-Tech stepped in to finish the deployment on site[150]. ThoughtWorks were also commissioned to design data migration tools for Enda Inter-Arabe.

In the same vein GF-Tech were experiencing difficulties with both deployments at Fundación Adelante[151] and Grameen Koota. In Figure 37, Fundación Adelante is represented by only one node (Andrew White). Despite the travelling of GF-Tech delegates to Honduras, Mifos implementation trailed and was not successful in the end[152]. In Grameen Koota, GF-Tech had also intervened. GF-Tech's partner IBM replaced MfTech, GK's first local partner –see Figure 34- in order to resolve data migration issues, improve reporting and finish roll out. Walji was also GF-Tech's Program deployment officer on site.

Knowing that they were not able to avert contingencies locally has triggered a new shift in GF-Tech's approach to Mifos development. As these example show, instead of letting MFIs build their own networks locally, GF-Tech started to rely more heavily on its own contractors and in-house competences to plan and organise deployment locally. Reflecting back on this period, Cable says:

> "***Our [Grameen's] attempts to reach out to local IT specialists through MFIs and have the deployment negotiated locally have failed. We ended up finishing the deployment in these institutions by ourselves, which was not financially sustainable"*** (Skype interview, June 2011).

Contributing to Mifos deployment on sites increased financial pressure on GF-Tech. It needed to secure alternative revenue streams to supersede philanthropic donations. The shift in Mifos development strategy became official once GF-Tech talked about selling

[149] This was stated in an online document published by GF-Tech: Mifos case study, http://mifos.org/sites/rollout.mifos.org/files/u5/gk_enda_case.study_.PDF

[150] After an independent consultant report, paid for by ENDA and conducted by Dailey, Whitney was sent to Tunisia to see to the completion of branch rollout, while Tucker supervised the process remotely.

[151] Adelante is microfinance NGO, which serves poor women in rural Honduras by providing small loans for women to start and grow businesses (MixMarket.org Last accessed 13/12/11).

[152] This information was supplied by Dailey after he reviewed this chapter

Mifos as a service (after Mifos version 1.1 was released). To back up this choice, it also decided to stop functional enhancements and focus instead on improving code architecture – to be released under a new codename, Cheetah[153]. In this regard Emily posted the following road map to the developers' mailing list (see Figure 38).

From: "Emily Tucker" <ETucker-DnEsXXvMQJxj/JC5u5XAOISLwOllVvif@public.gmane.org>
Newsgroups: gmane.comp.finance.mifos.functional,gmane.comp.finance.mifos.devel
To: "Developer" <mifos-developer-5NWGOfrQmneRv+LV9MX5uipxlwaOVQ5f@public.gmane.org>; "Mifos functional discussions" <mifos-functional-5NWGOfrQmneRv+LV9MX5uipxlwaOVQ5f@public.gmane.org>
Sent: 23 July 2008 18:30
Subject: Mifos Product Roadmap

Dear Mifos Community,

Now that v1.1 has shipped, we'd like to update you on our product plans going forward.

While working on v1.1, it became very clear to the Mifos team and many of our contributors that the current code base is extremely difficult to work in. As you may be aware, the original code for Mifos was all written by developers who are no longer part of the project, and in many cases was done in a way that is difficult to maintain and improve.

Because of this, it took more effort and time to get to a stable release of Mifos v1.1 than should have been the case. We will still continue to maintain and make improvements to this code base for all customers, with the next milestone in this track being the release of the next Mifos version, codenamed "Rhino", in Q4 of 2008.

On another track, in order to become better equipped for maintenance, rapid improvements, and product support in the longer term, we are also pursuing a strategy of completely re-architecting Mifos.
Re-implementing the functionality of Mifos using open source standards, consistently high code quality, intentional APIs, and clean service layers will make it much simpler and faster for the team of developers (both internal and in the extended community) to add new functionality.

(…)

The codename for this project is "Cheetah". Our target is to release Cheetah sometime in the second half of 2009, but the final target date and schedule will not come until later.

While this is a very exciting decision, it is also a big undertaking. The "Rhino" release, scheduled for the end of the year, will primarily contain small enhancements and bug fixes. Because new functionality built into Rhino will need to be re-implemented for Cheetah, we will be limiting the amount of new functionality in this track. Additionally, most of our resources, going forward, will be focused on Cheetah. One of Cheetah's primary goals is to make it easier to build features into the product (including integrations between Mifos and other systems) so although there will fewer new features added into Mifos in the short term, the investment in Cheetah will ultimately allow us to add these features more quickly.

I realize this is a lot of information and I'm sure there will be a lot of questions and feedback. We'd like to hold a meeting to discuss these plans and answer any questions sometime in the next 3 - 4. More details to come shortly.

Thanks,
Emily and the Mifos Team

Figure 38

[153] For a road map of all Mifos code names and releases, see table in appendix 2

6.4. Mifos Code re-architecture: 2008-2009

Emily's post marks the end of a period. It implies that GF-Tech's vision of an OSS platform for MFIs stopped at their last 'gift' to the community, the source code of Mifos 1.1. Whilst re-"architecturing" the code improved the Mifos software overall, it also meant that MFIs could not benefit immediately from future enhancements that they saw necessary –if they were to adopt Mifos. As a consequence, community participation in the mailing lists dwindled to its worst quota in my period of study –see Appendix 3.

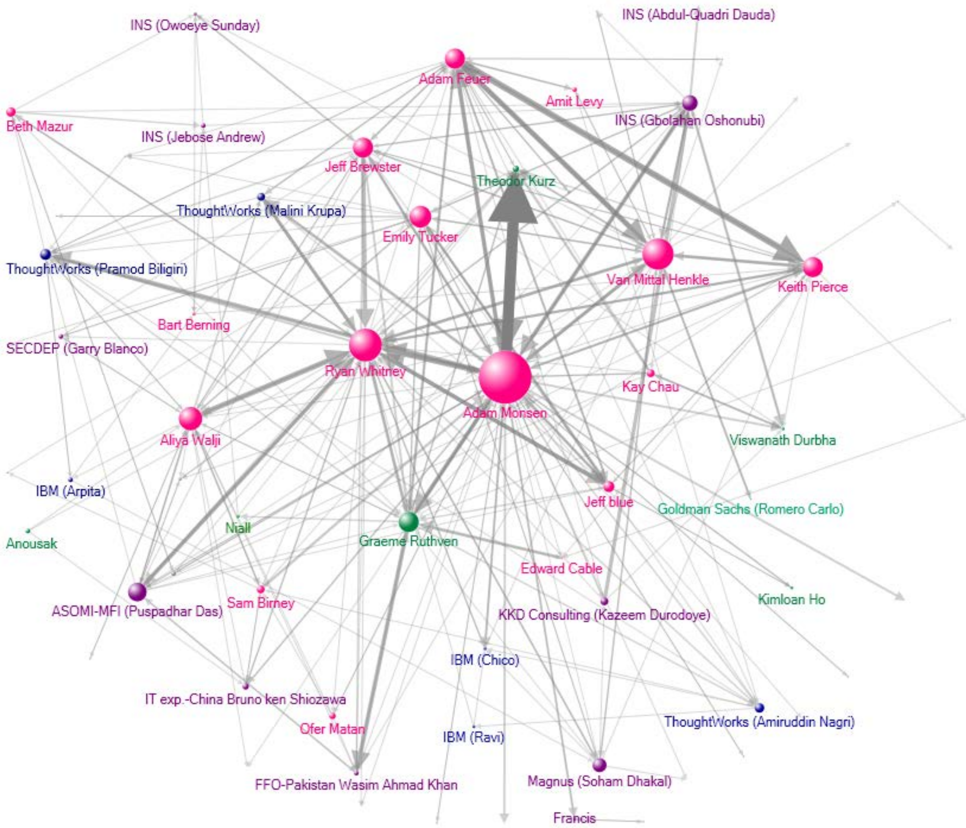


Figure 39
Source: Func. Mailing List, 7-12 2008

Figure 39 shows that GF-Tech members re-grouped. They are more strongly tied and closer to each other, while the number of blue nodes (institutional contractors) has substantially decreased compared to the previous time wave. Figure 39 also shows that some pink nodes are strongly tied to open source volunteers, suggesting that these two groups of actors intensively exchanged views and opinions during this period. This can be explained, to the extent that re-architecturing Mifos –as Tucker's post of the 23rd of July has announced- was about coming back to a more open source development, re-implanting the existing features using more open source standards and integrating APIs.

Overall there are substantially less exchanges in the developers' MLs, discussions have run out of steam, keeping to basic Q&A and installation queries –particularly in the functional ML (see Figure 40). This is also highlighted by the absence of strong ties including GF-Tech leaders. Community members kept to themselves, working on deploying Mifos 1.1 locally and offline, or/and re-designing new code in parallel online sites. In fact, the structure of this time wave is also the closest to reflect GF-Tech organisational hierarchy, showing at the centre of operations the main two protagonists of this phase, Monsen and Whitney. The first is an experienced developer, who is very much interested in the OSS design methods. The second is GF-Tech programme officer who took part in many on-site deployments. In Figure 40 we can also see that this actor is fully central, gradually becoming the expert of Mifos local deployments and thereby users' vis-à-vis.

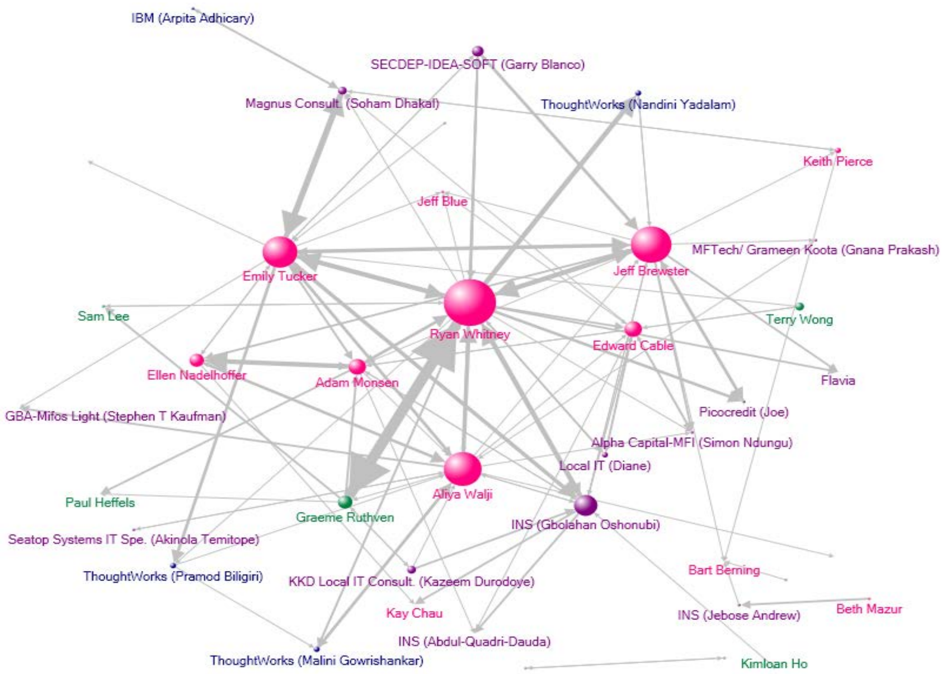


Figure 40
Source: Func. Mailing List, 7-12 2008

As I argued previously, GF-Tech's resolve to sell Mifos as a service is tightly related to re-architecturing Mifos code. GF-Tech was planning on taking Mifos to another level of development that would leverage its future commercialisation as a saas[154] package. As a consequence, the organisation started looking for customers. In fact, GF-Tech already had MFIs partners that were part of what they called the Lighthouse programme. Yet, this time, it aimed to provide a full service-package that would address MFIs' localisations' issues and keep their MIS supported in the long term (Mifos. org, last accessed 08/09/2008) –so it's aim is different.

SECDEP[155] was GF-Tech's first Cloud (or On-demand) customer. It was offered a package that consisted of a fully hosted, maintained, and supported solution, which was

[154] Software as a service
[155] This is a small NGO, which help members become self-reliant economically in the rural communities of Iloilo-Philippines.

delivered as a subscription service. It was based on the Amazon EC2 Cloud[156] service, instead of the classical local installation. By keeping the application and the database on remote servers, GF-Tech – or its local representative- provided its user with an interface to input transactions, while, as a service supplier, it remained in total charge of the system's maintenance and upgrades.

In this time wave, we can see SECDEP represented (purple node Garry Blanco) in Figure 40. SECDEP figured also on the Mifos website. Somewhat surprisingly it was introduced as one of GF-Tech's MFIs partners in the Lighthouse programme. This is also corroborated by Garry Blanco's post in Oct. 2008. He writes:

> "…***I am currently involved in one of Grameen's Mifos v1.1 lighthouse users in the Philippines***" (Functional mailing List 08 Oct 2008).

Yet, at that time, SECDEP had used Mifos on a monthly subscription basis. Also Cable confirmed his organisation's general attempt to sell Mifos in my interview:

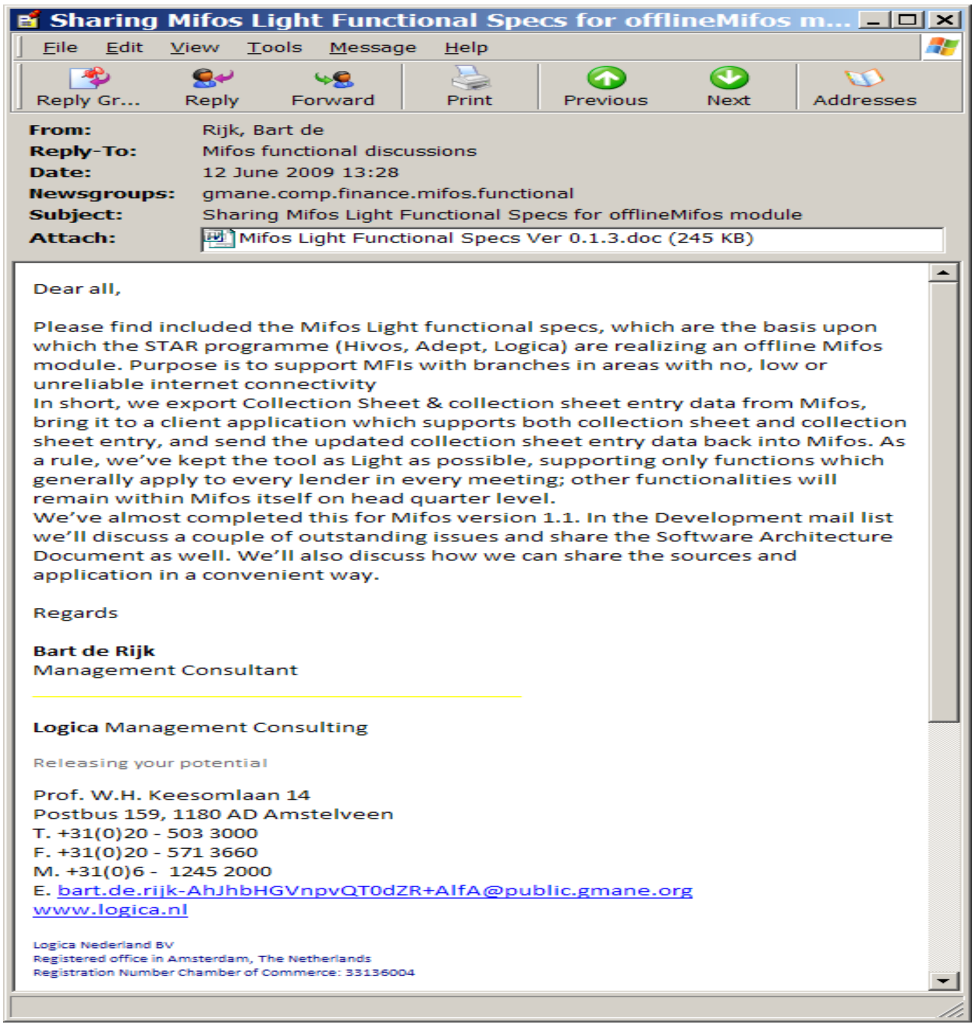
> "***We [Grameen] spent a great deal of time and effort doing a big dive in Philippines, trying to sell Mifos***" (Skype Interview Summer 2011)

Nevertheless, there is no contradiction here. I do not consider that GF-Tech had planned to abandon its OSS strategy or to pull out from trying to deploy Mifos locally. The organisation believed that SECDEP was a partner, which would benefit from Mifos open licence, even though it would require additional support. In this sense, servicing SECDEP for a subscription fee was still part of GF-Tech's strategy to extend Mifos outreach globally, and thereby it is yet another addition to the hybrid model of Mifos development.

Indeed, despite its new business plan, GF-Tech continued to nurture the connection between the Mifos initiative and the open source community. In the fall of 2008, Conard gave a talk at the O'Reilly Open Source Conference (OSCON) in Portland, where he introduced Mifos and invited open source developers to get involved (oscon.com 07/24/2008). He also raised questions related to the future of the project, stressing Mifos' need for a sustainable business model, which should take into account the product's open licensing and the extent of control required on code development and future distribution strategies (oscon.com 07/24/2008). His talk reflects again GF-Tech's struggle, as how to ensure a fair return on investment, while keeping at the same time its development and use sustainable.

[156] Amazon Elastic Compute Cloud (EC2) is a central part of Amazon.com's cloud computing platform (Wikipedia last accessed 21/12/2011). Users can use this service to boot an Amazon Machine Image to create a virtual machine, which Amazon calls an "instance", containing any software they installed. A user can create, launch, and terminate server instances as needed, paying by the hour for active servers, hence the term "elastic" (Ibid).

Also, community participation continued regardless of GF-Tech's new plans and challenges. The STAR[157] project is an example of another independent initiative that aimed to leverage Mifos' adoption among small and remote MFIs. It consisted of deriving an offline Mifos module –called Mifos Light- that supports MFIs' branches in areas with no, low or unreliable internet connectivity –see Figure 41. After a slow start, this subproject achieved its first release and was implemented in a few East-African MFIs.



Sharing Mifos Light Functional Specs for offlineMifos m...

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Reply Gr... Reply Forward Print Previous Next Addresses

From: Rijk, Bart de
Reply-To: Mifos functional discussions
Date: 12 June 2009 13:28
Newsgroups: gmane.comp.finance.mifos.functional
Subject: Sharing Mifos Light Functional Specs for offlineMifos module
Attach: Mifos Light Functional Specs Ver 0.1.3.doc (245 KB)

Dear all,

Please find included the Mifos Light functional specs, which are the basis upon which the STAR programme (Hivos, Adept, Logica) are realizing an offline Mifos module. Purpose is to support MFIs with branches in areas with no, low or unreliable internet connectivity
In short, we export Collection Sheet & collection sheet entry data from Mifos, bring it to a client application which supports both collection sheet and collection sheet entry, and send the updated collection sheet entry data back into Mifos. As a rule, we've kept the tool as Light as possible, supporting only functions which generally apply to every lender in every meeting; other functionalities will remain within Mifos itself on head quarter level.
We've almost completed this for Mifos version 1.1. In the Development mail list we'll discuss a couple of outstanding issues and share the Software Architecture Document as well. We'll also discuss how we can share the sources and application in a convenient way.

Regards

Bart de Rijk
Management Consultant

Logica Management Consulting

Releasing your potential

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F. +31(0)20 - 571 3660
M. +31(0)6 - 1245 2000
E. bart.de.rijk-AhJhbHGVnpvQT0dZR+AlfA@public.gmane.org
www.logica.nl

Logica Nederland BV
Registered office in Amsterdam, The Netherlands
Registration Number Chamber of Commerce: 33136004

Figure 41

- *Year 2009*

The major change for the first half of 2009 –according to Figure 42- stems from the increased presence of volunteers (green nodes). Some of them have strong ties with GF-Tech, suggesting that they were collaborating with GF-Tech developers for the ongoing release. Some of these nodes bear the acronym SGoC. This stands for Google Summer of Code, an annual programme, in which Google awarded small amounts of money to students who successfully completed a requested open-source coding project during the

[157] A programme sponsored by the International Development Research Centre (IDRC) and executed by a Dutch NGO –Hivos- in partnership with local IT experts in East Africa.

summer (Wikipedia, last accessed 10 Jan. 2012). In 2009, Google selected 150 open source projects, including Mifos[158] (Google open source blog Sep. 2009) –hence, Udai and Johan's presence in this graph.

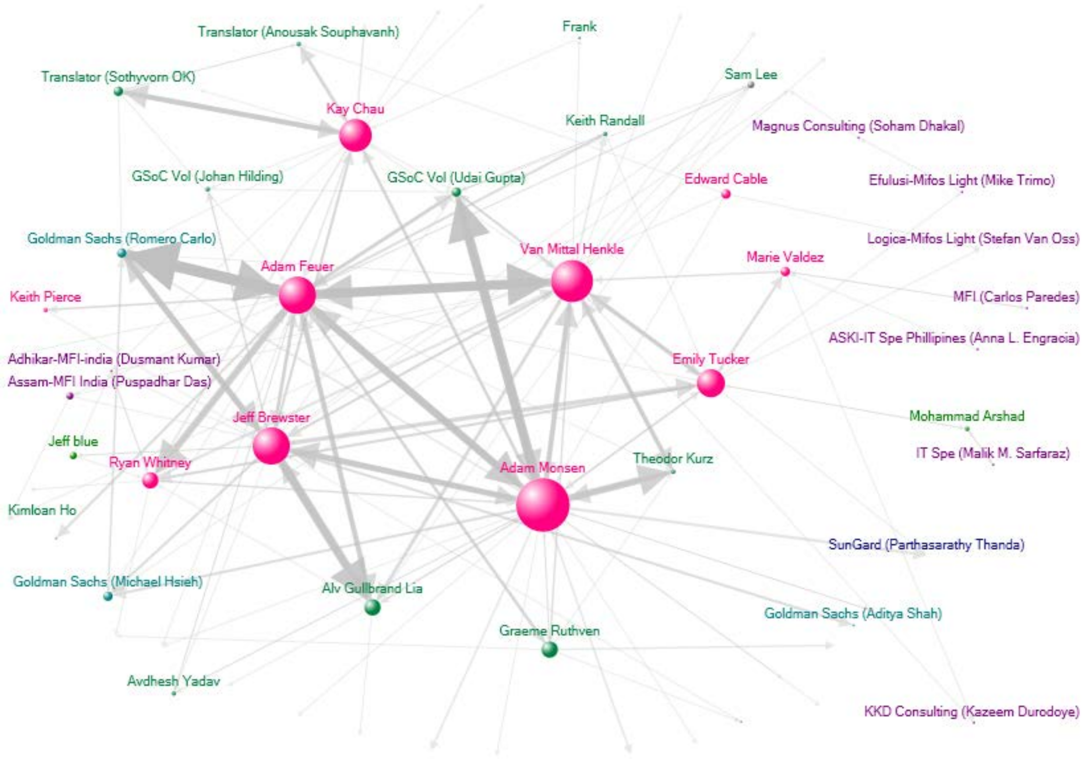


Figure 42
Source: Dev. Mailing List, 1-6 2009

These students contributed to Mifos under the mentoring of Monsen and Brewster. Their collaboration was challenged by different time zones[159] (google-opensource.blogspot.com, Sep. 2009) –which explains Udai's strong tie in the ML as they used the ML extensively to collaborate. Udai did not remain a volunteer for long. In 2010 he joined Mifos development team in Bangalore[160]. At the same time, Johan stopped his participation, once GSoC was over.

Sustaining volunteers' participation is undeniably difficult, which also explains why GF-Tech had to retain experienced developers by paying them. As a consequence, the organisation acquired a large development team, which now tried to earn its keep by selling Mifos –this plan was taken forward during 2009, taking a definite shape.

To boost its sales, GF-Tech had thus established regional platforms using the Open Source image of Mifos. Below I present an extract of the organisation's commercial

[158] Each organisation was chosen based on a number of criteria, such as the virtue of the projects, the ideas given for students to work on, and the ability of the mentors to ensure students successfully completed projects (Wikipedia, last accessed 10 Jan. 2012).

[159] Udai was based in India, Johan in Stokholm, Monsen worked remotely from Minnesota, and Jeff from Grameen's Tech centre in Seattle (google-opensource.blogspot.com, Sep. 2009).

[160] After Mifos transition (see last section of this chapter) he continued to contribute to Mifos as volunteer

pitch, presenting its services and the Mifos community as one integrated package[161] -see Figure 39.

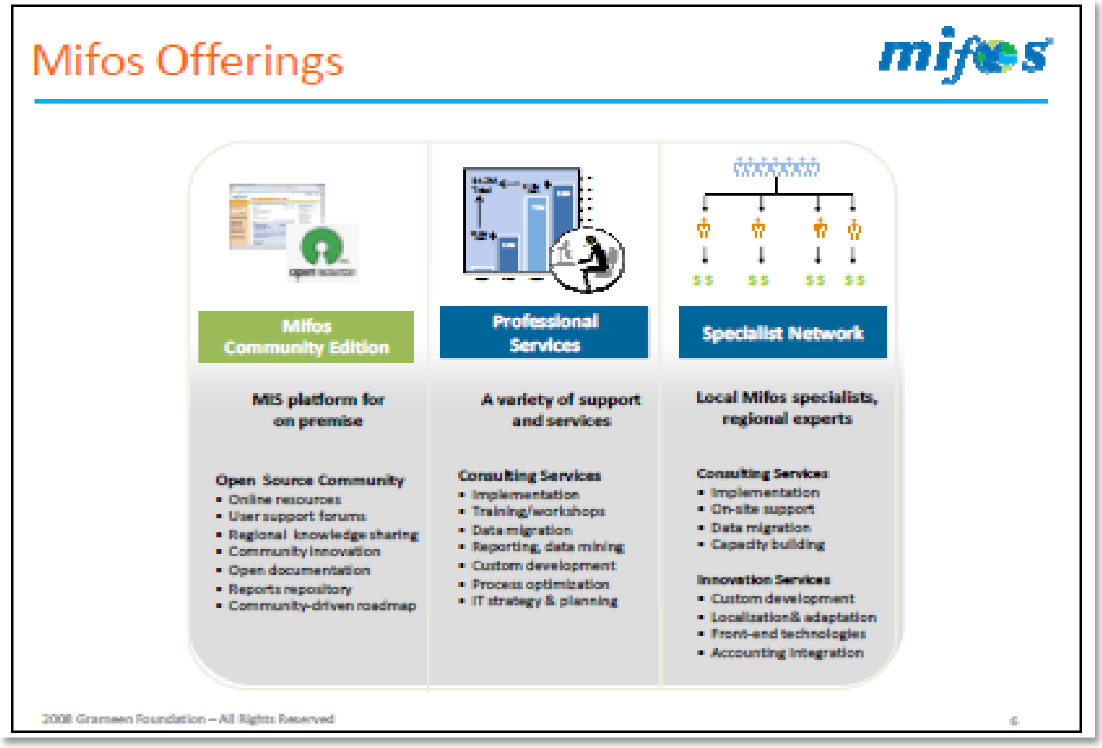


Figure 43

During this period, Conard also gave an interview on the FLOSS Weekly show, an online radio program[162] where he claimed that selling Mifos as a service was the best way to expand Mifos outreach globally.

To the presenter who half laughingly remarked,

> ***"… really, Mifos does not sound like a typical OSS project…it sounds like … more 'organised'!"***

Conard retorted,

> "…***Mifos could not just be thrown into the wild… it needs much more structure!"***

In fact, Conard did not disagree with the presenter about the hybrid nature of the Mifos development strategy. Yet he was convinced this was the only way to create a:

[161] Source: Online Presentation–GF, Slidshare.net. Presentation's title: "Mifos Community Edition"

[162] A series that regularly broadcast live-talks about the last-in-the-news open-source deeds (http://twit.tv/show/floss-weekly/47 (last accessed Jan 2012)

> ***"…global enterprise-level platform offering a flexible and configurable solution to support the unique business requirements of microfinance organisations locally***"

His point was that participation can be mobilised, but not necessarily sustained (Fang and Neufeld 2009). He explained that open source developers do not generally offer the commitment that is necessary to leverage Mifos development and its global outreach over time. In the same way, MFIs and their Mifos intermediaries need to strengthen their inside capabilities, if they are also to assume a role in Mifos future development. Conard added that the proof of that is that there were few MFIs "***doing things by their own***."

Conard concluded that GF-Tech needed to intensify its involvement and control of the platform's future in order to improve Mifos' long-term development and its impact on MFIs. At the same time, the more GF-Tech increased its commitment and role in the community, the more financial sustainability became a concern and thereby the need to generate a source of revenue.

Monsen –who attended the show too- added that the commercialisation of Mifos does not exclude necessarily the continuity of OSS development. Selling Mifos as a service strongly relies on parallel and open development –that is on volunteers' contributions. He stated that volunteers foster a dynamic coding environment that is necessary to improve code.

> ***"The cool thing is to have all these guys who contribute and think it is cool that they are helping to reduce poverty"***

The two GF-Tech representatives believed that it is the project's goal that makes it so unique. According to them, the not-for-profit, poverty-driven nature of Mifos does not only create an incentive for participation –giving professional developers an extra layer of altruism and social purpose- but it also justifies the hybrid development model. This idea also illustrates Yearley's (1999) argument about the importance of the project's goal in developers' mobilisation –see Conceptual Framework Section III.2.

The two representatives claimed that:

> ***"If it would have been fully for profit, this project would have been larger than what it is realistic"***

It can be argued that GF-Tech's new business model may not prevent the Mifos OSS venture from developing and expanding. Quite the opposite, to convince MFIs to buy Mifos, it was necessary for the open OSS platform to 'prosper' in parallel, with the help and advice of volunteers and the community. In this sense, GF-Tech has positioned itself at the other end of the OSS production spectrum, by building a portfolio of services on top of the shared and open Mifos platform and thereby increasing its total offerings.

Deployments on sites also became significant during this time wave. The functional ML (Figure 44) shows a majority of Mifos intermediaries and MFIs, which are particularly well connected to the GF-Tech team. Ryan Whitney has particularly represented GF-Tech in providing support and answering their questions and requests for help.

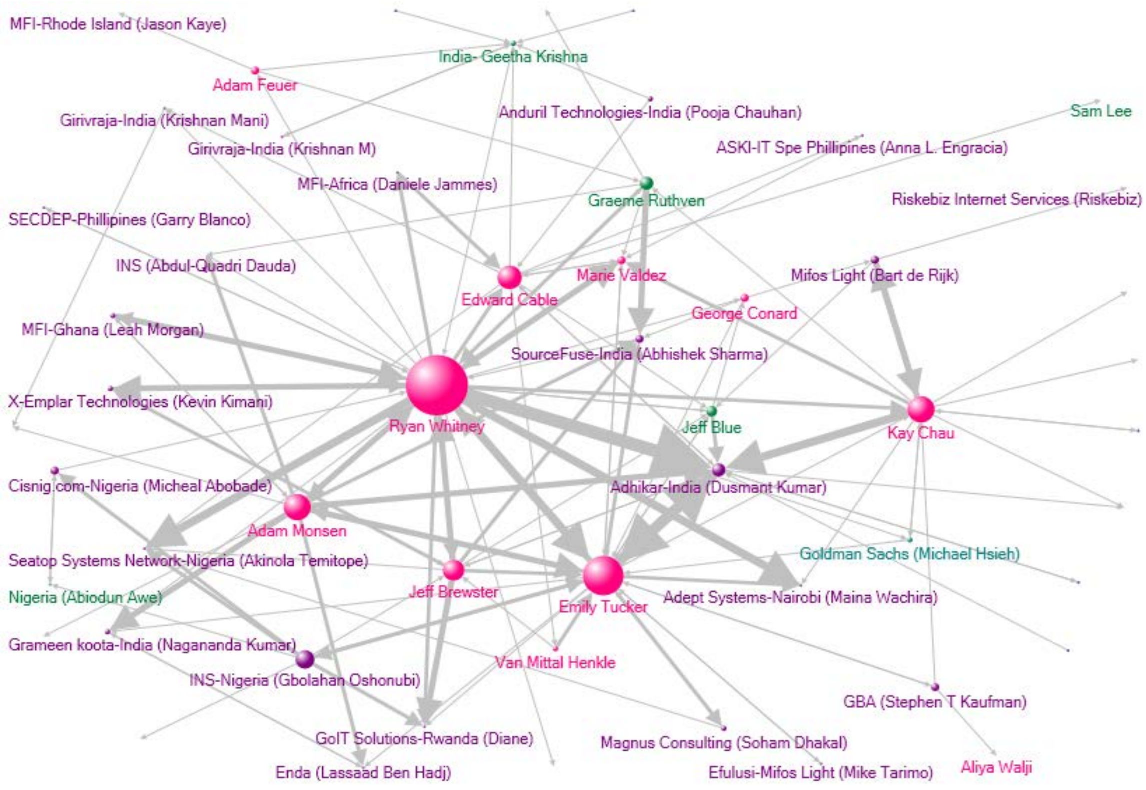
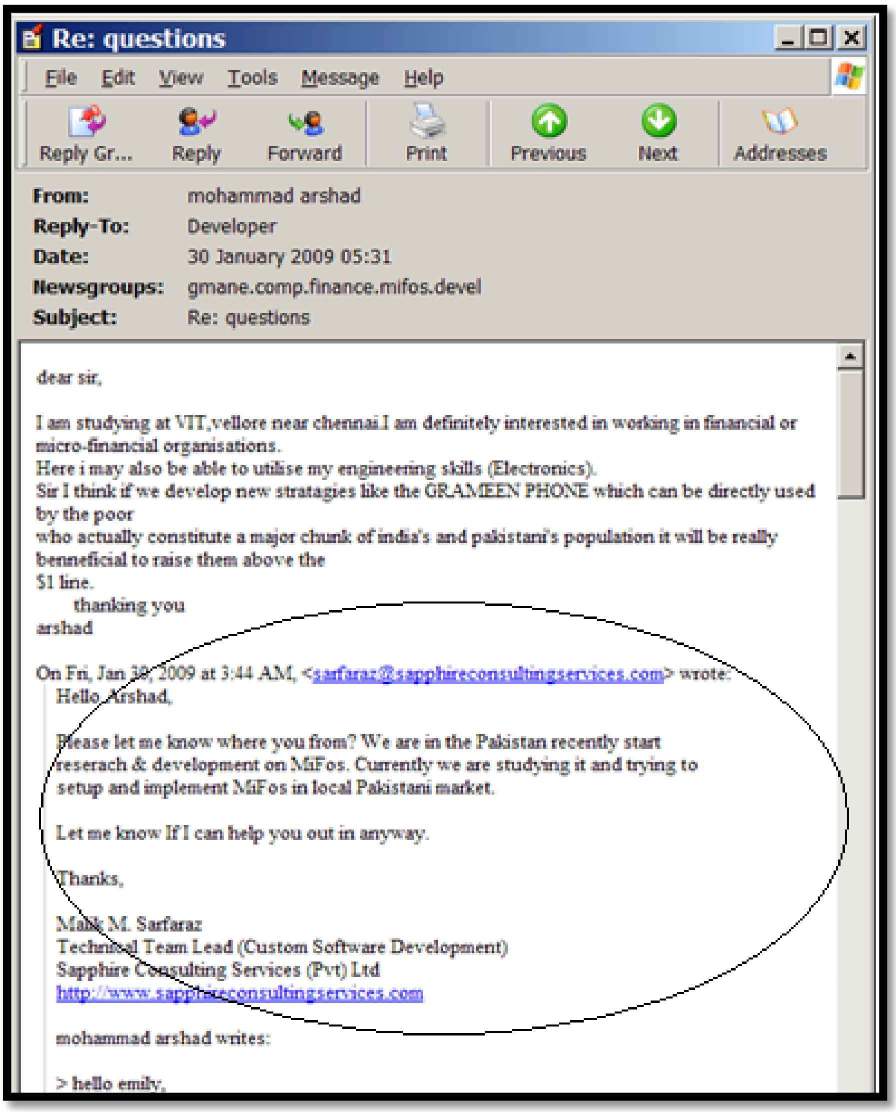


Figure 44
Source: Func. Mailing List, 1-6 2009

Figure 44 also shows that some of the purple nodes (MFIs or local IT specialists) are moderately interconnected. Interrelated Nodes are in general compatriots –for example in the INS-Nigeria, Gbolan Osnubi, is connected to another Nigerian node Michael Abobade. This is a sign that Mifos outreach in the region is high. As old subscribers acquire significant ‘know-how’ about the platform and its users so their posts become particularly helpful to newcomers in the region. Some of them have even used the MLs to advertise their Mifos expertise and attract local MFIs.

Clearly, the online spaces of Mifos MLs have a life of their own. They run simultaneously to GF-Tech’s efforts to organise, and lead the community, attracting new users and creating new opportunities of reuse. At the same time, the ML’s rich and dense activity was also an outcome of GF-Tech’s efforts to seed the MLs with information and has increasingly benefited from its intensive media lobbying –which boosted Mifos project’s reputation globally.

Indeed, there have been several attempts by students, software professionals, entrepreneurs, etc. to join the community. They are often visible in the sociograms, as they start their involvement in the MLs, asking questions like ‘how can I join Mifos’, ‘how can ‘we’ be involved’, ‘we would like to offer our help’...etc. Generally, it is a GF-Tech member who replies, whenever the information seeker demonstrates some useful experience, skills, etc; exceptionally, the answer comes from a non-Tech person. For example the green node, Mohamed Arshad on the centre right side of the graph is linked to purple node Malik Sarfarez in Figure 44. These represent a Pakistani student who wanted to be involved (email Mohamed Arshad 30/01/2009). The technical team lead of a Pakistani Consulting Services company answered; he offered to contract him for implementing a Mifos regional platform for the microfinance market in Pakistan – see Figure 45.



Re: questions

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From: mohammad arshad
Reply-To: Developer
Date: 30 January 2009 05:31
Newsgroups: gmane.comp.finance.mifos.devel
Subject: Re: questions

dear sir,

I am studying at VIT,vellore near chennai.I am definitely interested in working in financial or micro-financial organisations.
Here i may also be able to utilise my engineering skills (Electronics).
Sir I think if we develop new stratagies like the GRAMEEN PHONE which can be directly used by the poor
who actually constitute a major chunk of india's and pakistani's population it will be really benneficial to raise them above the
$1 line.
thanking you
arshad

On Fri, Jan 30, 2009 at 3:44 AM, <sarfaraz@sapphireconsultingservices.com> wrote:
Hello Arshad,

Please let me know where you from? We are in the Pakistan recently start reserach & development on MiFos. Currently we are studying it and trying to setup and implement MiFos in local Pakistani market.

Let me know If I can help you out in anyway.

Thanks,

Malik M. Sarfaraz
Technical Team Lead (Custom Software Development)
Sapphire Consulting Services (Pvt) Ltd
http://www.sapphireconsultingservices.com

mohammad arshad writes:

> hello emily,

Figure 45

These examples refer to market niches and potential participation. They point to future possibilities for Mifos regeneration and its code reuse potential. In the case they become successful they are embedded layers of innovation that are gradually built on top of Mifos common platform, expanding its localisation regionally.

At this point of the story, I would like to stress that Mifos has entered a new stage of development, which begun once community members looked for new ways to make it work for them and their clients locally. After the release of Mifos-Cheetah, not only GF-Tech, but many Mifos intermediaries sought ways to expand Mifos development locally and globally, as well as to ensure a return on their investment. In this sense developed the Mifos project into two parallel yet interconnected highways; the first consisted of the Mifos core code source: the second, of embedded layers of code, which gradually started to provide added value. Each one required sustained time investment, and substantial resources separately. Yet Mifos services could only take off and prosper, once the core source code was well developed and robust –which reminds us of the theory of common goods (Ostrom 1990; Melucci 1996).

Typically, potential community members started their involvement in the MLs, asked long-term subscribers and GF-Tech’s for support in order to install, use and to modify the code. Once they got familiar with it all –code, documentations, wikis and network- they would take charge of roll out in their clients’ offices and branches. MFIs have then the benefit of choosing between local intermediaries –which reduces deployment costs and creates incentives for Mifos adoption overall. Sometimes, they are also helped by not-for-profit technical partners such as NGOs, or volunteers, which make competition even more effective.

However, Mifos intermediaries had to be significantly IT-savvy in order to use Mifos. The extent to which they were able to overcome the difficulties of installation, code modification, and local roll out often determined their future involvement in the community and Mifos use. Over the three years that followed Mifos launch, many members reported technical difficulties, bugs and errors in the MLs. Apart from frequent installation problems, and they also faced difficulties in configuring Mifos according to their practices. For example, setting a particular interest rate and payments’ calculations were common requirements for MFIs. Yet, many users were challenged in this respect; they needed to modify the source code and add additional interest calculation features in order to be able to use it.

In this sense Mifos code was complicated and challenging and developers struggled to get a grip on its multiple code and database objects. This fact explains why most MFIs and Mifos intermediaries were doing little by themselves, as, Conard complained in his interview with FLOSS Weekly –which I mentioned previously. It also explains why there were few code commits by community members, and failed localisations –giving GF-Tech even more chance to be in a position of monopoly.

To conclude this time wave, I should emphasise that GF-Tech’s commercialisation of Mifos services did not reduce participation in the MLs, nor did it threaten open source code development. Particularly, GF-Tech has substantially leveraged participation in the MLs by contributing with answers and information. More importantly, it invested massively to keep the platform (documentation, communication channels and wikis) open, and accessible –which has constituted a major input to Mifos.

6.5. Mifos as a Service

Over the second half of 2009, the activity of the MLs continued to increase. Figure 45 shows a more mixed participation in the MLs, including Mifos specialists, volunteers, GF-Tech's employees and contractors. The number of nodes belonging to the first two categories has indeed increased in contrast to the previous waves.

On the other hand, GF-Tech teamed up exclusively with SunGuard for the next Mifos release. Figure 45 shows over eight SunGuard nodes (Blue), who contributed to building more test environments, procedures and quality assurance (Mifos.org, last accessed Jan. 2012). They also joined forces with Mifos local intermediaries, and GF-Tech's personnel to provide direct support to their Lighthouse partners and clients regarding data migration, reporting and project management (grameenfoundation.org, last accessed Jan.2012). This explains their ties with purple nodes, and their parallel presence in the users' MLs[163].

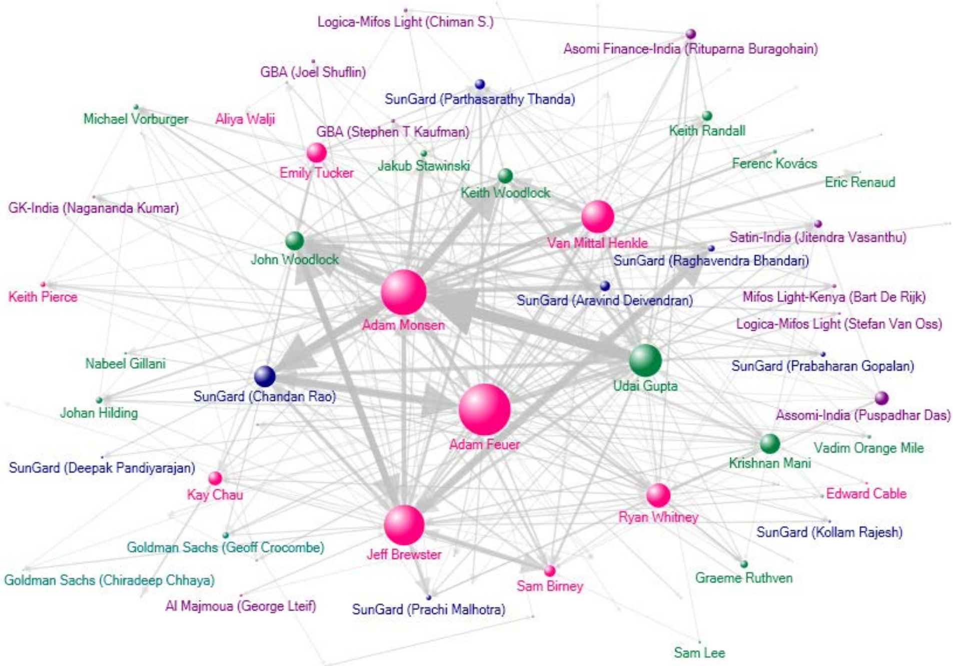


Figure 45
Source: Dev. Mailing List, 7-12 2009

The increase of volunteers and local IT vendors' participation in the MLs is mainly due to the growing publicity that the project enjoyed. In 2009, Mifos was officially listed in the CGAP Software Review page[164], rated four (out of four) stars. The inclusion of Mifos in this list substantially increased its visibility, as a majority of MFIs use this

---

[163] The users' ML is a compilation of both functional and user MLs.

[164] CGAP is the Consultative Group to Assist the Poor, a major consortium of microfinance experts and supporters housed at the World Bank. CGAP produces and publishes independent policy and research that are dedicated to help MFIs advance financial access for the world's poor (see http://www.cgap.org). With regard to technology CGAP's website contains –among other things- a list of software that were reviewed by the consortium's IT experts –there is also a list in CGAP's website.

website and trust it. This event is also subsequent to Mifos winning the award for the Best Java Technology –the Duke award[165] –Figure 46. These successes were significant and triggered a large boost in the project's reputation.

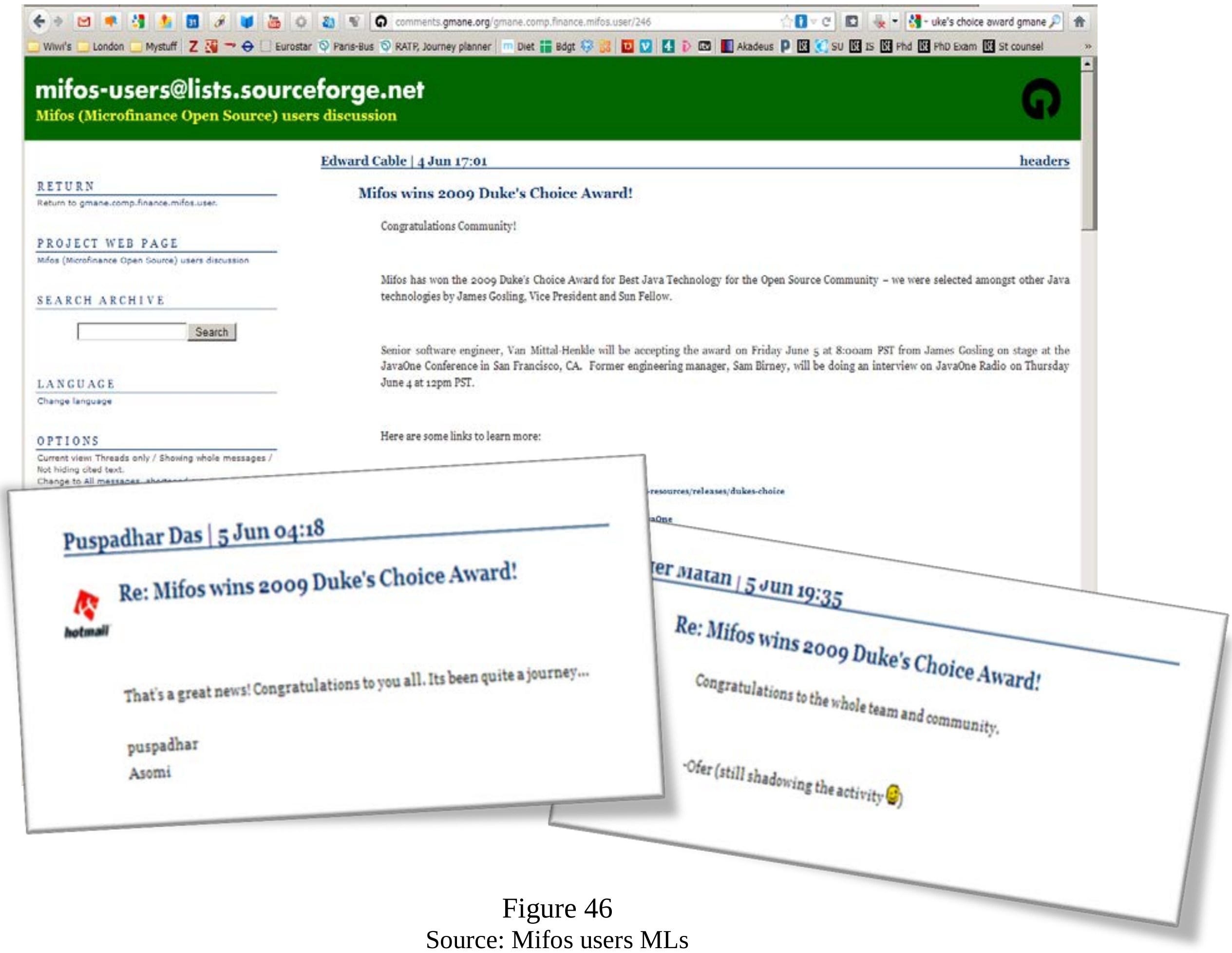


Figure 46
Source: Mifos users MLs

After the Duke Award, many public events ensued where Mifos was presented as a key innovation for the microfinance industry. First, Matt Duncan, director of market development at GF introduced Mifos in the Microfinance Leadership Summit in Nov. 2009 –see Figure 47. Then, GF-Tech organised in collaboration with Microsoft a series of forums, which aimed to sensitise MFIs' executives about investing more strategically in IT. There was then the Mifos Workshop in Nairobi, already mentioned. It helped develop and consolidate the Mifos network in this region.

[165] Java is widely known, particularly for enterprise software and in the OSS sphere. At the Duke's award conference, thousands of projects are reviewed. The Duke's award ceremony is the culmination of this event.

Figure 47

All these events contributed to expand and consolidate Mifos reputation worldwide. The results of such intense media coverage are also reflected in the users' MLs. Figure 48 shows an additional green node (Blue), which represents a new independent Mifos localisation. Blue is a Washington-DC volunteer. He and his daughter helped a small microfinance NGO in Senegal, named SEM install and deploy Mifos. Blue found Mifos open code, while he was looking for an MIS solution for this MFI. He posted to the user ML to ask for help on installation, which helped him set the Mifos application remotely on a US-based server, then began building custom reports for SEM. His daughter managed rollout and training from afar, helping SEM go live on the French version of Mifos 1.3 (http://mifos.org/community/news 2009).

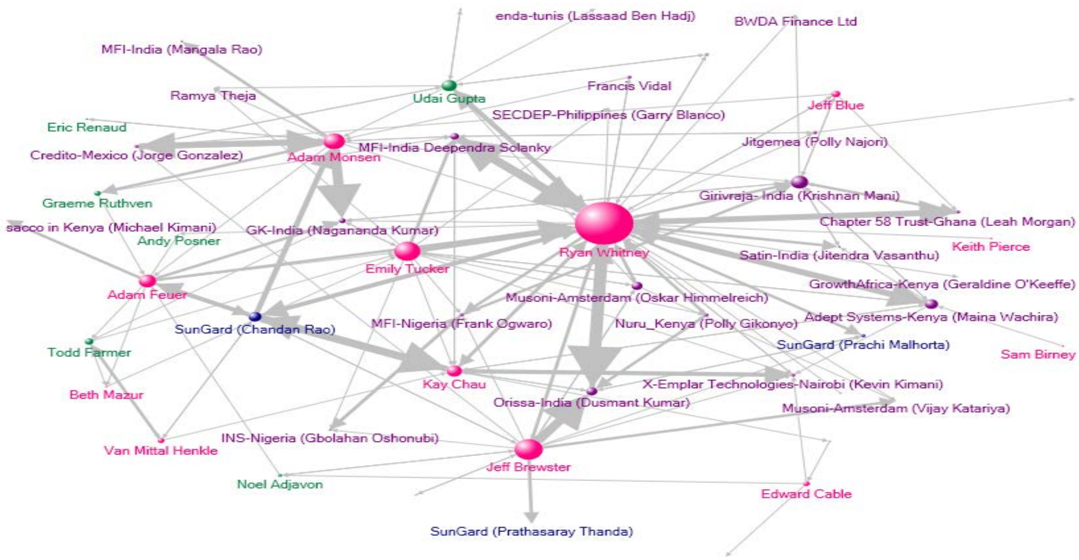


Figure 48
Source: Func. Mailing List, 7-12 2009

It is through the project's newsletters that I found the details of this story and of many others. In fact, GF-Tech has reported them to reinforce the project's open and altruistic reputation. It also used them to retain volunteers. Furthermore, the organisation has created several virtual walls of fame, **where** pictures and profiles of advertised volunteers were, giving them free publicity and public recognition –recommendations in social networks websites, congratulations in public events, etc. By the same token these have improved GF-Tech's market value.

In spite of the hype behind these stories and the free publicity, Mifos community was growing. The anecdotes that GF-tech used referred to real opportunities, parallel and independent forms of code and platform's reuse (Haefliger, Von Krogh, and Spaeth 2008). They affected positively Mifos code and platform, which attracted more people and boosted the project's reputation. They are therefore a testimony of Mifos reaching a new stage of maturity that gives credit to the hybrid nature of its development.

- *Year 2010*

Mifos development and success in the media continued in 2010, which earned the community more volunteers. Consequently, the number of its releases also went up[166]. This is echoed in the MLs' activity. Figure 49 and Figure 50 cover the full year. They show a stronger presence of GF-tech's core developers, a larger group of volunteers, and more contractors, including SunGuard and ThoughtWorks. The latter group became even more prominent over the second half of the year, suggesting a larger participation in releases 1.6 and 2.0. The number of GSoC Volunteers also reached a peak, which approximates 10 nodes over the period (green nodes).

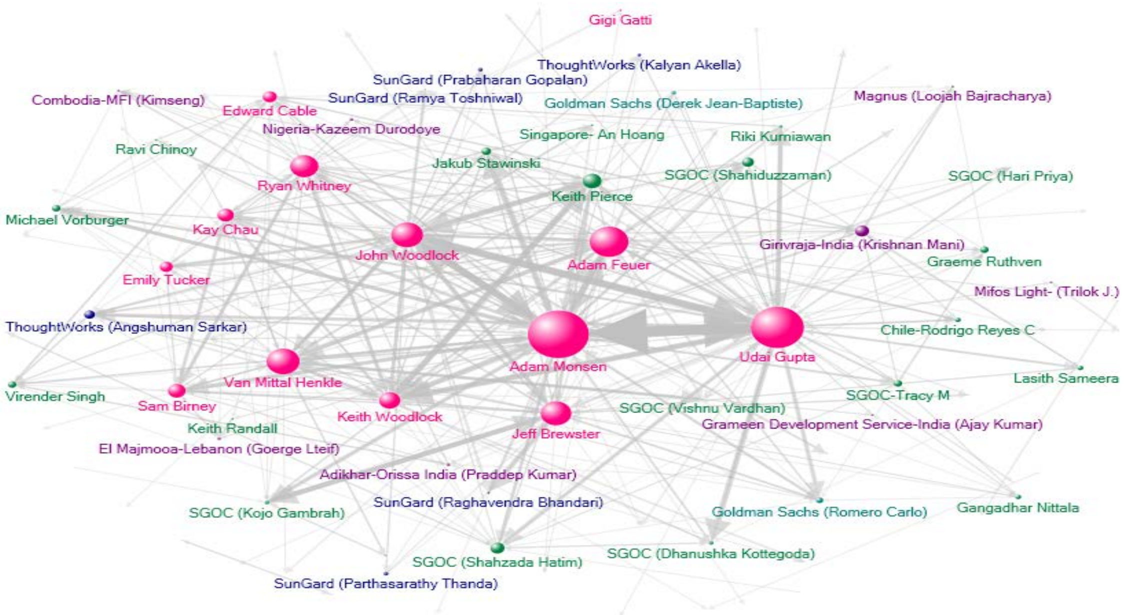


Figure 49
Source: Dev. Mailing List, 1-06 2010

166 In 2010, there were three Mifos releases 1.5, 1.6 and 2.0. They focused on functional enhancements.

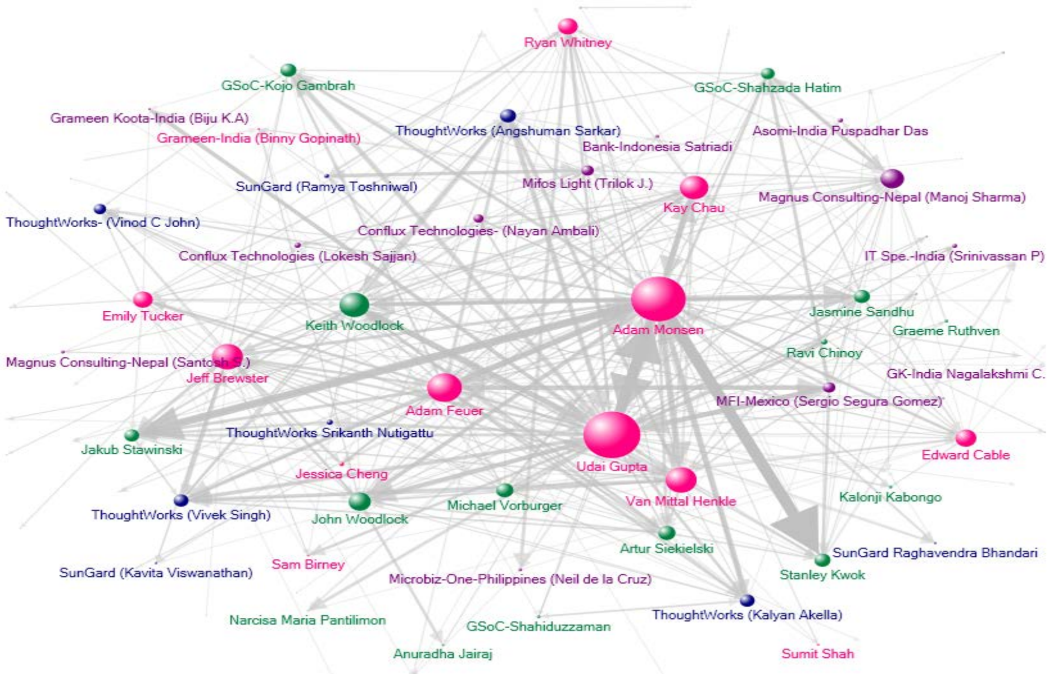


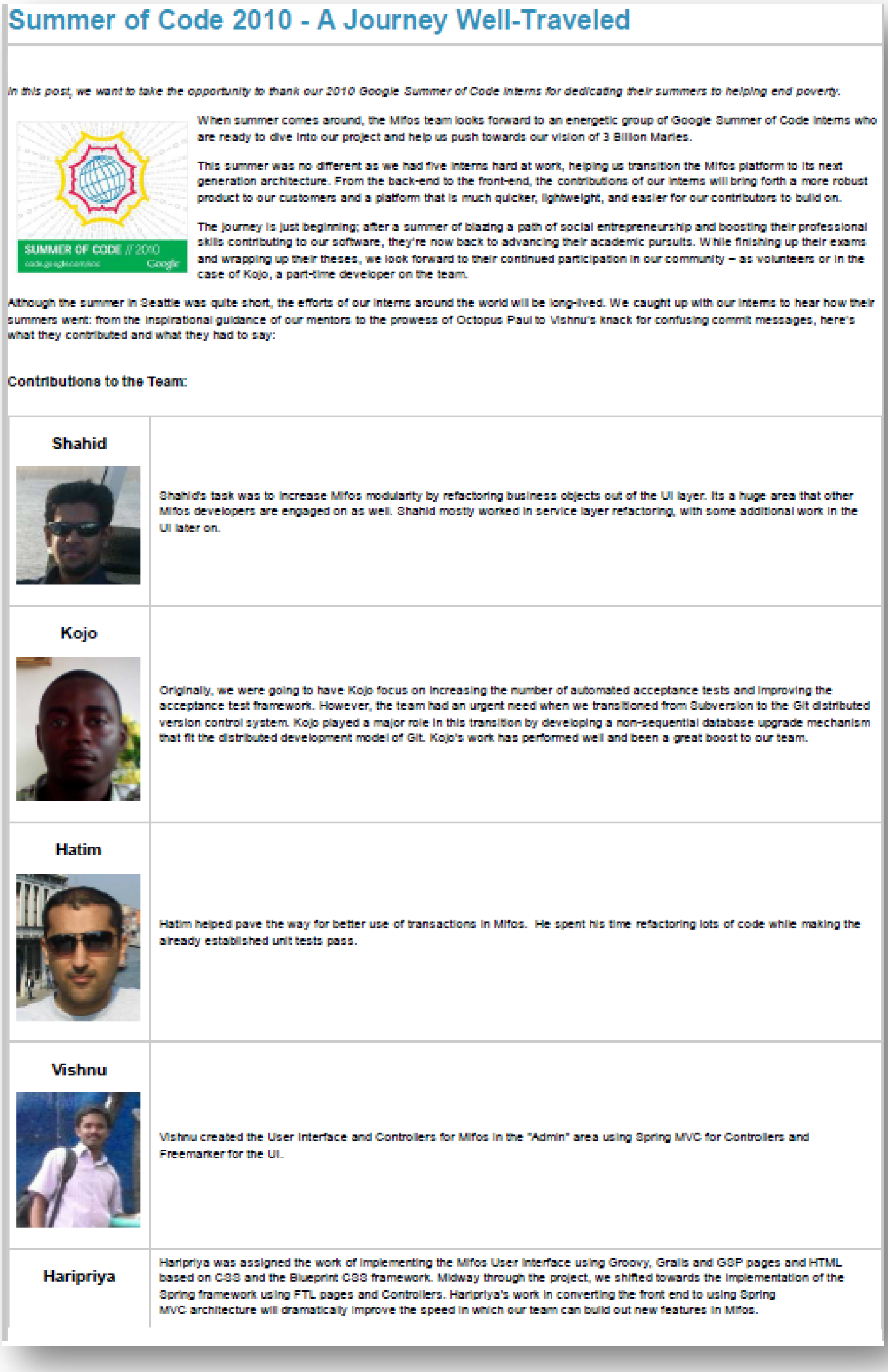
Figure 50
Source: Dev. Mailing List, 7-12 2010

In fact, Mifos was selected for the second year by the Google Summer of Code programme. This time, more volunteers were allocated to the Mifos project, as Figure 49 shows. Seven GSoC volunteers helped with the undergoing series of enhancements for the Mifos online platform, transiting some of the developers' wikis and online spaces into the next generation architecture. Their names, mentors, contribution and profiles are presented below[167] –see Figure 51 and Figure 52.

Student	Mentor	Project
HaraPriya K	MIFOS:Van Mittal-H nkle	Mifos front end prototype using Groovy, Grails, and a CSS Framework
Vishnu vardhan Pasupula	MIFOS:Van Mittal-H nkle	Mifos front end prototype using Groovy, Grails, and a CSS Framework
Kojo Gambrah-Sampaney	MIFOS:Jeff Brewster	Enhance automated acceptance test suite
Ruth Frowein	MIFOS:Jeff Brewster	Mifos mobile voice
Dhanushka Kottegoda	MIFOS:Udai Gupta	Spring managed entity persistence and transactions| Speed up unit & integration automated test suite
Shahzada Mushtaq	MIFOS:Udai Gupta	MifosNG
Mohammad Shahiduzzaman	MIFOS:John Woodlock	Increase Mifos modularity by refactoring business objects out of UI layer

Figure 51

167 Source: Mifos.org and mifosforge.jira.com, last accessed Jan. 2010



Summer of Code 2010 - A Journey Well-Traveled

In this post, we want to take the opportunity to thank our 2010 Google Summer of Code interns for dedicating their summers to helping end poverty.

SUMMER OF CODE // 2010
code.google.com/soc
Google

When summer comes around, the Mifos team looks forward to an energetic group of Google Summer of Code interns who are ready to dive into our project and help us push towards our vision of 3 Billion Maries.

This summer was no different as we had five interns hard at work, helping us transition the Mifos platform to its next generation architecture. From the back-end to the front-end, the contributions of our interns will bring forth a more robust product to our customers and a platform that is much quicker, lightweight, and easier for our contributors to build on.

The journey is just beginning; after a summer of blazing a path of social entrepreneurship and boosting their professional skills contributing to our software, they're now back to advancing their academic pursuits. While finishing up their exams and wrapping up their theses, we look forward to their continued participation in our community – as volunteers or in the case of Kojo, a part-time developer on the team.

Although the summer in Seattle was quite short, the efforts of our interns around the world will be long-lived. We caught up with our interns to hear how their summers went: from the inspirational guidance of our mentors to the prowess of Octopus Paul to Vishnu's knack for confusing commit messages, here's what they contributed and what they had to say:

Contributions to the Team:

Shahid	Shahid's task was to increase Mifos modularity by refactoring business objects out of the UI layer. Its a huge area that other Mifos developers are engaged on as well. Shahid mostly worked in service layer refactoring, with some additional work in the UI later on.
Kojo	Originally, we were going to have Kojo focus on increasing the number of automated acceptance tests and improving the acceptance test framework. However, the team had an urgent need when we transitioned from Subversion to the Git distributed version control system. Kojo played a major role in this transition by developing a non-sequential database upgrade mechanism that fit the distributed development model of Git. Kojo's work has performed well and been a great boost to our team.
Hatim	Hatim helped pave the way for better use of transactions in Mifos. He spent his time refactoring lots of code while making the already established unit tests pass.
Vishnu	Vishnu created the User Interface and Controllers for Mifos in the "Admin" area using Spring MVC for Controllers and Freemarker for the UI.
Haripriya	Haripriya was assigned the work of implementing the Mifos User Interface using Groovy, Grails and GSP pages and HTML based on CSS and the Blueprint CSS framework. Midway through the project, we shifted towards the implementation of the Spring framework using FTL pages and Controllers. Haripriya's work in converting the front end to using Spring MVC architecture will dramatically improve the speed in which our team can build out new features in Mifos.

Figure 52

Among the more senior volunteers in Figure 49 and Figure 50 is Jakub Stawinski –see Figure 53. He is a professional developer and the head of a software start-up named SolDevelo Sp z o.o in Poland. He and his team first joined Mifos at the end of 2009, after having heard that Mifos won the Seventh Annual Duke's Choice Awards.

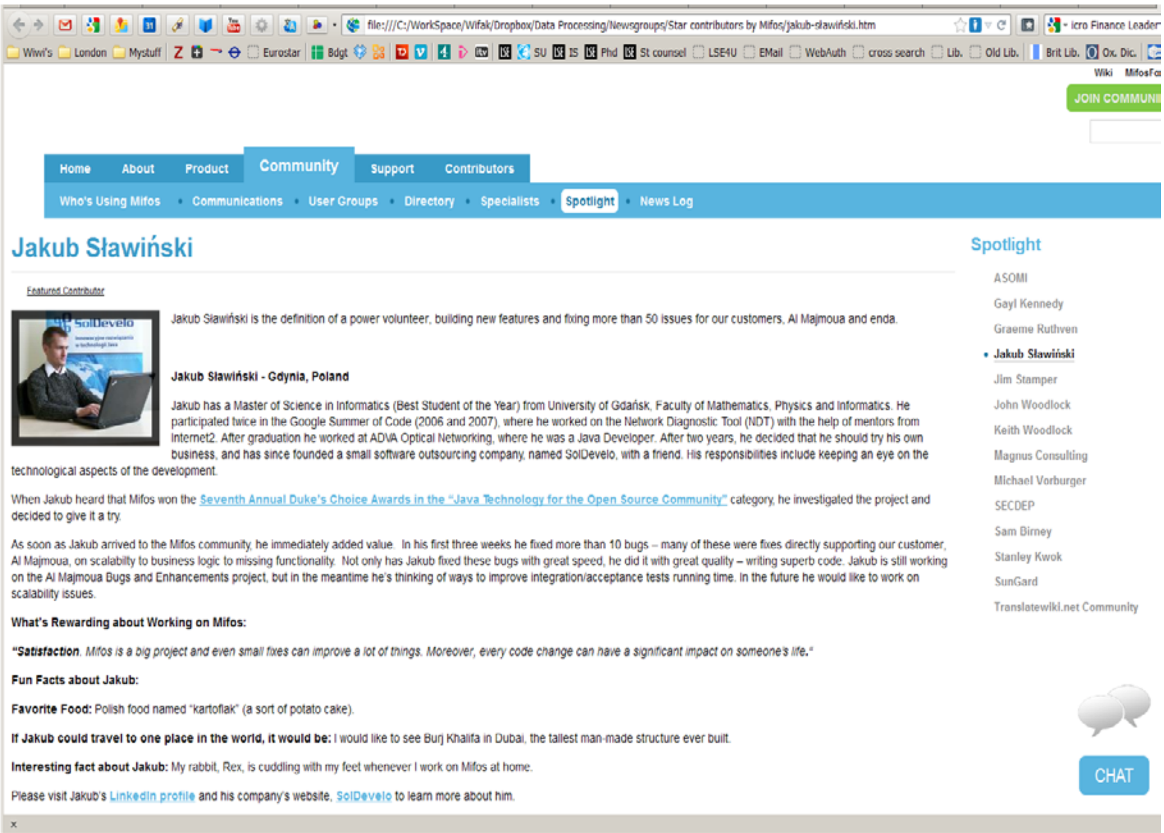


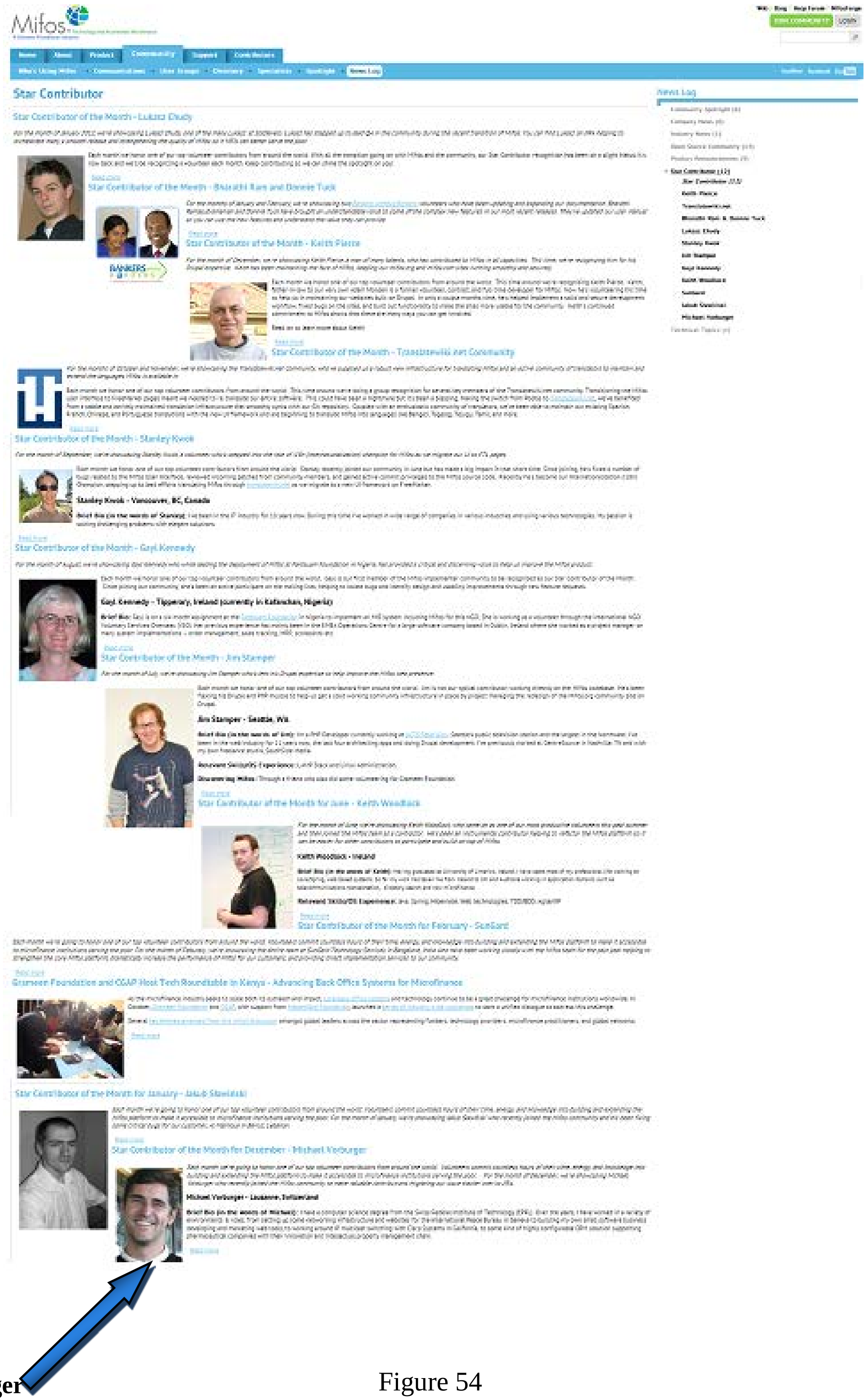
Figure 53

He and his team contributed mainly to the Shutdown interface and helped fix bugs and commit some feature enhancements for Al Majmoua in Lebanon and Enda Inter-Arabe in Tunisia. Jakub also resolved issues related to the Question Groups feature, completed the Automated Regression Testing project, which included rewriting/adding hundreds of test cases/acceptance tests, and added new features, like Quartz/Spring Batch integration, Early Repayment of Fees and M-PESA Loan Disbursals. In 2010, Jakub won the Mifos Star Contributor award.

The 'Star Contributor of the Month' is GF-Tech's way to promote volunteers who contributed to Mifos code and platform. Each month, one of the community's volunteers is designated and his picture and story displayed in Mifos newsletter and website. In 2011, the list of Mifos Star Contributors showed 12 individuals or/and groups –see Figure 54.

Among the star contributors in Figure 54, there is also Michael Voburger[168] -see the direction of the arrow. During one of his visits to London, two years ago, I had the chance to interview him. He is an IT professional, who works for a leading wealth and asset management software vendor and had held a number of management roles in Technology and Architecture groups during the past three years (LinkedIn, Last accessed Jan 2012).

[168] Michael Voburger's post is the last in Figure 54.



Michael Vorburger

Figure 54

Vorburger told me that he came across Mifos –what he considers a typical OSS Java project- as he was browsing for a new OSS project in his free time. Mifos recent success in the media with the Duke's Award convinced him to give it a try, and "***he was hooked since then"***. Cable, Grameen Technology Center's community lead at the time, was his contact person. Following a conversation in which Michael pointed to several potential defects related to Mifos platform, Edward suggested he did something. Michael then settled on an important platform's enhancement project –migrating Java.net-based issue tracker to Jira.

His participation has fluctuated between several hours a day –notably when his wife was on vacation- and low activity periods. Michael has been in continuous contact with Cable through IRC, in case he is needed. Recently he helped migrating the developers' wiki Confluence, which has improved developers' tools and archival management. More importantly, he presented the Mifos project to Java developers in several public events, including Jazoon 2010 (an International Conference for Java developers) where he gave a presentation entitled "Ending Poverty One Line of Code at a Time." Michael insisted that he did not talk about Mifos for its technical merit. He said:

> "***I wanted to gain more people to the community… it is the goal behind this project –and not its technical performance- that I and many other people find outstanding!"***

As a result of the growing interest and community contributions, the Mifos project was becoming by the day, more robust, resourceful and sophisticated. The Mifos application was also translated into several languages, including French and Spanish. It had a richer analytical layer of transaction management, including several social impact indexes, like the Progress out of Poverty Index[169] (social performance intelligence). In 2010 the following statistics were registered[170]:

- ***Over 8870 Product Downloads***
- ***2906 Volunteer hours from 25 volunteers***
- ***≈ 120000 lines of code, 5 Languages Translated***
- ***≈26 MFIs' Users, 21 active Mifos Specialists***

[169] http://www.progressoutofpoverty.org These features are inscribed by Northern standards of poverty alleviation. They establish a first layer of analytical representation that MFIs can gradually develop further, according to their local standards –once they directly or indirectly work out the necessary code changes.

[170] Source: Michael Vorburger: "Mifos Ending Poverty One line of Code at the Time", The Open World Forum, Paris Sep 23rd 2011.

At the same time, GF-Tech was experiencing difficulties to sell Mifos in the Philippines. Cable –community lead at GF-Tech- reported that:

> ***"The execution*** [of GF-Tech commercialisation plan] ***was more time consuming and expensive, than what we*** [GF-Tech] ***expected"*** (Skype Interview Summer 2011).

Slowly, GF-Tech withdrew its delegates from the Philippines. Instead, its local partner, MicrobizOne replaced them, and continued to support Mifos as a 'Software At A Service'-based application to MFIs in the region. Simultaneously, GF-Tech tried to establish itself in India, believing the dense microfinance network should boost its sales. A new GF-Tech-India was implanted. Cable reported that GF-Tech had then recruited:

> ***"A dedicated development and support team, which has hosted and supported a version of Mifos deeply focused on India... We [GF-Tech] aimed to establish a consortium***[171] ***of IT specialists – high-growth, mid-size microfinance institutions serving up to one million clients- which would sell Mifos as a package, including strategic IT consulting, and finally develop Mifos into an enterprise solution"*** (Skype Interview Summer 2011).

In this regard, GF-Tech aimed to convert existing Mifos users to cloud, by reengineering their business processes and internal Mifos strategy[172]. By plugging them to the cloud, GF-Tech believed that it could then pursue embedded technological developments, like a mobile payment Mifos module. GF got MasterCard Foundation and Cisco Foundation to help fund its plans. GF-Tech believed that this money would help ***'demonstrate Mifos potential return on investment'*** (Grameenfoundation.org, last accessed Jan. 2012). GF-Tech also organised a series of industry-wide workshops to support this idea[173] –see Figure 55.

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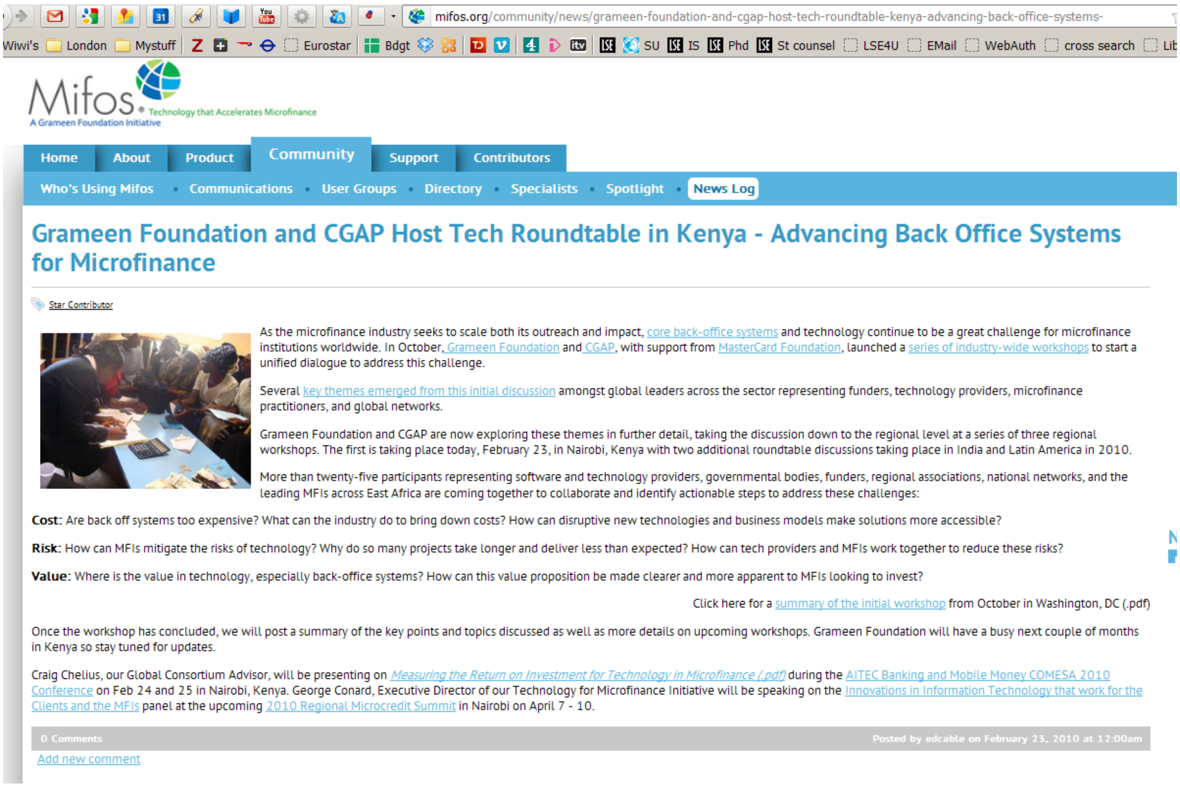
[171] The inaugural members included Grameen Koota of India, Enda inter-arabe of Tunisia, Al Majmoua of Lebanon, KEEF of Kenya, and KMBI of the Philippines.

[172] GF-Tech went on with this project with KEEF in Kenya. It evaluated the NGO's critical business processes and came up with a strategic IT plan. This intervention occurred in 2010, two years after KEEF had independently installed and rolled out Mifos.

[173] Source: mifos.org/community/news, last accessed January 2012.



mifos.org/community/news/grameen-foundation-and-cgap-host-tech-roundtable-kenya-advancing-back-office-systems-

Mifos Technology that Accelerates Microfinance

A Grameen Foundation Initiative

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Grameen Foundation and CGAP Host Tech Roundtable in Kenya - Advancing Back Office Systems for Microfinance

Star Contributor

As the microfinance industry seeks to scale both its outreach and impact, core back-office systems and technology continue to be a great challenge for microfinance institutions worldwide. In October, Grameen Foundation and CGAP, with support from MasterCard Foundation, launched a series of industry-wide workshops to start a unified dialogue to address this challenge.

Several key themes emerged from this initial discussion amongst global leaders across the sector representing funders, technology providers, microfinance practitioners, and global networks.

Grameen Foundation and CGAP are now exploring these themes in further detail, taking the discussion down to the regional level at a series of three regional workshops. The first is taking place today, February 23, in Nairobi, Kenya with two additional roundtable discussions taking place in India and Latin America in 2010.

More than twenty-five participants representing software and technology providers, governmental bodies, funders, regional associations, national networks, and the leading MFIs across East Africa are coming together to collaborate and identify actionable steps to address these challenges:

Cost: Are back off systems too expensive? What can the industry do to bring down costs? How can disruptive new technologies and business models make solutions more accessible?

Risk: How can MFIs mitigate the risks of technology? Why do so many projects take longer and deliver less than expected? How can tech providers and MFIs work together to reduce these risks?

Value: Where is the value in technology, especially back-office systems? How can this value proposition be made clearer and more apparent to MFIs looking to invest?

Click here for a summary of the initial workshop from October in Washington, DC (.pdf)

Once the workshop has concluded, we will post a summary of the key points and topics discussed as well as more details on upcoming workshops. Grameen Foundation will have a busy next couple of months in Kenya so stay tuned for updates.

Craig Chelius, our Global Consortium Advisor, will be presenting on *Measuring the Return on Investment for Technology in Microfinance (.pdf)* during the AITEC Banking and Mobile Money COMESA 2010 Conference on Feb 24 and 25 in Nairobi, Kenya. George Conard, Executive Director of our Technology for Microfinance Initiative will be speaking on the Innovations in Information Technology that work for the Clients and the MFIs panel at the upcoming 2010 Regional Microcredit Summit in Nairobi on April 7 - 10.

0 Comments | Posted by edcable on February 23, 2010 at 12:00am

Add new comment

Figure 55

Finally, GF-Tech India secured four contracts on Mifos Cloud, including three of the top MFIs in India (news.mifos.org, last accessed Jan.2012). Yet, after some time being in the local market GF-Tech decided to abandon its Mifos Cloud plans in India. In this regard Cable admitted that:

> ***"Controversies about microfinance institutions in India and the media turning to Mohammed Yunus involvement with politics have created a situation of crisis and made it even harder to sell Mifos"*** (Skype Interview Summer 2011).

Further to this adverse outcome in India, GF-Tech decided to abandon definitely any plans of selling Mifos and its associated Mifos Cloud services. More importantly, GF-Tech decided to withdraw from the whole OSS initiative. This happened very quickly, as the last section of this chapter recounts.

6.6. Epilogue: 2011+

Figure 56 shows GF-Tech's plans in January 2010[174].

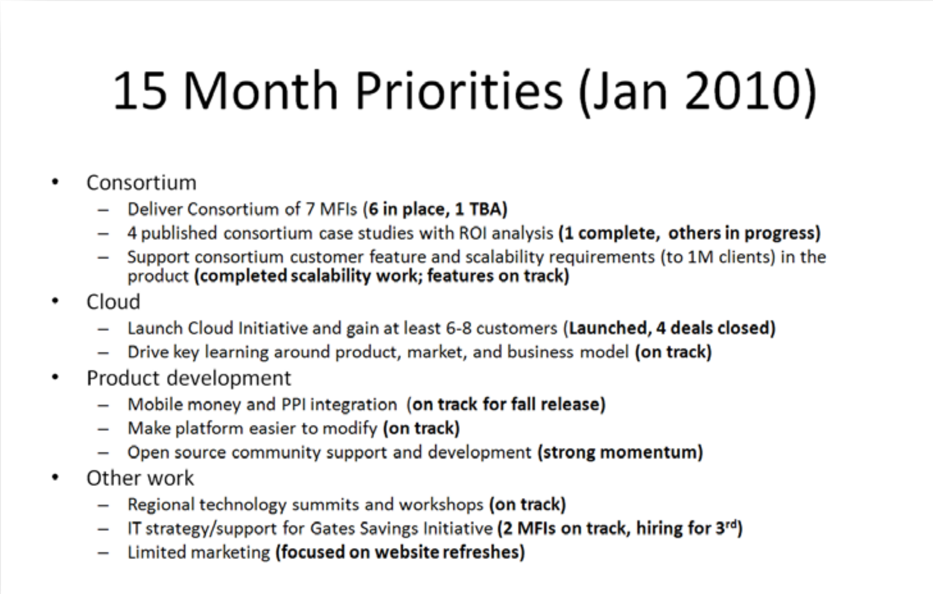
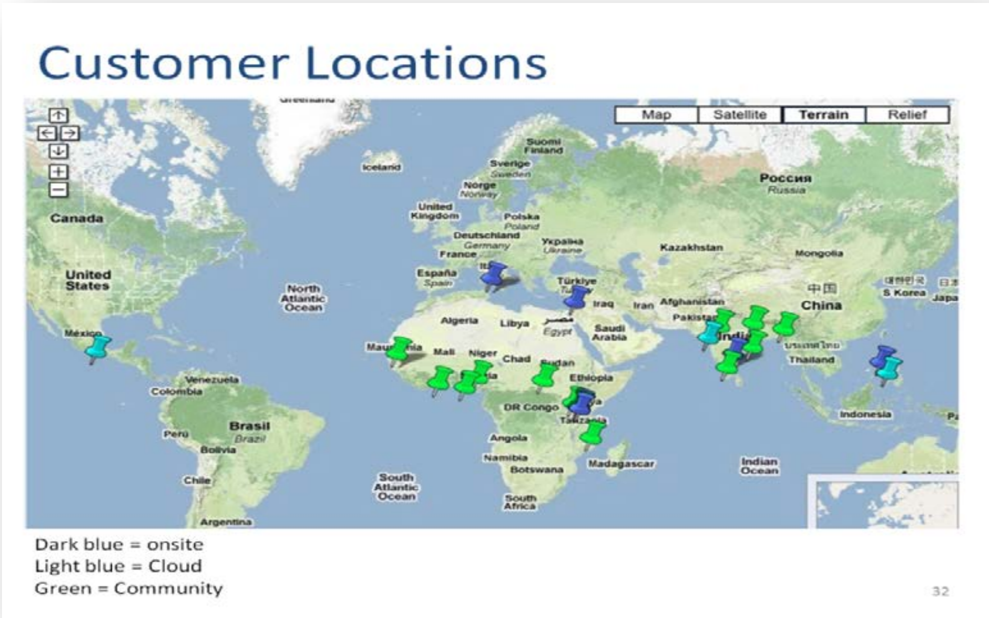


Figure 56

At the same time, it presented its global reach as following –see © 2013 Google Figure 57:

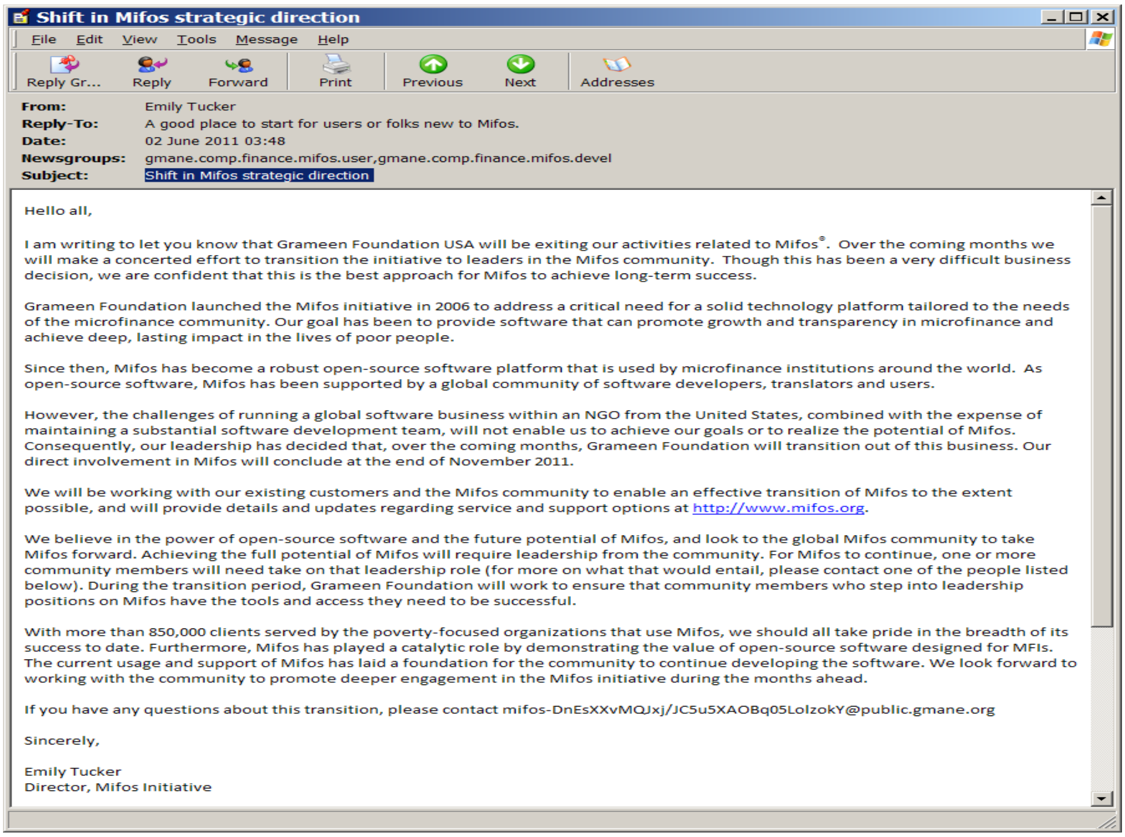


© 2013 Google

Figure 57

[174] Online Presentation published by GF in SlidShare, and entitled 'MIFOS USER MEETING' last accessed Jan. 2010.

Yet, the 2nd June 2011, Tucker sent a post, in which she announced that GF decided to step out of the Mifos initiative (Figure **58**).


Shift in Mifos strategic direction

File Edit View Tools Message Help

Reply Gr... Reply Forward Print Previous Next Addresses

From: Emily Tucker
Reply-To: A good place to start for users or folks new to Mifos.
Date: 02 June 2011 03:48
Newsgroups: gmane.comp.finance.mifos.user,gmane.comp.finance.mifos.devel
Subject: Shift in Mifos strategic direction

Hello all,

I am writing to let you know that Grameen Foundation USA will be exiting our activities related to Mifos®. Over the coming months we will make a concerted effort to transition the initiative to leaders in the Mifos community. Though this has been a very difficult business decision, we are confident that this is the best approach for Mifos to achieve long-term success.

Grameen Foundation launched the Mifos initiative in 2006 to address a critical need for a solid technology platform tailored to the needs of the microfinance community. Our goal has been to provide software that can promote growth and transparency in microfinance and achieve deep, lasting impact in the lives of poor people.

Since then, Mifos has become a robust open-source software platform that is used by microfinance institutions around the world. As open-source software, Mifos has been supported by a global community of software developers, translators and users.

However, the challenges of running a global software business within an NGO from the United States, combined with the expense of maintaining a substantial software development team, will not enable us to achieve our goals or to realize the potential of Mifos. Consequently, our leadership has decided that, over the coming months, Grameen Foundation will transition out of this business. Our direct involvement in Mifos will conclude at the end of November 2011.

We will be working with our existing customers and the Mifos community to enable an effective transition of Mifos to the extent possible, and will provide details and updates regarding service and support options at http://www.mifos.org.

We believe in the power of open-source software and the future potential of Mifos, and look to the global Mifos community to take Mifos forward. Achieving the full potential of Mifos will require leadership from the community. For Mifos to continue, one or more community members will need take on that leadership role (for more on what that would entail, please contact one of the people listed below). During the transition period, Grameen Foundation will work to ensure that community members who step into leadership positions on Mifos have the tools and access they need to be successful.

With more than 850,000 clients served by the poverty-focused organizations that use Mifos, we should all take pride in the breadth of its success to date. Furthermore, Mifos has played a catalytic role by demonstrating the value of open-source software designed for MFIs. The current usage and support of Mifos has laid a foundation for the community to continue developing the software. We look forward to working with the community to promote deeper engagement in the Mifos initiative during the months ahead.

If you have any questions about this transition, please contact mifos-DnEsXXvMQJxj/JC5u5XAOBq05LolzokY@public.gmane.org

Sincerely,

Emily Tucker
Director, Mifos Initiative

Figure 58

Tucker's post announced that GF had decided to exit its activities related to Mifos and prepare its transition to community-led effort (Mifos.org last accessed June 2011). As the post explained, Mifos had grown into a robust open-source software platform that is supported by a global community of software developers, translators and users. Yet it had also become difficult for GF-Tech to '***realise***' its potential.

Both Mifos code and platform were to be transited to the community. In the meantime, the main production website (including wikis and Issue Tracker), as well as the documentation translation and the mailing lists remained active and used by all community members. Until the announcement of the transition, 'Elsie F', GF-Tech's most stable version of Mifos was available, as well as few minor associated fixes. 'Maya G', was the first release to be published after transition –see Appendix 2. It was still signed GF-Tech. Later, community members and particularly, Jakub Stawinski[175] and his team from SolDevelo in Poland released new Mifos enhancements, and began to play a leading role in the community[176] – (Figure 59).

[175] Jakub Stawinski and his team have been working in collaboration with Grameen tech Center for almost two years.
[176] Source: Mifos.org

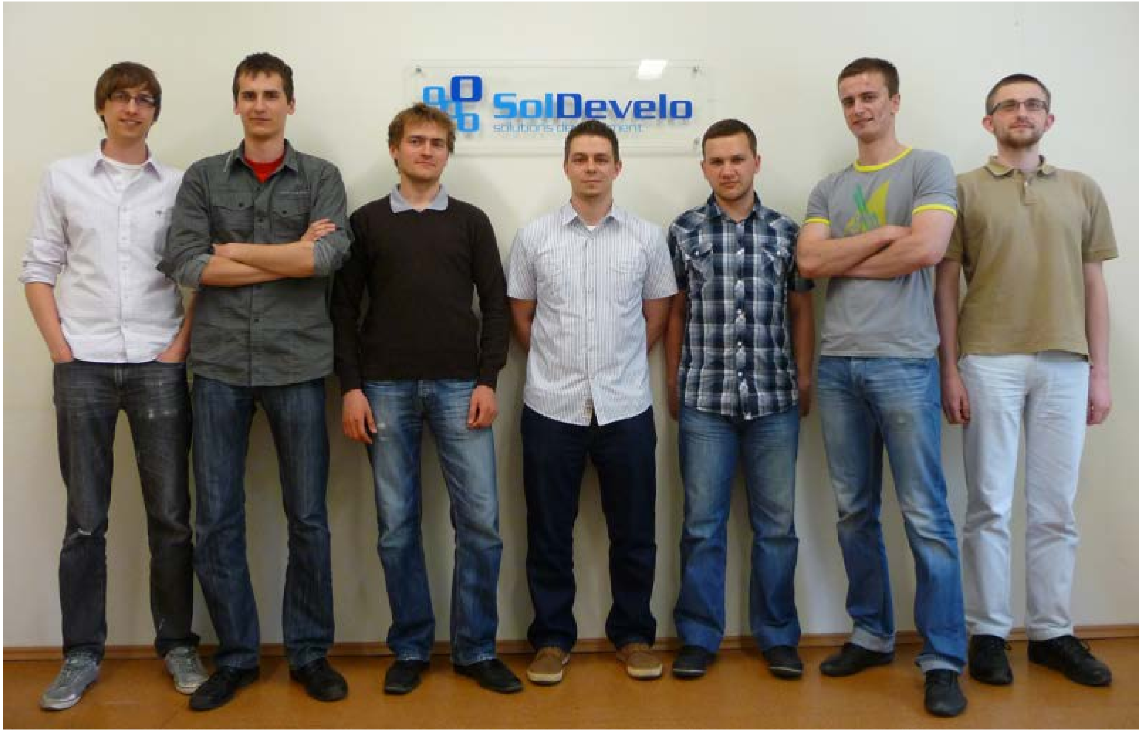
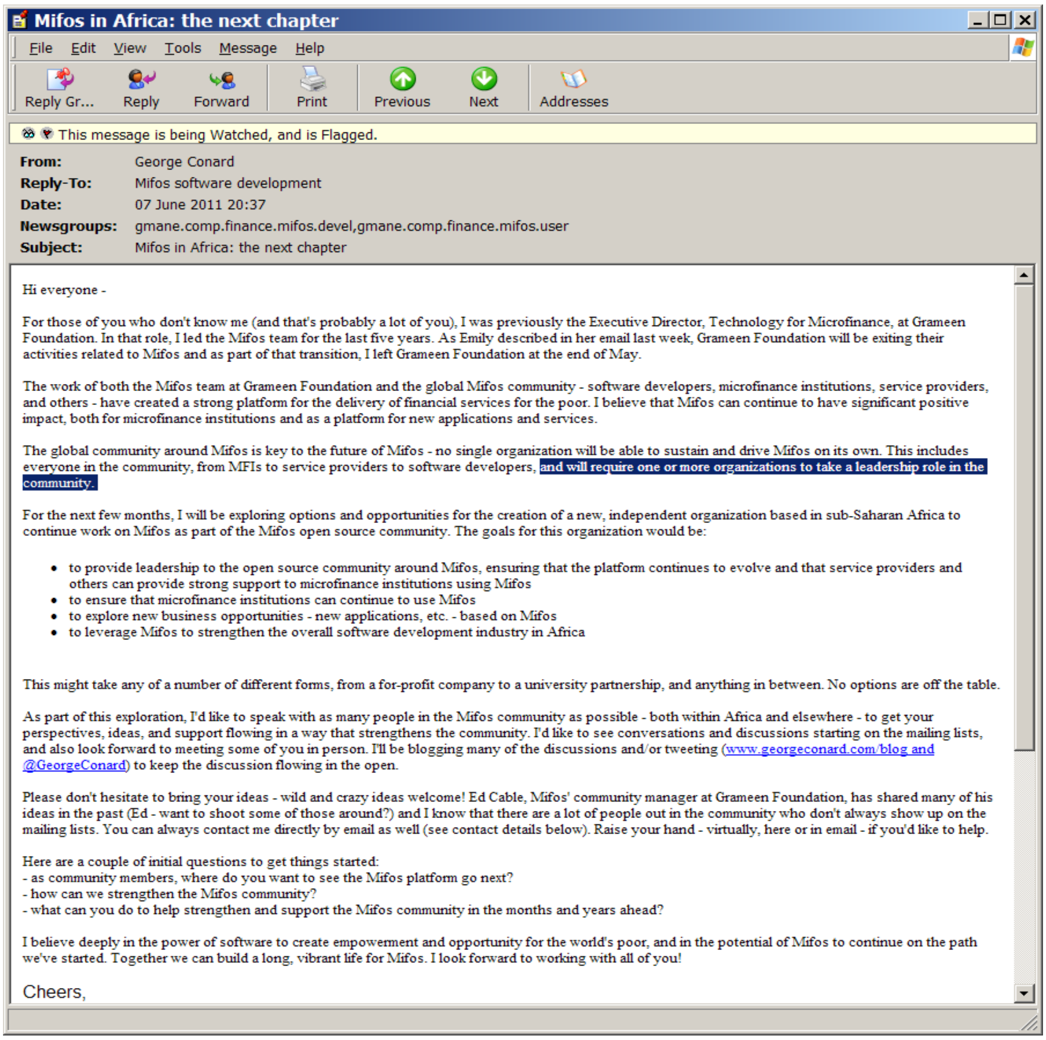


Figure 59

Shortly after Emily's announcement, the MLs were buzzing with posts about the transition. Members from GF-Tech started hot discussions on the future of the initiative, and how to organise the next releases. For example, Conard posted to the MLs a call to community members, raising the issue of future leadership. He also announced that he intended to create a new independent Mifos organisation in Sub-Saharan Africa, and asked for support from the community (Figure 60).

After his post, more posts about leadership and the community's future continued to be sent. Many people showed interest to step in and lead the Mifos community, especially among GF-Tech former employees.


Mifos in Africa: the next chapter

File Edit View Tools Message Help

Reply Gr... Reply Forward Print Previous Next Addresses

This message is being Watched, and is Flagged.

From: George Conard
Reply-To: Mifos software development
Date: 07 June 2011 20:37
Newsgroups: gmane.comp.finance.mifos.devel,gmane.comp.finance.mifos.user
Subject: Mifos in Africa: the next chapter

Hi everyone -

For those of you who don't know me (and that's probably a lot of you), I was previously the Executive Director, Technology for Microfinance, at Grameen Foundation. In that role, I led the Mifos team for the last five years. As Emily described in her email last week, Grameen Foundation will be exiting their activities related to Mifos and as part of that transition, I left Grameen Foundation at the end of May.

The work of both the Mifos team at Grameen Foundation and the global Mifos community - software developers, microfinance institutions, service providers, and others - have created a strong platform for the delivery of financial services for the poor. I believe that Mifos can continue to have significant positive impact, both for microfinance institutions and as a platform for new applications and services.

The global community around Mifos is key to the future of Mifos - no single organization will be able to sustain and drive Mifos on its own. This includes everyone in the community, from MFIs to service providers to software developers, and will require one or more organizations to take a leadership role in the community.

For the next few months, I will be exploring options and opportunities for the creation of a new, independent organization based in sub-Saharan Africa to continue work on Mifos as part of the Mifos open source community. The goals for this organization would be:

- to provide leadership to the open source community around Mifos, ensuring that the platform continues to evolve and that service providers and others can provide strong support to microfinance institutions using Mifos
- to ensure that microfinance institutions can continue to use Mifos
- to explore new business opportunities - new applications, etc. - based on Mifos
- to leverage Mifos to strengthen the overall software development industry in Africa

This might take any of a number of different forms, from a for-profit company to a university partnership, and anything in between. No options are off the table.

As part of this exploration, I'd like to speak with as many people in the Mifos community as possible - both within Africa and elsewhere - to get your perspectives, ideas, and support flowing in a way that strengthens the community. I'd like to see conversations and discussions starting on the mailing lists, and also look forward to meeting some of you in person. I'll be blogging many of the discussions and/or tweeting (www.georgeconard.com/blog and @GeorgeConard) to keep the discussion flowing in the open.

Please don't hesitate to bring your ideas - wild and crazy ideas welcome! Ed Cable, Mifos' community manager at Grameen Foundation, has shared many of his ideas in the past (Ed - want to shoot some of those around?) and I know that there are a lot of people out in the community who don't always show up on the mailing lists. You can always contact me directly by email as well (see contact details below). Raise your hand - virtually, here or in email - if you'd like to help.

Here are a couple of initial questions to get things started:
- as community members, where do you want to see the Mifos platform go next?
- how can we strengthen the Mifos community?
- what can you do to help strengthen and support the Mifos community in the months and years ahead?

I believe deeply in the power of software to create empowerment and opportunity for the world's poor, and in the potential of Mifos to continue on the path we've started. Together we can build a long, vibrant life for Mifos. I look forward to working with all of you!

Cheers,

Figure 60

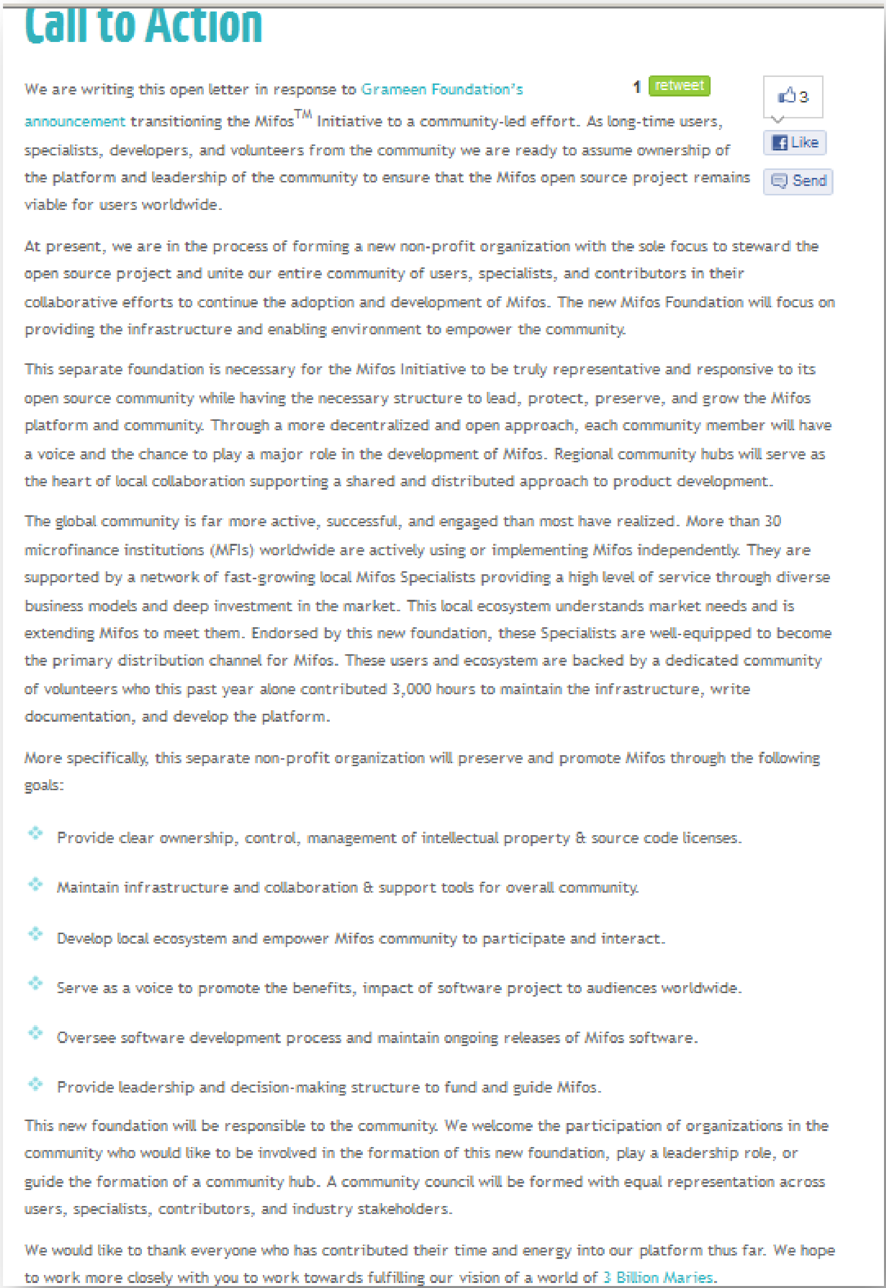
Cable, former community lead at GF-Tech was one of them. In fact, I heard the news about the transition for the first time from him. He then informed me about his plan to leave the organisation and take on an active role among community members. He explained:

> ***"…During all these shifts and strategies, the 'community' remained a focal hub despite little investment…First, we built our software in a complicated way and people were finding it hard to find their way through. We never really taught them. We did organise one training session at some point, but that was it. We focused on the software solution; the community was never a key point of our culture in the past years."***

> ***"…However a lot of things are going on today. Many local Mifos specialists are being very successful. They have aggressive marketing strategies to sell Mifos to MFIs. Also many MFIs have successfully deployed Mifos.***

> ***"…Throughout the time line we tried to develop a commercial business strategy at the expense of a community-driven strategy. Now these two must intersect. Our emphasis on the community was high initially; it has dropped half way and now it is high again."***

Gradually, more concrete propositions about Mifos future started to emerge. A new website, mifoscommunity.org, published a letter in which a group of community members announced their intent to create a new non-profit organisation dedicated to Mifos, to provide 'the necessary structure to lead, protect, preserve, and grow the Mifos platform and community (Figure 61).



Call to Action

1 retweet | 3 | Like | Send

We are writing this open letter in response to Grameen Foundation's announcement transitioning the Mifos™ Initiative to a community-led effort. As long-time users, specialists, developers, and volunteers from the community we are ready to assume ownership of the platform and leadership of the community to ensure that the Mifos open source project remains viable for users worldwide.

At present, we are in the process of forming a new non-profit organization with the sole focus to steward the open source project and unite our entire community of users, specialists, and contributors in their collaborative efforts to continue the adoption and development of Mifos. The new Mifos Foundation will focus on providing the infrastructure and enabling environment to empower the community.

This separate foundation is necessary for the Mifos Initiative to be truly representative and responsive to its open source community while having the necessary structure to lead, protect, preserve, and grow the Mifos platform and community. Through a more decentralized and open approach, each community member will have a voice and the chance to play a major role in the development of Mifos. Regional community hubs will serve as the heart of local collaboration supporting a shared and distributed approach to product development.

The global community is far more active, successful, and engaged than most have realized. More than 30 microfinance institutions (MFIs) worldwide are actively using or implementing Mifos independently. They are supported by a network of fast-growing local Mifos Specialists providing a high level of service through diverse business models and deep investment in the market. This local ecosystem understands market needs and is extending Mifos to meet them. Endorsed by this new foundation, these Specialists are well-equipped to become the primary distribution channel for Mifos. These users and ecosystem are backed by a dedicated community of volunteers who this past year alone contributed 3,000 hours to maintain the infrastructure, write documentation, and develop the platform.

More specifically, this separate non-profit organization will preserve and promote Mifos through the following goals:

- Provide clear ownership, control, management of intellectual property & source code licenses.
- Maintain infrastructure and collaboration & support tools for overall community.
- Develop local ecosystem and empower Mifos community to participate and interact.
- Serve as a voice to promote the benefits, impact of software project to audiences worldwide.
- Oversee software development process and maintain ongoing releases of Mifos software.
- Provide leadership and decision-making structure to fund and guide Mifos.

This new foundation will be responsible to the community. We welcome the participation of organizations in the community who would like to be involved in the formation of this new foundation, play a leadership role, or guide the formation of a community hub. A community council will be formed with equal representation across users, specialists, contributors, and industry stakeholders.

We would like to thank everyone who has contributed their time and energy into our platform thus far. We hope to work more closely with you to work towards fulfilling our vision of a world of 3 Billion Maries.

(…)

Signed,

Users

Niranjan Sheelavant, CEO - Nirantara Community Services

Polly Najori, IT Manager - Jitegemea Credit Scheme

Pradeep Panda, - IT and MIS Executive - Adhikar

Henrik Esbensen, Founder - Creocore

Vivian Lu, CED Program Manager, Nuru International

Stephen Kaufman, International Aid Services America

Satriadi, IT Business Analyst - Bank BTPN

Gayl Kennedy, Fantsuam Foundation

Specialists

Nayan Ambali, Conflux Technologies

Miguel Joia de Santos, Co-Founder - Iniciativa Mifos Mozambique

Thomas Ndugwa, Vastech Uganda

Ed Balontong - Microbiz One

Jean de Dieu Rurangirwa, GoIT Solutions

Contributors

John Woodlock, November 2009 Star Contributor

Michael Vorburger, December 2009 Star Contributor

Jakub Sławinski, January 2010 Star Contributor

Keith Woodlock, June 2010 Star Contributor

Jim Stamper, July 2010 Star Contributor

Bharathi Ram, January 2011 Star Contributor

Keith Pierce, December 2010 Star Contributor

Supporters

Matt Duncan, former Mifos Director of Market Development

Jeff Brewster, former Mifos QA Manager

Adam Monsen, former Mifos Software Engineer

Figure 61

For the first time, volunteers like Woodlock invited Mifos users to voice their needs and share what they wanted to see done on Mifos (Figure 62). His post received several comments from several members, while some answered Cable, instead. Among members to react was Jakub Stawinski. He wrote:

> ***"…new independent organisation based in sub-Saharan Africa should listen very carefully to the current Mifos users (maybe each of main MFIs should have their representative in this organisation?)"***

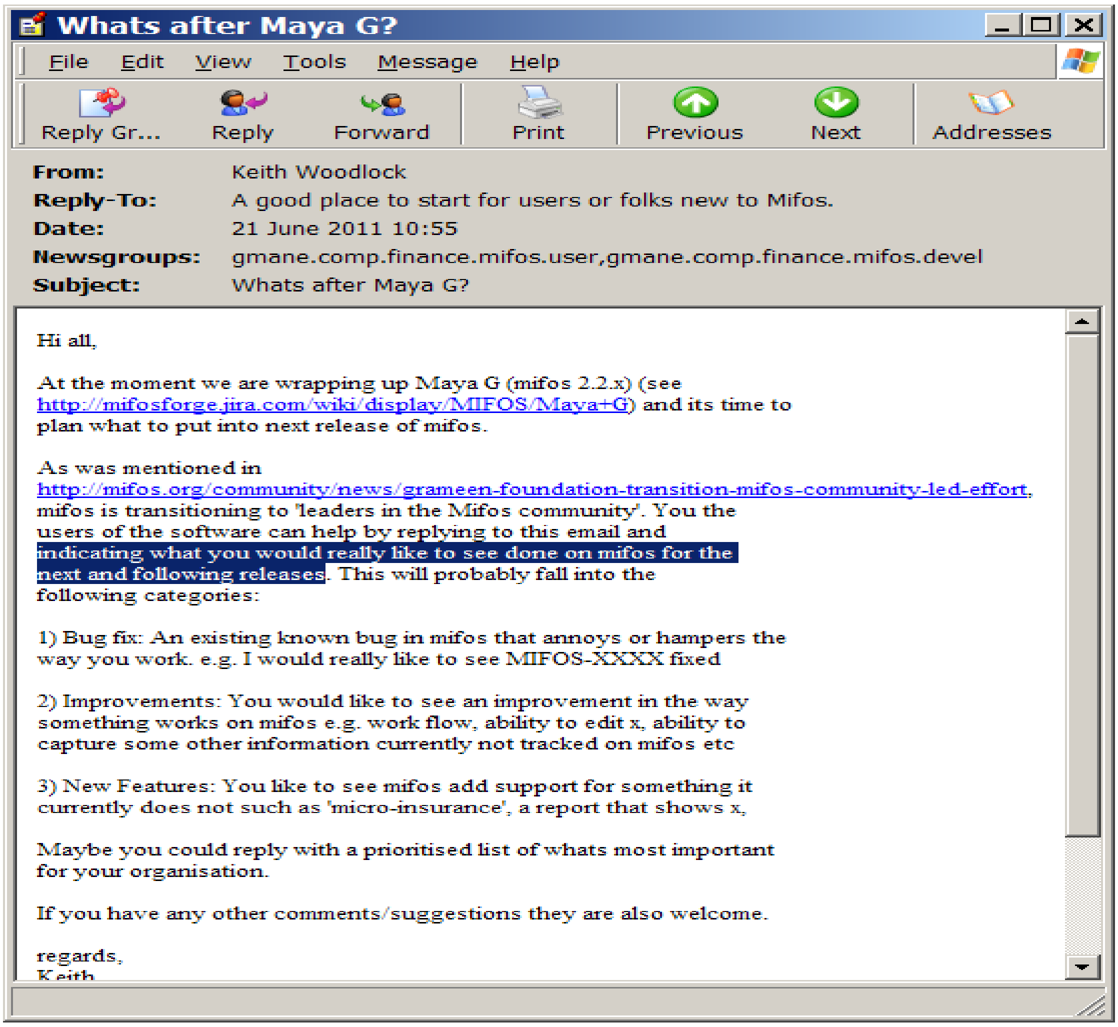


Figure 62

In fact, contestation and conflict were rising fast. After more than five years of activity, the community was suddenly re-inventing its governance, structure and future. Members did not agree necessarily and they were not shy to say so. Sides were forming in the MLs, whereas they used to remain underneath. Users wanted to be heard[177]. In 2011, a radical shift in the balance of power occurred. As I witnessed these changes in the MLs, I realised how unstable the community was. The Mifos community has yet to go through a new phase, whilst as a silent observant I withdrew my presence from the MLs' scene.

177 Recently, one of the current top contributors in developers' mailing list 2011-2012 (Lukasz Chudy – SolDevelo, Poland) took charge of centralizing members' requirements on JIRA dashboard (Mifos.org).

6.7. Conclusion

When I started this chapter, my aim was to show how change is a major aspect associated with community participation, and thereby a major dimension in software development. I aimed to convey a sense of movement through the succession of time waves and the way transient configurations of nodes and ties reflected multiple and embedded social dynamics, which continued to shape the development process whilst their digital footprints keep materialising.

The combination of the MLs activity –in terms of nodes and ties' sequential configurations- and their underlying roots –in terms of the re-constructed assemblage of events and anecdotes- has followed this, illustrating how Mifos development was a series of interdependencies between actors, technologies and their potential for extension and regeneration.

Furthermore, mapping Mifos mailing lists into a chronological series of time waves has demonstrated to be relevant to the study of mobilisation and sustained participation in software development, insofar that it has revealed the extent to which MLs are supporting code production. The Code shapes and is shaped simultaneously by the course of multiple social dynamics channelled across the MLs online and offline.

More importantly, this chapter has revealed several development stages over the period of observation. They have gradually shaped the becoming of this software and have grounded its design in the social fabric of sustained code production and use. By re-constructing the stories around them, I thus documented a software genealogy that is mainly the outcome of finite momentums that punctuate an emergent and boundless software ontology (Simondon 2007).

At the beginning and similarly to other self-built and open source software projects, Mifos was a vision. It was still devoid of materiality; it did not yet take shape, or crystallise into a clear product design. It was expressed by the project founder's hope (j.Dailey) to create a software application that is:

> ***"…disruptive enough to spark change in banking and financial services software"*** (J. Dailey 01 11 2006).

Soon, the vision transformed into a collective, which brought in the first aspects of its structuring and the organising of production. Accordingly, GF-Tech took on the administration of the project and negotiated a development strategy, including the mobilisation of resources and community participation among GF-Tech members and their peers in the nascent Mifos community.

Gradually Mifos story revealed a point of tension, i.e. a continuous mangle between control and emergence, which the project's administrators tried to sustain and keep to their advantage. I also reported that the project's founder was concerned that the organisation's struggle to keep control over the development process –recruiting its own developers and outsourcing the design of code objects to contractors- would not help differentiate it from a commercial software ventures obliterating the disruptive dynamic of the bottom-up, open source approach. In this regard, I would like to report this blog exchange[178] between Dailey, former project founder and his former senior developer at GF-Tech:

> Kingdon: ***"I certainly hope that open source is disruptive, because we'll make a lot more progress if progress happens without getting bottlenecked through people like me".***
>
> Dailey: ***"Yep! Agree. I believe that GF will need to be less hierarchical about this project moving forward, so your role is important but isn't the end of the story. I also believe that open source communities work best when they are based on merit."***

This dialogue shows that these two individuals were indeed convinced that the Mifos development approach was bottlenecked by the hierarchical structure of its founder and administrator at GF-Tech. They both believed that this structure was a threat to the project's future development and to the achievement of its goals –in terms of building a sustainable information platform for MFIs.

Over time, the project did nevertheless develop into a hybrid development model, where several knowledge profiles have tried to sustain their participation over the period of observation, and collaborate. Many MFIs joined the project, as they tried to deploy Mifos locally. They contributed to the code and the MLs, through local IT specialists, which mediated between them and the rest of the community.

The product as well as its online platform went through several forms. At times, the Mifos project looked like this altruistic, meritocratic and hacker-ethic driven community that Raymond has described in his book (Raymond 2001). Yet at other times the whole network of participants was tied by GF-Tech's central position and seemed to be the mere outcome of its politics, alliances and strategic partnerships (Monge et al. 1998).

This narrative has also revealed an interesting dichotomy between open governance and open design, which in the open source scholarship are amalgamated in the notion of open source approach. Open governance is represented by community participation and a bottom-up organising of roles and responsibilities. By contrast, open design is defined by open source tools and design approaches that foster code integrability, continuous and not necessarily interconnected code commits and bug fixes. Mifos administrators have somehow disconnected these two dimensions at times, favouring one at the expense of the other. Particularly, after the release of Mifos 1.1, it became obvious that GF-Tech understood Mifos as the output of open standards and open design tools.

[178] Source: Travel Through Life Last accessed 23/11/2011.

GF-Tech administrators and their affiliates then became the major decision maker, setting code objects' priorities, defining users' requirements and intervening on sites to monitor and manage Mifos roll out. Volunteers, Mifos intermediaries and MFIs' position in the community shrunk and were limited to peripheral roles. They were free to reuse the code, contribute to the project inside the lines of its predefined development strategy and benefit from the online support of the GF-Tech team, guiding them for their own Mifos localisation projects. In this sense, they stood apart from the main decision process.

At the same time, Mifos code design was reengineered by GF-Tech employees and contractors so as to fit with a more open design approach in terms of tools, libraries and the rationale underlying code architecture. Together with the lobbying of Mifos in the technical circles of the Java and open source professionals, Mifos code has become more open attracting new batches of code and volunteers' contributions, which has enhanced the overall design features and increased the application's appeal globally.

The implications of GF-Tech's new policy were immediate. Following its growing involvement –in terms of resources and responsibilities- the organisation had decided that it needed to create financially sustainable streams of revenue in order to guarantee Mifos development.

As a consequence, Mifos product developed into two potential avenues. The first ensured the continuity of the software development through its commercialisation as a private software service. Here, I described how GF-Tech explored this new business plan in the Philippines and in India, trying to sell Mifos as part of an inclusive package that provided a host-access, maintenance and upgrading through annual subscription. The second avenue was the actual open source project, which sustains the same hybrid model of volunteer contributors, users' intermediaries and GF-Tech contractors, providing open access to new code releases and the platform's online resources.

These are two software development models that I compared earlier in this chapter to two highways. These run in parallel and present two separate alternatives, which are yet interpenetrable. In this regard Mifos as a service –also referred to as Mifos Cloud- provides an additional layer of innovation and value that is built on top of the features that are provided by the common code (Ostrom 1990; Melucci 1996). It is a derivative product that requires the common and open Mifos code in order to sustain its own future. Such a situation was also observed in the case of the open source Linux kernel and its commercial derivatives, like the Red Hat Enterprise Linux (DiBona, Stone, and Cooper 2005).

Finally, the Mifos project took a U-turn. In the epilogue, I announced GF-Tech's decision to withdraw its direct involvement from the Mifos project and transit its code and platform to the Mifos community. Mifos then entered a new phase of its development, as some old members of the community showed their strong intent to continue supporting the Mifos initiative and discussed new possibilities of leadership.

At the same time, new releases continued to be published, while new volunteers, or group of volunteers (companies) were gradually increasing their involvement, contributions and users' support.

This last twist in the Mifos genealogy was quite unexpected, although I connected it to the failure of GF-Tech to sustain the Mifos Cloud model in the Philippines and in India. If I have mentioned it in this chapter, it is not because it is the end of the Mifos story. I do not want to conclude either, that GF-Tech control-driven development approach was not sustainable over time. On the contrary, this event shows that Mifos is an outcome of an ongoing participation, which can still change overtime the project's map of relations and thereby affect future code development.

From this perspective, Mifos' development model is not an outcome of a planned strategy, which one person (or organisation) is able to sustain over time. Rather, it is the consequence of a set of completely context-dependent situations, which have spurred Mifos life expectancy. Time is crucial, as Mifos sustainability is contingent on actors' ongoing negotiation processes across crises, changes and restructuration.

7. Analysis Chapter III: Knowledge Building and Software Development

7.1. Introduction

See note below[179]

Until now, Analysis Chapter One provided several synthetic overviews of the MLs, where information flows were mainly ‘gatekeeped’ by Mifos project’s administrators, GF-Tech. Chapter two put the administrators’ involvement into perspective, highlighting major momentums in Mifos life, which were influenced by key non-admin actors, making thus the overall development’s approach look more hybrid than straight top-down hierarchy. Indeed, the MLs have served as a space of encounter for several knowledge profiles, whose participation increased over the period of observation, despite continuous in and out flows of newcomers and people leaving. All along Analysis Chapters I and II, community participation was captured through frequencies of post-exchanges, connectivity and the behaviour of subscribers in the MLs with regard to their roles at the broader level of the project. Analysis chapters I and II have thus complemented each other, in the sense that they described participation as an outcome of MLs’ activity (inside view), but also in context –as the product of emergent relations between participants’ individual and organisational affiliations and the setting of the Mifos project (outside view).

Going a step further, this chapter suggests to deepen the inside view of participation, beyond the structural aspects of nodes’ frequencies and degrees of connectivity. Indeed, while the analysis of sociograms in Analysis chapter I provides a set of measures to inform the general position of actors and their roles, it has largely remained agnostic with respect to the content of what flows through their ties (Hansen 1999). Whether it is simple information or richer forms of knowledge that flow through the links, the analysis of static sociograms is insufficient to reveal the quality of participation among posters, notably in terms of the inherent mechanisms that induce participation and motivate people to exchange posts and views. Besides, the danger in relying on sociograms and node measures lies in concluding that the level of activity in the MLs reflects the level of learning in the community (Mason 1992).

While the MLs are still used as the research proxy, I do not base my analysis of participation here on posts’ frequencies, but on their content. In this regard, Kuk (2006) argues that the analysis of posts and message-threads is highly valid considering that it reveals epistemic aspects of subscribers’ interactions that are inherent to OSS development. He writes, that threads are “functionally similar to the concept of “ba” (Nonaka and Konno 1998)”; […] they “serve as a conduit for knowledge sharing to a

[179] This chapter is built on the basis of empirical material that is stored in Appendix 5. I did not use direct citations here. Instead I referred to illustrations in Appendix 5. It is thus necessary to read the following text and the illustration that it refers to in Appendix 5 in order to get a sense of the ideas explained.

wider epistemic network embedded within and beyond the borders of discussion threads" (Kuk 2006). Based on this view, this chapter looks at the processes through which actors exchange and build community knowledge, and how they collectively construct a space of socialisation embedded in code production. It also relies on open coding of selected messages to explain some of the social and epistemic dynamics of community participation, why community members diffuse information, ask questions and share solutions and how by so doing they affect future participation and the continuity of their community and code –post exchanging as incentive for participation or a cause for withdrawal and demotivation.

As mentioned in Chapter II (theory chapter) motivation and incentives in OSS community participation have stimulated a lot of debate among software scholars (Lerner & Tirole 2000; 2005; Maxwell & Scacchi 2004; Lakhani & Wolf 2005; Feller et al. 2005). Yet few among them have presented knowledge transfer and individual learning as mechanisms inducing sustained participation (Shah 2006; Fang and Neufeld 2009), and only a few scholars have employed text analysis approaches for analysing OSS MLs. They include Ripoche & Sansonnet 2006; Barcellini et al. 2008; Sack et al. 2006 and Fang and Neufeld 2009. This chapter does not use a systematic approach to all messages though, given it was preceded by two previous analysis chapters. it mainly focuses on a selection of posts, examining closely how structuring agency is channelled through participants' communication strategies and MLs' capabilities to trigger learning situations and knowledge coproduction.

The next section describes the process of socialisation in the MLs. It examines how post quality is expected to be defined by actors' roles in the community (Ducheneaut 2005). However, section two argues that interactions between community members are in the first place a social engagement that is coproduced by the organising capabilities of posts and the MLs. As people, engage, discuss opinions and share information; they create a situated social instance, whose outcome shapes their behaviour and the conditions of their future interactions. Section three shows therefore how learning and knowledge sharing are emergent and socially constructed (Wenger & Snyder 2000; Lave & Wenger 2000). Section four carries on this constructivist path and argues that learning and knowledge building are co-dependent on the potential of Mifos platform and its code objects. Finally, section five shows how social dynamics induced by post-exchanges are a chain of sustained participation and a major aspect of code future.

7.2. Mifos MLs

1.1.1. The structure of Mifos MLs

OSS development is strongly conditioned by the mix of an eclectic array of knowledge groups and expertise. Some participants are specialised in software code and its objects (Collins & Evans 2002; 2003). Others might have less experience in this domain, but a substantial knowledge in project management, requirements' specification, business practices, etc. In this sense, software development is a knowledge-intensive process (Von Krogh et al. 2003); various skills need to coexist and to enable socialisation and learning, in order to ensure the continuity of design and code re-use (Pliskin et al, 1991; Waterson et al, 1997).

As a social microcosm (Moon and Sproul 2002), MLs exemplify the mixing of knowledge groups and foster interactions between community members. Often, profiles of posters embody all sorts of software-related backgrounds (Feller and Fitzgerald 2002; Sowe, Stamelos, and Angelis 2008). Mostly documented are the contributions of volunteer core designers, notably in successful OSS projects like the Linux kernel, the Apache project, etc. (Maxwell and Scacchi 2004; Mockus et al. 2000; Mockus et al. 2002; Lakhani and Von Hippel 2003; Von Krogh et al. 2003). Typically they stand for 20% of community members, but achieve the greater bulk of code commits (Markus et al. 2000; Moon and Sproull 2002; Von Krogh et al. 2003). For the remaining 80%, who are generally the vast majority in the project's community, they are what the OSS literature considers peripheral members (Kuk 2006; Krishnamurthy 2002). These are generally code/platform users, who achieve mundane development activities (Fitzgerald 2005), like testing, writing documentation, translation tasks, reporting bugs, suggesting new features, improving localisation, etc. (Jørgensen 2001; Moon and Sproull 2002; Lakhani and Von Hippel 2003).

Similarly to other OSS projects that have been reviewed in the literature (Markus et al. 2000; Krishnamurthy 2002; Mockus et al. 2002; Von Hippel & Von Krogh 2003; Lakhani & Von Hippel 2003; O'Mahoney & Ferraro 2004), Mifos exhibits a nucleus of core developers who administer the project, review code commits, and decide the project's development strategy (See Appendix 5, I-20). In this case, they are the GF-Tech developers, and a few of its affiliated contractors and volunteers. The other participants are mostly irregular posters and temporal participants including the majority of MFIs, volunteer developers, and Mifos experts[180] (Figure 63) below. MFIs, local intermediaries and volunteers are irregular posters in the MLs. However their large number affects the MLs activity. When they post, they share their experiences in installing, localising, or modifying the code and ground its features in daily use. For this reason, I consider that they are important and include them in this chapter where I document their participation and collaboration.

[180] Mifos experts are local IT vendors, who mediate communication between their clients (MFIs) and GTC administrators in order to facilitate Mifos localisation.

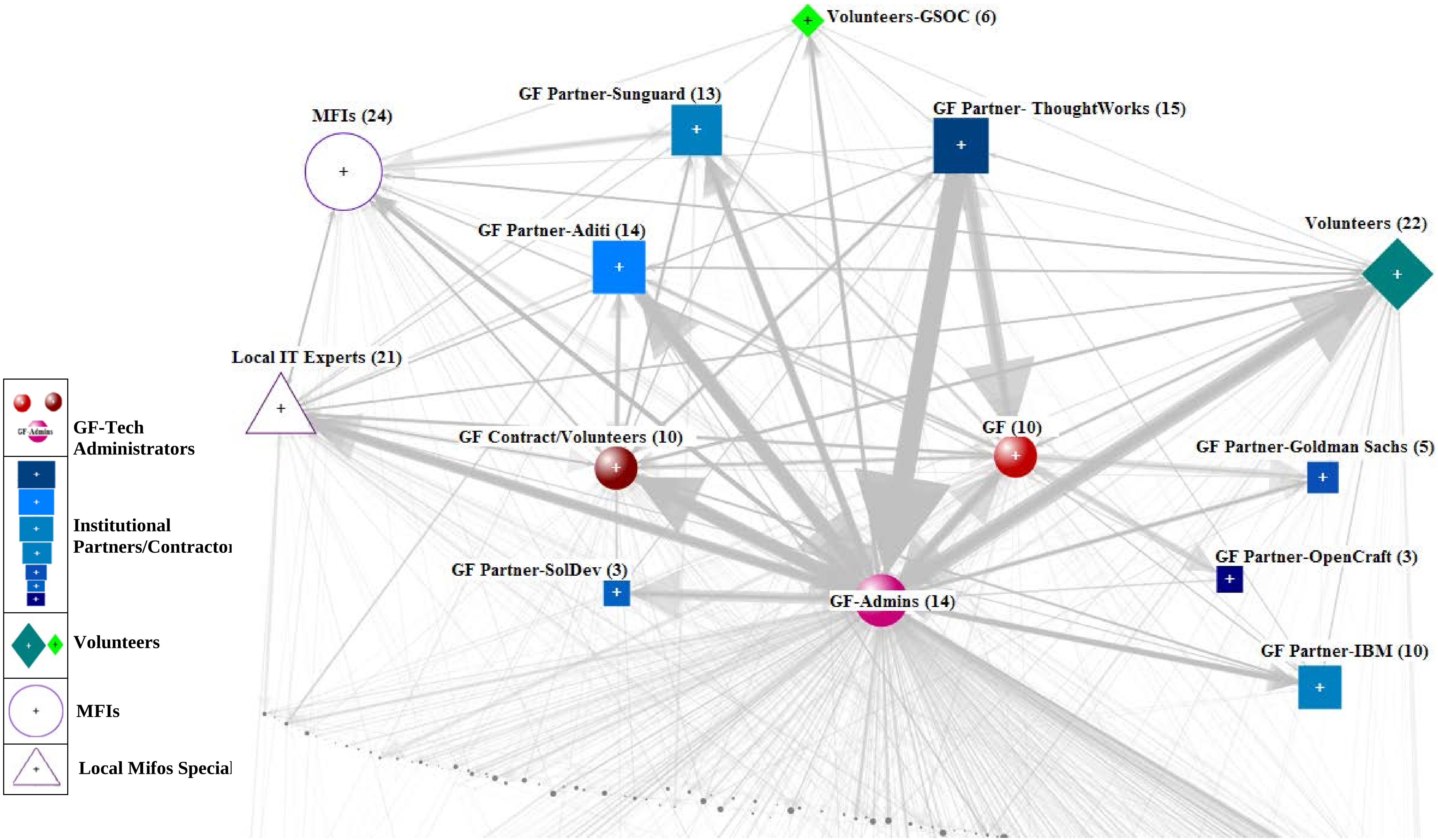


Figure 63

Source: Analysis Chapter I/ Section 3

7.2.1. Taxonomy of Mifos Subscribers

In chapter two of the analysis, I made an attempt to trace the project's genealogy. Going back to the project's launch, I explained that most Mifos founders inside GF-Tech Centre never took part in an OSS project before. Lacking in software background, they tried instead to frame a vision of OSS-4-microfinance for others to concretise. Then, they just concentrated on driving participation and mobilising resources.

First, they set up alliances with MFIs in order to collect requirements. These started to form a pre-community, a sort of affiliation group, which embodied the founders' vision. Then, they recruited into this nascent membership a few institutional IT contractors, to whom they outsourced parts of the code design. At the same time, they fostered external participation, by inviting experienced open-source(rs), microfinance experts, mobilising donors, sponsors, and encouraging volunteers' input from allover the world. Slowly, the Mifos community became an eclectic and hybrid grouping of various profile groups, with different backgrounds, expertise and motives to participate.

In the first chapter of the analysis, I identified these groups and represented them as interconnected mega nodes in a network (Figure 63). I also mapped their relations across the MLs, emphasising the strength of their ties. In this section I provide a glimpse on their profiles and roles in the Mifos community[181]. Particularly, I re-shuffle some of the nodes that appear in Figure 63 in order to create generic use groups that apply to the overall project –see (Table 7). However, use groups do overlap; once a Mifos expert contributes new lines of code for example, she can also be seen as a volunteer or a contractor –according to whether her services were paid for or not; in the same way, if a volunteer takes part in Mifos localisation, she can also become an MFI IT partner, etc. So, these categories are seen more like epistemic demarcators, which differentiate between members' background knowledge, and initial motives.

[181] To create this taxonomy, I profiled over 250 nodes (more than 50% of Mifos MLs' population)- see appendix 6. This consisted in searching the Internet for their organisational affiliations, background knowledge, technical expertise and collecting evidence about their involvement in Mifos project: when they joined the community, objective, achievements, etc.

1-Mifos Developers:

- GF-Tech Admins: Both core developers and project managers. They are under GF-Tech payroll and represent the internal Mifos team at GF-Tech.
- GF-TECH Regional Employees: Project managers and developers; they represent GF-Tech in the regions where Mifos was localised. They are also under GF-Tech payroll and part of the internal Mifos team.
- GF-Tech Contractors: These are individual IT contractors (developers). Sometimes they also lead small IT start-ups in the regions where Mifos is localised. They are generally recruited by GF-TECH to provide support services to their MFIs partners. Often, contractors are selected among community members, prior to being a GF-Tech employee, or after having been an active volunteer.
- GF-Tech IT Partners: These are representatives of institutional contractors. They have intervened in different stages of Mifos development. They have contributed with code or bug fixes. Often, there was more than one institution represented in the same time wave. Their participation generally depended on the terms of their contract, but some developers have also volunteered work hours more or less regularly.
- Volunteers: Experienced Open-source developers who have other work commitments; they are not under GF-Tech payroll. Their participation is also irregular and varies over time.
- Volunteer students: Most of them contributed to Mifos through GSoC 2009 and 2010. A few have stayed beyond the summer term that is GSoC official period of commitment.

2- MFIs

- MFIs which started their membership in the Mifos community as Grameen Partners (the Lighthouse programme).
- MFIs which decided to deploy Mifos independently from Grameen.

3-Mifos Specialists

- GF-Tch local IT partners (like Open Craft, Sol-Dev); they have contributed to code re-use, through fixes, functional enhancements, improvements, etc, while supporting Mifos localisation efforts in India, Africa, etc. They tried to leverage Mifos adoption locally, designing a wide array of services around the application that they gradually marketed to local MFIs.
- MFIs' local IT partners. Whether institutional or individuals, they helped customise and implement Mifos for their clients. They were not directly recruited by GF-Tech and might have committed code, or not. They used the MLs to ask for help and share their experiences.
- Local IT vendors who were involved in the community separately, and committed code. Later, they became known to GF-Tech administrators and eventually became their partners.

4-Others

This is a dump category. It contains irregular posters, members who are not identified (lack of information), and subscribers who do not belong to any of the other categories.

Table 7

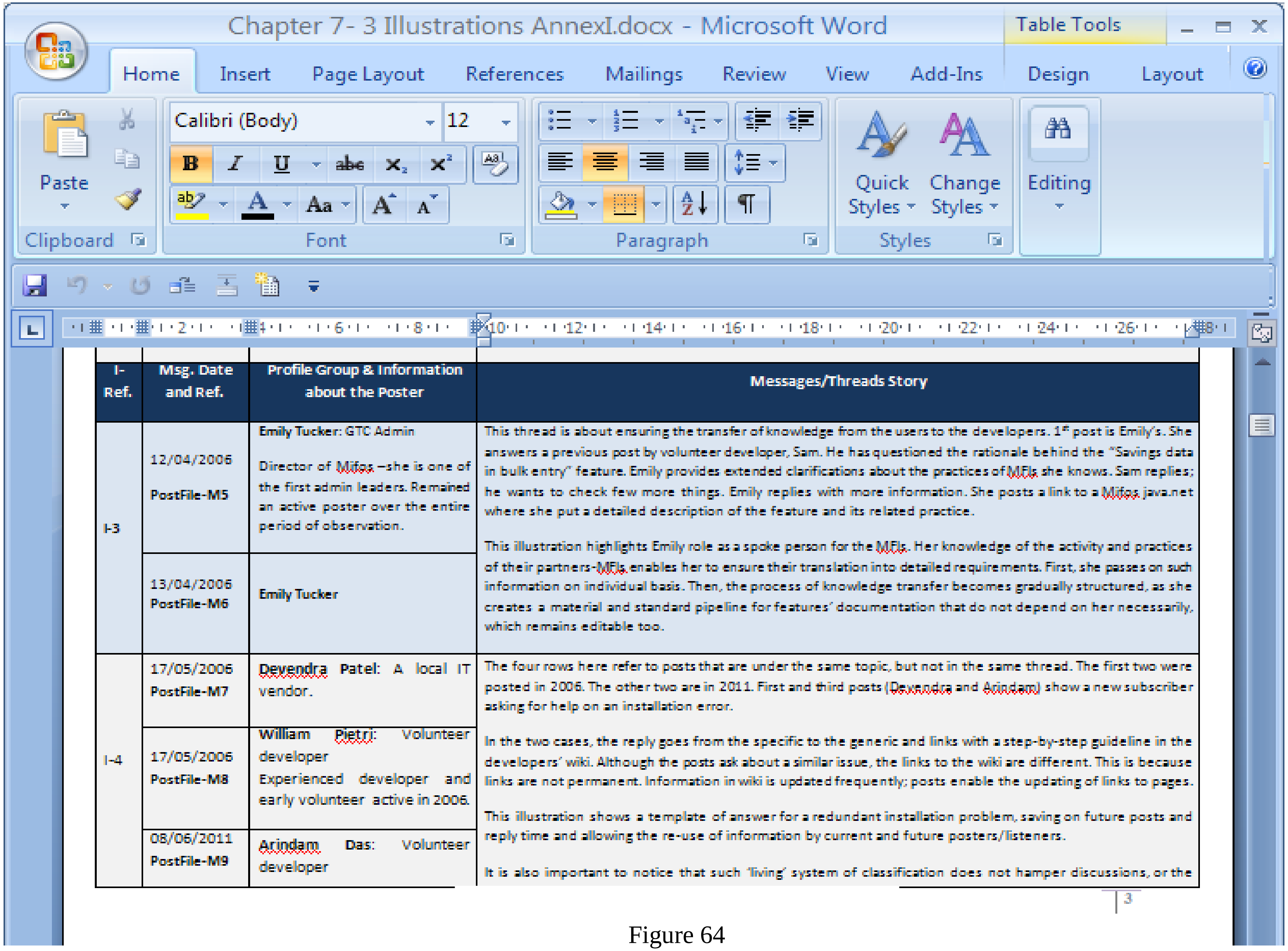
7.3. The Dynamic of the Social: Post Quality and Knowledge Profiles

MLs are believed to facilitate communication in environments of extreme distributed collaboration (Mockus et al. 2000). However, MLs require in themselves a productive social dynamic, in the sense that they support, but do not make discussions or collaborations between subscribers. This is confirmed for example by the central role played by GF-Tech administrators in the MLs; they have strongly contributed to creating a vibrant space of discussion between different profile knowledges. They broadcasted information related to code decisions, enabling paprticipants to follow code advances (Appendix 5, I-3)[182]. They also ensured the uploading, and indexing of different data artefacts to posts, gradually connecting the MLs with the rest of the platform (Appendix 5, I-1; I-3), and making many 'internal' documents public (Appendix 5, I-2; I-6; I-7). Their behaviour created an incentive for the rest of the community to do the same and encouraged relatively open exchanges of information (Appendix 5, I-6).

Similarly, GF-Tech contractors manifested their membership to the Mifos community, once they subscribed to the MLs along volunteers, MFIs and local IT vendors. By doing so, they showed willingness to be challenged by members who are just 'contributors', thus becoming themselves accountable to the community at large (Fielding 1999, Gallivan 2001) –Appendix 5, I-1; I-11; I-12. They made room for an 'off-hierarchy' membership, which is defined through involvement intensity, meritocracy, reputation, and other 'regimes of worth' (Scacchi 2007) –Appendix 5, I-1; I-11; I-12. From this perspective, a post represents the subscriber's labour, and is a token of her membership. As a craft, it translates her knowledge, perceptions, and understanding, and so is also a statement that speaks for her (Himelboim 2008; Himelboim et al. 2009; Ibrahim et al. 2010). In the same vein, the quality of a subscriber's participation is determined once she writes a post, and answers others' posts.

From this perspective, how a question is asked and a post framed defines the quality of posts, and reveals the poster's background knowledge and role. A post provides a great insight into the identity of its sender, to the extent that it captures traits of character, knowledge, norms and ideologies (Stewart and Gosain 2006) –Appendix 5, I-3; I-4; I-5; I-6. Across most of the stories indexed in Appendix 5 (for example I-1; I-7; I-15; I-16), one can still explain the difference between posts, according to whether these were sent by an administrator, a local intermediary, or an MFI. Participation is thus influenced by users' profile and so are the social processes through which they learn and exchange. Based on that, I kept a separate data column to present the protagonists of each story I documented (Figure 64). In this column, I indicate the group profile of the sender and gave a summary of her role in the community.

[182] 'I' stands for the word illustration. These are described in Appendix 5, and listed from I-1 to I-26.



I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-3	12/04/2006 PostFile-M5	**Emily Tucker**: GTC Admin Director of Mifos –she is one of the first admin leaders. Remained an active poster over the entire period of observation.	This thread is about ensuring the transfer of knowledge from the users to the developers. 1st post is Emily's. She answers a previous post by volunteer developer, Sam. He has questioned the rationale behind the "Savings data in bulk entry" feature. Emily provides extended clarifications about the practices of MFIs she knows. Sam replies; he wants to check few more things. Emily replies with more information. She posts a link to a Mifos java.net where she put a detailed description of the feature and its related practice. This illustration highlights Emily role as a spoke person for the MFIs. Her knowledge of the activity and practices of their partners-MFIs enables her to ensure their translation into detailed requirements. First, she passes on such information on individual basis. Then, the process of knowledge transfer becomes gradually structured, as she creates a material and standard pipeline for features' documentation that do not depend on her necessarily, which remains editable too.
	13/04/2006 PostFile-M6	**Emily Tucker**	
I-4	17/05/2006 PostFile-M7	**Devendra Patel**: A local IT vendor.	The four rows here refer to posts that are under the same topic, but not in the same thread. The first two were posted in 2006. The other two are in 2011. First and third posts (Devendra and Arindam) show a new subscriber asking for help on an installation error. In the two cases, the reply goes from the specific to the generic and links with a step-by-step guideline in the developers' wiki. Although the posts ask about a similar issue, the links to the wiki are different. This is because links are not permanent. Information in wiki is updated frequently; posts enable the updating of links to pages. This illustration shows a template of answer for a redundant installation problem, saving on future posts and reply time and allowing the re-use of information by current and future posters/listeners. It is also important to notice that such 'living' system of classification does not hamper discussions, or the
	17/05/2006 PostFile-M8	**William Pietri**: Volunteer developer Experienced developer and early volunteer active in 2006.	
	08/06/2011 PostFile-M9	**Arindam Das**: Volunteer developer	

3

Figure 64

Following this logic, I expected to see a difference between developers' posts and those of MFIs. It is widely known that recognition and reputation drive developers to participate[183] (Hertel et al. 2003; Lerner & Tirole 2000; Lakhani & Wolf 2005; Roberts et al. 2006). Developers typically expose their skills engaging in exercises of professional appreciation through the sharing of code commits (Appendix 5, I-9). Their aim is to build a name in the industry and to extend their social network (Lakhani & Wolf 2005; Fang & Neufeld 2009). In Mifos case, most of volunteers were registred in professional social networks where statistics of their commits are advertised online. As one of the participants put it, increasing the visibility of volunteers creates incentives for participation and recruits even more developers to the Mifos cause (Appendix 5, I-9).

By contrast MFIs and their local partners do not seek necessarly recognition and professional merit. They ask for support about how to compile the code, install a new feature/version, resolve software conflicts, run the build, etc. (Appendix 5, I-15). They directly and indirectly post (through partners) to 'be able to use' Mifos solution in their organisations and do not always intend to contribute to the source code (Appendix 5, I-5, I-4). MFIs behave as information seekers (Sowe et al. 2008) rather than experts who show off their experience and competences (Appendix 5, I-16).

I also expected differences between experienced open-source developers and non-open source developers. Both can report build and installation problems to developers' ML (Appendix 5, I-7; I-10; I-16); but wheras the experienced open-source developer would require just a hint from peers to sort out the problem by herself (Appendix 5, I-11), a non-experienced developer –who is not familiar with OSS tools and libraries- might struggle and need extensive help (Appendix 5, I-5; I-16). In this regard, I-16 in Appendix 5 showcases how poor language skills and inexperience have contributed to make Sergio –a local IT vendor- strongly reliant on the help of the community: subscribers' patience, labour and good dispositions.

Besides, there are also situations described in Appendix 5, where participants' organisational membership has dominated their interactions and influenced the quality of their posts (I-1, I-5, I-6 and I-7). For example, In I-7, GF-Tech developer Monsen announces that volunteer students will be mentored by GF-Tech administrators, and he posts links to wikis that walk them through the application process. This example establishes evidence that posts were used to enable explicit relations of subordination between GF-Tech and other developers in the community. In I-21, we see that posts were also used by GF-Tech administrators to resist the opinion of other developers, in the absence of a voting system.

[183] Reputation and recognition are understood here in terms of involvement; that is the labour and social skills that a volunteer puts in order to make herself visible and enact her membership to the community. Contributions to code are varied and cannot possibly be measured in equal terms. For example, a non experienced volunteer seeks alignment with those who are up in the hierarchy. This makes it known that she can produce the required labour necessary to transform a text into an accepted code commit (Ducheneaut 2005; Sack et al. 2006).

All these examples show posts that are strongly influenced by the identity, knowledge or organisational membership of their senders. Particularly I-7 and I-21 capture a situation where GF-Tech administrators have behaved as the decision makers, enacting top-down governance. In contrast, there are other examples in Appendix 5, which show a more symbiotic community that is not so much, gatekeeped by GF-Tech (Appendix 5, I-1; I-6). For example, in an exchange of posts between volunteers in I-1, GF-Tech administrators and contractors show how accountable they are to the community. In I-6, Emily, GF-Tech administrator mediated communication between GF-Tech contractors and participant MFIs; she contributed to the translation of their requirements into terms of reference.

Despite their contradictions, these examples are instances where posts were merely a mean for participants to showoff, perform organisational membership, and occupy predefined roles. These examples contribute to supporting the view that socialisation in this network (MLs) is determined by actors' background knowledge and organisational membership (Emirbayer and Goodwin 1994), whereas the network (Mifos MLs) remains outside and is merely the backstage of social action. However, this is not necessarily true; Socialisation in the MLs is a product of posts' exchanging, where embedded tools create a contingent assemblage that defines future interactions (Garfinkel 2005). How subscribers communicate and challenge other subscribers is a product of the conversation that is also shaped by MLs' capabilities to organise information. Not only do MLs enable socialisation, but more importantly they organise it, fostering collaboration and enabling knowledge coproduction (Pickering 1995).

7.4. Socialisation and Materiality: Collaboration and Building Local Knowledge

Going one step further, **this section makes the point that Mifos MLs are not one technology, but an apparatus of embedded technologies, where subscribers and the content of their posts are defined and redefined once participants interact and post-exchange**. Previously, I included illustrations where socialisation is shaped by participants' profiles. Here, I use these same illustrations and others to show how their content is co-constructed and is a product of a material mediation between different tools and participants in the interaction.

For example, I mentioned in the prior section that non-administrators were able to challenge GF-Tech contractors, making them accountable, through questions and different didactic posting strategies. Questions also allowed new volunteers to step in and get familiar with the project. As they increasingly contributed to the project, they slowly became themselves information brokers (Appendix 5, I-16; I-17; I-8)[184]. Questions were a significant didactic tool in participants' communicative strategies.

[184] Three years after the Mifos launch, Udai Gupta was involved as a GSoC candidate. He gradually came to assume an important role in code development, as he was responsible for many commits, bug fixes, feature enhancements, as well as being strogly present in the MLs (Appendix 5, I-16).

They gradually contributed to ‘breaking the ice’ between knowledge groups, getting members’ help, and more generally sharing information[185]. Similarly, threads of question-answer leveraged discussions and collaboration. Their effect was amplified because they were sent to all (broadcasting capability of the ML). Together, questions and MLs combined to amplify the outreach of practices, and solutions, enhancing their visibility and the probability of more participation.

From this point of view, questions, posts, and MLs are not exclusive technologies. Together they operate as an imbricate and embedded material assemblage for Mifos continuous production and use. Yet, each one of these tools is in a different position across the spectrum of social interaction: MLs represent the social milieu that hosts subscribers’ interactions (macro), while questions are communicative strategies that are used once members are engaged in discussions (micro). In motion, this assemblage progressively enables collaboration, information sharing and learning, which are a de-facto condition for participation. In the remainder of this section, I list three properties of the MLs and explain how they enable the Mifos assembalge to go beyond socialisation, in order to organise collective action, by fostering collaboration (sections 7.4.1;7.4.2), and enabling knowledge building (sections 7.4.2; 7.4.3).

7.4.1. Synchronicity and Collaboration

A major property of Mifos mailing lists consists of being a medium for instantaneous information diffusion. In this regard, it was argued that MLs are a good place to trace the quality of work being done on code objects, given the strong relationship between code hunk counts (CVS, etc) and email counts (Bird et al. 2008). It is not uncommon in Mifos MLs to see posts holding instructions and task allocations, or describing processes that require immediate interventions, answers, etc. (Appendix 5, I-2; I-3; I-6). By subscribing to the mailing lists, subscribers ensure that they receive announcements, questions and help in a relatively real-time fashion (Appendix 5, I-7; I-10). Once they reply, they contribute to message threads, which represent a virtual equivalent of coherent, face-to-face conversations, thus enabling the resolution of problems and task advancement (Ibrahim et al. 2010).

The role of the MLs as a platform for collaboration is embodied by the mailing lists’ etiquette. Mifos website argues that MLs keep participants informed in real time. Hence, members are asked to ***"search first if there is already a thread on the topic to reply to...then it is fine to start a new thread if the existing one is very old...but consider including a link to the existing thread in your new post"*** (Mifos.org, Last accessed 19/02/2010). Also, it is mentioned that members are required to ***"...quote only the relevant portion of the email to which they are replying..., and then post their response below the quoted text ..."*** (Ibid). Some of the messages also confirm that this etiquette was applied. One particular illustration shows that a poster was able to re-

[185] Questions were all the time used (I-1; I-3; I-6; I-10; I-11; I-12; I-16; I-19; etc). They helped to earn sympathy showing participants’ willingness to accept challenges, and new insights (I-15).

animate a thread and engage subscribers in a productive discussion, months after it started (Appendix 5, I-11). In this example, the object of the discussion was still a matter of concern for the original poster, and referring back to the old thread allowed the continuity of the debate, the progress of an associated task process and the working out of a potential solution to the original problem.

I-3; I-19; I-6 and I-23 in Appendix 5 show how the synchronous use of the MLs enables task advancement, knowledge building and code production. Particularly, in I-3, I-23 and I-6 we see how the functional ML served to collect MFIs' work practices, organise work on specifying requirement, and functionalities production. Here one GF-Tech administrator triggered a discussion; then some MFIs' IT representatives (employees and local partners), as well as some volunteers, and GF-Tech contractors engaged in building a collective understanding of the MFI requirements –the example shows an instance of collaboration through cohesive and continuous question-answer post exchanges. I-6 in Appendix 5 also documents the negotiation process necessary to collaboration. Here I observed how participants' divergent opinions "condense and solidify into software requirements" (Scacchi 2004, p.61). Similarly, I-1 in Appendix 5 illustrates how designers collectively commit code by challenging and at the same time, solving each others' errors, bugs and code-related decisions.

In I-1, some code objects have created a controversy (Latour 2004; Marres 2004; 2005); then GF-Tech administrators and their contractors explained their decisions. As posts with more questions continued, it was decided that a virtual meeting should take place. Later, the results of the meeting were posted in the MLs. This illustration is about MLs interoperability with other communication channels (video-conferencing). This makes MLs inclusive, enlarging the outreach of their discussion to related events and parallel social dynamics.

In the previous section I argued that MLs are important because they mediate between Mifos various knowledge profiles. However, such mediation is not natural; it is coconstructed by the medium itself. I-1, I-11 and I-12 show how posts between participants were synchronised. They obeyed a sort of tempo, where initial questions were asked in bulk. Then, replies were automatically broken down into separate sections (Appendix 5, I-1; I-7; I-11). Respondents provided detailed explanations, citing known developers and referencing their practices. By doing so, they enabled a 'modular' response process. Discussions about particular points deepened, while others were neglected, showing what subscribers considered important (Appendix 5, I-1; I-5).

I-11 and I-12 in Appendix 5 also provide evidence of **how** volunteers' questions and clarification created a disruptive dynamic across code contributors. They caused a commotion in GF-Tech's established ways of thinking and process building, and so gave way to a more gradual and consensual process of knowledge building (Appendix 5, I-11; I-12). As one of GF-Tech senior developers put it in I-12, Mifos is about doing 'the right thing'. For this reason, rounds of question-answer fostered dialogue, making decision-makers and code reviewers' account for what they did and how they did it. As decision- makers wrote their answers, by the same token they were forced to listen to what others had posted.

Contrary to a face-to-face conversation, a post allows its writer to express her views uninterruptedly. It provides space to argue and ask questions, but also to use knowledge to compile evidence and document the possibility of alternatives (Appendix 5, I-11; I-12). Therefore, thread-discussions are autoreflexive, giving actors' time to ponder their ideas and choices. They also allow ideas to mature and crystallise through several question-answer iterations until consensus is reached and if not, until sufficient information is provided to 'align' those who are involved. From this perspective participation is not merely about achieving a goal (code commits), it is about negotiating a meaning and continuously testing code and its objects design decisions.

7.4.2. Interconnectivity, Collaboration and Knowledge Building

As mentioned previously, the MLs were the first material embodiment in the Mifos platform that integrated all group profiles in the dynamic of post exchanges and broadcasted data processes to all subscribers (Appendix 5, I-1; I-11; I12). For this reason, interconnectivity between the MLs and other data artefacts in Mifos platform was crucial (Appendix 5, I-26). For example, I-1 and I-13 in Appendix 5 show how some posts connected, on the one hand, questions, events and tasks in Mifos IRC channel, developers' wikis, etc. and on the other, the MLs. Thus they created bridges between these separate online spaces. In I-13 in Appendix 5, Jeff, a GF-Tech developer, replied to a question that was asked in the developers' wiki (not the ML). By so doing, he increased its visibility, thus encouraging its discussion in the MLs. Many posts also show that links were constantly changed and updated (Appendix 5, I-18; I-1; I-13).

Interconnectivity is therefore about establishing and maintaining a continuous and visible link between the MLs and the multiple online settings of Mifos social production. But, interconnectivity is also about creating and maintaining bridges inside MLs. This way, it is possible to create interdependencies between production and use processes, foster collaboration, and knowledge building overall. This indeed corroborated by Figure 17 in Analysis Chapter I. It shows an important overlap between the three MLs; over 25% of the developers' list subscribers have posted to the users' lists simultaneously.

A ML constitutes a space of exchange for a specific group of users (Sack 2000; Butler et al. 2001; Himelboim 2008; Smith & Wesley 2004; Hansen 2007; Himelboim et al. 2009; Welser et al. 2009). MLs' administration typically requires developing and maintaining components that are unique to the needs of a particular user group, such as an up-to-date content archive, ancillary files, group descriptions and lists of FAQs (Butler et al. 2001b). Hence most OSS projects have separate, but interconnected MLs, like users' and developers' MLs (Von Krogh et al. 2003; Sowe et al. 2008).

This is also the case in Mifos[186]. Users' ML was meant to provide a direct help line to MFIs employees and local Mifos specialists. In this list, one can see users' demands for help, and questions as they run Mifos build, and stumble across errors (Appendix 5, I-4; I-5; I-15; I-16). This list also contains questions about Mifos re-use, when users try to localise Mifos, by modifying the source code and adding new features/options (Appendix 5, I-15 and I-16 in particular).

However, a ML does not exclude users from participating based on their knowledge groups. For example, a member who has registered in the Users ML is encouraged to post to the developers' list whenever his questions touch on design issues or can be better answered by a peer developer. The reason to have for example MFIs registered in a ML called Users ML is only to make discussions beneficial to a maximum number of subscribers who have similar experiences and issues (homophily).

On the one hand, a user-orientated ML fosters collaboration, reducing the level of peripheral noise (Appendix 5, I-26). This is important for example, when you have a group of developers collaborating on some task advancement. They are less spammed by posts and threads that are peripheral to their activity or which they do not find interesting (Welser et al. 2007; Smith & Kollock1999; Sack 2000; Himelboim et al. 2009). On the other hand, interconnectivity and the brokering of information between lists reinforce members' exposure to –and learning- from different practices/domains of knowledge that are generally kept separate.

Thus, if users post to the users' ML, this does not mean that their posts do not mix with those of software developers. In the Mifos case, the MLs' administrators have enforced interconnectivity between lists, by redirecting posts to the lists they thought appropriate, so as to reduce spam, enhance their visibility, and increase senders' chances for a reply (Appendix 5, I-15; I-18). By so doing they also improved their searchability. For example, some of MFIs' IT staff have learned by eavesdropping on conversational threads that debate the use of design tools, libraries, or the rationale behind Mifos code architecture –which means that they also searched these posts (Appendix 5, I-18).

7.4.3. Asynchronicity and Building Local Libraries

Finally, MLs are a local knowledge base for the project's history (Jensen, King, and Kuechler 2011). Over the five years of observation, Mifos MLs gradually start to form a reusable public collection of posts; a kind of archive that contain past designs and use experiences. As they point to other data repositories, through links and attachments,

[186] As I described in the Analysis Chapter one, Mifos has several MLs, which were created at different times and serve different purposes. For example, the commits' ML broadcasts code commits in real time. There is also an automated ML for bugs, etc. This study examined only three: the functional, user and developers' MLs, which arguably cater to the needs of these specific user types. There is also an overlap between the users and functional MLs. The former was meant, as I explained before, to collect MFIs' requirements, but ended up replaced by the Users ML in 2008 (see Chapter IV).

they also keep a record of the culture of the whole platform. In this regard, my own work is a testimony to the archival potential of Mifos lists, as the majority of data I collected comes from, or is guided by their content.

For example, I-2 in Appendix 5 describes how Dailey reframed the post of a local Mifos specialist, transforming it into a sort of localisation protocol. This helped the participants go beyond the specificities of the user's case and contribute to a standard template (Appendix 5, I-2; I-7; I-10). I-3 in Appendix 5 is also one example of the many occasions where Tucker translated MFIs practices into requirements. Tucker progressively created a template for feature documentation that can be copied, filled in and re-uploaded by anyone in the MLs.

These illustrations are not merely instances of socialisation, as I claimed earlier. More importantly, they illustrate how participants used the MLs' capabilities to introduce various information protocols and templates, which have organised information and fostered its dissemination over time. By doing so, they went beyond mere chatter, creating a structure that reinforces data conservation and MLs' archival potential (Appendix 5, I-4; I-15). This I argue later was also fundamental in developing local knowledge, as well as fostering information sharing and learning.

Archives are about remembrance. They do not store only positive aspects of actors' socialisation. I-14 in Appendix 5 is about an unfulfilled promise and its repercussion on a volunteer's motivation and participation. In this case, it also shows that administering the MLs requires labour and commitment. When administrators fail, the digital imprint of their action remains as a token of mismanagement and inefficiency.

Finally, the archival role of Mifos MLs becomes crucial when considering the 'silent subscribers' (Nonnecke & Preece 2000). Conversations can be continuously overheard (Hansen 2007). Those who are not among the immediate discussants can still benefit from the posts. Indeed it does not cost more to have 1000 subscribers listening to peer-support than 100 who are really participating (Nonnecke & Preece 2000). From this perspective, the MLs are a living memory of the community, where the community learns from listening to its participants, and each participant learns from eavesdropping the community (Sowe, Stamelos, and Angelis 2008).

Although, the use of archival MLs was not observed in situ, there is evidence in the messages' content that Mifos MLs were searched, especially when people looked for a particular type of information (Appendix 5, I-11; I-26). Indeed, some posters mentioned that they searched the MLs before posting their questions, in order to show that they knew the newsgroup etiquette and so could attract helpful replies. The same thing can be said about the silent listeners; they did not leave digital footprints per se. However, some of the illustrations in Appendix 5 show the example of MFI MIS administrators, whose posts became gradually more elaborate and informative –despite the low frequency of their posts (Appendix 5, I-23).

7.5. Knowledge Co-Production

In the previous section, I showed how the materiality of the MLs went beyond socialisation, enabling a real dynamic of collaboration, libraries building and the development of an integrated knowledge platform over time. From this perspective, it is not enough to say that MLs are a medium for social interaction. The quality of participation is incrementally built by the working of embedded technologies that facilitae collaboration and the coproduction of local knowledge over time. The previous examples indexed in section 7.3 have therefore stressed only one aspect of post-exchanges creating a blindspot. They showed how socialisation is shaped by senders' profiles, and by the same token have obscured the contingent and negotiated nature of post conversations, which sometimes were so multiple that a same person would occupy different roles in the same conversation (I-6 in Appendix 5).

Indeed, there is more to post exchanges than what is defined by subscribers' initial roles or profiles. As a consequence, section 7.4 pointed out the working of several technologies embedded in MLs post exchanges that together contribute to changing participants' interactions and influence overall, the communication process. In this section, I provide more evidence, where participants' behaviour does not conform to pre-defined profiles; I show that post-exchanges are generative assemblages that do not necessarily uphold the values that participants embody initially. Instead, perceptions and opinions form and develop, as threads of messages are gradually woven and their content made sense of and integrated in the flow of conversations. This way, the whole assemblage (thread, post and content) creates a unique instance, where the outcome of the interaction is yet to be defined and re-defined over time.

I-22 in Appendix 5 shows for example, how Nazir (MFI local IT partner) invested in post-exchanging beyond his contractual obligations. In another setting, project director at GF-Tech, Conard, 'puts on the user hat' to diagnose a design deficiency that was reported by a participant from an MFI (Appendix 5, I-5). As I reviewed the thread in I-5, I thought that such a situation was surprising. Had GF-Tech developers been the only Mifos designers, there would have been little chance to have one of them trying to make Mifos code more user-defined; let alone see one of GF-Tech contractors suggesting a fix for a volunteer user (Appendix 5, I-5).

Many post-exchanges just emerged out of the Mifos MLs, making it possible for discussions to take unexpected turns or sometimes evolve into more productive knowledge building activities. In fact, there are many other examples where subscribers have crossed the lines that separate them from their peers: clients, contractors, and the simple, inexperienced and volunteer code users. As they did so, they nurtured an overlapping membership that superseded their organisational affiliations, making emergent relations possible. This also brought improvements, gradually affecting code performance and its sustainability.

7.5.1. Against a Dichotomist View of Participation

There cannot be a clear cut distinction between the qualities of posts' content based on profile groups; the way community members participate, share information and learn is undoubtedly influenced by subscribers, their background knowledge and motives (Shah 2006; Fang and Neufeld 2009); but post exchanges are intrinsically grounded in the act of socialising which they are the outcome. In this sense, socialisation does not qualify the act of post-exchanging, as it is in itself a structuring act. It is more than mere talk; it enables collaboration, learning and the building of knowledge.

Whether developers, Mifos experts or MFIs' IS administrators, all subscribers had a similar understanding of the purpose of the MLs. As mentioned earlier, most of them participated in post-exchanges, in order to post their questions and get answers (Appendix 5, I-1; I-5; I-12; I-14; I-15; I-16; I-17; I-21). MLs were a space where members could expose their problems, reveal their doubts, and hope to get feedback – regardless of their background or who they represent. Whether experienced developers or not, the majority of posters were **information seekers**[187]. They required information so as to enable a form of inquisitive tinkering (Coleman 2008, citing Levy 1984), which leads over time to the solving of more errors and the improving of code design. Because, participating in open code development is a time investment (Shah 2006), even the most experienced developer needs help from peers to be efficient (Scacchi 2007). Particularly, I-17 in Appendix 5 shows how despite a strong experience and commitment to the Mifos project, GF-Tech's partner Microbizone (in the Philippines) used the MLs mainly to get familiar with the project, asking for help with installation issues etc. In I-17, Neil, the company's contact person recieved several answers, tips, and suggestions, which recursively affected his code commits.

Based on that, I argue that members' actions are interdependent[188]; through their local knowledge, subscribers transmit information that enable the whole collective to contribute effectively (Hakken 1999; Hine 2000); or to put it differently, I-17; I-26 and other illustrations of the sort confirm that interactional expertise is essential for contributory expertise (Collins and Evans 2002) –see Theory Chapter. Going a step further, Lave and Wenger (1991) have suggested that learning involves the construction of identities and is itself an evolving form of membership (Sack et al. 2006). Whether the subscriber is an experienced developer or not, she must first learn how to ascertain her membership to the community; she must not only convince others of her expertise, but she must sustain it, constantly negotiating her position in the network (Ducheneaut 2005) –Appendix 5, I-14; I-26.

[187] I wrote at the beginning of the chapter that I expected differences between developers and MFIs, because the latter are information seekers, whereas developers are experts. By generalising the status of 'inforation seeker' to all MLs' participamts, I thereby redefine the epistemic function of of post exchanges that is to enable participants to acquire information and knowledge.

[188] I must clarify here that interdependence must be understood in the sense of the product of actions or posts in a conversation, rather than that profile groups are interdepend.

I-26 in Appendix 5 shows for example how the leadership of a complementary module called Mifos Mobile was bestowed to a local Mifos specialist by a GF-Tech. However, the leader's posts elicited very few responses, so he could not perform his presumed leadership, let alone channel collective knowledge. Knowledge transfer and learning in the MLs are thus situated and inter-subjective acts of production, where participants interact in order to achieve sufficient understanding of the others' perspectives and negotiate collective agreement (Wenger & Snyder 2000) –Appendix 5, I-6; I-19.

When, two or more Mifos subscribers post and reply to a message thread, they create a particular social instance where perceptions and attitudes are worked out locally (Appendix 5, I-6). In other words, participants' perception and behaviour change on the basis of transient roles they perform over the duration of the interaction (Appendix 5, I-24). Participants are immersed in the process of socialising; they monitor (rather than control) the development of topics. They also react and adjust accordingly, in order to enable the necessary communication, collaboration, and/or information transfer (Appendix 5, I-6). Conversely, this performance shapes their role in the Mifos network, gradually affecting their background skills, motives and experience (Lave & Wenger 1991; Fang & Neufeld 2009).

In I-6 in Appendix 5, we see for example how discussing a feature requirement means that the involved participants first lay down their expectations, goals, etc. By so doing, they trigger loops of exchanges in order to negotiate some sort of common understanding that enables the progress of their discussion, the generation of specifications, and design. In this illustration, we clearly see how Emily's role in the discussion has continuously shifted, as her perceptions and performance changed according to senders, dates and posts' content.

It is unlikely that a participant remains just an information seeker all the time (Jensen and Scacchi 2005; Scacchi 2007). I-24 in Appendix 5 shows a subscriber who could not get a useful tip. This did not prevent him from replying in the same thread to another person who posted about a related issue. This example describes how the dynamic of post-exchanges does sometimes override the utility that one gets from posting. This does not apply only to answer persons (Himelboim et al. 2009; Welser et al. 2007); that is people who are dedicated to answering users' questions[189]. Even those who used the MLs –mainly to post their questions- were found many times to reply and share their experiences, as part of peer-support (Appendix 5, I-16; I-17; I-21; I-23).

In fact, peer-support is crucial to participation. It does not merely facilitate use, but it is crucial for the continuity of code redesign. Many subscribers, whether experienced or beginners, have shown that providing support, and sharing experiences is what MLs are about (Appendix 5, I-16; I-17; I-18; I-26, etc.). For me, the statement that stresses this point most is what Sergio wrote in that 'unexpected' post after he finally resolved nagging error messages (I-16):

[189] This role was played by GTC administrators, like Witney, Tucker, Monsen, etc.

> ***"…thank you for all of you that helped me with this, and took some of your time to guide me. i want to share all the process with others i don't know if in the wiki or for other media, what is your advice?... i really thank you.".***

7.5.2. MFIs' Participation and Code Development

Such a statement led me to think about the productive nature of peer-support. Clearly, knowledge sharing in collaborative environments results in more knowledge overall (Lazonder et al 2003). Even when participants only pinpointed bugs, absences, or dysfunctions –did not try to fix them- they still helped others understand better the nature of the problem and address it (Appendix 5, I-5; I-2; I-23; I-24). Thus, **information seeking is not about subscribers consuming knowledge (free-riding), in contrast to others who are 'altruist'; so they are happy to give it for free.** The act of sharing a question helps also shape its object, which comes to say that "knowledge is a synergetic process –you get more out than you put in" (Sowe et al. 2008).

Many examples in Appendix 5 show how bugs were identified because some users reported errors and started a discussion (Appendix 5, I-5; I-11; I-17; I-18; I-28). Also, I-6, I-3; I-12; I-1 and I-18 in Appendix 5 show that breaking down long errors into sequences of questions that can be answered separately is an effective communication strategy, which is quite knowledge productive; it resulted in more conflict resolution and task advancement in these cases. I-23 gives a nice example of that; Lassaad, who is an MFI employee, posted bits of code in answer to Sam's request. Sam is an experienced developer working for GF-Tech; he had emailed the list fishing for a query to interrogate the database (Appendix 5, I-23). After receiving Lassad's answer Sam replied saying he cannot use the code; he also explained that Lassaad's query might create potentially a mismatch with another code object. By doing so, Sam did not just discard Lassaad's post; he produced information, he contributed to the learning of a participant rather than just consumed a service (peer-support)[190].

Having skimmed through hundreds of posts, it is clear that practices of information sharing are recurrent. Many subscribers passed on bits of their knowledge and experience to others whether they were experienced or not (Appendix 5, I-24; I-27; I-28). They seeded the MLs with information, enhancing the degree of exposure for other members. A dichotomist understanding of participation is therefore nonsensical; all participants are in times, information seekers and in other times answer person. Particularly, MFIs (as users) are not free-riders[191]; their posts including requirement, installation problems, or error reports are vital to the continuity of design, insomuch that they are the basis of an incubatory system, sustaining code use (Iivari 2006) and reuse.

[190] Bergquist & Ljungberg (2001) have talked about peer support as giving away information in return for status and reputation. I am not sure that Sam was looking to build a reputation in this case, though. I believe that he wanted to warn Lassaad, in order to prevent a potential problem.

[191] In the sense that they consume freely the services of the collective good (Olson 1965; Melucci 1996)

In fact, users co-guarantee code development because they intermediate its localisation in related social domains of utility. By participating in post-exchanges and peer-support, they do not only impact on their own use experiences, but contribute to continuous redesign (Fang and Neufeld 2009; Kuk 2006; Sowe et al. 2008; Iivari 2009). In this case, being a global system, Mifos poses important feature gaps for potential users (Appendix 5, I-6; I-23; I-25; I-28). MFIs' lending processes and work practices tend to be often quite idiosyncratic, so that implementing Mifos solution will necessarily come at a cost –in terms of customisation- for most users (see Chapter 1). MFIs' input in the MLs is therefore geared towards functional enhancements and code changes, which feeds back code continuous redesign (Iivari 2009), and guarantees that code will at all have a future and new opportunities for use and reuse.

Hippel & Lakhani (2000), Scacchi (2002), Ye & Kishida (2003), Çetin et al. (2007) have also argued that users are important in code development. For decades, the emphasis on the users was central in Participatory Design (Iivari 2009). What section 7.5 shows more specifically is how OSS developers and users' post-exchanges is mutually knowledge productive; going back and forth between localisation experiences and existing code objects, they enable problem-solving and the building of incremental advances, which guarantee code objects survival and make them durable. To articulate this point further, I selected the following illustration.

I-19 in Appendix 5 shows a group of discussant trying to solve a problematic issue with Mifos web design. Among them, many were experienced developers in the community. As some suggested new theoretical propositions, others highlighted possible courses of action. Gradually the thread became large, started to trail off, and at the end it just stopped, bearing no straight fix (Appendix 5, I-19). When I read participants' posts, I could not see what else they could have done in this situation. Then, I noted that one discussant suggested collecting more use patterns, implying that there was not enough attention paid to the initial source of the problem. In addition the user himself, who reported the error, seemed to have vanished away from the thread.

In this case it was essential to collect data on use patterns in order to qualify the bug; otherwise, post-exchanges of this sort become of little help. This example subscribes in fact to the idea proposed by Boland and Collopy (2004), and Garud et al. (2008) who agree that the value of theorising lies in the options that are generated, rather than the uncertainties that are resolved; this comes to say that code (algorithm), let alone a bugged code, is just a representation; the very meaning it can achieve is to be re-negotiated in and through use (Mackenzie 2006, 64). So developers can only gradually 'discover' their design once they continue working on it, following use patterns[192].

In the realm of software design, everyone today knows that software boundaries are often unclear and user preferences are both heterogeneous and evolving (Garud et al.

[192] There is a commonality between this example and the Guimbal Turbine (Theory Chapter). Both exemplify the integration of conceptual design into the artefact's associated milieu (or the lack of it), how design transforms into an operating whole is what the biography is about —see Sections 2 and 3.

2008). In this sense, to perform complex design and to continually modify it in the course of users' implementations and reported bugs has much in common with painting with oil; i.e. every new spot of pigment laid on the canvas creates some kind of pattern that provides new ideas to the painter (Simon 1996, 163). These develop through cycles of iteration, where "current goals lead to the new application of paint, while the gradually changing patterns suggest new goals" (Ibid).

Simon's metaphor about design and oil painting illustrates in a poetic fashion the emergent and creative nature of design. I think though that he wrongly represents this activity as a solitary interaction between the artist/designer and its canvas/tools – obscuring the collective and negotiable reality of designing software (let alone distributed open software). So if I am to account for these elements in how open source software is produced, I am left instead, with a crude, and pragmatic view of software code design where designers' "dream of perfection is being replaced by distributed-problem solving and team-based multidisciplinary practices" (Mau and Leonard 2004, 11).

Back in the 1950s, Gilbert Simondon reached the same conclusion –although in the context of what we see today as a primitive form of technology (the Guimbal Turbine). He stated that conceptual design is the materialisation of principles in action (Simondon 2007). Once a technology is embedded in its social milieu, the circumstances of its use shape how it should behave (Ibid). Half a century after and in the dazzling world of the digital, Simondon's ideas are still valid. Hybrid networks of users, software vendors and developers across OSS communities are today learning how to use and design software code as a process of continuous redesign, rather than as a finite product (Garud et al. 2008; Haefliger et al. 2008; Gasser et al. 2003; Fang & Neufeld 2009; Nyman et al. 2011; Mockus et al. 2000; Scacchi 2002).

7.6. Continuous Redesign and Sustained Participation

To conclude, I would like to emphasise the notion of continuous redesign as a key element of code development. Continuous redesign is about keeping a social dynamic of question-answers iterations, problem-solving tasks, as well as incremental and negotiated knowledge building processes around code and its objects. Its objective goes beyond bug repair and code objects' maintenance[193] (Gasser et al. 2003). **Continuous redesign aims at slowly improving software interlinked code objects, which are necessarily underspecified** (Mackenzie 2006). Therefore, a software version release is essentially incomplete; its repertoire of algorithms and connectable code objects gradually build its meaning through association with possible domains of utility and use (Ibid). In this sense a code is no more than a beta release of its potential, which is yet to be (Garud et al. 2008) –see Theory Chapter.

[193] Testing, debugging and providing bug fixing after product release are known to generate the highest cost in software production (Bessen 2006).

Accordingly, continuous redesign is about ensuring the continuity of distributed and collective software specifications, code commits and problem-solving practices through community participation (Gasser et al. 2003; Scacchi 2002b). The MLs enable developers to keep an eye on on-going debates and hot topics and monitor their structuring into sub-lists, adapting to the changing conditions of work processes and new reports of use patterns (O'Mahony 2006). They co-construct "new ways of learning about, representing, and defining systems that challenge current models of representation and design" (Gasser et al. 2003; Garud et al. 2008).

In contrast to cross-sectional and quantitative research on OSS –which typically does not engage with the content of community members' interactions- studying the content of post-exchanges has allowed me to unearth some of the inherent mechanisms of information sharing and learning. These are positively associated with constantly renewed participation, and so are more important than the initial motives that draw OSS volunteers to participate (Fang and Neufeld 2009).

I explained how these mechanisms emerged once Mifos community members engaged in collective practices to negotiate emerging requirements and specifications, as well as organise new design tasks and peer support. Therefore, the ML social arrangement –including the posting practices- does not only strengthen the identity and sustainability of members' participation (Fang and Neufeld 2009); but it also organises the setting of an encounter between users' experiences and code design, making users' patterns more sustainably integrated in software features and in the long term development of code objects.

In this regard, I-18 in Appendix 5 also reveals some of the practices and tools that MFIs used to enable the embedding of use patterns into the main system of code production. These were also interconnected to the MLs in order to stimulate debate and leverage bug fixing and troubleshooting. Such a combination provided users the opportunity to inscribe their local contexts into the design. It created a relatively inclusive system where users were part of problem-solving practices. By doing so, users have fostered their learning opportunities and their gradual appropriation of code objects, making the boundaries of code's technical and social architectures co-evolve with one another (Neff and Stark 2002) sustainably.

7.6.1. Software Sustainability

As I read, I spot sometimes the word 'sustainability' noticing how it was thrown in, seemingly taken for granted. Indeed sustainability is seldom presented as a requisite of code quality and is barely discussed at all; however this comes as no surprise. Sustainability is about rejecting software consumerism in the first place –instilling in software consumers the desire to own something "a little newer, a little better, a little sooner, than is necessary" in order to create market (Nyman et al. 2011). Particularly, sustainability sounds at odds with the whole digital world, where the rapid pace of an innovation and its novelty seem to be the only determinants of how good it really is.

Here I would like to note that sustainability can be seen two ways, from a user perspective and from a code perspective. In the first case, it is important to situate the Mifos project in the context of MFIs. Often, MFIs are gifted software packages by partners and donors –to ensure transparency (see Appendix 1). Those who are well-off and dispose of their own capital to invest in technology might even prefer to buy ERP packages that are designed for the banking sector in general, which some believe are more effective and secure. At the same time, most MFIs lack IT competences and struggle to build organisational capacity. Thus, their use of software remains hindered by administrative and management hurdles[194].

In this case, sustainability is about MFIs and their local partners having a choice to continue code development and ensure a gradual, nonetheless empowering appropriation[195] of its objects over time (Iivari 2006) –see also (Byrne & Sahay 2007; Lewis & Madon 2004; Braa et al. 2004). I also argue that sustainability is in this case implicit in the way MFIs and their partners invest to make Mifos code slowly better, slowly richer, and slowly stronger. By participating in Mifos community notably through post-exchanges, they take part in its current localisation; but more importantly they learn how to negotiate a place for their social practices and reality in Mifos future 'becoming'; they so align themselves temporally to current features and key members, while working towards channelling their own 'knowledge' once they acquire a better position in the community (Ducheneaut 2005).

Second, from the code perspective, sustainability is about ensuring that open code has a future, slowly melting in the fabric of social domains in order to become invisible or an infrastructure (O'Reilly 2005). Such a view is based on the fact that code is inherently incomplete and that it is gradually perfected through continuous redesign as it is tested and contested across domains of use and over time. In this regard, the study of Mifos is an extreme case, where the objective of empowering the users (MFIs) supersedes the fact that code objects develop through use and sustained participation to its continuous redesign and reuse.

Indeed, sustainability is more easily addressed in OSS projects, where users are the developers of their code (Mockus et al. 2000; Neff & Stark 2002; Garud et al. 2008; Nyman et al. 2011; Von Hippel & Von Krogh 2003). In the case of the Linux project for example, Garud et al. (2008) have identified a set of technologies that made the continuity of engagement among contributors possible. For instance, they report how the Linux community experienced a large growth in 1992 when the Yggdrasil distribution made it possible for users to install Linux from CD-ROMs (Diedrich 2001, quoted in Garud et al. 2008). They also pinpoint Torvalds' decision to redesign the Linux kernel in one unique code base, which made it possible for contributors to

[194] See Chapter 4: Overview of the Case Study.

[195] Software appropriation is not only about learning personally how to code or ensure system's maintenance. It is also about building social capital –that is socialising and building connections with the extended network of Mifos specialists, and volunteers, which should to a certain extent, enable MFIs to take advantage from competition at the support service level and improve their bargaining power.

continue their work in various hardware environments. Also, they note that when Linux was released under GPL licence, it forced code re-users to make their own contributions available to everyone else (Ibid). Garud et al. (2008) have also highlighted how the Linux MLs encouraged access to data repositories, documentation and wikis, pushing participants for more inquisitive tinkering with code and its objects.

This chapter's findings align with their argument, and confirm that although the question of sustainable design converges with the issue of sustainable use in the context of IT4D, it is not limited to it. Linux has gradually climbed more and more echelons of innovative design –making it mature software. This was progressively achieved, as the social dynamic around its code objects intensified and continued with renewed and stronger design features and utilities, thus increasing its share of adopters in the Operating System market (Ibid). Similarly, Mifos has matured substantially over the past few years, exhibiting improved design features, quality, and a larger network of supporters (Analysis Chapter II). MFIs' participation in its design has also become progressively stronger. They have built on top of the Mifos open platform, regional networks and innovative portfolios of services, which have leveraged its value globally.

In this chapter I thus focused on the MLs, to the extent that I describe the role of post-exchanges in organising collaboration, the mechanisms of information transfer, learning and how the MLs have remained interconnected with other data repositories, documents, and wikis. I also argue that the social dynamic that resulted from the use of these embedded technologies contributed to the development of code objects. I do not necessarily have the data, or the appropriate approach to study and measure the contributions of other design decisions and technologies on Mifos continuous redesign and development in the way of the abovementioned Linux paper. However my analysis of the content of the posts (Appendix 5) revealed several related matters. Finally, I would like to open a parenthesis on modularity, which is also related to sustained participation and continuous redesign. Although this concept is not associated with the MLs per se, it was reflected through the content of some post-exchanges and notably I-25 in appendix 5.

7.6.2. Modularity and Re-use

Modularity is very much related to continuous redesign. Modularity mainly complies with the need for code to expand into loosely coupled connectable modules (Fitzgerald 2005). Moon and Sproul (2002) argue that a modular system can minimise the need for communication among different components of the kernel and makes it possible to write code simultaneously on different portions of the code programme. To illustrate this, I-25 in Appendix 5 shows Soham's long post where he shares his concern about the lack of modularity in Mifos 1.1. He also highlights what it entails to build a modular architecture from both developers and users' perspectives. He writes:

> *"… if MFIs could pick and choose which feature they would like to have given the hardware costs... if there was a modular (like plugin) concept, MFIs could pick and choose features they want installed....*"

He thus confirms Moon and Sproul's idea (2002) that having separate functions or modules reduces overlap between features and can make the code commit process more effective overall, as there is less queuing for the review process (Appendix 5, I-25).

In fact, Mifos code objects are gradually produced, maintained and changed through accumulation of parts that are generated by a distributed community. As this grows, it becomes necessary to have interoperable and integratable compendiums of modules or functions that users can run simultaneously on the same tree, or separately. One obvious reason for that is that such a code structure may prevent the additional cost of investing in new hardware, as some MFIs or other users can decide to limit their selection of the modules that they want to install, use or modify. This way, all code users, whether MFIs, volunteers or local IT vendors must be able to a certain degree to build their contributions locally and separately without endangering the whole source and making the source code "lighter to travel" (Pollock et al. 2007). Also, they can benefit from the re-use of modules and generic software components in the production of new code, processes and products, which is an important mitigating factor for the cost of innovation (Haefliger et al. 2008).

From this perspective, modularity is an important aspect of code long-term development (O'Reilly 2005; Fitzgerald 2005). Both I-25 and I-12 show that Mifos administrators have come to understand the importance of modular design in ensuring the continuity of Mifos. Emily's post in I-25 shows that she believes that modular design reinforces participation beyond the opportunities of open governance (see Analysis Chapter II and Appendix 5, I-25). In fact, her post illustrates the idea that building space in Mifos code architecture for more code users' to inscribe[196] their choices, preferences and opinions is more important for the sustainability of community participation, than for instance community voting, or discussing modularity in the MLs (Appendix 5, I-25). Modularity is here translated as an important non-human delegate, or an obligatory passage point (Latour 1992), which is functionally indispensable to the network –in the sense that it holds code objects together, while individual agents continue to pursue their individual goals separately. Finally the concept of modularity gives software designers a way to rethink code objects as the interlinked pieces of a whole that slowly materialises once they are used and reused. As to understand whether this feature may be more important than the dynamic of social exchanges, one needs to go beyond the basic idea that modularity is about designing separate modules that can be run together or separately[197] –which is beyond my scope here.

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[196] Use means reuse here –that is users creating innovative features on top of the source once they modify. (Haefliger et al. 2008; Gasser et al. 2003).

[197] Fitzgerald (2005) argues while citing Narduzzo and Rossi's (2003) paper that there are challenges in designing a highly modular architecture of autonomous modules with minimal interdependencies.

7.7. Conclusion

This chapter is the final component of a three-stage methodological scaffolding that aimed to construct a biography of Mifos. As I mentioned previously, constructing a biography of open source software is not merely about lining up important events in the life history of the project. Instead, my approach seeks to exploit different, yet complementary analytical cuts to study the social process of distributed software production over time, including the embedded tools and material assemblages, which have contributed to it.

From this perspective, this chapter has provided a new insight into community participation and community-based software production, to the extent that it complemented the two other scope-driven approaches in Analysis Chapters One and chapter Two –the static analysis of sociograms and the dynamic analysis of time waves- with an explanatory lens, which revealed in-depth dynamics of knowledge coproduction and collaboration in auxiliary communication channels of open software production (the MLs).

This investigation has resulted in the articulation of a contrast between the idea of knowledge sharing and building and community participation –which is legitimised by the inherent agenda of the Mifos project and the vision of its founders- and the constructed, and gradually emergent concept of sustained participation –which is grounded in the MLs' mechanisms of problem solving and knowledge building.

The first idea is commonly employed in the social network scholarship and the social sciences, and is referred to as "embeddedenss" (Barnes 1954; Granovetter 1985; Emirbayer and Goodwin 1994; Jones 1999; Diani 2003). It describes how social membership is an outcome of collective identity (Diani 2003) which is materialised by individuals' decisions to unite with others in order to achieve social goals –notably the production of open source software (Von Krogh, Spaeth, and Lakhani 2003; Bessen 2006; Spaeth et al. 2008). In the Mifos case it is also embodied by the assumption that the network that is Mifos MLs, as well as its other interconnected and related networks –the GF-Tech organisation, or the Mifos initiative overall- represent an ensemble of placeholders holding the same interest in social change (Knoke and Wisely 1990), thus enacting the vision of open source MIS for microfinance grassroots.

From this perspective Mifos subscribers' post-exchanges are influenced by their knowledge profiles (background, organisational membership, roles in the project, etc.), which should systematically influence the social processes through which they collaborate and learn. This chapter demonstrated though that there is more to socialisation in the MLs than encapsulated in subscribers' identities, to the extent that post-exchanges are socio-technical assemblages, where subscribers and the content of their posts are defined and redefined once participants interact. Indeed, post-exchanges are a material configuration of embedded tools and communication artefacts that not only facilitate participants' interactions but hold the potential to organise them (Pickering 1992; 1999; 2011).

Accordingly, this chapter has described the MLs' online spaces as an apparatus of embedded technologies, which have intermediated between the knowledge profiles and structured the space of exchanges, providing subscribers the opportunity to cite, reference and demonstrate expertise and debate and pounder design processes and peers' views (Smith 1999; Bergquist & Ljungberg 2001; Lanzara 2005; Pattison et al. 2008; Welser et al. 2009).

By so doing, this chapter emphasised collaboration and knowledge sharing in Mifos production and described them as situated and inter-subjective acts of social production (Pattison et al. 2008; Détienne et al. 2005; Edwards 2001; Kuk 2006; Sack et al. 2006; Sowe et al. 2008). It explained that post-exchanging is crucial in order to acquire sufficient understanding of peers' perspectives, discuss and collaborate. Yet, negotiating collective meaning is also a transient instance, whose outcome is emergent. Sometimes the dynamic of exchanges overrode the utility of single posts, making people exchange more than expected (Lave and Wenger 2000). Besides, the productive nature of knowledge makes the sharing of experiences and the reporting of errors contribute to the building of more knowledge overall (Lazonder et al 2003).

Building on these conclusions, this chapter argues that the mechanisms underlying knowledge construction in the MLs constitute progressive incentives for sustained participation that are as important as the motives and incentives that push volunteers and other members to join OSS communities in the first place (Fang and Neufeld 2009). Sustained participation is also crucial to continuous redesign in the sense that it enables the gradual crystallisation of design features, which are inherently underspecified (Gasser et al. 2003). Accordingly, sustained participation is about keeping continuous iterations of question-answers posts, problem-solving tasks, as well as incremental and negotiated knowledge building processes. These can be positively disruptive, as they create change enabling the gradual grounding of code constructs into social practices (Pattison et al. 2008).

The sustained participation of MFIs and their local intermediaries enables a double mangle between use and design, making users' error reports, feedbacks, and other non-code contributions interdependent and necessary to developers' code commits. This also integrates users' patterns in the gradual enhancements of code features, thus supporting continuous redesign and the sustainability of open source software overall (Gasser et al. 2003; Braa, Monteiro, and Sahay 2004; Fang and Neufeld 2009; Nyman et al. 2011). Finally, this chapter concludes that the questions of sustained participation, sustainable design –which brings in the concept of modularity- and sustainable software use –users' appropriation and learning- are convergent, and they are of utmost significance given the IT4D agenda of this research.

8. Discussion: Cross-Analysis Discussion

8.1. Introduction

Typically, OSS projects feature multi-group ecosystems fostering distributed development (Grinter et al. 1999; Herbsleb et al. 2000). To facilitate collaboration, they make profuse use of web 2.0 technologies, data repositories, MLs and portals, like Java, SourceForge, etc. These material layers of technology are necessary to software production; at the same time, their potential for traceability adds significantly to the scope and visibility of software studies. Not only do they offer a great opportunity for researchers to sneak a peek into the organising of software production, and the social dynamics of community interactions; but they also offer a global and evolving setting, which brings together users and developers into the same social production space, where they develop relations over time.

When I started this study, I saw that the Mifos project offered an ideal case study, in terms of the size of its platform, the interconnectedness of its data repositories and production websites and their openness. The time scope of this project –it had been running for three years already at the time I started writing this thesis- and its numerous and globally distributed sites of production and implementation spoke of maturity and offered a strong case of open source software long-term development in the context of IT4D and in the microfinance industry in particular.

The Mifos case provided me with the opportunity to research the becoming of software, to the extent that Mifos was undergoing constant cycles of transformations, including its design, community, goals, etc. which showed that there is much happenings in its journey, in the organising of processes and the mobilisation of resources that one can learn from. This case study is unique, in the sense that it is particularly associated to the context of the microfinance industry and particularly to the idea of ‘developing’ an open source MIS for microfinance NGOs (MFIs). From there, it was necessary to understand how MFIs fitted in and how developing open source software would eventually address their needs in ways that commercial software would not.

Accordingly, the thesis design had to be particularly comprehensive; it required a double zoom-in and zoom-out to juxtapose multiple views and provide a longitudinal study overall. Also, progress in the analysis was gradual; I went from exploring the MLs, putting signals and landmarks across in the MLs (Analysis Chapter I), to creating a rich, and thick narrative retracing Mifos genealogy over time (Analysis Chapter II), and finally examining the content of post-exchanges to explain the mechanisms of participation (Analysis Chapter III). This way, the three analysis chapters encompassed a multi-stage methodology that combined qualitative and quantitative techniques, whereas the overall approach remained very much interpretive (Klein and Myers 1999) –studying context as part of code development, epistemologically speaking (see Myers 2008, 39).

In my view, the thesis design reflects its results. By mixing approaches and data types, I aimed to re-create some of the richness of this case and re-construct a Mifos biography that is emergent, and yet retrospective. Indeed the OSS biography stresses dynamism and dislocation; it also emphasises multiplicity and heterogeneity (actors, visions and practices), in order to escape the idea of OSS as a collective action (Spaeth et al. 2008; Söderberg 2011; Oost et al. 2009; Heckathorn 1993).

This chapter starts where Analysis Chapter III ended that is the idea of sustained community participation and continuous code design (8.2). It argues that Mifos is an instance of hybrid code breed which potential is to create new possibilities of alliances and partnerships for MFIs (8.3). Building on that, the last sections of this discussion shows how Mifos potential is valuable, as it enables MFIs' to escape lock-in (8.4). In this respect, it is about code gift giving, but creating new economic and social opportunities for participants (8.5).

8.2. Community Participation and Sustainability

Community participation is crucial, without it, OSS cannot thrive! argues Fang & Neufeld 2009; Puri & Sahay 2007; Lakhani & Wolf 2005; Shah 2006; Feller et al. 2005; Maxwell & Scacchi 2004; Von Hippel & Von Krogh 2003; Lakhani & Von Hippel 2003; Gasser et al. 2003; Lanzara & Morner 2003; Scacchi 2002; Mockus et al. 2002; Markus 2001; and Markus et al. 2000. Finding myself repeating this statement, adding my work to the already substantial pile on OSS participation, I stress that this idea has developed and matured over the research process, finally crystallising as the meaning of the OSS biography.

First, this thesis starts by showing how post-exchanging in the MLs is in itself a form of OSS participation. Posts not only, enable information broadcasting, but they also provide peer-support and substantiate problem-solving tasks, which combined produce code. This point joins Collins and Evans' (2002) idea that contributory expertise relies on interactional expertise to build and legitimate scientific knowledge and technology publically, as post-exchanging forms the basis of an evolving and collective library in which code is rooted (O'Mahoney 2006).

The investigation of participation across Mifos MLs was thus necessary in order to study the organising of code production and document the micro-processes and rituals that have sustained its collective development. Particularly, the social network tools that and the synthetic overviews of analysis Chapter I (sociograms) proved to be an appropriate exploratory approach. They backed the overall objective of this thesis by informing members' communication strategies. Complemented by Analysis Chapter II, they also built a dynamic and horizontal view of actors' long-term involvement in the Mifos project. Whereas, Analysis Chapter III established how sustained participation is grounded in post-exchanging, learning mechanisms and knowledge production practices.

8.2.1. Sustained Participation

Findings show that the MLs structure Mifos life (Pattison et al. 2008), in the sense that such an embedded apparatus of tools shape, but do not determine socialisation, the co-production of knowledge and the organising of software production overall. Admitting this is not technological determinism. Rather it is a solid materialism that recognises that technologies influence the fabric of human interactions and the domains of our social production (Hansen et al. 2011, p.12). Analysis Chapter III also shows that the participation of MFIs, their Mifos intermediaries and local IT vendors is of the utmost significance, because it ensures code localisation and creates a growing interlink between the on-going practices of global and distributed design, and software use locally -posting questions, and asking for community support shape code objects according to use patterns, making the latter evolve as part of users' lived experiences and capabilities.

I previously argued that the first layers of design are inherently vague, under-specified and bound to change (Garud et al. 2008; Mackenzie 2006; Neff and Stark 2002); thus software solutions remain inherently incomplete (Ibid). Their small repertoire of algorithms and connectable objects build up their meaning slowly through interactions (Wegner 1997) and association with emerging domains of use[198] (Mackenzie 2006, 64).

Indeed, OSS code objects develop through incremental changes and the enhancement of existing applications (Fleck et al. 1990, cited in Pollock & Williams 2010; Mackenzie 2006). In the Linux example, that I previously referenced- the open code is a mutant clone of the old UNIX (Mackenzie 2006, 70); there are also many examples in OSS studies that also confirm that code substantially change, before partially becoming generic. In fact, the mantra 'release early, release often' (Raymond 1999) does not apply only to OSS –even though it is its landmark- but applies to code design in general –in the sense that code is built through small increments which slowly enhance its design over time while its software package is already 'in operation' (Jørgensen 2001).

Mifos 1.0 had originally limited appeal across microfinance local markets, because it focused only on one lending methodology, lacked essential features and had a particularly complicated yet basic code architecture. Indeed, the time wave that corresponds to that period did not show much activity; yet after Mifos first localisation experiences and its new reengineered code release, both percentages of code commits and use levelled up (See Section 4, Analysis Chapter II). Also MFIs and their local intermediaries increasingly post-exchanged, reported errors (Appendix 5, I-18; I-19), and received peer-support (Appendix 5, I-15; I-16; I-21; I-22; I-23). Thus, Mifos code continued to change and improve, showing more built-in features, new APIs, etc.

[198] Suchman (1994) describes the design of developers who do not have the users in mind, or do not plan constant interactive design practices including the users, as 'design from nowhere' (Hales 1994).

8.2.2. Participation as Users' Empowerment

Furthermore, there is a parallel between community participation in OSS long-term development and Participatory Development. Indeed, this thesis subscribes to development discourse about involving locals in the development of technologies, of which they are the target. Its conceptualisation of OSS aims to address the longstanding bias placing local populations or 'insiders' at the receiving end of a development process designed by powerful 'outside' developers (Mohan and Stokke 2000). It argues that the participation of MFIs and their local partners is vital for empowering local communities and microfinance NGOs; So, the OSS biography is also about the transformation of MFIs and local IT vendors from people who passively await change, to people who can influence it through communicative action (Habermas 1981).

As an essential component of the OSS biography, the MLs enable the interlinking of MFIs and their IT partners with OSS developers and software volunteers enlarging their social networks. Results of content analysis in Analysis Chapter III show how MFIs and local partners joined problem-solving discussions, received/provided peer support and have gradually learnt (Appendix 5, I-16; I-17; I-23; I-26). In addition the MLs facilitate the gradual appropriation of the code objects over time. By learning and developing social capital, Mifos users have increased in the best cases their capacity to maintain and upgrade the system, and more generally have improved their negotiation power with local IT vendors. Overall their use of the software has created a potential for software sustainability (Byrne & Sahay 2007; Braa et al. 2004; Puri & Sahay 2007b).

MFIs did not though oversize their IT divisions, invest massively in IT, or shift their business to become software vendors (see argument by Collins and Yearley 1992; Collins and Evans 2002; Collins and Evans 2003; Jasanoff 2003). Indeed, there is no need for them to massively develop internal capabilities, as recruiting and keeping the right programmers might be too difficult and costly. Yet, one might argue for a balance. This consists of developing enough IT understanding in house to ensure upstream negotiation power, as the plurality of participation is what prevents lock-in[199] (West 2007).

Mifos –as an OSS for MFIs- accentuates the focus on community participation. The OSS biography in particular allows the researcher to shift lenses in order to conceptualise participation as intrinsic to code becoming. So this study shows Mifos potential to incite regional and private investment (notably in MENA). In fact the two notions underlying community participation (code and users) seemed a priori disconnected. Mifos biography shows through that they converge to the extent that the participation of code users is what sustains continuous redesign.

[199] Lock-in is prevented when it is possible to develop over time a network of software providers, which customise their offer according to MFIs local market, enabling competition and fair prices.

Building on the above, Mifos is not only about affordance (availability of features and open access); but it is also about creating a common platform for sustained participation, for developers and users to be actively involved[200].This result is not limited to the Mifos case though. Recently, many OSS scholars have demonstrated that OSS development has infiltrated the software industry and become intertwined with the production of commercial software. In this respect they argue that OSS mature projects provide a potential to create standards and infrastructures that enable wider participation and use and at the same time facilitate their regeneration into added-value commercial services and products.

8.3. What is Hybrid in Mifos?

In Analysis Chapter Two, I recount how Mifos founders planned to sell the code for a monthly subscription. One way to interpret their decision is to consider that it epitomises inconsistencies between GF-Tech's vision to create an open and accessible code and the reality of their control-driven development. Instead, I argue that this event marks a new stage in Mifos life, where the core code started to be regenerative –that is capable to grow into multiple code objects and create extra value. Besides, GF-Tech decision continued to benefit the code to the extent that the new service layers have fed back the core code, resulting in a new code architecture[201] and APIs[202].

Indeed, Mifos online platform expanded as a result of this event in the code's life. The platforms' facilities –in terms of data repositories, wikis and online documents- have increased and their content grew more sophisticated and detailed. Together, the increasing elasticity of Mifos code, and its platform have prompted a momentum in Mifos life history. After that, Mifos project reputation travelled faster, as Mifos became international; also the project enjoyed more volunteers' contributions (section V in Analysis Chapter II), increasingly viewed as a major information platform for MFIs. From this perspective, Mifos is a case of a 'network effect', where the more users there are, the more developed its code and platform grow[203].

Indeed, it is now widely accepted that OSS is a sort of "natural language" for networked software communities (O'Reilly 2005). O'Reilly argues that even famous Microsoft

[200] Community participation was measured in my network analysis through the size of nodes (frequencies and outdegrees) as well as the strength of their ties (Analysis Chapter I). Then, participation was described in terms of users' dynamics at the level of the project and alliances with GF-Tech (Analysis Chapter II). Finally, it was analysed through posts' content (Analysis Chapter III).

[201] Code architecture is important; when it is too tightly coupled it might prevent an open source approach (O'Reilly 2005). O'Reilly cites Linus Torvalds. He writes: "Linus expressed a sense that architecture may be more important than source code. "I couldn't do what I did with Linux for Windows, even if I had the source code. The architecture just wouldn't support it." Too much of the Windows source code consists of interdependent, tightly coupled layers for a single developer to drop in a replacement module."

[202] APIs is what Katz and Von Hippel (2002) call a 'toolkit for customer innovation' (Bessen 2006). APIs are application program interfaces that allow users to pre-customize software based on code properties.

[203] In this regard O'Mahony (2006) claims that OSS projects are inoculated from the danger that befell social movements as they grow because the project's entire interaction order is online and open.

products were born out of hacked code, as "forks"[204]. In his book "the Open Source Paradigm Shift" (O'Reilly 2005), he documents moments in the history of software industry where code is born "naturally" –both in organisational/inter-organisational settings (Ibid). O'Reilly's argues that open code is not a product in itself, but an infrastructure. Once it attracts enough attention, it becomes a field standard and a commodity[205] (Murdock 2005; O'Reilly 2005), which serves as a stepping stone for other code objects. From this view, the OSS biography provides a rich case where code's process of individuation (1890) can be documented –less than the code itself, it is its potential to build up a 'network effect' that matters.

In fact, web 2.0 technologies, like Amazon and Google have become a standard by providing "a dynamically updated database whose utility comes from its completeness and concurrency" (O'Reilly 2005). The maturity of such database depends on a network effect and encompasses members' continuous production practices and their material attempts at collective knowledge negotiation –which is analogous to developing OSS community libraries containing code and projects' documents. This database is an outcome of members' sustained collective content through reviews, posts, exchanges etc. The main reason is that post-exchanges is a synergetic process, the more participants interact the more code's potential is concretised –in terms of new layers of code and services (Fang and Neufeld 2009).

In the Mifos case, GF-Tech succeeded to create a critical mass of activity, which spurred Mifos life expectancy. In spite of that, the way it administered Mifos was not open and participatory. The founder's decision to reengineer Mifos code was strongly debated and controversial (see I-25 in Appendix 5), as project administrators imposed their road map. This did not arguably help the Mifos community to regain a more open-source edge – I refer here to the egalitarian norms and meritocracy-based relations that Raymond (2001) and others (O'Mahony 2002; 2006) refer to through OSS[206]. On the contrary, it preluded a new dichotomy between OSS design and OSS governance.

Mifos project's development was only partially inclusive and participatory; MFIs and local IT intermediaries did not equally take part in design priorities; neither did volunteer developers really shape the Mifos road map. Inspite of that, community participation continued to increase[207]. Such a paradox is not surprising; according to OSS scholarship, Mifos joins a breed of software that Fitzgerald (2006) labels OSS 2.0.

[204] Two Microsoft developers hacked code in order to make Microsoft ASP's product XML aware.

[205] O'Reilly explains commodity as fungible things defined by uniform quality standards, thus making them basic building blocks that can serve many different purposes (O'Reilly 2005).

[206] To show the extent, to which Mifos management was top down, let me explain that the Debian project (Coleman 2004) was divided into hundreds of discrete units of code, which were picked up by people who were potentially living with oceans between them and did not speak the same language. Yet they still could take all these pieces and to put them together (O'Mahoney 2006). O'Mahony reported in an interview with one of the contributors the following: "It is not that there is a real hierarchy or somebody who really makes a decision. The decision process [is], somebody decides what [he or she] want[s] to work on and they work on it and it will get accepted or not" (Ibid).

[207] Fitzgerald (2005) argues that modularity is a sine qua non for OSS, recording how successful OSS were rewritten to be more modular, including Sendmail, Samba, and even Linux itself (Fitzgerald 2005).

This represents hybrid software initiatives, which use OSS as a lever for code design, including commercial software companies, as well as volunteers. They do not believe necessarily in the virtues of openness and are not necessarily governed by meritocracy – so their governance structure would be top down and part of their code technologies would be chained through strict proprietary rights, yet, such communities believe in the positive and disruptive dynamic of OSS and are convinced that it improves code quality (Fitzgerald 2006; Shaikh & Cornford 2009a).

From this view, it does not really matter whether the OSS community is value-driven, geared by goals of freedom and equality, or whether the open source code is merely a weapon in the fierce jungle of the software industry. Open code has a potential to develop a life of its own, to the extent that once an open code is released, the code producer –or her competitors- are forced to top it up to create added-value services, APIs, modules, etc. – searching for new niche market. Competition mimics the process, increasing the code's network effect and eventually turning it into a standard. As more people continue to redesign the code and create new derivatives, they expand its outreach even more and it becomes thus a stepping stone for innovation (Von Hippel & Von Krogh 2003; Fitzgerald 2006). Similarly, Mifos is expected to continue to develop into interconnected but distinct modules, some of which will remain open. Modules that hold competitive value will be typically absorbed by the private market including local IT intermediaries –similarly to the Linux case; this should improve the Mifos offerings and expand MFIs' choice.

8.4. OSS Biography

Based on the above the OSS biography is an appropriate methodology to study OSS, given it puts the spotlight on the code journey and how it builds gradually a network effect (or fails) – rather than emphasising code value, its design, localisation experiences, or users' perspectives. Such an understanding of code is first enacted by Pollock and Williams' (2009) software biography, precisely as the authors criticise the reliance of SSoS on context and how they value local sites of implementation at the expense of code development per se (Pollock, Williams, and D'Adderio 2007). In this respect, the authors argue that it is unhelpful to only pinpoint the mismatch of design features and work practices in organisation settings; this overlooks broader dynamics where code continues to grow at the heart of global markets (Pollock & Williams 2010).

The software biography concept is thus inherently dislocated, going beyond software implementation studies and bringing in a view of design that is very much social and dynamic (Pollock & Williams 2009). Building on that, Pollock and Williams use the concept of "generification" to refer to the turning of a software into a standard, or a common platform that supports future services (Pollock et al. 2007; Pollock & Williams 2009); they describe how this occurs as communities of users are grouped and made to align with software packages' development cycles (Pollock et al. 2007).

However there is notable evidence between OSS and software packages in that the latter grow in closed communities –as large and distributed as they might be-; whereas OSS communities are open and emerging. To get close to market standard, software firms must by themselves conquer new markets and increase their clients' portfolio. In contrast competition is what spirals up OSS potential, increasing its chances to gain a network effect and become an infrastructure for extra features. From this perspective, the focus of the OSS biography is on code transformation primarily and the micro-processes of community participation thereof –whereas the software biography can only study how code is "generified" through market closure.

In this respect, the Mifos case has offered a unique opportunity for an OSS biography; this was possible through its platform and the MLs as the research proxy. Indeed the materiality of the Mifos platform kept the traces of members' daily routines, interactions and processes. It also gave multiple evidence of the involvement of various knowledge profiles, multiple development practices and knowledge transfer. The maturity of Mifos platform is in this sense an ideal life laboratory that permitted this Mifos biography to examine members' footprints, and the generative processes of code transformation across community. Mifos biography has thus unearthed sustainable development practices (real-time reporting, peer-support, problem solving iterations, etc.) and exposed at the same time, the difficulties that users had installing Mifos code, trying to modify its incomplete and standard features. By so doing, it showed that localisation experiences are intrinsic to code development and how it works globally.

In fact, Mifos biography enshrines "generification" and localisation in a double loop [208]. The main reason is that code transformation is an outcome of localisation where users' experience feeds back collective knowledge negotiation and incremental design practices. From this perspective, the OSS biography extends the notion of software biography; the process of OSS individuation continues much as, parts of code objects are taken for granted, genrefied and turned into stepping stones for new layers of services (Scacchi 2007). So it is not enough to speak of generification; it is also necessary to study community participation over time.

[208] By contrast, Pollock and Williams (2007) describe the generification of SAP in the case of universities community as something rather static, which stopped changing once the users were aligned to its core features.

8.5. The Gift Culture and OSS in the context of MFIs

Before concluding this discussion chapter, this final section builds on the idea that the OSS biography is an extension of Pollock and Williams software biography. To do that it shows that open code long-term development is different from software packages' development; hence the OSS biography is also different. This section starts by breaking with the popular myth that open code is a free gift and notably that it is a gift for MFIs. Instead it shows that OSS is an emerging community participation that once its collective contribution is sustained it can potentially lead to new economic and social opportunities and enhanced participatory code development overall.

In the remaining of this section I add a brief illustration that describes one commercial pre-packaged MIS for MFIs called 'MP'[209]; I compiled this story based on interviews with people who were part of the MP design team and with a group of its users' community in Morocco. The aim is to draw on the lessons that people shared with me in order to contrast some features of MP development with Mifos and reassert that Mifos code development is emerging, versatile and constantly changing[210]. In fact I decided to include this illustration as a way to contextualise the OSS biography, and to be more specific about its implications and the differences in its open code with regard to software packages for MFIs.

In Appendix 1[211] there is an introduction to the context of MFIs in the MENA region (Middle East North Africa); this should be read as a preliminary to this section. Briefly, the microfinance industry in the region is quite embryonic, as most MFIs are small, and adhoc. As MFIs also tend to mushroom quite rapidly, their needs are not adequately addressed by pre-packaged solutions causing MFIs a great deal of customisation and expense[212]. Yet, MFIs' limited demand for software in this region does not create incentives for local IT vendors to innovate. Only a few software companies have partnered with MFIs across MENA causing lock-in –see Appendix 1. In addition, donors and experts' attempts to address software shortage remain sparse. Also Appendix 1 shows that in many of these cases, interviewees reported that they were partially (or not) used because of the lack of customisation.

[209] The names of the system (MP), its company (PF), and involved MFIs are all fictional in order to respect anonymity.

[210] The MP story was not studied as part of the OSS biography approach; its scope is not longitudinal and the facts that I describe are mainly based on my notes and interview transcripts. The participants have attended the MP quarterly meeting in the HQs of the PF microfinance expert in Morocco when I interviewed them. I also need to add that I introduced my role in the meeting and the purpose of my research when I interviewed them separately after the meeting and have therefore their informed consent.

[211] Appendix 1 is the result of a pilot study. It describes issues and problems that MFIs in the MENA region have with their MIS and packaged software based on a series of interviews that I conducted across five countries in the region (Morocco, Tunisia, Egypt, Jordan and Lebanon). Appendix 1 gives an insight about the region's level of software adoption and focuses on the specific situation of MFIs.

[212] A situation that is also common in other industries (Pollock, Williams, and D'Adderio 2007; Bessen 2006), but it is more critical in the case of MFIs, because of resource scarcity.

The MP Case

MP is a packaged software solution acquired by PF, a major and influential institutional expert company operating across the MENA region. MP is an MIS solution for MFIs, which provides loan tracking and monitoring features, among other financial management modules such as capital assets and accountancy. PF includes MP in its wide range of technical support services that it sells to MFIs in the region and aims to expand its adoption globally. Originally, MP was designed by a developer in Sub-Saharan Africa and licensed by PF. The developer is also a partner at PF and in charge of its long-term development. The product was implemented by 16 MFIs in Haiti, Madagascar, Mali and Morocco (March 2009).

The local community of MP users in Morocco consist of four local microfinance NGOs, which are the smallest and least equipped MFIs among the nine patented and active MFIs in Morocco. The MFIs-PF (Morocco) partnership aims to help them develop organisational and software capabilities and move from Excel data processing to a database enabled system –knowing that the four of them had bad experiences with software previously and failed to use other off-the-shelf solutions that their competitors in the local market use.

My personal encounter with MP and its support team occurred in the regional office of PF, where I was to interview the director of PF-Morocco. The MP support team had planned a meeting there with four representatives of MP's four MFIs users, which had previously signed partnership contracts with PF-Morocco; these include provision for support services and the MP support team staying for a few months in Morocco to manage implementations on sites and finish roll out. The MP team is also expected to provide maintenance and upgrades remotely, once the system is in use.

This story is based on my notes of the meeting in PF-Morocco office (March 2009); all participants accepted that I attended and took notes that I could include in my study. The meeting lasted a nerve-racking 6 hours that all members endured with great patience, revealing all sorts of problems that the MFIs were experiencing in branches and HQs. Later, I interviewed all the attendants separately when they were back in their offices. I also interviewed on a different occasion the head of the MP support team and a second member in charge of data migration and roll out in two of the partnering MFIs. The bullet points that follow are a summary of participants' experiences based on what they accepted to share with me.

…

…

- The main problem that the four MFIs' delegates kept coming to is the insufficient resources of the MP support team and their limited progress on sites, causing severe delays at the time of the meeting. Participants explained that MP's main developer was very experienced but he was also very busy and did visit sites; they had only met him at the first MP launch meeting. I was also told that the MP team was quite extensive and global; but the team that was sent to Morocco lost staff, and its size shrunk. They were also young and not very experienced –which somehow disturbed MFIs' participants.

- The MP team had been in Morocco for more than 6 months when we met; they were exhausted; they complained about the lack of collaboration they met in two MFIs, and more generally that MFIs' IT people relied on them heavily. They were expected at that time to conduct data migration and recover all four MFIs historic data (from legacy Excel files) and make it interoperable with MP. They were quite aware that they were short-staffed and knew that PF could not send more people; they had recruited a new local developer in replacement, but there were no plans then for MP's support team to expand in the region or to partner with local software vendors.

- There were also issues related to a new requirement from the MFIs. The Moroccan Central Bank undertook the creation of a credit bureau a few years before and required that the MFIs transfer certain data fields about their operations on a monthly basis. The MFIs negotiated with PF-Morocco so that MP included a new API to format the required data and connect it to the credit bureau server; but the global MP-team had to design this feature from scratch, as it was very much specific to MFIs in Morocco. The process was slow and the involved MFIs were not reassured by the lack of progress in this regard.

- The MP support team could not train MFIs' IT staff, as they could not make them delegate their daily tasks to free themselves totally for the MP roll out. All four MFIs had very few IT competences internally and the process of recruiting and staffing the teams internally was taking time. MFIs' IT staff could not fall on peer-support, as there were no other MP users locally, and there was no online platform, or MLs to share their experiences or get tips from other users/developers in other countries.

- Costs for all parties were going up because of the snowballing of problems on sites and signs of frustration were quite visible. Participants' motivation to carry on the project was nevertheless steady and fortunately there was no real mistrust between them.

8.5.1. MP, Software Biography and Mifos

In a way, MP and Mifos are similar; they both, address adhoc and small growing microfinance NGOs; they both embody their founders' discourse (Grameen in Mifos and PF in MP) with regard to providing MFIs with a cost-effective MIS; they both want to channel features that will permit automating financial transactions, and monitoring; finally, they both presuppose that MFIs will learn to use the system and maintain it over time. Yet the Mifos biography and this exert of MP's story are bound to be different; Mifos has a larger and emergent community; this includes both developers and users who continuously interact and try to build alliances, and new ventures. The numerous stories of Mifos local implementations have travelled – part of its online library- and lessons were learnt by peer MFIs and intermediaries; so code has much evolved since it was first used; a circle of continuous reuse, based on peer-support, problem solving, and incremental knowledge building has made it strongly regenerative.

In contrast, the MP's community is closed; as the number of its users grows, their dependence on the sole and main institutional developer- increases, and so their lock-in. PF must also increase its investments and expand its development structure regionally in order to meet the demands of the new Moroccan MFIs and support MP growth. The latter MFIs must also pay an extra because they are different – last members in a line of pre-existing customers. In this respect, MP shows already some similarities with the case that Pollock and Williams' (2007) describe in his paper on SAP Campus Management[213]. Both communities of users in the Campus Management case and MP here depended on one supplier and only one top-down development model[214]. The authors found also that the first clients of SAP Campus were better served than those who joined afterwards – as customisation became harder and costly (Ibid). In the MP case, MFIs in Haiti, Madagascar, and Mali are core users; their requirements shaped substantially how MP looked when it was implemented in Morocco. Overall, it is possible to imagine, just as MP grows that it will share more similarities with Pollock and Williams' SAP (2007) over time.

In the Mifos case too there was an alignment of new users according to the requirement of the lighthouse users[215]. Some MFIs wanted (or were persuaded) to align in order to benefit from GF-Tech and their IT partners' technical support. As for those who went ahead with code changes, they paid the well-too-known cost of customisation; I expect they were also excluded from the overall project advances as they did not input their code to the common source (or were not allowed). From this perspective politics play

[213] In their paper Pollock, Williams, and D'Adderio (2007) describe community of universities who bought Campus Management and were aligned, as gradually the core code became generified.

[214] In contrast, several sociograms in the case of Mifos illustrate community-to-community interactions in addition to the community-to-administrator predominant type. Such relations in the case of Mifos imply partnerships between MFIs and volunteers, outsourcing companies or new regional intermediaries that can overtime supersede the place of Mifos administrators.

[215] In Analysis chapter II, I introduced the GF-Tech's Lighthouse programme, where MFIs partners joined Mifos as beta users. Besides, as GF-Tech sold Mifos as a service in 2009, it continued to add Mifos code features according to its clients' requirements.

also an important part in the shaping of Mifos; also MFIs did pay a price at the end of the day –in the sense that Mifos was not given entirely for free.

In fact, there was both, evidence that Mifos participants (MFIs) did benefit from mutualising cost with other members (like GK and Enda), as well as evidence that MFIs paid dear for customisation, add-ins and additional APIs that were not shared (or only shared regionally). However, the social dynamic of OSS bore overall more opportunities, contacts, alliances and new capabilities over time. While partnerships between MFIs and GF-Tech or between MFIs and their IT partners went sore, other local/regional networks took their place, including new members (developers and users) and renewed chances to use, or reuse code objects in different ways. Indeed members' exposure and use of the project's platform including the interactive capabilities of the ML's has empowered them, to the extent that it provided them with choice, a chance to learn and a constantly emerging web of alliances (7.5 and 7.6 in Analysis Chapters III).

8.5.2. OSS and a New Regime of Worth

Chege (2008) criticises OSS gurus who he argues expand a 'puritan' view, where any talk of money and profit seems to taint the reputation of the open source community. He writes, "free software advocates often treat the topic of money like the Victorians treated sex: everyone knew that sex must exist to produce little Victorians, but any talk about sex was considered verboten" (Chege 2008). I agree with Chege that Mifos has a cost, and that the latter dimension was sometimes overlooked in the OSS literature. Money is what justifies the participation of software companies, which by the same token are what make open code so competitive.

However, I am not sure that the question of OSS financial sustainability is just about profit maximisation at a particular moment in time, to the extent that the dynamics of people participation are multiple, entangled, contingent and not just motivated by short-term views. Although the OSS biography did not include cost in its conceptualisation, there were many references to money issues in the three analysis chapters, as part of the story of Mifos and as the source for some design decisions that influenced its overall development (see Analysis Chapter II).

From this perspective, money is intrinsic to Mifos long-term development, just as this case provides proof that OSS cannot be for free. Thus, Mifos value lies in emerging social and economic opportunities that can benefit participants and notably coextend their capabilities (MFIs and local IT). The main reason is that practices, such as problem solving, incremental code redesign, peer review, and peer support inherently include situated mechanisms of knowledge building, which leverage OSS life expectancy. **Mifos value is influenced by the robustness of its code, the dense composition of its functions, and its friendly interfaces; however its individuation –as a software technology- is primarily affected by its potential to evolve; this is also dependent on MFIs taking an active part in this process, participating in problem solving practices, and extending their social and technical capabilities.**

A decade ago, Berry (2002) published an article where she explains the aim of various seminal net art projects, which use code to rearticulate new modes of production where anyone can extend the free software ethos to cultural and social production and break with modern enslaving dogma, including software, the market economy and passive consumerism. She argues that closing the source code artificially narrows its potential adaptations and condemns it to the stifling monotony of a fixed identity (product), altered only by strictly controlled modifications and upgrades, giving an "illusion of innovation and difference in a regime of unwavering homogeneity" (Berry 2002).

In this respect, I argue that MP is also a pale imitation of innovation; it depends on a few individuals to keep code in autarky, by isolating the users from each other and from its long-term development. In contrast OSS becomes through a continuous emergence and involvement of 'third parties' that sustain participation overall and co-build knowledge-productive relations. Open code and platform (libraries, toolkits, etc.)[216] mark in this sense a new transactional mode (Bergquist and Ljungberg 2001), which upholds new and constantly changing social interdependencies with small and local software companies (Bessen 2006), and other emergent actors who join the open source project's ecosystem to offer consultancy, service and support (Fitzgerald 2006).

In the context of microfinance, such a process strengthens the exposure of MFIs, freeing them from the monopoly of a few isolated software companies and eventually enabling them to learn, develop a better negotiation power, and extend their capacities (Von Hippel 2005a). Like all OSS 2.0 members, MFIs do not believe in a zero cost software, but hope to get value-for-money services (Fitzgerald 2006). These pinpoint new regimes of worth that are more likely to lead to sustainable software production and use[217] (Von Hippel 2005) of which the Debian Case[218] is an example – (Coleman 2004; Coleman and Hill 2005). Such regimes are still connected with the use and enjoyment of property[219]; yet they also exist as a product of sharing and as a consequence of users pushing the boundaries of inquisitive tinkering (Von Hippel 2005; Coleman and Golub 2008).

[216] Scacchi (2002) refers to these as software "informalisms" –in contrast to formal requirement procedures and design plans and tools in software engineering scholarship (Sommerville 2004)- Scacchi argues that open source software "informalisms" have superseded software formalisms and they actually capture the crystallisation of software requirements and the progress of its continuous redesign in general, to the extent that they encapsulate the debates, the rationale, and the problem-solving collective exercises, attesting of developers level of comprehension and knowledge building over time (Scacchi 2002; 2007).

[217] Fitzgerald (2006) argues that those who are involved in OSS 2.0 are neither driven by ideology nor seeking to make vast fortunes. "they simply wish to earn a reasonable livelihood from their efforts (Everitt 2004)" (Fitzgerald 2006).

[218] Introduced earlier in this Chapter

[219] Glass argues (2005) OSS movement is part of the liberal economy of today's Society of Information; yet the nobility and the faintly utopian views that surround the open source and the free software movements are what convinced people, got open source code in the heart of software market's dynamics in the first place and ensured its appeal (Glass 2005). In this sense, the more government agencies, and development gurus believe that OSS constitute an alternative to pre-packaged software, the larger the dynamics that surround open source code projects and the greater their becoming (Fitzgerald 2006).

9. Conclusions: Contributions and Limitations

9.1. Summary of the thesis

Drama and time weight are nested into my words edging the conclusions of the PhD; they are also visible in my storytelling of the Mifos biography, wracked by its actors' personality conflicts, organisations and individuals' struggles through 'aha' moments and 'coups de theatre' over time. Right from the start there was synergy between how this research progressed and how its theoretical constructs were slowly grounded into the Mifos case. This aimed to emphasise the incremental becoming of OSS and the extent to which it is a component of a socially constructed and continuously productive assemblage made of embedded technologies and human agency –which is how I also see my research.

Introduced in the Theory Chapter, the theoretical constructs provide a vocabulary to describe and articulate how open source code is concretised through micro-historical processes and the daily practices of community participation over time. These were detailed throughout the Analysis Chapters and analysed according to the following. I start by arguing that the potential for individuation is what accounts for technology formation (Simondon 1992, 298); objects gradually building emergent relations with other objects and individuals. They embody ideas and social meaning that are collectively negotiated, and which only crystallise over time.

Also the concretisation of technological features is retrospective; humans document how design materiality and human energy coalesce into cultural objects, which are embedded in larger social structures. Accordingly, the 'biographical' work of the researcher co-shapes the ontology of technology; it contributes to its becoming, which can only be partial – i.e. technology is a "pre-individual left-over", a potential, itself making possible future individuations (Combes 1999, pp.6-9). It is this long-term, incremental and constructed view of technology that I also confronted in Pollock and William's concept of Software Biography.

These authors built their software biography mainly in the context of global pre-packaged systems, like ERPs, as they sought to emphasise their dislocated production and code generification (Pollock & Cornford 2004; Pollock et al. 2007; Pollock & Williams 2009; Pollock & Williams 2010). My 'reuse' of this concept remains in line with their philosophy.

It allows me to 'operationalise' (empirical grounding) and to resituate Simondon's idea of technology individuation within more recent Science and Technology Studies and Software Scholarship in particular. I also extend it to the study of open source software. To do that, I characterise the open source biography through the qualities of open source code, its associated and social milieu (community) and the sustained participation of members who contribute to its long-term development.

First, I show that code objects typically open up to the environment and are inherently interactive (Wegner 1997), spanning the boundaries of software packages and connecting to a larger web of code (Pollock & Williams 2009, p.20). Code meaning is thus emergent and changing, gradually concretised through multiple associations with possible domains of utility and use, which are recursively shaped by it as it matures and crystallises (Mackenzie 2006, 64; Garud, Jain, and Tuertscher 2008).

Thus, open source code is inherently vague, undetermined and malleable. Its design value lies in the options that it generates rather than the uncertainties it resolves (Boland and Collopy 2004, 5); as a conceptual and a static representation of human activity, it does not exhaust its full meaning; but once it is localised and 'reborn' in use, code is then a performing cultural object (software) (Schieffelin 1998, p.194) – code is localised once it is the 'object' of community members' interactive practices, problem solving iterations, knowledge building, etc.

Typically, the core source code also becomes generified after periods of use and redesign (Pollock, Williams, and D'Adderio 2007); in open source terms, the open source code becomes an infrastructure – i.e. standard code supporting top layers of additional code objects in which it is nested (O'Reilly 2005). Standard code underlines new layers of private/open innovation and potential meaning that is yet to be defined and redefined through use (Von Hippel & Von Krogh 2003).

Consequently, a second quality of the open source biography is its growth; open source code can be seen as expanding ripples of interlinked text (network effect) that develop within the boundaries of heterogeneous, software communities including 'philanthropic' developers, global software companies, various knowledge groups and users (O'Reilly 2005; Von Hippel 2005a; Fitzgerald 2006). They operate from dislocated settings and sometimes out of sync. They are also an invisible mass of labour which is not necessarily structured as a collective organisation (Ågerfalk and Fitzgerald 2008).

However, participation can be traced back and interlinked retrospectively. Members leave footprints of their socialisation and negotiation of collective meaning, which make their efforts to produce and (re)use code observable (Ibrahim et al. 2010; Pattison, Bird, and Devanbu 2008; Spaeth et al. 2008; Kuk 2006; Sack et al. 2006).

Building on this, a third quality of the open software biography is sustained community participation (Fang and Neufeld 2009); it is the outcome of members' concomitant acts of production and use over time (Von Hippel & Von Krogh 2003; Von Hippel 2005a). Members' participation is transient and varies considerably in quality – reflecting uneven commitments and time investments; yet it is also cumulative and transformative, enabling local knowledge building and continuous redesign (Gasser et al. 2003; Haefliger, Von Krogh, and Spaeth 2008; Markus 2001).

Indeed members' participation is knowledge productive because their interactions and collaboration are supported and co-constructed by embedded and material platforms, which are related to code development online and offline; these endow members' practices with their own materiality and durability (Ducheneaut 2005). Open source software platforms are thus a key component of code objects' long-term development (Ye and Kishida 2003).

Particularly, mailing lists are the central hub of community dynamics; they run simultaneously with daily software work processes, reflecting and co-shaping the organising of code production and members' interactions and socialisation (Mockus, Fielding, and Herbsleb 2000). They are also the link between the offline and online; posts capture through text the continuity of code objects' life offline, as members exchange their implementation experiences, report errors, or announce meetings and social events.

For these reasons, Mifos MLs are a crucial participant in the production of code objects; if a large proportion of Mifos participants – whether administrators, code committers or simple users - ever stopped logging on their newsreader to post or reply to peers' messages, the platform might run 'silent', which would disrupt developers' ongoing processes in interconnected code production sites and threaten the continuity of software development.

From this perspective, mailing lists (MLs) are an ideal setting to sneak a peak into micro-historical processes and study the social dynamic of OSS (Mockus, Fielding, and Herbsleb 2002; Scacchi 2002b; Spaeth et al. 2008; Kuk 2006; Ducheneaut 2005; Sack et al. 2006). In this research, the MLs were also a major gateway to the Mifos arcane world; they are interlinked with most of its components, enhancing their visibility and providing direct access to various data repositories, electronic tools, production websites, etc. – which explains why I use them as main data source.

To study Mifos MLs, Analysis Chapter One proposes a study of their structure, as well as the behaviour and strategies of their subscribers. It captures network graphs (sociograms) based on patterns of post-exchanges between subscribers – links (ties) between subscribers (nodes) which form whenever one subscriber sends a post directly to another subscriber. Analysis Chapter One hence provides a bird's eye view of the Mifos ML's; it makes relations between nodes visible and constructs a material embodiment, of this communication space. By so doing, it also conveys a sense of togetherness that is shaped by the capability of sociograms to connect between subscribers.

Sociograms revealed centralised networks of Mifos community members, where core subscribers have intermediated post exchanges between peripheral subscribers, creating a common ground between them and leveraging the interactive potential of the MLs. This result confirms the findings of previous research on newsgroups and MLs (Preece & Ghozati 1998; Sack 2000; Smith & Wesley 2004; Erickson & Herring 2005; Hansen 2009; Himelboim et al. 2009; Gleave et al. 2009; Hansen et al. 2011); but it also relates to traditional open source studies, which have claimed that open source production is highly skewed – a few core members stand for the majority of contributions and are largely responsible for code organising and projects' social dynamics (Mockus, Fielding, and Herbsleb 2000; Tuomi 2001; Moon and Sproull 2002; Mockus, Fielding, and Herbsleb 2002; Scacchi 2002a).

In Analysis Chapter One members' participation is studied through the relational properties of the nodes – which is a way to interpret members' posting behaviour on the basis of their position in the network and vis-à-vis other members (connectivity). This approach proved to be necessary for finding landmarks in the data, making sense of Mifos MLs and exploring such 'vociferous' spaces (Viegas & Smith 2004; Welser et al. 2007; Turner et al. 2005; Donath 2002; Sack 2001). However it presents at the same time limitations due mainly to the way these results seem to infer that Mifos members' participation equates to their position in the network (MLs) at a given point of time.

The second part of Analysis Chapter One tries to address this shortcoming. By importing exogenous attributes of nodes and shaping the visual effect of sociograms, it shows post-exchanges as an extension of actors' broader involvement in the Mifos project; as well as a proxy of members' multiple memberships across embedded social systems (Wellman 2001); so attributes like subscribers' knowledge profile and geographical locations make divisions in the sociograms visible. These divisions illustrate different information transfer and sharing practices, giving a socio-cultural meaning to node-ties relations that is inherently related to Mifos software production and use.

Although the import of exogenous node attributes helps to re-contextualise the MLs and reconcile them with their utility and meaning in the Mifos project, it is in conflict with the philosophy of social network analysis; it deviates from the 'performative' understanding of networks as flows of relations in favour of a more traditional view of network as embedded structures whose qualities are predetermined (Emirbayer and Goodwin 1994; Wellman 2001; Kilduff and Tsai 2003; Matzat 2009).

Therefore, the study of static sociograms does not account for change and subscribers' emergent, transient and incremental relations. To understand community participation one needs to go beyond the limits of the structural qualities of nodes in a network. Thus, Analysis Chapter Two proposes to 'enlarge' the lenses that I used to observe community participation in two ways.

Firstly, Analysis Chapter Two creates a link between members' interactions – who to post to and whose message to answer - and the content of their stories - their reported experience and digital footprints as they join the Mifos platform, decide to leave, partner with the project's owner, implement Mifos locally, etc. Then, Analysis Chapter Two positions members' posting patterns longitudinally during all the project's development stages observed in this thesis.

Time waves (sociograms designed within series of time intervals) become the backbone of my narrative, complemented by other data types and sources. The multiplicity of sources (interviews, online news, blogs, documents, etc.) and diversity of data type (text-picture-sociogram) enable triangulation and provide a rich, ethnographic-like description of members' involvement, actions and achievements (Cox and Hassard 2005). This entire chapter becomes a detailed and rich collage that flows over the project's timeline.

Findings of Analysis Chapter Two show that Mifos originally expressed the vision of its administrators (GF-Tech), who mainly aimed at "creating a disruptive technology that sparks change in banking and financial services software". GF-Tech's original design was vague and limited; but the organisation increasingly sought volunteer developers' mobilisation and alliances and partnerships with selected MFIs (pilot users) to help concretise their Mifos vision. So their development approach remained centralised and top-down. At the same time, they strongly invested resources to document and enrich the Mifos online platform (updating public links, documents and wikis) and carried their plans to reengineer Mifos code and make it more flexible and open-source-like –which improved the code potential for regeneration and gave incentive for code reuse.

I later argue in the discussion that the Mifos hybrid development model is not 'unique' in the open source field –although the philanthropic nature of the Mifos project did provide a specific incentive for the mobilisation of volunteer developers. In fact, the participation of GF-Tech and its apparatus of institutional affiliates, contractors and sponsors gave the project leverage – even as GF-Tech tried to sell it as a service in a few countries. This has enhanced its potential today, establishing Mifos as an information platform and creating a network effect among Mifos intermediaries, MFIs, and local IT vendors (O'Reilly 2005; Fitzgerald 2006).

From this perspective, a sense of maturity and crystallisation – generification in Pollock and Williams' terms - has gradually emerged out of the stories, events and anecdotes in Analysis Chapter Two creating a retrospective re- composition of the Mifos genealogy. Mifos long-term development is a series of interdependencies between actors, technologies and their potential for extension and regeneration. These are captured through 'finite' momentums or development stages that punctuate 'boundless' and 'timeless' processes of transformation (Simondon 2007).

Also, the scope of community participation in Analysis Chapter Two widens qualitatively, contextually and longitudinally; this chapter describes involved individuals and organisations whose commitment and time investment vary and whose actions – and/or their repercussions - are directly and indirectly intermingled across one or more time periods. Participation materialises as the product of emergent and transient interactions, as well as an outcome of ongoing collective grouping and regrouping.

Analysis Chapter Two thus succeeds in giving a holistic interpretation of the Mifos case, depicting its development as a trajectory – which strongly aligns with the long-term and constructed view of the software biography and open source biography concepts that I mention at the beginning of this summary. Also, this chapter allows the Mifos biography to escape the reductionism implied in the static analysis of sociograms and so provides a richer and more context-based account of subscribers' participation.

Yet, until Analysis Chapter Two, the analysis still does not focus on the micro-historical processes of software development and so only partially addresses this thesis' research question – how sustained community participation enables Mifos long-term development and how MFIs' participation is different in particular in the case of open source software compared to commercial ventures. The mechanisms underlying participation and particularly posting – as the research's proxy - are black boxed; examining how participants socialise, discuss and develop software knowledge is thus necessary in order to complete the study of the Mifos biography.

Indeed, sociograms in Analysis Chapter One could not zoom inside the content of posts and study the social mechanisms underlying subscribers' exchanges; even though sociograms highlight the 'stuff' the MLs are made of and show connectivity among their subscribers, they do not allow the researcher to examine its nature in qualitative detail. While the longitudinal narrative (in Analysis Chapter Two) is qualitative and examines in detail community members' relations, its overall perspective only skims the surface of a variety of aspects, without really studying the inner workings of any of them.

Therefore, it is not enough to outline Mifos trajectory and the 'historicity' of its development, it is also important to examine the semantic workings of text-based-socialisation – that is posts and discussion threads - and their embedding in the MLs' capabilities. Thus Analysis Chapter Three is necessary; it refocuses on the content of members' posts and how they are constructed in relation with threads and the MLs' capabilities to co-shape their meaning (search, archive and facilitate collaboration). Examining only a few selected illustrations (from thousands) could not be methodologically valid in the absence of the prior two Analysis Chapters One and Two; in this sense the three analyses work together, providing context and triangulation.

Analysis Chapter Three starts by taking a look at' the features of posts. It reveals that these are defined a priori by subscribers' knowledge profiles and organisational affiliations, as they show differences in the writing of messages that enact the top-down structure of GF-Tech and their affiliates. From this perspective, posting reflects the social structure of the Mifos project and the inter-subjective values of its community (Diani 2001; Diani and McAdam 2003; Ansell 2003).

As the chapter progresses, it discovers that there is more to subscribers' socialisation in the MLs; illustrations provide evidence that socialisation is the product of post-exchanging (Ducheneaut 2005; Pattison, Bird, and Devanbu 2008); embedded tools influence the content of posts and create a contingent assemblage that defines the future of participants' interaction (Garfinkel 2005). Post-exchanging is thus a socio-technical assemblage, where subscribers and the content of their posts are defined and redefined as they interact and discuss.

Subscribers, posts, threads and MLs occupy different positions across the spectrum of social interaction: MLs represent the social milieu that hosts subscribers' interactions (macro); their capabilities are also agential to the extent that they allow the archiving, and searching of information, as well as facilitate information diffusion and collaboration.

Similarly, questions and the breaking of themes inside messages are communicative strategies that structure posts' content (micro). Once subscribers post-exchange (discuss), this assemblage is set in motion, going beyond sheer socialisation and enabling information sharing and building; the technical and the social are co-constructive and knowledge productive[220].

The findings of Analysis Chapter Three show that not only did the MLs echo Mifos social structure, but they also acted as an embedded technological apparatus, which offers – but does not determine - a favourable setting for socialisation, the co-production of knowledge and the organising of software production overall (Pattison, Bird, and Devanbu 2008; Détienne, Martin, and Lavigne 2005; K. Edwards 2001; Kuk 2006; Sack et al. 2006; Sowe, Stamelos, and Angelis 2008). Admitting this is not technological determinism. Rather, it is a solid materialism that recognises that technologies influence the fabric of human interactions and the domains of our social production (Hansen et al. 2011, p.12).

Post-exchanging has intermediated between the knowledge profiles and structured the space of exchanges, providing subscribers the opportunity to cite, reference and show-off expertise and by the same token debate and pounder design processes and peers' views (Smith 1999; Bergquist and Ljungberg 2001; Lanzara 2005; Pattison, Bird, and Devanbu 2008; Welser et al. 2009).

Building on that the last part of Analysis Chapter Three shows how Mifos members have repeatedly negotiated collective meaning. They also participated in rounds of problem solving, peer support and local expertise building, which are essential for sustaining continuous redesign and the gradual grounding of design features in daily patterns of use (Gasser et al. 2003; Fang and Neufeld 2009). Such practices affect developers' participation and also explain why members increase/decrease their commitment, or decide to stay/leave the community; they provide incentives for participation that go beyond mobilisation and motivation to join the community in the first place (Fang and Neufeld 2009).

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[220] An analogy can be made with face-to-face interactions. Knowledge circulation and learning would be circumscribed in the context of face-to-face interactions where the durability of information is bound to the utterance of words. In this circumstance, their meaning is quick to evaporate if not noted or recorded. In comparison, the MLs and their linkages into growing online spaces and documents (the Mifos platform) leverage interactions and increase their content's informative potential.

Finally Analysis Chapter Three provides evidence that post-exchanging includes users (MFIs and local IT vendors) who slowly and increasingly learn; they are exposed to the MLs' content, participate in problem solving and peer support, share their experiences and gradually appropriate the system. In the discussion I add that in the case of the Mifos project, such learning is vital for the sustainability of code and its users (MFIs) (Braa, Monteiro, and Sahay 2004; Puri and Sahay 2007a); it makes the latter (MFIs) a little more IT savvy, and more importantly gives them an opportunity to expand their network of IT partners and prevent lock-in.

To conclude this summary, I would like to restate here what I previously articulated in the Discussion Chapter. The process of documenting the Mifos biography overall emphasises the journey – i.e. the mangle between community participation and the long-term view, and the incremental becoming of the Mifos code. I argued that this 'becoming' journey is important to study and document – and not just code design - because as an OSS project it does not rely on the 'gift economy' and it questions the idea that open source code is about free access. Rather it highlights 'potential' in technological progress, including through users' contributions.

9.2. Contributions

The aims of this thesis were to develop theory and begin the process of its ‘concretisation’ by designing an empirical approach that grounds it into a case study. Having discussed what has been achieved so far, and the answers that it provides to the research’s questions, the remainder of this chapter reviews the thesis’ contributions, and their implications, and how they shift existing debates in the studies of software.

9.2.1. Theoretical Contributions: The Software Biography Extended

As mentioned previously, studying OSS biography is not merely about lining up important events in the life history of an open source code; it is different from historical studies of technology, which for instance trace back chronologies of the development of pre-modern techniques or new industrial arts and technologies (Mitcham 1994, 114). In contrast, the OSS biography offers a view of code development as culturally embedded, revealing layers of social meaning and informing social change.

In this respect the OSS biography aligns with Pollock and Williams’ software biography (2009) reconstructing a long-term view of code development in a global context and offering a methodology that examines code objects, the platform and the materiality of the organising processes and how they partake in the process of code individuation. Similarly to Pollock and Williams’ software biography (2009), the OSS biography brings to the studies of software a spatiotemporal locus by broadening the technology paradigm to include transnational movements and historical connections that are reflected in biographical details. However, The OSS biography also extends this concept in that it re-contextualises it in the open source code domain.

I argued previously (see theory chapter) that OSS scholars have substantially studied motivation and incentives to explain participation in OSS communities. However, most of them confuse mobilisation and participation; they strive to identify the institutional, utilitarian and economic reasons behind individuals’ decisions to join OSS initiatives in the first place, whereas from a process-based view, participation is a long-term venture; this is defined by microprocesses of knowledge sharing and collective negotiation which gradually shape individual membership. From this perspective it matters less to know the motives that push people to subscribe to MLs, as more important are the mechanisms that sustain their participation and lead to code and community transformation.

Such an understanding of community participation is intrinsic to the study of OSS biography; it drives the researcher to focus primarily on micro-histories, interactions and practices of code development over time in order to explain collective knowledge production and the global role of code – and not the other way around (Latour 2005). Therefore I mention in the discussion that the OSS biography is different from software biography because it looks at sustained community participation, rather than the mechanisms of code generification per se. This is necessary because the process of open code individuation continues whilst parts of its code objects are stabilised, taken for granted and turned into stepping stones for new layers of services (Scacchi 2007).

An important feature of open software development is that open code has a potential to evolve and mutate beyond its primary domain of usability. Also, open source communities and the social meaning they co-produce are transient and emergent. From this perspective OSS is an open-ended environment where researchers can observe in-situ how users' local experiences affect design decisions and code development over time – notably when they encounter practices that monitor real-time use patterns and integrate them in continuous redesign and problem-solving iterations (see Analysis Chapter III). As a result the OSS biography introduces a framework where in-site implementations and the context of use in general are linked in a double bind with code generification. Generification is an outcome of the social dynamics of code development where the study of software use cannot be separated from the biography of code; hence the OSS biography approach extends the notion of software biography.

In fact, the software biography framework is influenced by the qualities of ERP systems, which might grow very large and distributed, but remain a genre of closed software; as such an ERP package can potentially set standards in the software industry, once its firm has successfully conquered new markets and aligned important partners and users. In contrast, it is the openness of the OSS that allows competition to contribute to its future development. As they reuse open code technologies and libraries, competitors spiral up OSS potential, increasing its chances to gain a network effect and to be transformed into an infrastructure for new layers of innovation (O'Reilly 2005; Fitzgerald 2006). From this perspective, the focus of the OSS biography is on code transformation primarily and the micro-histories of community participation thereof – whereas the software biography can only study generification through market closure.

To study OSS biography, the researcher must therefore first examine the embodiment of the community supporting the code – that is its online platform, its tools and online data repositories. All these are conceptualised in this research as the associated 'social milieu' in which code objects are committed, used and redesigned over time. Second, the open source biography provides a vocabulary to describe and document changes in micro-historical processes, and users' and developers' daily routines as they interact, collaborate, provide peer support, implement and produce code.

Obviously, the transformation of open code into standards is more likely to occur in the case of large scale, mature projects; today Mifos' mature platform and high number of code lines are comparable to some well-known iconic OSS projects – not as much in scale as in significance. Yet, this cannot be said for every open source project in the SourceForge. It is indeed widely known that only a small percentage of the 100,000+ projects in this website are stable (Fitzgerald 2006); the vast majority is short-lived with little or no growth (Capiluppi et al 2003, Madey et al 2005).

In this respect, a majority of open source code will not transform into standards, and most will not live long enough to experience the resounding successes of the Apache web server, the Mozilla browser, The GNU C compiler, the PERL scripting language or the MySQL database management system (Fitzgerald 2006). However, the chances for an open source project to rekindle developers' interest, enable sustained participation and create a network effect are based on the 'potential' of its code – i.e. its actual or future value proposition (West 2007). From this perspective, open access to code is important, but does not alone make developers itch to join a project and commit[221].

Planning an OSS venture represents a major risk that any private entrepreneur takes when she starts a new business, as to whether it will become a great success or a road to bankruptcy. To know whether an "itch is worth scratching" – in Raymond's (1999) terms[222] - is to foresee the open source project's potential to establish and sustain a network effect (O'Reilly 2005) –which is also an important and major aspect of software becoming. In this respect, the OSS biography delivers a framework to investigate such a potential – that is documenting code and community processes of transformation and investigating opportunities for regeneration.

To do that, it emphasises – in contrast to the software biography - sustained community participation (including the interplay between end-users and developers and knowledge co-production and continuous redesign). In this thesis, sustained participation was examined through post-exchanges and the content of posts in terms of peer-support, problem solving and learning practices. By doing so, it did not really explain how code became stable or 'blackboxed'; instead it emphasised the possibilities of code regeneration through users' and developers' knowledge productive processes. Thus, the open source biography views open source code as a productive process of transformation, which is not so compromised by the actual inadequacies of its features, and more so if it fails to engage a sustainable social dynamic of production and use.

[221] (Bauer & Pizka 2003) argue that Mozilla – which is now one of the main flagships of the OSS success stories - is a distant mutant of the Communicator, the first open source project that gave birth to Mozilla. Bauer and Pizka argue that the project has undergone many architectural changes, after having remained for many years an unmaintainable and unsuccessful OSS project that did not draw much attention.

[222] Fitzgerald (2006) has used this phrase as the planning phase in the open source life cycle, arguing that generally single developers start an OSS when they have an "itch worth scratching."

9.2.2. Methodological Contributions

In a way this thesis has “drawn away from holism”, and moved towards “connectivity as an organising principle” (Hine 2000, 60). In this respect, Hine refers to Hastrup and Olwig (1997) who reckon that a new sensitivity to the ways in which ‘place’ is performed and practised is required. This might involve viewing the research field not as a site but as a field of relations (1997: 8). Based on that, this thesis provides an approach that grounds the open source biography in the micro historical processes of open code production and use online and also explores their extended ramifications offline.

This approach focused on the study of sustained community participation through multiple stage methodological scaffolding that combines several perspectives and constructs producing different analytical cuts to examine the same data in various ways. By so doing, it conveys the ‘uniqueness’ of a case study design and its context, but it also bridges the gap between a microscopic view of post exchanges and interactions, and a broader macro view re-contextualising insights into a holistic and long-term perspective of open code development.

The loose coupling of the thesis’ three Analysis Chapters offered complementarities that were necessary to inform my research question and go beyond the technology (structure) vs. socialisation (agency) debate (Jones 1999; Jones, Rose, and Truex 2005). My methodological approach to the open source software concept shows precisely how knowledge production involves conceptualisation, structure and theory (code); yet all these three qualities are developed and articulated through social interactions (sustained community participation). In this respect, an examination of code features is important, but if researchers neglect studying social processes, collective meaning negotiation and problem solving, this on its own will bring limited knowledge gains.

Indeed, the MLs and the underlying Mifos platform are portrayed as antecedents and necessary and sufficient conditions for ‘participation’ to occur –an a priori structure. Thus sociograms are designed to construct a bird’s eye view of the MLs that encloses and frames the activity and interconnectivity of its subscribers.

At the same time, it is necessary to resituate and recontextualise post-exchanges and the relational dynamics of the MLs (micro) within the broader frame of the project and its code development over the period of observation (macro); this step is essential in order to reconstruct the global context and emphasise the emergent and shifting dimensions of members’ relations over time – showing the embeddedness of actors in larger social structures and their struggle to collectively construct inter-subjective values into objects, as change keeps happening over time.

Yet, this analytical approach remains insufficient if it does not provide some explanation about how code is coproduced over time, particularly emphasising the articulation between the social and the material, to understand how the properties of the code and its platform enable and facilitate information sharing and local knowledge building. It was therefore necessary to adopt a different analytical cut that would not take interactions for granted; instead it needed to zoom inside interactions (post-exchanges) to understand their workings – that is their underlying mechanisms of information sharing, knowledge building and learning.

The utilisation of different perspectives unravelled the 'dynamism' of software design constructs and the way their meaning changes over time in order to accommodate new circumstances of design and use (Kaplan and Duchon 1988). Indeed, this three-stage methodology enabled a gradual and incremental exploration of different angles, viewpoints and perspectives, which provided evidence how change emerges "from complex indeterminant interactions" over time (Kaplan and Duchon 1988). Thus, this three-stage methodology shows an alternative from quantitative and qualitative approaches that stress either technology or human beings as agents of change.

9.2.3. Empirical Contributions

As well as an integrated perspective on knowledge coproduction in software development, this thesis seeks to provide a specific insight into the context of the 'philanthropic' programmes of microfinance NGOs that design software to be implemented and used in local MFIs. It explores what it means to design and use an open source code in the Mifos case and the extent of MFIs' participation in this process.

From this perspective, the aim of my thesis is to palliate the lack of empirical studies with regard to the design and use of open source software for microfinance NGOs. It focuses particularly its attention on one region –MENA- where microfinance NGOs suffer incapacitating organisational limitations and where there is a widespread belief that these should subside with technological progress and targeted software innovation.

Whereas global microfinance experts try to enrol MFIs into novel IT programmes – and by so align them to their views and those of mainstream microfinance - there has been very little attempt to explicate the real stakes and implications of the long-term development of software in the context of MFIs. From this perspective, this thesis seeks the empowerment of local agents – legitimating their freedom and highlighting opportunities of expanding their choices and capabilities.

The long-term view of software development puts therefore the emphasis on coproducing sustainable technologies, where users' capabilities enable continuous redesign and the grounding of code in use patterns and so also progressively limit the gulf between standard and global software packages and the local context of implementation and use.

Whereas the concept of sustainability is broad, most of the definitions of sustainability are heavily inspired from Brunstland Commission's principles of sustainable management which focus on “meeting the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987 p.8).

In terms of software long-term development, this means developing flexible systems which have potential to generate change that is not impeded by the delivery of the end-use copy to remote customers. Sustainable software thus includes source-code, design patterns, written manuals, and programs, which are conceived, designed and implemented as adaptable and reusable components that have the potential to spawn new code lines of an indefinitely long line of descents (Cook et al. 2006). In evolutionary terms, this implies that sustainable systems are ‘germ-line replicators’ in their own rights (Ibid).

In studies of IT in developing countries, it is also believed that NGOs should be more concerned with software sustainability than investing in new technologies (Puri & Sahay 2007b). Here sustainability refers to the long-term viability of the IT system, including the maintenance of assets created, after technical support from vendors is withdrawn (Ibid).

Similarly, this research places a premium on the active involvement of MFIs and local IT vendors in Mifos long-term software development. Their participation across the microfinance industry ensures a better appropriation of code features, and gradually reduces technical and functional discrepancies; but more importantly, taking part in the long-term process of developing software pushes them to rethink practices and routines through innovative design conceptualisations and new opportunities for change and improvements.

Finally, this thesis shows that the participation of these community members in particular, guarantees that the whole open source community recombines and continues to move code forward. By so doing, the role played by these members integrates also environmental factors, such as local structures and socio-political circumstances that are reflected by participants’ views; becoming more visible, these widen access to code and increase possibilities of its use and reuse locally.

9.3. Limitations and Future Research

Being based on a philosophical understanding of technology – the individuation of technical beings (Simondon 1980) - my open source biography concept is extremely general. This is both a strength –as its application can be widespread - and a weakness, to the extent that the ‘operationalisation’ of such a concept remains loosely coupled, aiming mostly to provide a robust, progressive and incremental approach and appropriate vocabulary to documenting software long-term development.

In this respect, the dimensions that I highlight in the Conceptual Framework Chapter and the middle ground concepts that I articulate to study them are ‘recombinable modules'; they aim to expand the capabilities of software studies rather than construct an 'applicable' framework that supports knowledge production. Accordingly, they are relatively new developments which require significant further work. For this reason, I would like in the remainder of this section to attract attention on a few and not necessarily interlinked points; these notions are referred to throughout this thesis; yet they still show ambivalences and need to be elaborated.

9.3.1. MFIs and local IT intermediaries

First, it is beyond the scope of this research to investigate the relations between local IT intermediaries and MFIs in more detail and how these affect code localisation and its long-term development. In this thesis I consider them both as 'the local' users of the Mifos code whose participation is essential to the use-design interplay and to the sustainability of the software in general. From this perspective, I may have occulted aspects of their duality and amalgamated the qualities of their 'participation' under the umbrella of the 'local' user.

Thus, these are important areas of further work and may perhaps include the incorporation of additional conceptual dimensions. This could provide the basis for a better understanding of the local technologies and social structures that local IT vendors, in developing countries particularly, incorporate and their role in code development.

9.3.2. MLs as a proxy to study community participation

Using the MLs as a proxy to describe the social dynamics of Mifos community participation raises the question of representation. In this sense, the analysis of community members' participation is seen through subscribers' posting activity, which in this case comes to saying that all community members are MLs' subscribers. This is the reason why I strongly emphasised in the Methodological Chapter and the thesis summary in this Conclusions Chapter, the importance of re-contextualising the activity of the MLs and their subscribers' relations within the broader social dynamics of the project.

Participation in Mifos long-term development came to mean many things, as this was my purpose right from the start; I find it important to account for the multiple aspects of participation and to deconstruct a predominant view in the open source literature that members' participation equals their contribution to code and to the count of their code commits in particular.

Yet, I describe the multiple facets of participation, mostly through subscribers' post-exchanges. This is due to my choice of the MLs as a research proxy. By doing so, I rely on the fact that the MLs are the Mifos platform's major social hub and that posts' content reflect the majority of tasks and processes that members pursue in parallel to ensure software long-term development. However, I acknowledge that the empirical grounding of community participation requires further work.

9.3.3. Network Visualisations and SNA

Sociograms have a strong connection with the theory and tools underlying Social Network Analysis (SNA) studies. Typically, analysts make visual enhancements and use data demarcation techniques to facilitate the reading of sociogram configurations – especially when high volumes of ties and nodes make any network visualisation undecipherable. In this case, and as I mentioned previously and justified, I first used SNA connectivity measures (such as the counts of indegrees and outdegrees as filters) to amplify the size or position of selected nodes and enhance the visual layout. In a second stage, I combined these with exogenous properties of nodes (like members' organisational affiliation, job position, location, etc).

For social network scientists, here lays the heart of one of the most interesting controversies in social network analysis; that is of structure versus flow. Looking back at SNA papers in sociology and sociology of organisations, many have treated configurations of networks as interconnected pipelines underlying social and organisational relations.

Traditionally, networks have been analysed as static social structures which are mainly defined through the agential properties of their nodes (exogenous attributes). From this perspective, nodes' exogenous attributes – such as organisational affiliation, friendship or kinship circles, etc. - predetermine the outcome of nodes' relations; as these attributes are introduced as potential explanans – to inform nodes' position and behaviour in the network – this approach implies that the performativity of interactions is neglected.

So the use of exogenous attributes in the second part of Analysis Chapter One can somewhat be seen as enacting a long standing structuralist tradition. To a certain extent, the approach undertaken also contradicts the agenda of this research. In this respect, the open source biography notion conceptualises open source code as 'transformative processes of becoming' which must be captured through changes in code and practices. Yet, incorporating nodes' exogenous values puts the spotlight on subscribers' agential properties, shadowing at the same time the qualities of the relations between them. By doing so, the sociograms seem to imply that the qualities of the nodes are more important than the outcome of their interactions and communicative practices.

In fact, social network theory takes for granted the 'existence' of network variables, such as nodes and ties, while it seeks to investigate the consequences of their subsequent configurations (Brass 2002). From this perspective, social network theory's concern with the **nature** of the relation is relevant only insofar that researchers' methodological choice as to what type of connector to use is consistent. Once a researcher has defined her network (Borgatti and Halgin 2011), social network analysis starts as to explain certain outcomes for individuals and groups (Ibid).

Building on that, I believe that social network analysis does not provide the tools or the vocabulary to examine the multiple aspects of community participation in software long-term development. In this case, it relies unquestionably on the research proxy (the MLs) to predefine the nature of the tie (posts), and from there bases the study on the outcome of individuals' activity (frequencies) and connectivity (post-exchanging patterns).

The use of sociograms might feel confusing, and presenting epistemological ambivalence as how I build these findings. So I wanted here to pinpoint my rather 'instrumental' use of this approach; I did not seek to explain community participation through nodes-ties configurations; instead, I wanted to 'wrap up' the activity of the MLs and illustrate the interpersonal connections between its subscribers, which I previously refer to through the idea of capturing a 'bird eye view' of the MLs.

Based on that, my importing of the exogenous node attributes into the sociograms has little bearing on my interpretation with regard to the quality of posting (which I study by analysing the content of posts in Analysis Chapter III). Whereas the study of community participation continues in Analysis Chapter Two, transcending social network analysis and exploring the nature of interactions and relations between community members.

While I remind the reader here the specific role of the sociograms in this thesis –as infrastructure for visualisation (see Methodology Chapter) - I also acknowledge that this approach abides by its own doctrine and philosophy; in this case it may generate discrepancy and so it requires further work in this respect and a better articulation with the research's agenda.

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List of Appendices

- ***Appendix1: MFIs in the MENA region***
- ***Appendix 2: Code Releases Map***
- ***Appendix 3: MLs' Activity***
- ***Appendix 4: Membership in MLs by Country***
- ***Appendix 5: Emails Analysis***
- ***Appendix 6: Subscribers' Profiles***
- ***Appendix 7: Mifos Newsgroups***

Appendix1: MFIs in the MENA region

This appendix analyses some of the important challenges that face MFIs in the Middle East and North Africa Region (MENA) based on a pilot study that I conducted in the region. First, it highlights traits of MFIs' socio-political context in five countries, namely Morocco, Tunisia, Egypt, Jordan and Lebanon –where I interviewed local MFIs, microfinance experts and a few microfinance software vendors. Building on that, it pinpoints specific conjunctures and policies whose consequences affected the organisation of MFIs, and their internal competences including IT. Particularly, it focuses on describing software capabilities issues at the organisational level, as they were reported by interviewees employed by MFIs in the region.

1. Morocco

The emergence of microfinance NGOs (MFIs) in Morocco traces back to the 1990s, subsequent to a series of substantial technical and financial support from the UNDP's Microstart programme, the USAID's microfinance programme, and the state's fund Hassan II (Brandsma & Burjorjee 2004). During that period, local authorities also established a policy to reduce poverty and provide jobs, through launching the National Initiative for Human Development (INDH), a $2 billion social development plan to address poverty and unemployment and to improve the living conditions of the country's urban slums (CIA FactBook 2008). Many local social-welfare-NGOs were welcomed to join this national programme (Isaia 2006) and establish microcredit schemes in order to mainly support women and their families (Garbero 2006a).

In 2000, a law 18/97 for microfinance was published providing a protective regulatory framework for MFIs under the authority of the Ministry of Finance, and pushing local welfare NGOs to convert their microcredit programmes into MFIs (Reille & Lyman 2005). The 2000 Microfinance Law was instrumental in enabling the local MFIs to access banks and in supporting MFIs' integration within the local economy (Brandsma & Burjorjee 2004). However, it is claimed that the Moroccan regulatory framework is also a bottleneck for MFIs long-term development (Duval 2001; Mourji 2002). First, the law allows MFIs to provide microcredit but not to collect deposits. This limitation positions them forever outside the financial sector, as savings will not compensate for the cost of their interest rates. Second, the 2000 Microfinance Law includes a financial viability clause, which forces them to gradually replace donations and subsidies by private capital after five years of activity, or else, their licence will be withdrawn. Given that MFIs' beneficiaries are mostly located in remote rural areas –implying higher cost and higher default risk- this measure makes MFIs life a struggle for financial sustainability. It also impacts the social character of their mission and threatens the social change they are expected to achieve (Armendariz 2002).

As a consequence, Moroccan MFIs did not effectively invest in acquiring capabilities and developing internal managerial competences, they remain today adhoc and rather non-professional, and are kept out of mainstream finance. Moroccan MFIs are not banks; they are not totally welfare NGOs either. They remain in a limbo, where they are forced to account to a multitude of governmental, financial, and philanthropic bodies. This situation increases their need to collect and process all sorts of information and tighten the grip on information management.

2. Tunisia

The emergence of microfinance in Tunisia dates back to President Bourguiba's post-independence era (70s) and the establishment of the Tunisian National Bank of Solidarity. The bank's activity is an extension of a state policy and a national-wide plan to revive the economy, increase employment and spur investment opportunities for Small and Medium Enterprises (SME). The National Bank of Solidarity has a long tradition of providing subsidised loans at cupped interest rates to graduate youths in rural and semi-urban areas. Accordingly, a large portion of the country's income that is generated by informal activities and non-licensed family enterprises is left un-catered for. In addition, the National Bank of Solidarity is often said 'not to belong' to the global microfinance industry because of its cupped interest rates that do not reflect the reality of the market and which do not constitute incentives for the bank to be financially sustainable –as is the case normally for MFIs in the MENA region.

In the 90s a pioneer couple (Essma Ben Hamida and Michael Cracknell) received authorisation to establish a privately owned NGO, which is commissioned to provide non-subsidised microcredit services for unemployed and low income populations. Today, there is no other competition, except for the local NGOs affiliated to the National Bank of Solidarity.

The activity of this MFI, named Enda Inter-Arabe has increased exponentially over the past decades. It serves approximately 200 000 active clients and has 65 branches across the country (MixMarket.org, last accessed 2012-08-22). Rapid growth has affected Enda Inter-Arabe's organisation and its back office, resulting in a pressing need for a decentralised information management system.

3. Egypt

The SFD -Social Development Fund- is responsible in Egypt for SMEs' overall coordination and development (Hazem & Nabil Baz 2006). There is yet, a scarily large number of informal businesses in Egypt that receive no support or regulatory framing, as they are not on SFD's lists. It is said that 90% of Egypt's demand of financial services is unmet (Hazem & Nabil Baz 2006). These are in a large sense, the actual beneficiaries of local MFIs.

Only 4 out of 63 banks have reported a microfinance service, including: Bank Misr in 2003, Bank of Cairo in 2001, Principal Bank for Development and Agricultural Credit- PBDAC in 1993, and the National Bank for Development-NBD in 1987 (Hazem & Nabil Baz 2006). As for the rest of the microcredit services delivery, they are provided by NGOs, which are regulated by the Ministry of Social Affairs and are prohibited from collecting savings and deposits. These include specialised MFIs, Umbrella NGOs –which deliver a large range of community-based social services, of which microcredit is but one- and finally Community Development Associations to whom microcredit field operations are outsourced to both MFIs and Umbrella NGOs (Hazem & Nabil Baz 2006). Institutional differences exist between microfinance banks and NGOs. In comparison to banks, NGOs are able to lower interest rates and provide more flexible services; yet, they have to a lesser extent free access to commercial loans. Banks suffer also restrictions on their microfinance activities, because of taxes and high administrative charges; surprisingly they still lag behind NGOs in terms of beneficiaries' records.

Consequently, international aid remains the major source of funding for local MFIs –which is undeniably a sign of precariousness. The current financial support is not adequate to satisfy the full demand of the current population, which was estimated in 2004, to 3 million individuals (Garbero 2006b). Microfinance activity in Egypt was declared underdeveloped (Brandsma & Burjorjee 2004). The lack of clarity in government policies and the absence of a global commercialisation strategy have hindered its potential for expansion. USAID and UNDP have massively backed microcredit delivery in Egypt (Garbero 2006b; Hazem & Nabil Baz 2006; Brandsma & Burjorjee 2004). Recently, UNDP, in partnership with SFD piloted a restructuration programme for local MFIs (named MicroStart), which aims to leverage their institutional, organisational and technical capabilities (UNCDF 2009).

As a result of the limitations in the local microfinance industry, these are indeed poor. Local microfinance providers are often very small, disorganised, and suffer shortages of staff and resources. Their growth is hampered by several external and internal factors that limit their organisational and information management capabilities in particular.

4. Jordan

Jordan benefits from political stability in a highly sensitive region. This might be considered an advantage for trade and the national economy in general. Thus the Jordanian government's social policy is extensive and aligns gender inequities and poverty alleviation through financial incentives for SMEs (Brandsma & Burjorjee 2004).

Several public organisations were established to provide microfinance services delivery. These include public institutions such as the Development and Employment Fund (DEF) providing subsidized credits; the Industrial Development Bank (IDB) and the National Assistance Fund (NAF) who provide soft loans to poor households (Brandsma & Burjorjee 2004). By the end of 2001, they disbursed together, 90 million dollars in outstanding loans, against 6 million by non-state-owned MFIs. In contrast, non-state-owned MFIs are influenced by USAID, in terms of lending 'best practices', interest rate fixation, achieving self-sufficiency, impact measures etc. Thus, they are considered by the international community as effective and positively growing.

In opposition to the other four countries, microfinance providers in Jordan are not NGOs –mainly because local welfare NGOs are prohibited from delivering microcredit. In the absence of a specific regulatory framework, MFIs have accommodated their activity by becoming financial companies (Brandsma & Burjorjee 2004). The operations of MFIs in Jordan are limited nonetheless because of excessive taxation and their poor institutional legitimacy (Ibid). As a consequence, a major obstacle for the growth of microfinance in Jordan is the lack of a global strategy for microfinance –for both public and private MFIs.

In this case the intestine wars between the state's programmes and non-state-owned MFIs are fundamentally territorial and have negatively impacted their organisation and performance. Indeed, private MFIs are better staffed relatively to their competitors in Egypt; yet they remain quite adhoc and unprofessional. Their idiosyncratic socio-political context has imposed on them strict and unique accountability requirements, which their MIS must account for.

5. Lebanon

Prior to the [1975-1991] civil war, the Lebanese market had benefited from a strong laissez-faire tradition that gave primacy to trade and finance (Assrawi 2006). Lebanon had been a financial and commercial crossroad in the region for many years. During the war, the Lebanese economy sunk, causing GNP to shrink (Ibid). As the economic crisis deepened, inequities have raised and middle range entrepreneurs' access to financial resources diminished considerably –merely 1% of private businesses benefit of half of the total loans disbursed (Isaia 2006c). Informal businesses developed to reach 30% of the Lebanese PIB according to some experts (Susaeta & Galifa 2006). Yet given the government's incapacity to provide adequate financial support, EU intervention introduced the Economic and Social Fund for Development (ESFD) to foster employment creation by all means but subsidies (Assrawi 2006; Brandsma & Burjorjee 2004); hence the role of microfinance.

MFIs in Lebanon are mainly NGOs, as banks' participation remains scant (Susaeta & Galifa 2006). They strongly rely on international aid programmes such as USAID and UNDP (Assrawi 2006). The main reason is that economic growth in the aftermath of the 1990s has been slow and, similarly, microfinance activities –As per 2003, local MFIs had 13 500 active clients overall (Assrawi 2006; Brandsma & Burjorjee 2004). In addition, local MFIs were claimed to charge borrowers exorbitant interest fees that average 40% -which explains their low activity (Ibid).

Doubts as to which extent MFIs' interest rates represent the real condition of the market rose after ESFD opened a 1.2 million Euro fund for MFIs who charge the lowest interest rate and at the same time, fully covering their operational costs. Many proposals went beneath the 40%; one in particular offered less than half of that (Assrawi 2006). After this episode, local MFIs were declared inefficient and underperforming (Ibid). Microfinance growth in Lebanon is believed to depend on the internal capacities of MFIs and a more cost-effective organisation, which IT and automated information systems are said to be the key.

2-Repercussions at the MIS Level –Across MENA

According to the five stories that I described in section I of this appendix, there is something almost redundant in the way microcredit operations emerged and developed across MENA. States pursue prospects of economic growth; microfinance operators are created, aided by local bureaus of International Agencies, which use them as proxies to seed the foundations of neo-liberalism and the market economy. As a consequence, states regulate too much (Morocco) or not enough (Egypt), mostly in ways which do not help the integration of MFIs in the local economy or facilitate coordination between them and other institutional players, like banks.

The lack of effective regulatory frameworks at the national level sparked MFIs' ambiguous identity; not entirely social welfare organisations, nor fully for profit financial companies, they tried to achieve economies of scale without appropriate organisational capacity and not necessarily addressing the needs of their communities, either. Local microfinance markets, across MENA looked more and more precarious and non-optimised and impacted recursively on MFIs' organisations and information systems in a negative way.

This result is also echoed by the people I interviewed, as on many occasions, they connected events and changes at the socio-political level with the lack of organisational resources, their growing needs in information, or specific reporting obligations. The material underlying the remainder of this appendix is the outcome of over 20 interviews with MFIs' executives and heads of IT, as well as several interviews with employees working on microfinance in state and non-state owned local development agencies, and a few software companies' owners notably in Morocco, Tunisia and Jordan.

The Approach

During interviews, I typically introduced myself, the purpose of my research, the interviews, explained my interest in studying their MFIs' MIS and obtained informed consent. I asked about their organisations' levels of IT adoption, interest in web 2.0 technologies like open source software and their use proficiency. As a result, people presented their own and their teams' competences; they described their IT resources, activities within their organisations and discussed their IT-related opinions in a non-structured fashion (Yin 2003; Myers & Avison 2002).

In the interview sessions which lasted on average between one to two hours, I recorded their answers with an MP3 recorder. I later listened to the interviews' records which were in Arabic, French, English, and sometimes a mix, and wrote transcripts in English. I open-coded them using the qualitative data analysis software, Nvivo 8. Results are provided here and presented as 'lessons' from my pilot field research. These also describe issues or problems that interviewees reported with regard to specific themes related to their MIS, their IT adoption and their local or regional software industries.[223]

IT-4-MFIs and related issues

Results show that IT is today a hot topic for MFIs in the MENA region. Many among the interviewees reported their organisations' hope to find the 'ideal' MIS. Among the interviewees, Ten MFIs were in the process of implementing new software packages; four reported their continuous struggle to develop and customise their MIS, and six others were looking to invest in new systems.

Participants talked about different episodes in the life history of their information systems. According to their situation, they highlighted their achievements and the current difficulties they face –for example problems with legacy systems; limits of packaged software in the local software market, problems with in-house development, implementation issues, etc. these are organised as follows:

Resources

MFIs across MENA suffer scare resources, as they depend most of the time on donations and subsidies. Their capital is equal in majority to their loan outstanding portfolio, but for their operation costs. MFIs' resources should remain scarce and rely on donations as long as they do not achieve economies of scale. For this reason scale and maximisation of the number of beneficiaries are very much sought after, as the subsequent turnover should pay for the interest fee on their capital, their operational expenses and an additional return to be invested in their portfolio.

Typically MFIs prefer to use their few resources to strengthen their branches and recruit frontline staff –that is to pay Loan officers who do field work, client visits, credit assessment, etc. They recoil at spending money on administrative and IT overheads, and so either offer salaries that are easy to outbid, or fail to ensure satisfactory carrier development plans for their employees. Consequently IT turnover rates are generally high across MFIs.

When they started microcredit delivery, many MFIs could not afford to pay the cost of increased banking software, with customisation expenses. Ten participants declared that their IT divisions were created through recycling loan officers and using Excel spreadsheets –Excel applications came with the computer[224]. The main objective was to record loan disbursements per clients and register repayments, which IT-reformed loan officers and spreadsheets did well enough.

[223] List of Interviewees and original transcripts can be consulted if required.
[224] Some MFIs have infringed Microsoft copyright policy by acquiring illegal copies. However most have ended up buying a proper licence after a certain time of utilisation due to copyright restrictions.

Professionalism vs. Dedication

Among the MFIs I visited many confirm Lascelles' (2008) claim; they are "headed by amazing visionaries and leaders but lack the mid-management resources" (Lascelles 2008). This is due to the philanthropic culture of the global microfinance industry, which emphasises dedication; while this does not necessarily go hand in hand with internal competences, capabilities and professionalism. The lack of mid-management resources is reflected by the absence of applied strategies and middle-term plans at the operational level –which also makes MFIs management in branches a sort of a day to day job.

The repercussions of 'last-minute' decisions and tight-flow management in branches snowball at the back office level, where a few administrative people –generally not well enough equipped- struggle to follow operations, process and monitor daily cash-flow, loan issuing and repayment transactions –Not to forget that the back office needs to put up with a constantly growing volume of data and a high error rate. Most of the times, MFIs cannot communicate their priorities to partners, donors, and trustees, and when they do so, their reporting is based on retrospective forecasts, or on calculations that show gaps (positive and negative) with their realisations.

Furthermore, MFIs' IT divisions are in many occasions truncated. They often start with one or two people; he/she has relatively unimpressive skills (general knowledge of hardware, limited network knowledge, and little programming competences); he/she creates and slowly administrates the MFI's centralised database –by consolidating branches local databases or inputting transactions at the head office. As data volumes grow, MFIs recruit people to input transactions and help out; they become somehow the apprentices of the old IT members, who get promoted to take charge of IT. Slowly the IT division becomes larger, but its skills remain embryonic, and no one really heads it; unless the MFI decides to move its operations to the next stage and is keen to invest in off-the-shelf MIS. MFIs then recruit –according to their size and resources- one or two IT executives, who are often programmers.

Most MFIs' IT people I interviewed had several years of experience, when we met. They told me about 'the hard days' –where they had to do everything from scratch- and were proud to show that they learned the hard way too. Yhey migrated their MFIs' data from first Excel files, to Access, or other first database enabled systems, and finally to more sophisticated banking or decentralised database software; they somehow dealt with their legacy system, they succeeded in saving (hardcopy or electronic) their operations' historical data; and worked harder and harder to consolidate data, etc. Although turnover in IT divisions is high, there were often one or two that stayed and for me they were like the MFI's living memory. They showed perseverance and an aptitude to learn that were stronger than what one would expect to see and they definitely are different from the corporate world.

Rapid Change, heterogeneity and Volume management

Organisationally speaking, things start to change with growth, which is rapid and often exponential in the case of MFIs. Typically, back offices' size mushroom in response to growing volumes of data; yet the underlying logic behind their structure, information flows, and strategy are neglected and thought to be artificial and not-so-necessary – these are things to talk about in donors and partners' reports and not necessarily internally. MFIs abide for their decision-making by the logics of "Management by Crisis".

Many of the interviewees reported that their MFI recorded their operations on Excel spreadsheets, when they first begun. This arrangement sometimes was pursued for one to two years, before MFIs move to Access centralised databases, using few and basic Visual Basic commands to create reports and query the database. Rapidly, Excel and Access-enabled MIS show clear inefficiencies.

First, people are confronted with increasing volumes of transactions and are soon overwhelmed with work. Second, they show little flexibility, in terms of generating customizable outputs. Thus files start to pile up as IT staff struggle to manage information in a timely manner. Error rates increase, as MIS become more permeable to risk of fraud and delinquency. Generally, this is the time when most MFIs start to look at larger MFIs neighbours, ask about the software they use and start exploring the local market.

Not only volumes of data increase with growth, but complexity does too. Interviewees reported that they were increasingly pressurised by their bosses to change report formats, create new sorts of calculations, include more data fields, etc., as their bosses' needs in information unavoidably and quickly grow and change. As explained –in Chapter I, MFIs' needs in information are both internal and external. There is often a correlation between the two, as internal growth also means more funding required; so new and different types of stakeholders with new and different information reporting obligations (e.g. banks, governments' agencies, and other financial partners).

From this perspective, MFIs' data requirements are constantly changing and growing. They are both legitimised by organisational changes –for example MFIs often decide after a few years of activity to adopt a decentralised decision making system with regard to lending and credit assessment procedures, which implies that branches have more autonomous MIS in terms of security rules and users' rights. They are also caused by institutional constraints, such as changes in regulatory compliances, the emergence of new legal measures, or changes in stakeholders' contract terms.

MFIs' MIS is often tightly tailored to their workflows, processes and procedures –even when the number of their active clients is still low. From this perspective, it is hard to find MFIs working in the same country or locality, which use the same system, or share the development of some features. Most of the interviewees repeated –almost religiously- the same line, when I asked why they did not invest in a shared MIS and mutualise costs. "*…you see, we do not have all the same size, nor do we use the same workflows and rules internally, our system must espouse our operational structure so as to facilitate data inputs and data transfers between branches and HQs*".

Despite a common backbone, consisting of core lending processes (loan disbursements and repayments) MFIs' internal policies, procedures, interest calculations, etc. vary widely[225]. For example, until recently a mature, very large, leader MFI in Morocco had clients' records and loan approval forms inputted in its HQ, loan officers filling in loan forms in branches and internal hardcopies physically transported between branches and HQ. Such a procedure was deemed necessary for its internal control policy –"*to keep an eye on loan officers*", the interviewee told me. In contrast, the MFI XX, its main competitor and also very large, has a fully decentralised MIS and use a heavy and sophisticated ERP that is one of the highly rated pre-packaged software in the local banking sector.

Indeed all participants are convinced that the only way they can carry on providing microcredit services is if their MIS meet the idiosyncrasies of their work practices, their beneficiaries and institutional constraints. A few participants even confessed that they were scared to buy pre-packaged solutions because of the huge customisation investment required.

An IT executive of a small scale Moroccan association reported that his association got a pre-packaged solution by a software company in Latin America (for a good price). The MFI wanted to customise the application and change its language (from Spanish to French) among other configuration issues. This revealed to be much more expensive than the MFI expected. After a short period, the MFI decided not to use it –preferring to go back to Excel spreadsheets. Another example was shared by the interviewee of a small MFI in Egypt; it is also about the same application. This time it was paid for by a donation from USAID. The MFI could not get the technical support of the provider as part of the prepaid package; so it also decided to put it aside.

Contrary to what some participants have said, there is scope for MFIs across MENA to use a shared backbone system and customise specific modules. In this case, the issue was that some MFIs in Morocco have tried to design a sort of national microfinance system from scratch through a local IT vendor –which made local MFIs behave competitively towards each other and sometimes refuse to collaborate, as each one tried to impose its requirements and at the same time spend less.

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[225] It is important to note that this is also true at the global level. Although, MFIs across MENA use similar lending methodologies (that is group lending and individual lending with different rules and interest calculations), this is not the case if we were to compare MENA with the Asian, or African microfinance industries, which use other lending methodologies, like village banking.

Supply and Demand: MFIs Lock-in

Once MFIs start to look for the ideal pre-packaged MIS, they know little about the off-the-shelf software market. The software selection process is often a hassle, as MFIs discover who they are and what they need when they start looking for software. Many participants also claimed they were only interested in locally-designed loan tracking systems, (rather than the few Asian, South American and African systems) because of their institutional constraints and the huge feature gap with Asian, South American and African software.

Most of them reported that the selection process starts by looking at CGAP's[226] review of microfinance software. They also enquire through their local network what the other MFIs use. As a consequence, many IT executives were not aware about software that is not in the CGAP list (at the time of their search) and is not local either, like Mifos or Octopus[227] -which can be adapted to the specific use of MFIs in a more cost effective way. Paradoxically, many participants said they did not 'trust' CGAP's software review; they claimed the CGAP's review page does not offer "*a rigorous software assessment framework*" and is merely based on users' appreciations; they also pointed to its limited number of reviews.

Consequently many MFIs stayed under the monopoly of a few IT suppliers, which were mostly based in Morocco, Egypt and Jordan. I recorded three ways through which microfinance NGOs acquired software. A majority bought off-the-shelf licences from local IT-microfinance experts. A few designed and built in-house software solutions internally or by outsourcing. A few others received free (or subsided) technical support from International Microfinance NGOs, like Planet-Finance and implemented proprietary software, which the latter outsourced from international software companies.

One particular software company in Jordan supplied 20% of the MFIs market across MENA. The owner of the company –who I interviewed- has designed his software for one of the local MFIs, and gradually added more features to it, as other MFIs in the region joined. The reputation of this vendor is somehow controversial, as some interviewees in Egypt had a very bad experience and complained about how poorly designed his system was, and its ineffective support, while a few participants from MFIs in Jordan asserted they were totally satisfied.

In addition, a few MFIs decide to develop their MIS in-house due to the lack of skills and resources –However in Egypt one leading MFI has succeeded in designing a relatively multi-feature, mature system that was sold to its local competitors and was also exported to other Arab MFIs in Oman, Jordan and Saudi-Arabia. This MFI

[226] CGAP stands for the Consultative Group to Assist the Poor, a well-known global consortium that provides technical assistance for MFIs worldwide.
[227] http://www.octopusnetwork.org/

provides today peer-to-peer support to the rest of its user community, as well as in-branch and online training.

All participants agreed that buying proprietary licensed software meant they were totally dependent on a few suppliers in the region and the technical support that they are sometimes reluctant to offer. Indeed, participants stressed subsequent issues, like non-effective support, more money asked, lack of flexibility, mistrust, etc.

The reasons for this are twofold. First, the number of microfinance software providers is limited –which gives them more negotiation power. Second (which is also connected to the first reason), the MFIs' market from the perspective of the local IT companies has also restricted revenue prospects; local providers could not possibly achieve a return on investment, whenever one MFI asks for more support, or has additional requirements. "A customer [MFIs] can have a car [MIS] painted any colour that he [they] wants as long as it is black" (Ford 1922, p.72).

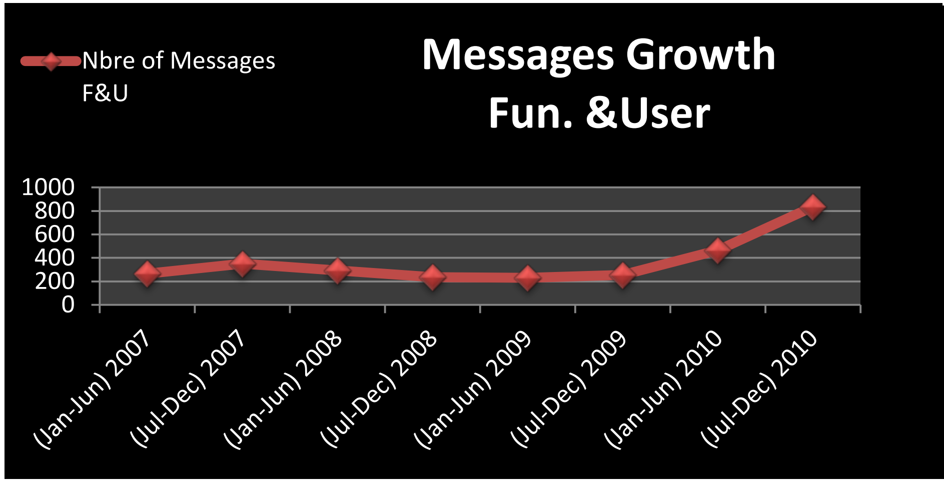
Appendix 2: Code Releases Map

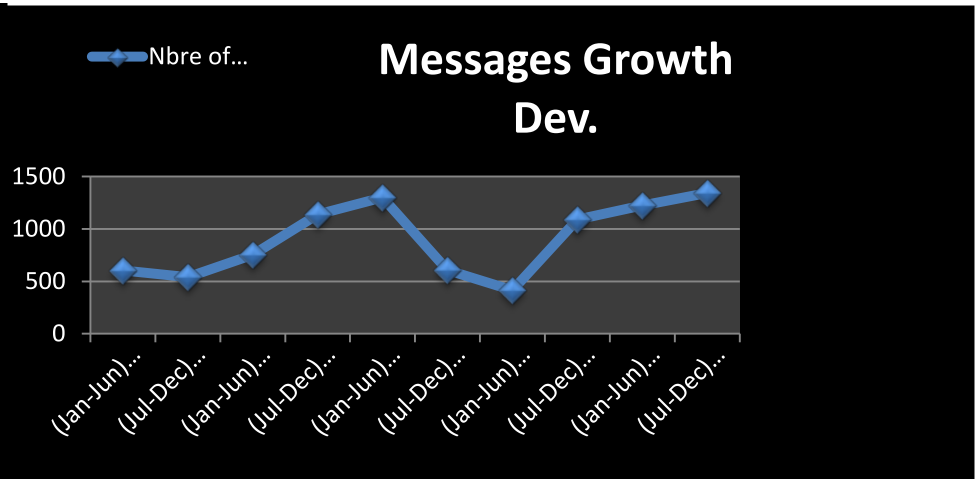
release	Date	code-name	overview
Latest dev2.21	October 17, 2011	head/master	Mifos 2.2.1, the first community-supported release of Mifos, led by SolDevelo, stablizes the Mifos 2.2 release candidate and builds on top of it with the following functional and architectural enhancements (Simplified procedure of adding new translations, New Mifos translation: Telugu, Added ability to edit user's birth date and center names, Implemented client photo upload functionality, Added new REST API module for better Mifos integrations)
2.2	July 1, 2011	G (Maya G)	Major Features (Labels have been replaced with Customized Text, Clients can now have loans with different multiple frequencies, User Interface Improvements to Create Loan and Redo Loan workflows)
2.1	March 9, 2011	F (Elsie F)	Additional Features (Variable Loan Installments and Cash Flow comparison, New interest rate type, Early and Partial Repayment of Fees, Improved M-PESA Integration, Permission for adjusting only last day's backdated transactions, Conversion to service facades, Improved Tally accounting integration)
2.0	December 21, 2010	E (Leila E)	Question Groups, Full PPI Support, m-pesa integration, 10 new standard reports, Tally Integration
1.6	July 27, 2010	Shamim D	Scalability to 1M, Branch-level holidays and moratoriums, Chinese Version, 2 Standard Reports
1.5	April 29, 2010	Gazelle C	Currency-Denominated Loan Products
1.4	December 16, 2009	Gazelle B	Collection Sheet Enhancements, Scalability Improvements, Spanish/Hungarian Support, Banking Import API, Firefox Support
1.3	July 23, 2009	Cheetah/Gazelle A	Architecture and Batch Job Improvements, Testing Framework, Improved Configuration

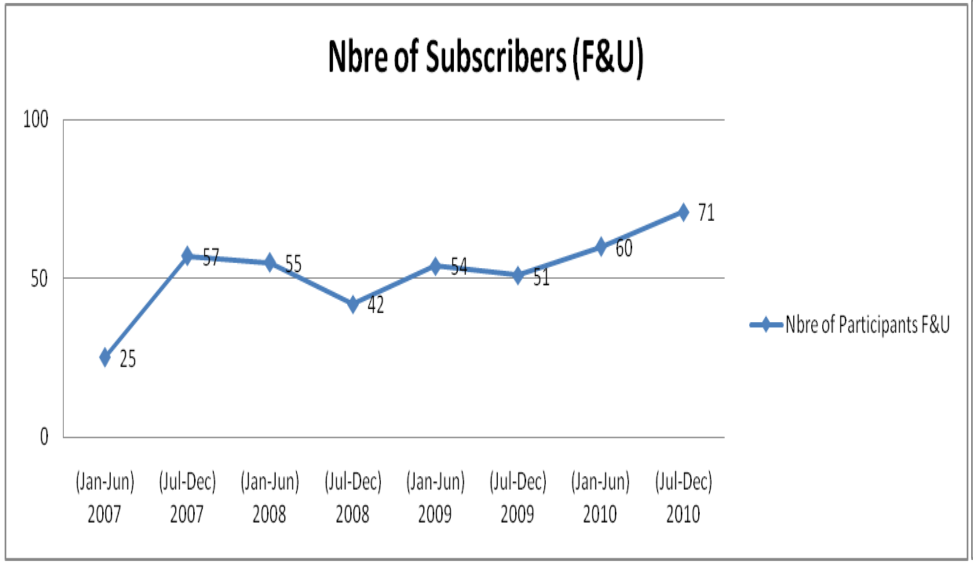
1.2	November 14, 2008	(Rhino)	Savings Enhancements
1.1	July 15, 2008		Enhanced Reporting Module, PPI, Support for Individual Lending
1.0	October 2006		Beta release for Lighthouse Partners

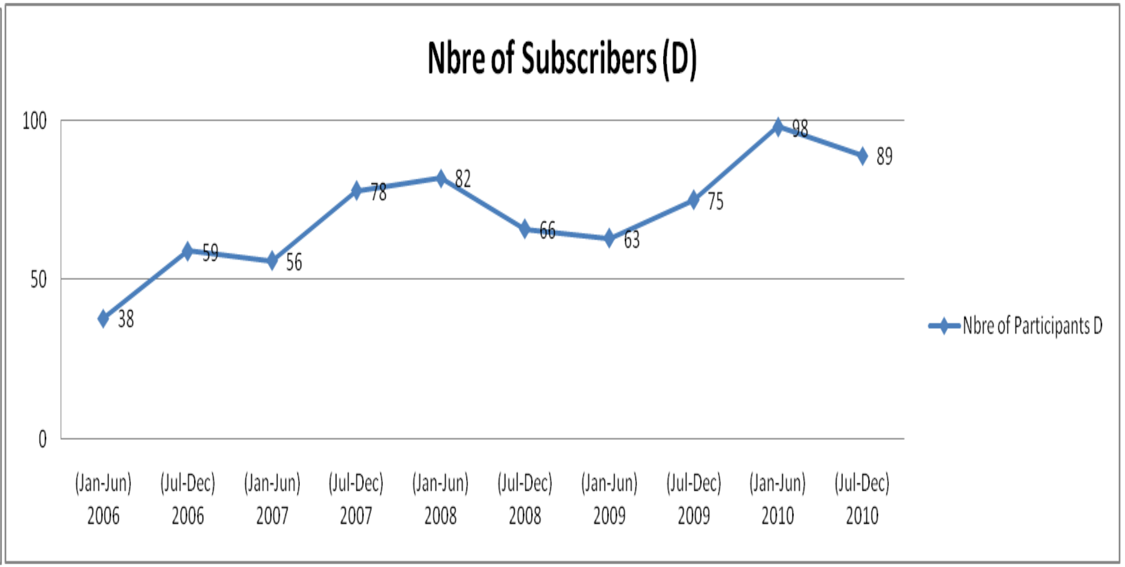
From 01/01/2005 to 31/12/2011
Source: Mifos.org/Roadmap/ (Last accessed 25 11 2011)

Appendix 3: MLs' Activity







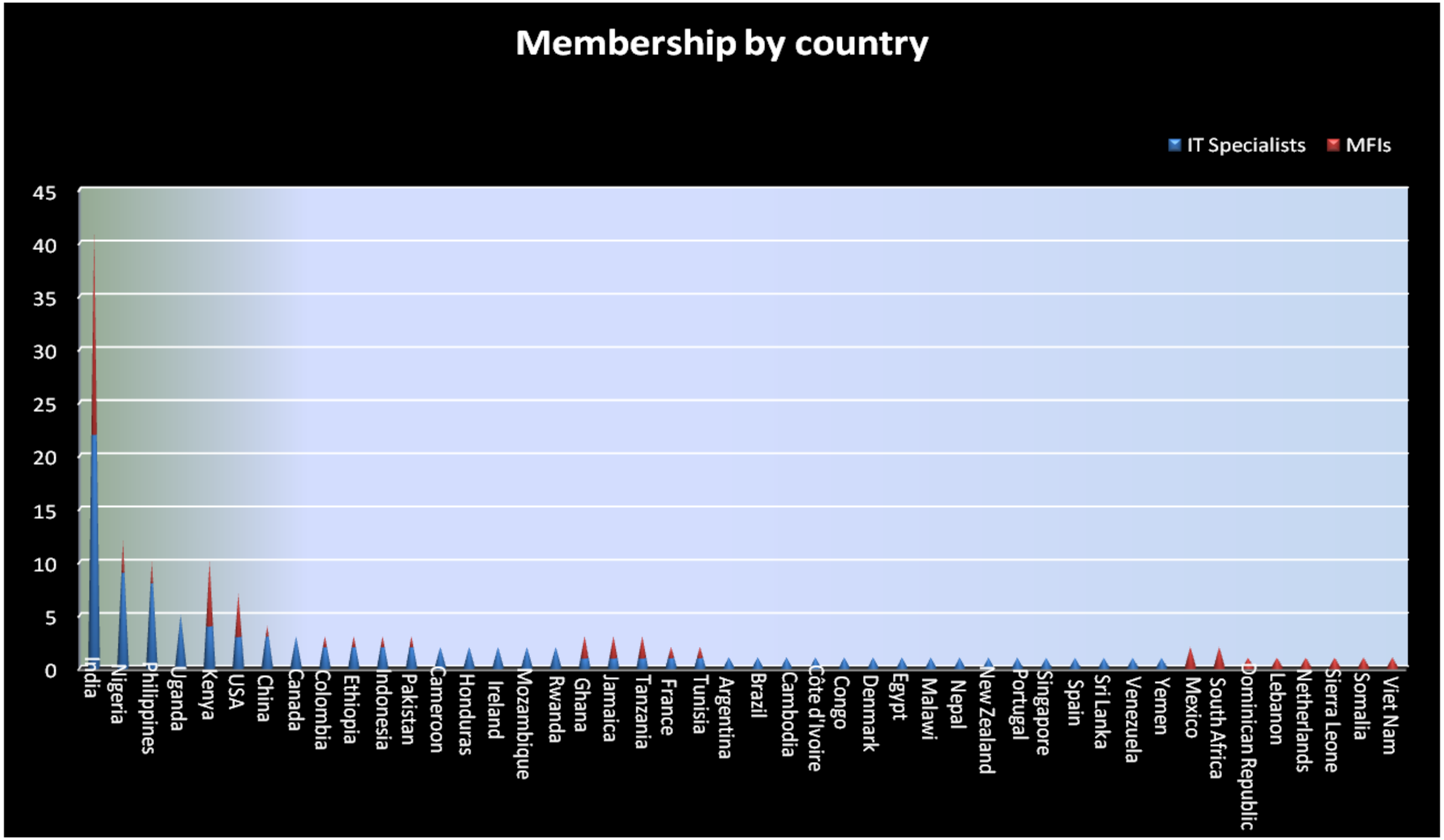


	(Jan-Jun) 2006	(Jul-Dec) 2006	(Jan-Jun) 2007	(Jul-Dec) 2007	(Jan-Jun) 2008	(Jul-Dec) 2008	(Jan-Jun) 2009	(Jul-Dec) 2009	(Jan-Jun) 2010	(Jul-Dec) 2010	2011
Nbre of Participants F&U	0	0	25	57	55	42	54	51	60	71	
Nbre of Messages F&U	0	0	265	350	293	235	230	254	464	835	
Nbre of Messages D	604	541	753	1138	1301	606	416	1089	1224	1345	
Nbre of Participants D	38	59	56	78	82	66	63	75	98	89	

Code Downloads

-Source: SourceForge.org, accessed on 02/02/2011-

Appendix 4: Membership in MLs by Country



Appendix 5: Emails Analysis

This appendix contains a list of 28 illustrations that I reconstructed on the basis of a random selection of over 106 posts (where relevant I selected whole post threads –that is interlinked group of posts) in the developers, functional and users MLs covering the entire period of observation.
These illustrations represent the empirical material supporting the analysis in Analysis Chapter III. Each illustration is contained in a box composed of four columns.
The first column contains the illustration reference number that is I (for illustration) and a sequence number, for example: I-1, I-2, etc. Column two contains in separate lines the reference number of the original posts that were described and analysed in the illustration, and their dates of posting in the MLs.
Column three contains a brief description of the profile of the post sender, or/and the profile of all who have posted to the thread under scrutiny. Column four contains a summary of the post, posts or threads that are described in the illustration and my interpretation. Sometimes, extracts of the posts are included too.
The 106 posts included in this appendix cover all the profile groups. The sample of threads referenced was selected in order to illustrate the analysis developed in the Analysis Chapter III. It does not aim to be representative of the population of the posts and threads but rather was chosen purposely to illustrate the mechanisms on which the research is focussed.
Posts' snapshots were captured and copied into a file followed by a reference number that starts with M (for message) and a number going from 1 to 106 following the order of their citation in this Appendix. Because of its length, this file could not be added as another appendix.

`I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-1	23/03/2006 **PostFile-M1**	**Manesh:** Aditi- GTC IT partner Mifos Team Leader.	These three posts are part of a thread that discusses early design decisions in Mifos. The thread starts with posts that were sent by volunteer developers, like Sam Lee, William Pietri and Steve Mushero. They review several points in Mifos code design and architecture, questioning features; the rationale behind some design decisions; asking for clarifications; proposing solutions and specifying potential scenarios. The first row in this table refers to Manesh's reply. Here, he answers Sam's questions (which are referred to in the post). Manesh's answer is divided to address each point of the original post separately. He makes important clarifications and acknowledges gaps in design and design documentation. He announces the scheduling of complementary tasks. The second post (2nd row) announces a virtual meeting, to enable the encounter between volunteers and Aditi members. Purpose: run through the new design of Mifos architecture with Aditi, outsourcing team, and GTC admin. Open to everyone. The third post (Sam) adds new detailed questions, reviews former clarifications and signals unclear aspects, or eventual problems to be discussed in the meeting. The thread ends with a post, including in attachment the notes from the meeting (for posters who could not make it). Another volunteer posts to the thread new questions and proposes solutions building on the notes that were circulated. This illustration is about the cumulative and incremental process of knowledge production in Mifos hybrid community. Particularly, this discussion-thread delineates an encounter stage between three stakeholders including three volunteers, GTC admin, and Aditi representative (GTC's outsourcing team). Information is transferred back to and fro between the involved volunteer developers and Aditi's representative and from the latter to the volunteers. This occurs through an iterative process of question-answering. Through questions, volunteer developers push Aditi's representative to account for some design choices and justify them. Manesh's answer provides necessary clarifications that enable the volunteers to step in the process of design and contribute. James, GTC technical director is also brokering the relation between these two groups. His decision to organise a meeting allows bringing all these players together into a 'virtual' face-to-face situation, where it is easier to discuss processes and move towards a consensus. The meeting aim to also facilitate future collaboration, creating a
	24/03/2006 **PostFile-M2**	**James Dailey:** GTC Admin GTC 1st technical director -2006 only in MLs.	
	30/03/2006 **PostFile-M3**	**Sam Lee**: Volunteer Developer Code contributor. Active poster in the MLs during the beginning of the project only (first months of 2006).	

			direct link between these separated profile groups. Finally, the thread is a mean to circulate information and update subscribers. Towards its end, a volunteer subscriber posts his meeting notes. By doing so, he ensures the continuity of collaboration by updating those who did not attend the meeting. Involved subscribers are thus able to build on the notes and take the discussion a step further by reviewing new elements, asking new questions and providing new solutions/options.
I-Ref.	**Msg. Date and Ref.**	**Profile Group & Information about the Poster**	**Messages/Threads Story**
I-2	31/03/2006 **PostFile-M4**	**Karuna Krishnaswamy**: Mifos Specialist Local IT vendor and individual consultant took part in Mifos roll out at Grameen Koota (GK) over the first half of 2006.	This post is part of a thread that discusses localisation issues for one of the first Mifos users in India, Grameen Koota (GK). Karuna's first post asks several questions that are related to Mifos roll out in GK's branches. Karuna goes into details, explaining the MFI's current OS, and other specificities of their IT environment. He receives four replies. First, James re-frames the questions for the sake of clarity. He mainly translates Karuna's post as following: *"… 1*-Linux/Windows server (admin issues); 2* Host internally at GK vs. external hosting in India (reliability issues); 3* Hosting in India vs. hosting outside of India (bandwidth issues)…"* Then, a volunteer suggests that GK should go for open source Operating System (OS), Linux. Other posts discuss this choice. Aditi member, Manesh joins the thread; he announces that Mifos cannot run on Linux without prior testing. He adds that more tests are to be-scheduled soon. Karuna replies. He thinks it is too premature for GK to work on Linux, given the lack of internal IT skills. Karuna's initial questions were specific to his client, GK. James has re-written his post, in order to facilitate communication with the other developers. By doing so, he also created a localisation template. Besides, selecting an OS is not a choice you make based on users' preferences. For example, Mifos early version could only work on Windows; if it were to be run on Linux, this would have required changes to Mifos code. This conversation about the need to localisation in GK has offered an opportunity to speed up work on Mifos integration with other OS, like Linux. In this sense, it also shows how use is interdependent with continuous re-design.

I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-3	12/04/2006 **PostFile-M5**	**Emily Tucker**: GTC Admin Director of Mifos –she is one of the first admin leaders. She remained an active poster over the entire period of observation.	This thread is about ensuring the transfer of knowledge from the users to the developers. 1st post is Emily's. She answers a previous post by volunteer developer, Sam. He has questioned the rationale behind the "Savings data in bulk entry" feature. Emily provides extended clarifications about the practices of MFIs she knows. Sam replies; he wants to check a few more things. Emily replies with more information. She posts a link to Mifos java.net where she puts a detailed description of the feature and its related practice. This illustration highlights Emily's role as a spokesperson for the MFIs. Her knowledge of the activity and practices of MFIs enables her to ensure their translation into detailed requirements. First, she passes on such information on an individual basis. Then, the process of knowledge transfer becomes gradually structured, as she creates material and a standard pipeline for features' documentation that does not depend necessarily on her, and also remains editable.
	13/04/2006 **PostFile-M6**	**Emily Tucker**	
I-4	17/05/2006 **PostFile-M7**	**Devendra Patel**: A local IT vendor.	The four rows here refer to posts that are on the same topic, but not in the same thread. The first two were posted in 2006. The other two are in 2011. The first and third posts (Devendra and Arindam) show a new subscriber asking for help on an installation error. In the two cases, the reply goes from the specific to the generic and links with a step-by-step guideline in the developers' wiki. Although the posts ask about a similar issue, the links to the wiki are different. This is because links are not permanent. Information in wiki is updated frequently; posts enable the updating of links to pages. This illustration shows a template for answers about a redundant installation problem, saving on future posts and reply time and allowing the re-use of information by current and future posters/listeners. It is also important to notice that this 'live' system classification does not hamper discussions, nor the possibility that a thread becomes more specific or about solving one particular problem. In Both threads (2006 and 2011), the information seekers (Devendra and Arindam) continue to post to the thread. They first replied to check what they understood. Then they got a new error message, which they also posted with a new set of questions. In 2011, one reply provided the information seeker with information to check other places, etc.
	17/05/2006 **PostFile-M8**	**William Pietri**: Volunteer developer Experienced developer and early volunteer active in 2006.	
	08/06/2011 **PostFile-M9**	**Arindam Das**: Volunteer developer	
	08/06/2011 **PostFile-M10**	**Van Mittal Henkle:** GTC Admin Long-term subscriber and core developer at GTC	

I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-5	23/07/2006 **PostFile-M11**	**Manoj Bharadway:** Volunteer Developer. Irregular poster	This thread is about an installation issue. Manoj, a new volunteer, posts for help. He got an error message when running Mifos build for the first time. An Aditi member, Kiran replies back. He has intercepted the error and diagnosed a failure in the connection with the database. He offers Manoj the following tip: *"The database needs to be mifos, the user name is root, and password is mysql. Try this and let us know if the problem still exists..."* A GTC administrator, George joins. He thinks that the problem is caused by the absence of configuration options when a user runs the installation files. He asks Manoj to make them "*user-defined at time of deployment."* Emily adds her contribution to George's. She asks the Aditi team to include this point in their to do list: "*…if this isn't on the list of remaining tasks to do, let's add it to one of the iterations. In the meantime, I've added it to iteration 10.*" Kiran replies that the file is already user-defined. In the meantime, Manoj has fixed his problem. Yet, George sends a second post: "*… for my deployment of Mifos on my laptop I've never actually built - I just get the war file and deploy it. Do I have an option of changing the authentication information at that time? If not, I don't think we can call this user-defined - it is developer defined at build time but not at deploy time.*" The final post in the thread sent by Aditi project leader Manesh, confirms that the team has actually planned to change the properties of the file and make it 'modifiable' by the user in iteration 13. This illustration shows an important aspect of socialisation. Manoj involuntarily signals a problem which George reframes from a user-perspective. In fact, George did not behave here as a developer; rather he acted like a user. He identified the problem and framed so that Aditi contractors can see it too. If the GTC team was alone in this project, George would not be able to see things from a different perspective. The collaboration between such various knowledge/interest groups has enabled this 'stepping out from one's shoes, looking at the problem from someone else's perspective and bouncing back'. Roles are indeed predefined. However members have performed a sort of overlapping membership. This enhances the performance of the code and its design substantially.
	24/07/2006 **PostFile-M10**	**Kiran Chakravarthy:** Aditi-GTC IT partner	
	24/07/2006 **PostFile-M13**	**George Conard:** GTC Admin: Mifos project director until Mifos transition to community led social enterprise in 2011	
	24/07/2006 **PostFile-M14**	**Emily Tucker**: GTC Admin: Director of Mifos –she is one of the first admin leaders. Remained an active poster over the entire period of observation.	
	26/07/2006 **PostFile-M15**	**George Conard:**	
	03/08/2006 **PostFile-M16**	**Manesh:** Aditi- GTC IT partner Team leader at Aditi	

I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-6	17/05/2007 **PostFile-M17**	**Emily Tucker**: GTC Admin Director of Mifos –she is one of the first 'admin' leaders. Remained an active poster over the entire period of observation.	This thread is about specifying ('specking') requirements of a feature called ‘Offsetting’. Emily starts the thread with a post addressed to Sumeetha (Aditi). It announces **GTC’s decision** to start ‘specking’ a new feature that is required by one of its Philippines lighthouse partners, ABS-CBN. The post explains the MFI’s related practice and introduces, Sumit, a third party who represents a local IT vendor commissioned to localise Mifos on behalf of ABS-CBN. Emily provides a basic summary of the MFI’s practice and addresses several questions to Sumit about its requirements. This post can be seen as an initial ‘terms of reference’ document that GTC passes on to Aditi, while at the same time connecting Aditi to Sumit (here representing the MFI), in order to ensure the continuity of specking and the sharing of responsibility. Emily follows her first post with a second, where she attaches Sumit’s document providing detailed information about the feature requirements. Sumit has communicated this document directly to Emily off the ML. Emily sends the attachment to Sumeetha (Aditi), thus making it public and part of the feature official requirements. Sumeetha posts back to the thread. She is already processing the requirements. In her post, she reviews the spec document and asks specific questions. For example, she signals possible exceptions and asks how to go about them; she also proposes things to enable design, etc. Her post is answered by Emily. A few more Question-answer iterations between them follow. Sumeetha posts again to the thread. She announces that there is now an output-feature that can be tested. She creates links to the developers’ wiki and demo sites, showing the UI and allowing testing. Her post is followed by Marie Valdez’, GTC’ contractor in the Philippines. Marie posts to the thread and introduces the case of three other Grameen’s MFI partners in the Philippines who are interested in the same feature. The post explains the MFIs’ ‘offsetting’ practices and proposes a new addition to the ongoing specifications. Emily comments on her post, asking for clarifications. She also addresses Sumit in the same post, replying to his previous off-ML message. She asks him to clarify what should be changed in the feature’s current design to improve its fit with ABS-CBN’ ‘offsetting’ practice. The following posts are about trying to negotiate a common understanding between the four stakeholders, integrate the necessary changes and move on. Again, this illustration shows the interdependence between subscribers’ roles and how these change within the settings of the interaction through the situated information arrangements, the structure of exchanges, and communication proxies. Emily starts the conversation instructing Sumeetha what to do. Her requirement template is
	18/05/2007 **PostFile-M18**	**Emily Tucker**	
	18/05/2007 **PostFile-M19**	**Sumeetha:** Aditi- GTC IT partner Mifos team developer	
	18/05/2007 **PostFile-M20**	**Sumeetha**	
	18/05/2007 **PostFile-M21**	**Marie Valdez:** Individual contractor- GTC IT partner Active poster. Limited participation. Was in charge of Mifos regional deployment in the Philippines	
	18/05/2007 **PostFile-M22**	**Emily Tucker**	

	19/05/2007 **PostFile-M23**	**Sumit**: Mifos Specialist Head of Local IT vendor, JSPL in Philippines. At the time of the post, he represents the MFI, SECDEP, in the Philippines	dependent on Sumit's input. She is an information seeker, who must listen and formalise members' shared experience. So, she becomes part of the task. She compiles the exchanged information, working towards a comprehensive frame for the selected feature. To do that, she intermediates the relation between Sumeetha, Sumit, Marie and the other involved MFIs –which are 'voiced' by Marie. Role shifting is reflected through the content of posts and structure of threads. Questions and clarifications frame the purpose of the interaction and enable communication. Threads follow though a form of systematic protocols. Posts contain specific questions, whereby replies break the answers down so as to acknowledge each point separately. This allows subscribers to continue building task-related knowledge by moving between points separately through citations. Design progress and situated consensus are gradually reached through small questions and answers iterations.

I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-7	21/03/2009 **PostFile-M24**	**Abu Zaher**: Volunteer Developer Software engineer student in Bangladesh –specialised in OSS technologies. Summer Google of Code (SGoC) candidate.	These three messages are part of the same thread. Abu Zaher first introduces himself. He is: *"…an undergrad student and intend to participate in GSoC '09…"* He is interested in two Mifos code objects: the "Data Migration Tool" and "Advanced Unit Test improvement". He states his work/study background: *"I have work experience in JavaEE tech like Spring/Hibernate/Oracle/Mysql as part of my Academic Projects"*. He asks the project administrators where he can fit. Adam replies. His post is addressed to all current and future GSoC 2009 applicants. Adam writes clear instructions about, what is the project purpose, how to proceed with applications and what the students should expect. He posts links to Mifos developers' wikis. There is an open template that students can fill in. Another volunteer student Ramnik replies to Adam's post, asking for guidance on his application. Adam provides more information. He announces that the wiki page was updated and gives practical tips and instructions to the new candidate. Adam's replies are shaped in the same way of using quotations, breaking down the initial post into several points, etc. He answers each of the points separately. Adam gave his answer in a neutral and professional tone. He did not show empathy with the personal tone that Abu Zaher has used in his post. His answer takes the content of the senders' post from the specific to the general. By doing so he creates a new information pipeline that is related to the GSoC event. This can be searched, or overheard by interested subscribers. He also defined the terms of the future relation between these potential participants (SGoC participants) and GTC administrators.
	25/03/2009 **PostFile-M25** 26/03/2009 **PostFile-M26**	**Adam Monsen:** GTC Admin Senior Developer, active subscriber. Technical leader; In charge of major design processes at GTC.	

I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-8	18/05/2009 **PostFile-M27** 20/05/2009 **PostFile-M28** 27/05/2009 **PostFile-M29** **PostFile-M30** 29/05/2009 **PostFile-M29**	**Udai Gupta:** Volunteer Developer Active subscriber. Started as volunteer in the SGoC 2009, became GTC contractor in India, then a volunteer again. Mentored some of the SGoC students 2010; Gave support to Indian GTC partners (MFIs) Made important contributions to code with tests, patches, extra LOC, etc. **Adam Monsen** Senior Developer, active subscriber. Technical leader; In charge of major design processes at GTC.	This thread is a 15-post-long conversation between Udai and Adam. The 1st post is a broadcast message from Udai; he announces that he has renamed/merged some tests and attaches files with related code changes. He asks for feedback. Adam replies back. He validates his output as follows: "*looks good…*". He also suggests a few modifications, and what Udai should be doing next. He posts complementary information and guidelines that are meant to improve Udai's general understanding of the task. This thread shows posts reflecting a pre-defined arrangement of roles and hierarchies. Udai discusses improvements based on his background knowledge. By providing detailed clarifications on how to do it, he makes it possible for Adam to agree and validate the change. In contrast, Adam gives assurance that Udai's participation does not transgress any implicit/explicit rule, by validating his posts. He also takes responsibility for the task, by making direct corrections. But at the same time he ascertains his position as task leader, by giving tips, 'solving' unresolved issues and sharing knowledge publicly. The thread also includes references (citations) to related discussions that occurred previously on IRC. This shows the continuity of collaboration and knowledge sharing over different media of communication, making pieces of information public and accountable, once forwarded to the MLs. Communication is mainly text based, which facilitates the transfer of information, its storing and its use as a reference point inside related conversations. It can also be retrieved through text searches.

I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-9	18/08/2009 **PostFile-M30**	**Johan Hilding**: Volunteer Developer -SGoC candidate 2009. Very active during the whole period of his Summer School.	Johan Hilding, another SGoC recruits starts the thread. He shares what he has done during his summer involvement, thus framing his contribution to the project. He is going back to school, so he promises to continue his participation. Van Mittal's reply acknowledges his contribution and confirms the impact of his work on the project publicly. He writes: "*Your efforts have helped to quickly increase our automated acceptance test suite coverage. This will help us to do more frequent releases and allow us to move forward with more significant changes to Mifos internals while knowing we haven't broken anything*." Jeff Brewster, Johan's mentor from the GTC posts to the thread. He too recognises Johan merits and highlights his commitment to his task. Other recognition posts from peer developers follow, mainly from GTC administrator, like Adam Feuer, Kay Chau, Adam Monsen. Krishnan's post is next. He comments on the previous posts in the thread, stressing the importance of such public recognition in the participation of volunteers to Mifos. He claims the 'marketisation' of volunteers' efforts creates incentives for participation and helps recruiting more developers for Mifos. He then suggests a special page on Mifos.org to highlight volunteer developers' contributions. He also asks to interview them to publish their experiences in other sites online. His post is answered by Edward Cable, GTC community lead, who decides to take his idea forward and create a page to acknowledge volunteers' work.
	18/08/2009 **PostFile-M32**	**Van Mittal Henkle:** GTC Admin Long-term subscriber and senior GTC developer	
	20/08/2009 **PostFile-M33**	**Jeff Brewster:** GTC Admin Employed developer	
	21/08/2009 **PostFile-M34**	**Krishnan Mani:** Mifos Specialist Local IT vendor, volunteer and active proponent of ICTs' use for social enterprise. He provided IT support for Mifos localisation.	
	21/08/2009 **PostFile-M35**	**Edward Cable**: GTC Admin Long-term subscriber. Mifos web administrator, community mentor.	

I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-10	26/02/2010 **PostFile-M36**	**Harsha**: Volunteer Developer Limited contribution. Irregular subscriber	Harsha's post (1st row) is an introduction. He is "*a graduate of Computer Engineering science*". He has a general interest in the project. He introduces his work/study background and asks the community to point to particular bugs. Van answers this post. He uses the now standard technique of resituating a personal question in the general case, by reminding how to introduce one's work and input propositions. He links his post to sources of documentation and general answers in the developers' wiki. He thus creates a path for local knowledge transfer that he shares with the MLs. Future interested volunteers can skim through posts like this one and know what to do. In this sense the MLs serve as archives or data repository. Adam posts a second reply. He adds clarifications to Van's post, by specifying another link with more information on the SGoC procedure for 2010. He thus ensures the continuity of this path, by updating the post rather than initiating a new topic.
	26/02/2010 **PostFile-M37**	**Van Mittal Henkle** GTC administrator	
	26/02/2010 **PostFile-M38**	**Adam Monsen** GTC Administrator	

I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-11	10/12/2009 **PostFile-M39**	**Adam Monsen** GTC Administrator	Adam's post (1st row) announces that it is not possible to have system control versioning (svn) and issue tracker integration on the Atlassian JIRA –this is a web-enabled project tracker for distributed software production. Adam's post shows the answer of Atlassian Support, where it is indicated that such integration is only possible if the project's subversion repository is also hosted in their server –Mifos subversion was at that time hosted on SourceForge.net, after it was migrated from java.net. Adam concludes that it is better to stick with SourceForge.net, while considering upgrading from svn to VCS (another format for subversioning) in the future. This is an important decision, as it affects the tools that are used to organise developers' code commits and bug fixes. Yet, Adam's post only got 1 reply from Adam Feuer (GTC), who basically agrees. Four months later, things

	09/04/2010 **PostFile-M40** 15/04/2010 **PostFile-M42**	**Michael Vorburger**: Volunteer Developer Recently joined the MLs. Active code contributor. Has achieved many improvements on Mifos code and platform. He tried to recruit volunteer developers and promoted Mifos in software conferences and social events (see Chap. II)	change. Michael Vorburger, a volunteer developer jumps into the thread. He has searched the MLs for a word that is related to the topic that Adam discussed before. He found the thread, so decided to continue the conversation. Obviously, the integration issue was still a "matter of concern" (Latour 2004), as Michael succeeds in reanimating the thread, triggering more replies and a second round of debate. In his post, Michael writes that he finds Atlassian 'dumb' to insist on having the subversion repository on Studio server. But he adds that it is a "shame" not to have an integrated issue/svn tracker in the Mifos project -thus reasserting the importance of the search for a solution. He moves on to discuss another JIRA plugin (Mercurial), which should enable Mifos subversion repository migration to VCS. He raises questions about the implications of such migration. He writes that it might *"hold people off/back"*. He bounces a few ideas about alternatives. He also backs up his views by referring to the latest practice in the field: "*Apparently people do this, and there is some Hg [Hudson] support for it - so I heard in a Mercurial presentation I attended the other night (see slides 35-36 on PDF first link…)*. He adds more references and links to online documents. He concludes: *"Hudson can do this (I've done it @ work), and am willing to fiddle with this to set it up if you want to give me admin on Hudson (uid vorburger)?* ". Adam replies (10/04/2010). He writes that he has already emailed Atlassian Support about Mercurial plugin and includes extracts of their reply. Adam's post shows that he has already decided to go about the migration (splitting several Mifos directories and hosting them in separate Mercurial repositories…). But, he welcomes Michael's help, asking if he would test Mercurial plugin in his own JIRA instance. Adam also comments on Michael's links: *"… That seems to show subversion being used as the central/master repository, and hg being used as client software. I'm not familiar with how a subversion client could connect with an hg server…*"
	10/04/2010 **PostFile-M41** 15/04/2010	**Adam Monsen** GTC	The thread carries on with another post by Michael. He writes that Mifos developers' wiki should contain the information that Adam has provided in his last post. He adds that he personally tried to update the website, but got insufficient privileges. He also confirms that the configuration of the Hudson repository is now almost done. Michael is also careful not to step over his privileges. He had decided not to go with a Hudson update, as he considered that *"it is safer if one of you [GTC admins] would like to do that first may be?"* Adam replies: *"…rmm, I'm not sure about the permissions (Ed [Edward Cable], can you help with this?). But even if you could edit it, there may be other problems. See [link]. We are migrating content off the existing*

	PostFile-M43	Administrator	*mifos.org site eventually (I'm not sure exactly when)…*" Adam also thanks Michael for his contribution and promises to do the update. Adam posts to the thread again. He did the upgrade and 'authorises' Michael to finish configuring the Mecurial plugin. The thread continues with Michael's post. He reports his progress. He also signals a new error, when he tried to finish setting up Mercurial plugin. He guessed what might have gone wrong. He finishes his message this way: "*…BUT Hudson STILL says "This is a valid URL but it doesn't look like JIRA" ! :-(Either it's caching it somehow stupidly, would you mind trying a quick Hudson restart? If that doesn't help... I don't know; could contact Atlassian Studio support..*". This illustration is about continuous redesign and threads' role in keeping the community memory alive over time. Searching the MLs has enabled Michael to re-activate a dying thread and trigger debate about the possible choices to achieve subverting and issue tracking integration. It creates a **necessary pause** where Adam, as decision maker, could pounder the implications of certain choices and hear the opinion of someone whose experience can make a difference. Again the organisational hierarchy of the GTC team imposes itself on the community interactions and labour. The GTC group remains a central brokering node, the major actor and decision maker in the community structure. Yet, the participation of volunteers in the dynamic of task distribution and execution creates a disruption. When Michael jumped into the conversational thread, he created a momentum in the task process. What followed was a gradual and consensual process of knowledge building that added as much to the decision maker, Adam as to Michael. The first is pressed to communicate information about his choices, thus disentangling what was obscure and unclear. The second is comforted in his effort to collaborate. He has also provided an input into the design.

	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-13	14/04/2010 **PostFile-M51**	**Jeff Brewster:** GTC Administrator Core developer at Grameen Tech Centre	Jeff Brewster's posts answers a question that was posted by another subscriber in the developers' wiki. Jeff writes "*…You mentioned in mifosforge.jira.com issue MIFOS-2825:* *"Now I'm trying to figure out why I don't get a loan instance name… when trying to create a loan account for an active borrower. Maybe you have a suggestion?"… Can you confirm that your loan product is "Active"? I'm moving this question to our users list so others can comment on suggestions and closing the original JIRA issue*." This post illustrates the interconnectivity between the platform's data artefacts. It creates a bridge between a question that is posted in the wiki and its answer in the MLs. It also makes the question and the answer public, and searchable. In this sense, it makes them open to debate. This example has only one single post, which means that the issue was closed. Sending posts for subscribers' scrutiny creates indeed a time window in the task process. Yet, it is not infinite, as the task executor is free to move on. But the digital imprint that his post leaves means that it can be potentially re-opened again.
I-14	26/04/2010 **PostFile-M52** 27/04/2010 **PostFile-M53**	**Adam Monsen** GTC Administrator -lead of GSoC program 2010 2011 **Mohit Mishra** Volunteer Developer -Candidate in GSoC 2010. Has only posted once	Adam first message is about the results of the GSoC 2010 contest. He posts a link to the students' projects which win this competition. He writes, "*…there was strong interest in the project and a limited number of slots. If your proposal was not one of those chosen this year, we encourage you to apply again next year…We may eventually be able to discuss reasons for your acceptance or refusal with each of you individually, but we have many people to talk with, so please be patient*." Mohit replies to the thread; "*hello Adam, I would like to have a discussion with John Woodlock regarding the reasons leading to disapproval of my proposal for UI refactoring project. Please reply to this thread and also send me the proposal that has been approved for the same*." John promises that he will reply soon. John did not follow up, as the thread ends after another subscriber posted a link to the list of accepted proposals. Mohit has not posted back to Mifos MLs. Posts

	28/04/2010 **PostFile-M54**	**John Woodlock** Volunteer and GTC contractor	are also about broken promises. They keep the history of constructive, buzzing debates, but they also record mismanagement and loss of commitment.
I-Ref.	**Msg. Date and Ref.**	**Profile Group & Information about the Poster**	**Messages/Threads Story**
I-15	04/05/2010 **PostFile-M55** 05/05/2010 **PostFile-M56**	**Sergio Alfredo Segura Gomez** Mifos Specialist Loacl IT vendor in Mexico. Localised Mifos for local MFIs and is a regular poster over 2009-2010 **Ryan Whitney** GTC admin Mifos team, point of contact for MFIs	This thread is about helping a new subscriber to the MLs. Sergio is a local IT vendor in Mexico. He searches the Internet for a loan tracking solution for MFIs and stumbles across Mifos. He posts to the developers' ML to check if Mifos has a feature that allows his client (MFI) to track loan repayments after six months from their Issue Date. Sergio includes two scenarios. First, when loan instalment is interest-based only, and when it also includes the principal (loan amortisement). Sergio finishes his post with an example. Ryan is MFIs vis-à-vis at GTC. He answers Sergio. First, he re-directs the conversation to users' ML. He confirms that Mifos 'can do it' and clarifies how to configure the loan conditions of scenarios 1 and 2 in Mifos user interface. He also posts a link to another thread in the users' list that provides a detailed example about interest calculation. This illustration is about users' support. After this post, Sergio has deployed and used Mifos. He continued to post to the MLs. It is also about how MLs become a database for the project. By re-directing the conversation to users' ML, Ryan has contributed to make it 'richer', as now it includes several threads about the same type of issues.

I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-16	[12/08/2010-25/08/2010] **PostFile-M57** **PostFile-M58** **PostFile-M59** **PostFile-M60** **PostFile-M61** **PostFile-M62**	**-Sergio Alfredo Segura Gomez** Mifos Specialist **-Ryan** Whitney GTC administrator **-Adam Feuer:** GTC Lead Software Developer, Expert in Agile and Lean Development App and long term MLs subscriber **-Udai Gupta:** Volunteer Developer Long-term subscriber and core developer. He started as a volunteer in the SGoC 2009. Became an Indian-based contractor. Then volunteer again. He mentored some SGoC students in 2010. Provided support to Indian	This illustration includes more than one thread. It aims to bring the focus on one particular Mifos user, Sergio, a local IT vendor in Mexico. Sergio provided Mifos support to his client MFI. In order to customise Mifos application, he first tried to build personalised reports for his client. He posted to the user MLs to ask about the Mifos database, the relationships between tables, support on MYSQL and how to import/export data. His posting behaviour has remained consistent throughout, as he generally posts to ask questions, clarifications or request help regarding errors. However, Sergio is not a good English speaker. His posts included generally questions that may be qualified as poorly formulated which made the job of the person who tried to help challenging. In August 2010, Sergio wanted to design a new interest calculation feature and a few other options that were asked by his client (a local MFI). To do that, he needed to install Mifos source code. This has proven more difficult than he expected. Four long threads followed where Sergio was clearly struggling to install Mifos First a long thread was triggered by Manoj's post –a Nepal-based IT vendor- as he run into an error when he tried to build Mifos the application for the first time. Sergio took this opportunity to signal his own problem, as following : *"hi i am getting the same error, …".* Stanley, a volunteer developer and contributor to Mifos code posted back a five-step workflow to get him started. This was not sufficient. Sergio needed more serious help, someone to 'walk him' through the installation process. In the meantime, Sergio continued to send desperate posts that described longer and longer error messages. His questions also showed a lack of experience in the use of the libraries and tools that accompany Mifos built, which, combined with a limited mastering of the English

		Grameen MFI partners, contributed to code with tests, patches, extra LOC, etc. **-Shahzada Hatim**: SGoC volunteer 2010 **-Stanley Kwok**: OSS Developer-based in Canada	language, presented a serious handicap. Over May-August 2010, Sergio sent probably a hundred messages to the Users' and Devs' newsgroups asking questions and help. Surprisingly, his posts were always answered. Most of time they triggered multi-posts conversational-threads where several subscribers provided tentative solutions, links to sources of information, tips, etc. The majority of respondents were GTC employees and contractors such as Ryan (GTC), Adam, Van Mittal, but also volunteers like Udai, Stanley and Shahzada. In one thread, Adam Feuer –GTC developer- posted back to Sergio five times. In another thread, Udai answered ten times in less than three days. Both tried to provide simple explanations about the functioning of Mifos code components, how to install tools, how to configure them, etc. They guided him, by checking the steps he accomplished, one by one, for example: *"…Are you building from the root of the project? (The directory that contains application/, acceptance Tests/, APIs/, etc.?..."' or "Sergio, 'mvn clean install' means install all the maven artefacts into my local maven repository… "; or "…That should work... so something else is amiss. What happens when you cd into the api/ directory and do 'mvn clean install'?..."; "Sergio, Please refer wiki pages about set up and configuration [link]. You need to have correct database properties for mifos, if you are not using default mifos mysql user..." etc.* Through question-answer iterations, Udai, Adam and others were able to overcome Sergio's hesitant English and inexperience and provide effective help. They supported Sergio in achieving a gradual understanding of some of the tools that were involved in the process. At the beginning Sergio's replies looked like this: *"…i am stuck, why why why? why …"; "Adam thank you for help me… mmm sorry i don't understand, is my first time using maven…i did set the m2 variable and m2_home but i did not set any local repository…"*; *"what do you mean with how to generate sure fire report only? at this*

point i don't know even what is that file or what is its purpose…"; etc.

After several trials and errors, his posts showed efforts to find solutions by himself:

> *"i downloaded the head from git. i did "mvn clean install" and i think it works. i don't have the snapshot error. i have this…"; "i am building 1.4.x because 1.5.x doesn't builds and head version nether. but maybe you can help me with this…"; "Udai thank you, i really appreciate your help ok, i am not interest in use the eclipse plugin, i think is very unstable…"; "Udai, ok, i did it. i have deleted the MIFOS_CONF variable, i dropped …, i created …, the connection works";* etc.

After a few weeks and dozens of posts Sergio felt again helpless and unmotivated:

> *"…hi it's me again Sergio. i don't know how to start this [Mifos] i have tried everything that you tell me, and i still can't build mifos…"*. Stanley answered, starting his post as following: *"I feel your pain :(You can ignore the fatal error messages you see in Mifos.log… Sounds like you are bogged down when maven is executing the test phase of the build cycle. You can tell maven to skip the tests…"*

Then, there was Sergio's Eureka moment:

> *"Hi and thank you, it works, almost i think… the deploy was successful and i can see the login page…"* Then, Sergio's post again answering Stanley: *"i did something better :) well faster, i run init_mifos_password.sql in test database, and it's working :) …"*

One thing this illustration shows is that most Mifos subscribers, especially GTC people were keen to spread Mifos use. So they provided support and help relentlessly. Email exchanges in English were also challenging for some, as the majority of Mifos users are in the South.

However, this particular issue about installing Mifos source code was particularly problematic. Many developers and IT savvy users experienced difficulties running the build due to GTC choice of technology. Many reported errors and asked for help in the MLs. GTC administrators tried to limit the effects of technology complexity, by providing detailed and up-to-date documentation in the developers' wiki and Mifos website. Yet, this indirectly added to the general information overload that typically accompanies large scale projects over time. As a consequence, users posted even more to the MLs, in order to ask for the support of more experienced members to provide the right links, tips and experience-based guidance.

Another insight is about knowledge sharing and learning. Providing help and support through questions can only be a productive process of creating even more knowledge. Despite the hard time that Sergio went through to install Mifos, once he succeeded he almost transformed from a 'difficult' information seeker into a 'zealous' answer person. Indeed when Sergio was struggling to fix the install process, another subscriber posted a help message with a similar problem with installing Mifos.

Srinivassan started his post as follows:

> *"When I am trying to do an mvn clean install, it is failing in surefire report…"*

Having learned the lessons from his recent exchange with Sergio, Udai followed back and asked him to check first that the local properties of his system were all correctly configured.

At the same time, Sergio replied:

> *"make sure that you have the test database, in my case the procedure did create it, but i don't get the build for other reasons"*.

In fact, Sergio and many other subscribers were sensible to the importance of getting and providing systematic support in progressing on process tasks and in building shared knowledge. For them this is part of what it entails to participate in Mifos. Once Sergio finally solved his problem, he posted the following:

> *"…thank you for all of you that helped me with this, and took some of your time to guide me. i want to share all the process with others i don't know if in the wiki or for other media, what is your advice?... i really thank you."*.

I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-17	07/05/2010 **PostFile-M63** 23/06/2010 **PostFile-M64** 23/06/2010 **PostFile-M65** 30/07/2010 **PostFile-M66** 03/08/2010 **PostFile-M67** 12/08/2010 **PostFile-M68**	**Neil Marion dela Cruz:** Mifos Specialist Developer at Microbizone Inc (Local Vendor in the Philippines).	Neil started a thread as follows : *"I am Neil, a developer of Microbizone Inc., a Microfinance technology consultation company based in the Philippines. And our company is really happy regarding the development along with Mifos. I have a question regarding the "meeting scheduling" functionality of Mifos. We know that the default frequency of meeting option in Mifos are for weekly and for monthly only. What we want is to have an option for a scheduling on a daily basis…"* Microbizone Inc. is a management and technology consulting company dedicated to the social enterprise market in the Philippines. It is also one of GTC longstanding partners, providing diverse Mifos-based services to local MFIs (see the empirical analysis in Chapter III). The Microbizone Mifos team is a code contributor. It added to Mifos source few feature enhancements that were required by its clients. This thread is situated in this context, as Neil needed to post to the MLs, in order to introduce his purpose and ask clarifications on related pre-existing features. He asks: *"…Are the constructors of the MeetingBO class already capable of a daily basis meeting? Or I still need to code a new constructor for this? ...How should I use the constructors of the MeetingBO class to enable daily meeting option?"* Neil was answered by Ryan, who asked him to elaborate on what he wanted to do exactly. This thread stops here. Yet, Neil's efforts to achieve his goal continue through new posts and threads. Neil keeps posting; he initiates new threads or joins conversations. By so doing, I was able to see his progress on the different tasks he set to accomplish. One thread was about his struggle –as many others before him- to run and install Mifos build. In another thread, he signals a problem with the General Ledger feature: *"…Every time we run Mifos (…), the application doesn't even start. Since we already have done all the conditions defined in the Configuring Mifos guide and the error still persists, we don't anymore have an idea what we have missed out…"*. Ryan replies. His answer is no doubt that Neil and his team have done something wrong: *"I found a couple of obvious issues right away(…)"*

			After that, Neil continued to post emergent issues and discuss potential workarounds, as he and the Microbizone Mifos team explored the code and platform. His tone changes. He gradually gains confidence. In another thread, he announces that his team has now “created customized GL Codes and Financial Action Mappings”, which were successfully added to the Mifos database. Next, he demonstrates how to upgrade the last Mifos release, although there was no clear guideline on the wiki. In the meantime, he becomes more familiar with the Mifos codebase and makes some modifications. Neil continues to use the MLs as a help-line. He still posts logs of errors yet they are not ‘execution’ errors anymore. He reports errors once changes are made to the Mifos codebase. Then, Neil calls on the whole community to have a guess at what might be causing the issue. Often he succeeds in engaging a discussion around the problem, like this; *“What could be the problem? We suspect that this might be an error involving our chart…”* The last post of Neil’s shows useful information that can benefit all Mifos code users. His writes: *“We probably found out why the reports shipped along with the 1.6 package doesn't work. Since the database column names…”* This example is about knowledge building, showing its incremental, progressive aspects. Being an information broker is not a matter of pre-disposition. Microbizone, GTC’s partner is already a socially driven institution, which explicitly stated its plans to provide support to all Mifos users. Yet, its contribution as a team did take some time to crystallise. Neil had first to learn the local knowledge that is inherently embedded in the Mifos platform, including wikis, tools, data repositories, etc. By doing so, he gradually became an information broker. Presumably, he learnt something, because he then helped others learn by sharing his experience.
I-Ref.	**Msg. Date and Ref.**	**Profile Group & Information about the Poster**	**Messages/Threads Story**
I-18	12/11/2007 **PostFile-M69**	**Nagananda**: MFI User Head of IT at Grameen Koota	Nagananda posts to ask for support. He starts as follows: *“Greetings from Grameen Koota! We have an issue on our live server. Can anybody help us! (…) It so happens that sometimes mysql on our database server overshoots the number of users which is currently*

			defined as 150 (…)”.
	14/11/2007 **PostFile-M70**	**Amy Besinger**: Individual Contractor –GTC IT partners Developer GTC contractor	Grameen Koota (GK) is a microfinance NGO (MFI). It is also a GTC partner and 1st Mifos user. Nagananda is GK’s database manager. He joined Mifos MLs in 2007 and since then has become a long-term user although he posts irregularly. Amy Besinger is a GTC individual contractor and delegate for the Indian region. She made long visits to GK in Bangalore-India, where she provided technical support and assistance, particularly over Mifos roll out in the association’s branches. Nagananda’s post was initially sent to the users’ ML. Then, it was redirected to the developers’ list by Amy Besinger. Thus, James posts daily to the developers’ ML. He writes: “*Yesterday, Nagananda, who is running Mifos in production at Grameen Koota posted the plea below - basically GF's largest (known) Mifos customer. It sounded to me like a pretty big deal, requiring some sort of immediate response at a technical level. Sorry to jump on toes, but was there a response off listserv? …The likely problem here is that the database connections are being opened and not closed properly (…) Maybe this link would be helpful? [Link]*” (…) Amy posts back: “*Hi, all. James thanks for your response. Yes, the issue is bothersome, but it does ‘not’ occur with great frequency and has been a known issue for a while. GK has a workaround for the issue in place. Nagananda and I wanted to throw it out to the community to see what options were available (...)* *Don't worry--high priority issues for active deployments are quite naturally handled with due concern, and in fact I am in Bangalore for several months to generally pester Nagananda, document how Mifos is being used in the field, and identify pain points to be fixed ASAP, as well as supporting other deployments in India (...). Aliya has also looked into the issue already and likely a defect will be filed by Grameen Koota…Thanks again for noticing and please feel free to work on the patch :)”*. Nagananda adds in the next post: “*Thanks for escalating the issue! Its great that I am receiving such fast responses from you all! I have already added issues in the issue-tracker”*. This illustration highlights the strong support that GTC has provided to Mifos users in general and particularly its partners. By picking up Nagananda’s post, James conferred priority to the issue, thus attracting the attention of the other community developers. Amy and Nagananda's answers show also that the issue is being taken care of due to

			the existence of a parallel system (issue-tracker) that enables issue reporting by users directly into Mifos production website (See Mifos genealogy, chapter III of the analysis), where it can be clearly tracked and patched by developers. However, this is not all. When, I started writing this illustration, I thought this is more or less what can be said about it. I was surprised to discover later that James Dailey has really escalated the issue in another 16-posts-thread where ten subscribers, including seven volunteer developers took part. Below the story continues.
I-Ref.	**Msg. Date and Ref.**	**Profile Group & Information about the Poster**	**Messages/Threads Story**
I-19	14/11/2007	**Nagananda**: MFI User Head of IT at Grameen Koota **Amy Besinger**: Individual Contractor –GTC IT partners Developer GTC contractor **James Dailey**: GTC administrator 2005-2007: Project Founder at GTC **Sam Lee**: Volunteer Developer Experienced Open Source developer and Code contributor. Active poster in the MLs at the beginning of the project only (first months of 2006). **William Pietri:** Volunteer Developer Experienced Open Source	The discussion re-starts with James Dailey in a new thread. He addresses his post to Amy : *“I'm not your guy for patches, but I would suggest that this deserves a P1 ranking and more discussion here - if I am right with my lens on this, it is likely a fair amount of work to puzzle out what is happening and then to correct it. The current ranking is P2 [link]…Again, if I am right with understanding this and the current priorities of Mifos, it is one of those design issues that only expresses itself intermittently to the user or superuser, and gets worst over time. That is, the more that you try to use Mifos in a large institutional setting, or the longer that you run Mifos continuously, the more this error exhibits, which kills all functionality since it causes a freeze (…). But to the user, it is a minor inconvenience - which is a classic mismatch on plumbing issues (…)”.* James’ post continues. He starts a reflection on some design features, naming several developers who worked on particular code objects: *“Van was working on the persistence layer earlier [link]*”. He quotes him: "*As you have found, Mifos uses the idea of a Persistence layer. These Persistence classes in Mifos are not yet implemented in as consistent a way as we would like …*”. He then talks about another design area: *“So, that's one area of major work in plumbing. But also, how are the connection pools handled in Mifos? … I noted that Jim Kingdon was working on removing the JNDI dependency with Terry Wong as late as October 2006.”*

		developer **Tom Bostelman**: Volunteer Developer Experienced Open Source developer **Van Mittal Henkle:** GTC Administrator Long-term subscriber and senior GTC developer **Aliya Walji**: GTC administrator Technical Program Manager at GTC. Experienced program manager, long term participant and active subscriber	James finishes his post with the general practice on the subject, referring to a book that he read. He concludes with the following: "*I defer to those now on the list to comment - Sam? William? Terry? Jim? Tom? Alija?*". This time, the discussion goes on. First to reply is William Pietri, a volunteer developer and experienced 'opensourcer'. He starts his post as follows: "*My hazy, hazy recollection, prompted by a note from Terry, is that there was something a little unusual about how MIFOS handled Hibernate sessions. The normal way web apps work is to map a single HTTP request/response cycle to one or more units of work from the database's perspective …*" He carries on with a brief insight on the functioning of web applications in the general case. He lists two design scenarios and states that MIFOS used the one with the downside that it is fragile and does not scale well (AnnexI-M)**.** He adds "*I feel like we looked at changing to the more standard approach, but there were some dependencies on the connection-per-HTTP-session approach. What has happened since, I have no idea. A quick search of my old email turns up nothing about this, so either it was only discussed verbally or I'm thinking of some other project entirely*." Amy is next, she posts: "*What might also be interesting is if any DBA-types have workaround suggestions/scripts while the longer term solutions are considered?*" After that, the tone of posts has changed. Sam –another experienced volunteer- suggests a workaround. He writes: "*Workarounds: an ugly but fairly effective workaround is to periodically force the application (mifos in this case) to close the connections…*" He explains, and gives two options about how this can be achieved. He asks for more clarification to "those who know Mifos configuration better". He adds: "*…If so, I could take a stab to figure out if we could have it reconfigured to use c3p0 connection pool to timeout the connections.*". Tom Bostelman is another experienced open source developer; he is next to post his opinion. He thinks that the

			code object 'java.sql.connection' "*is probably the culprit*". Two days later, Sam posts again. This time, He has spent the weekend studying the codebase and has tried few things. He writes: "*Over the weekend I took a stab to change the mifos' hibernate config to use c3p0 connection pool (and turn on c3p0's debugging tools). Here is the finding so far…*". He explains what he did and what his conclusions are. The next post to the thread is from Van. He is senior core developer at GTC. He writes: "*I've been catching up on all the action on the list that occurred while I was out on vacation and wanted to comment briefly on this thread regarding connection pools, connection leaks and Mifos behavior. First off, thanks to everyone on the list who contributed to the discussion on this-- it is an important issue. And complements to the various contributors for digging in on this. I don't have a simple solution to the problem to offer up, but just wanted to confirm what others have already uncovered…*" Van provides important clarifications on the subject of Mifos connection. He concludes that there are still important decisions to be taken regarding the best course of action to resolve this issue. He writes: "*…In the short term that may involve just trying to track down existing session/connection management issues in the code and fixing them (as Sam mentions in points #3 and #4…). Ultimately, we need to improve the way we manage sessions and connections so that it is easy for a developer to do the right thing and hard to do the wrong thing…*". Keith Pierce, a new volunteer and experienced developer answers. He asks : *"The one-connection-per-http-session is certainly not scalable, but my question is, how scalable does the application need to be?".* Amy replies that scale is important, as new user branches are continuously added. Adam Monsen joins in; he elaborates on Keith's question asking Amy to precise "*how many concurrent users would you expect to hit a particular Mifos instance at the same time? And any idea how long they would be online?*" He also provides a link to a Mifos webpage that provides estimates on scalability requirements. Then, Dion, who represents a local IT vendor in South Africa writes:

			"*MifOS is a rapidly maturing platform used in high load, concurrent environments already*". The discussion continues. Tom Bostelman posts to the thread again: "*I had similar thoughts when I first saw the email thread on this issue. However, as people discussed the problem it appeared to turn into a Session timeout problem and then quickly became a non-issue... What James is describing gives us a sense for how large this issue could be, so I agree that we should spend some time analyzing this. In general, we should be monitoring the number of open connections to the database at GK…For now, is there someone who can set up something at GK to record the number of open connections to mysql throughout the day?*". Amy replies that she can do that at GK. Next, Sam posts for the third time. He now thinks that this is a connection leak problem. He provides detailed scenarios on how to diagnose and solve this kind of issue. Aliya, another GTC administrator, starts a new thread. She knows how to set a connection monitoring schema in GK. She writes about a script that can gather statistics from the MySQL administrator tool, which can be used to get more information into Nagananda's issue. [The End] This long illustration is about problem-qualifying and the difficulty of incremental knowledge building. Several subscribers posted views and opinions in order to fix a user issue that by the end of the discussion was still not totally solved. What was initially seen as a user problem, James saw as the tip of the iceberg. So, he wanted to harness the experience of the experienced developers in order to unearth the root of the problem. Yet the more participants came up with theories, the more problematic were their answers. Their posts were abandoned, to the extent that the next senders did not really follow or comment on them. Instead, posters, like Sam, or Aliya went back to the origins of the fault with less theoretical considerations. By the end, it was agreed that there was more issue-monitoring required in order to decide a workaround. Often, a feature design follows some theoretical principle. However, the circumstances of its use shape how it should behave ideally. In fact, design is generally about devising fixes to users' practice, and problems, rather than being about building some big theories of code design (see the example of the Turbine in Section I, Chapter II – Conceptual Framework). This point leads me to thinking that continuous re-design should then enable a more sustainable design, as it is often about situated problem-solving tasks and incremental knowledge building

			processes. In this case, the involved participants have collaborated and shared knowledge. They created a chain of evidence from design theory to the use case and its specificities, thus enabling sense making and the working out of a potential solution.
I-Ref.	**Msg. Date and Ref.**	**Profile Group & Information about the Poster**	**Messages/Threads Story**
I-20	11/12/2007 **PostFile-M71**	**Adam Monsen**: GTC admin Senior Developer at GTC	This is a message posted by Adam. He writes: "*Just a reminder that there is an active IRC channel for Mifos [link]. Tomorrow at 2pm we'll hold a session of developer planning poker, where rough estimates will be given for upcoming work. The public is free to observe, but please withhold general chatter until after the session is over. Comments relevant to discussed items are ok, but please use discretion. If comments distract from the planning poker session, the channel will be moderated (don't take it personally)…*" Adam has announced the upcoming developers' meeting in the MLs, thus enhancing the visibility of the event. His message reveals two audiences. First there are those who are directly involved in task allocation and so legitimately interested to attend the meeting. Hence, Adam's post is meant to update them on the meeting's details. Then, there are those who are asked to remain some sort of 'silent witnesses'. This message shows that Mifos governance structure encapsulates definite hierarchies. It corroborates the 20/80% idea, where a small group or elite is engaged in software development, while the rest are nothing more than silent witness. This message is also about accountability. It can be interpreted as part of GTC administrators' effort to stay accountable to and inclusive of the 'broader community'. Indeed, Adam's post is public. By broadcasting the news in the MLs, he aims to spur curiosity, and attract more developers. This kind of meeting updates long-term users and Mifos supporters about project's advancement. It is a way of reporting what has been achieved and the project's future road map. For newcomers, this is an effective way of getting into the projects and to know more about processes, data, people, etc. Through exposure to such a collaborative environment, new comers are more easily integrated, enabling them by the same token to become active and central participants.

I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-21	10/12/2007 **PostFile-M72** 10/12/2007 **PostFile-M73** 15/12/2007 **PostFile-M74** 18/12/2007 **PostFile-M75**	**Amiruddin Nagri**: ThoughtWorks- GTC Institutional contractor. Employed developer at ThoughtWorks –India **Nazir LAJDEL**: Mifos Specialist Developer at Oxia- (Local vendor in Tunisia) **Van Mittal Henkle**: GTC administrator Senior core developer at GTC	This illustration is about one particular developer, who contributed to Mifos between the second half of 2007 and first term of 2008. Nazir is a developer at Oxia, a local IT vendor in Tunisia, which supported a local MFI (Enda) through deployment. Yet, after his company ended the contract following a disagreement with its client, Nazir stopped posting and contributing to the MLs. During the period of his involvement, Nazir contributed to the Mifos codebase with several functional enhancements, bug fixes and sent over sixty posts, some of which are studied here. First there was this thread. Amiruddin Nagri, a developer at ThoughtWorks in India, is new to Mifos. In Dec. 2007, he writes: “*I was going through the build process and there were some questions that I would like to know more about, if someone can help me out in these areas i can get ready to contribute to the project…*” From what his post reveals, Amiruddin had an installation problem. He notes that to run Mifos build, it took him over 40 mins to complete all the necessary tests and some of them were failing. He writes: “*…So the first question is why those tests are failing, the second is why the build is taking so long to complete. I have worked on projects with many database tests but it never took me so long to build the application, can we have a look into that too. Any inputs on these issues will help me get started and in general sort out major roadblocks from developer contributing to the project.*” His post is answered by Nazir. Nazir provides clarifications on the working of test classes: “*…Can you please send the total tests that were failures…Maybe that these are problems related to your environment: the locale from your machine or the time zone dependency…(You can try setting your time zone to Pacific Time (GMT -8) and see if the tests pass for you; it’s a possible that this solves the problem)”.* Amiruddin replies. He sends the log errors and remarks that there is something odd with the test naming convention. He proposes that he and Nazir work on it. He writes: ”*Can we try to clean it up and have some logical naming convention like files ending with 'Test' only tests the behavior inside application, and can have 'DBTest' and 'ServiceTest' which has some dependency on*

	18/12/2007 **PostFile-M76** 18/12/2007 **PostFile-M77** 01/11/2007 **PostFile-M78** 02/11/2007 **PostFile-M79** 06/12/2007 **PostFile-M80** 06/12/2007 **PostFile-M80** 05/12/2007 **PostFile-M81**	**Omar Bilani**: MFI user IT administrator- potential MFI user	*external data source so that we can filter it out and run selected functional tests."* Nazir replies. He informs Amiruddin that Van must review and first validate any patch about the testing procedure. Van replies, he thanks Amiruddin for reporting the faulty tests: "*…Currently tests are organized into a hierarchy of test suites that cover different areas of the application with ApplicationTestSuite being the one that runs them all. The problem as you have discovered is… when someone didn't follow the naming convention :-) But no matter how the test runs are organized, I would still be in favor of using a naming convention for the sake of consistency. I'll put forward the suggestion of following the convention <classname>Test for test class names…If anyone else in the community has comments one way or another regarding this, please chime in. After others have had a chance to comment, then if we're in agreement, we can put this on our list of refactoring to do...*" Adam and Tom post their consent. Then, Nazir sends a second post with a suggestion: "*I suggest setting up a development tool to help programmers write Java code that adheres to a coding standard…For example; "Checkstyle" can check many aspects of your source code. It's highly configurable and can be made to support almost any coding standard. Thoughts?*" Van is not sure about this tool: "*Checkstyle looks like an interesting tool, but I'm not sure we're quite ready for something like that…In the meantime, if you would like to experiment with Checkstyle …, then go for it! (and report back to the list on how it works)…"* Amiruddin shares Nazir's opinion. He writes: "*It is not necessary to force all the coding convention rules in one go, we can keep adding rules… We should really consider using checkstyle, and I think if we have a standard checkstyle guideline, we can import it into eclipse so eclipse uses it for formatting the code. I am facing some issues with eclipse reformatting my code, breaking into more lines than I want, so if something like checkstyle is in place, I can be sure of what eclipse is doing.*" Nazir informs Van that he already used checkstyle and he is happy to send a description on how it works. At the same time, he answers Amiruddin's post: "*…So pending setting up checkStyle you can proceed like that to better format your code within eclipse:*

			window > preferences > Java > code style > formatter.” Nazir has answered Amiruddin twice. First when the latter asked about the error log, and then sharing how to improve code formatting manually. Nazir did not make a connection between posting information to Amiruddin and his suggestion being indirectly rejected by Van. On the one hand, Van has encouraged the refactoring of test names convention. He submitted it for voting. On the other, he resisted the idea of using a tool to format code, based on his guess that this would deter potential developers, and so has decided against asking the opinion of other subscribers. This example is about the complex process of knowledge transfer and collaboration, in a hybrid work setting that is mainly dominated by GTC and its brokering role. On the one hand, Van tried to defend the ‘invisible’ majority who are not professional experienced developers and might see in the adoption of such a tool a constraint to their coding. On the other, he decides against voting. This again reflects ambivalence and unclear governance. While, GTC administrators strongly lobby for public participation, they sometimes ‘gently’ set aside those who are not in line with their thinking or methods.

I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-22	(see above)	**Nazir LAJDEL**: Mifos Specialist Developer at Oxia- (Local vendor in Tunisia)	This was not the only instance of Nazir intervening in a thread to help another developer, suggest a fix, etc. In another thread, there was again a discussion related to build problems[228], including Nazir. In the first post of thread that I have picked, Van writes: *"I have looked into the problems we talked about regarding build errors when building in a French locale…The problems in LoginActionTest is not related to code that I have worked on, but I investigated it and understand what is going on. The locale from your machine (French) is being used by Struts as the locale for looking up web page messages from properties files, while the test code has English results coded in. One possible solution would be... I looked into this, but have not yet been able to figure out how… If anyone is familiar with this, please speak up!"* Nazir replies that he will try. The thread stops after this brief exchange, implying that Nazir has found a fix and moved on. Five months later. Gary Weberg, a volunteer developer writes: *"I am still getting build errors. Attached is the test suite xml file. My version of mifos is 12171. My environment is…"* Nazir answers promptly: *"I investigated…The problem is: The locale from your machine (French) is being used by Struts as…, while the test code has English results coded in. Possible solutions…"* Nazir has obviously learnt from his exchange with Van, as he suggests some solutions. A few days later, Van answers Gary; he diagnoses a time zone dependence. He also replies to Nazir: "*Thanks for taking a look at this. You are correct to note that the test suite will fail when running the French (France) locale. I have logged this as issue 1492 in issue tracker. However the errors that Gary is seeing appear to be different and related to a time zone issue*". In another thread, Omar Bilani, the IT administrator of a Lebanese microfinance NGO writes: *"Hi all, can i know what are the reports that are already developed and if there is a way (if available) to*

[228] As other posts in previous illustrations have revealed, there were many reported difficulties for installing Mifos build, particularly for the first versions of Mifos.

			share them with me". Nazir replies: *"Yes, there are two reports available under mifos/BirtReportDesign. You can draw from them: Aging Portfolio at Risk [link]; Active Loans by Loan Officer [link]"*. Later, the same subscriber writes to ask for help on an error related to the tool that Mifos uses to create new reports. Nazir replies: "*We are now using version 2.1.3: (RCP Version of the BIRT 2.1.3 Report Designer) . Available here [link]."* In another thread (not related), Niroshani writes: "*I'm not clear this step… Can someone help me?*" Amy, GTC's contractor in India replies and asks him to clarify what he is looking for exactly. Nazir replies: *" Hi, I think that Niroshani talking about the stage of running Mifos under jboss server. If so; Copy/paste the directory named "default" (below "'JBoss_HOME'/serve /") under the same tree and change its name to mifos… Now, you can run Mifos by putting the Mifos's war file directly under the "'JBoss_HOME' / server / mifos / deploy" and run it as follow; run –c mifos."* These examples show Nazir providing information, sharing tips, suggesting solutions. This is in fact surprising if one is to consider that Nazir had a contractual obligation towards his client, Enda in Tunisia, and none towards the Mifos community. To the contrary, his subscription to the MLs and exchanges with GTC developers were originally meant to provide him with support in order to produce and commit his functional enhancements to the Mifos codebase. Yet, Nazir –like many others- was sensitive to the importance of knowledge sharing, exchanging tips and to all the social mechanisms of peer-help and collaboration that the MLs enable. In this sense, he abided by the OSS 'spirit'. However, it is not clear how GTC administrators behaved towards local IT vendors' developers whose participation they tried to leverage. Their relations towards MFIs IT partners who were contracted to customise Mifos and create new features, or like Nazir did, was ambiguous and is context dependent. I tried to understand some of the reasons that made GTC adminstrator distant (if not hostile sometimes) and less engaged with local Mifos specialists. There were undoubtedly language and cultural issues that sometimes prevailed. But there were also implicit power conflicts. On the one hand, GTC administrators welcomed their

			contributions to the Mifos codebase and to the project in general. But they also wanted to control them. GTC administrators were the main decision-makers with regard to what tools to use, requirements to adopt, actions to prioritise, etc. –particularly at the beginning of the project. GTC administrators also strongly brokered information. First they were more experienced about the Mifos project, and administered the project's data generation and access, so they knew how to direct community members; Second they had incentives to encourage contributors and help users embrace the project and use the Mifos application. In this sense, they encouraged professional developers' participation in providing support to other developers and users, but at the same time, they kept monitoring them and tightly and often intervened in conversations to confirm information, or re-direct information seekers. Providing information by administrators is not sufficient. Users wanted also to know what other users did; they wanted their personal feedback. They asked them to send links and documents about their progress; they wanted to know more about their difficulties, what steps they followed, etc. For example, Nazir posted in January 2007 a sort of progress report about the Mifos roll out at Enda. Soham Dhakal, a developer and founder of Magnus Consulting – an IT enterprise in Nepal and a major Mifos specialist in the region- has replied back with the following: "*Hi Nazir, Thanks for sending this email. I would also be very interested in documentation related to… Please let me know when the documents are available*." Nazir then replied: "*Hi Soham, You are welcome. Attached, you can find our data migration global analysis. Mss Nesrine MADHKOUR (Finance Solutions Consultant from OXIA) has been working hard building those documents): There are two files…*" Users needed to know more about each other, about who offers support to which MFI and how it worked out for the stakeholders involved. GTC administrators' role in mediating interactions, documenting and building a database out of users' reported errors and experience is certainly important and helps towards more localisation efforts globally. It also contributes to ground and develop shared knowledge among community members. However, GTC administrators' strong 'interventionism' affected social capital negatively, by limiting the gradual development of social links between users, reliance mechanisms and peers' support. If MFIs for example, were to rely solely on Grameen Tech Centre people because they know better about the project and are more effective at providing support, this should lead to Mifos saturation. In fact, it should become increasingly difficult for the organisation to cope with the demands of users, information seekers, and developers, leading to a bottleneck in

			both Mifos development and adoption. In the long run, this also implies that small users with limited resources will be segregated against. The multiplicity of Mifos specialists and developers who experiment with the Mifos codebase, try to get familiar with the project, provide support for their clients-end-users, etc. is beneficial to the long term development and performance of the Mifos project. It creates market-like dynamism and competition. In this sense, it also increases MFIs negotiation power, because end-users are less dependent on IT suppliers.

I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-23	23/01/2007 **PostFile-M82** 29/01/2007 **PostFile-M83** 31/01/2007 **PostFile-M84** 29/01/2007 **PostFile-M85** 30/01/2007	**-Lassaad Bel Hadj**: MFI user MIS administrator at Enda-Tunisia **-Emily Tucker**: GTC admin Director of Program Management at GTC **-Nagananda**: MFI user IT manager at GK-India **-Sam Birney:** GTC admin Engineering Manager at GTC	This illustration pursues the same logic of investigation as the previous example. It is about one particular subscriber, called Lassaad. Lassaad is IT administrator at Enda – a microfinance NGO in Tunisia. In the previous illustration, I recounted how this organisation called on a local IT vendor, Oxia, to get Mifos localised and rolled out in branches. Then, Enda was not equipped to deploy Mifos internally. The MFI had little IT competence of its own and Lassaad was not familiar with the tools and java libraries that were used for Mifos production. Lassaad is a long term subscriber, but posts irregularly. He intervened in a handful of conversations between 2007 and 2010. At the beginning of his membership he posted to discuss features (functional ML). He writes: "*This feature is completely great and useful and I admire the fact that the system keeps track of all loan transactions especially the adjustment ones, but I have a tiny suggestion…*" Emily replies, then the two of them start a discussion on Enda's practices and the utility of this feature. Emily has assumed an important role at GTC since the launch of the project, where she was often responding MFIs and the intermediating between them and GTC contractors. A few posts follow, in which Lassaad provides detailed answers. His posts show respect for the informal writing protocol that developers have followed, where Emily's posts are broken down into separate points and answered separately. They also show expertise in the administration of MFIs' transaction records. He is able to step outside work routines and identify potential errors and exception cases in order to inform general practice. He suggests how the system should enable exceptions, etc. He writes: "*…A common error case is explained by this scenario: the cashier enters mistakenly the payment of a Client A in the loan Account of a Client B and these two clients have an equal amount of payment. So if the error occurs in the May 1st and it is identified after June 1st, only the May 1st must be adjusted...*" In the first Mifos version, requirements were specifiedbased on Grameen Koota (GK) lending model. GK uses the Grameen group lending methodology, which many consider –including GTC- best practice. Thus, GTC administrators were keen to promote this model through Mifos. Whenever Emily discusses requirements with Lassaad, she also makes sure that what he asks complies with the features that were previously designed for GK and would be a fair addition to the group lending model. Emily writes:

	PostFile-M86 29/01/2008 **PostFile-M87** 29/01/2008 **PostFile-M88** 19/05/2009 **PostFile-M89** 19/05/2009 **PostFile-M90** 25/08/2009 **PostFile-M91** 27/07/2010 **PostFile-M92** 27/07/2010 **PostFile-M93** 28/07/2010 **PostFile-M94**		"*…Ah! I see. Currently, Mifos doesn't allow this (but I agree it should!). As I mentioned in the last email, there's some careful thinking that needs to happen about how to handle the edge cases, etc. If this is a feature required for Enda, I'd encourage you (and/or Oxia) to try to capture the functional requirements for how this feature would work… Here's a template you can use to capture the requirements [link]*". Emily needed to understand what this practice and its intended feature are about. But she did not dissuade Lassaad from working on its integration to the Mifos source. Examples of feature discussions continue through Lassaad and Emily's post exchanges: "*Can we configure mifos to disburse a loan in portions? (…) This is useful in the case of housing loans where the loans amounts are big and loan officer must be sure that the loans are really used to restore or renovate client's house*." Emily replies: "*Currently Mifos doesn't have this ability but it would be a great feature to add into Mifos. If Enda has begun using this functionality-- a first step is to capture the feature requirements and post them to the mifos-functional list. Guidelines for capturing functional requirements are available here* [link]." Here Emily finds Lassaad's suggestion interesting and worth adding to Mifos code. She encourages him to input the feature requirements in Mifos ML and develop it further. In another thread Emily asks Lassaad about a feature that Oxia has specified. She knows about a similar feature that is currently being added by GTC developers and wants to know how it can work for Enda. The two authors try to negotiate an understanding about which is the best practice behind. For Lassaad, it is important to convince Emily that he is the expert as his MFI is already doing the 'right thing': "*…I think the system must check if the previous loan was paid off at time of approval, since the loan approval must be based on reliable information*". Emily replies: "*Thanks Lassaad-- this matches our requirements as well. We'll see if we can build the functionality to work this way*." Gradually Mifos went beyond the Grameen methodology. GTC administrators opened up the Mifos code to new features and options that addressed different MFIs practices such as loan amortisement and repayment calculations. Specifications remain thus the prerogative of Mifos users' (the MFIs). First, MFIs post their terms of references; these are then negotiated with MFIs' IT partners and GTC. Then, IT partners go into design with the support of GTC and the Mifos community (volunteers and GTC contractors).

			Such an arrangement has continued after Mifos development snowballed. As localisations increased, the MLs showed more posts where MFIs and their local IT partners discussed Mifos code re-use, new features and requirements. Some of these features were negotiated in consensus with GTC and have so received their administrators' support and were later added to the source. Other additions were directly sponsored by the GTC network of contractors. There were also features that never made their way to the Mifos code. These were added in-house (inside the MFI) across a network of local users. Hence they are "forks", because they are not necessarily upgradeable through Mifos future releases. Although requirements are not necessarily translatable into features to be added to the Mifos code, they are still considered an important aspect of Mifos global use. Wikis and editable online templates enable MFIs and local Mifos specialists to input information on MFIs' practices, gradually creating a database of potential features. This serves current and future volunteers, local Mifos specialists, and more generally all those who are interested in leveraging Mifos adoption globally. In 2007, the content of Lassaad's posts starts to change. His institution has already migrated to Mifos. Its local IT partner, Oxia has left the project, and Lassad is not interested any more in discussions about features only. He posts to the users' ML: "*I'm Lassâad from enda Tunisia. We started working with mifos as a production system since the 13h of April…My question is : to make the mifos war connect the database server , should we change the conf file in the source code and compile it or there's another way? and how*?". One year before, Lassaad could not have sent this post. He could not have known what to ask, let alone do it alone. Lassaad is fully in charge of Mifos administration locally. He is one of the first in the community and knows how to get help. His post is answered by a volunteer developer, Graeme, and Adam. Other posts follow later.A few months later, Lassaad joins a thread and answers Nagananda's question about a new tool that was recently introduced in the Mifos platform. Lassaad writes: "*All you need is to uncomment the SSL definition in the server.xml file: the SSL definition looks like the lines below: <Connector port="8443" minSpareThreads="5" maxSpareThreads="75"…/>. Then change default values by your custom ones especially for the keystoreFile and the kesystorePass*". Adam does not contradict Lassaad. He posts a link to technical documentation that Nagananda could also use. As, his experience grows, we can see that Lassaad is confident enough to answer the question of a peer user. Another

			post shows that he is also more confident to sort out a technical configuration issue by himself. In 2009, Lassaad posts about upgrading to Mifos 1.3, which implies advanced IT skills and Mifos knowledge. His post reveals that he went through the developers' wiki and was able to make sense of it. He asks for clarifications. In fact, upgrading to a new Mifos version is certainly challenging as it means running Mifos build and working out questions related to the environment configuration. Many developers have posted for help about this before. Another thread in 2010 shows Lassaad providing support again, this time to Sam Birney –who is developer and GTC contractor. Sam was then a Mifos consultant for a Lebanese MFI. Sam writes: *"Does anyone have a SQL query for listing the active loans as on a certain date?"* Lassaad replies: *"Hi Sam, This is the query that we use in enda to count active loans by date: "SELECT count(if((account_1.customer_id is null) account. CUSTOMER_ID, account_1.CUSTOMER_ID))…"* In this example Lassaad is a Mifos user who has succeeded to use Mifos sustainably. His email exchanges prove that he has learned from the project's platform (documentation, wikis, MLs, etc). His IT capabilities gradually improved and so he was able to use the application and ensure its development internally. Hence this example is about knowledge transfer and learning. When looking at the social mechanisms of peer support that were rooted and sustained by community members such example of learning and technology appropriation is not unique. Many subscribers have taken part and benefited from peer support. So they have learned from this process overall. To illustrate this point, I would like to quote what Sam has replied to Lassaad, after the latter had sent his query: *"Hi Lassâad, thanks for sharing! This seems correct for enda and others that do not use back-dated transactions. There is one issue we ran into recently you should know about: when an adjustment is applied to a closed loan, the account.closed_date is not set back to null. So if you ever apply adjustments to closed loans they may still appear as closed in your query although they are actually open."* In fact, Sam did not find the information in Lassaad's post very useful. Instead of simply discarding his post, he posted back to share more information. By doing so, Sam has produced information, rather just consumed a not-so-useful post. After skimming through the content of so many emails, I realise that this type of post exchange is not unique. Many have passed on pieces of information in various ways, making the MLs in general an extremely productive knowledge environment, where people can potentially learn because they are exposed to, even if they do not participate in the community dynamic.

I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-24	30/03/2007 **PostFile-M101** 30/03/2007 **PostFile-M102** 04/04/2007 **PostFile-M1031** 04/04/2007 **PostFile-M104**	**Paul Were: Mifos Specialist** Local IT Consultant –Kenya **Yussef:** GTC Individual contractor GTC delegate for the MENA region **Carlo:** Volunteer Developer Developer at Goldman Sachs	Paul Were is a developer and Mifos Expert in Kenya. On the 30th of March 2007, he posts the following to the developers ML: *“I’m trying to login via the web interface and keep on getting a error on the password... i've tried mifos/mifos and mifos/testmifos but these do not work.”* Two developers answer his post. First Yussef informs Paul that he uses login/pass mifos/mifos himself, and so it should work for him too. Then, Carlo writes: *“Actually, I'm having this problem now, myself, with my locally built server. How does one unlock an account?”* Paul answers Carlo’s post, on the same day. He announces that he has fixed this problem, but surprisingly he also suggests a solution for Cralo’s problem: *“Update: Mifos/testmifos works fine. There were some build issues that were causing errors. Once those were resolved, I was able to login fine…* *…You can update the column NO_OF_TRIES (of the PERSONNEL table) manually by accessing the DB…, or you could also update the sql script... These scripts are -mifosmasterdata.sql…”*. This illustration shows that the dynamic of the MLs’ answer/reply and its problem-solving nature might sometimes be positively influenced if a developer has previously benefited from the ML-support himself. In this example, getting a reply to his post has triggered a dynamic which arguably made Paul answer Carlo’s query.

I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-25	06/02/2008 **PostFile-M95** 23/07/2008 **PostFile-M96** 22/08/2008 **PostFile-M97**	**Soham Dhakal**: Mifos Specialist Head of Magnus Consulting-(Local IT vendor in Nepal). He is an old member of the Mifos community and was responsible for may localisations in the region. **Emily Tucker:** GTC administrator **James Dailey**: Volunteer (from 2007 onwards) former GTC administrator	First to post is Soham Dhakal, an IT vendor in Nepal and a major Mifos specialist. His post pinpoints the lack of modularity and the absence of a feature-orientated design logic in an earlier version of Mifos: *"Hi all,...As it stands in mifos, every functionality that is developed is integrated (now this might be to make it easier for MFIs). But once a lot of custom requirements are added as mifos gains popularity, this could lead to features that MFIs do not need. And the upgrade of functionality is very linear, meaning i have to upgrade in sequence regardless of the functionality I want. Are there plans to make it more feature oriented? ...* *…As features are added, hardware requirements might change (disk space, RAM) so it would be nice if MFIs could pick and choose which feature they would like to have given the hardware costs... if there was a modular (kinda like plugin) concept, MFIs could pick and choose features they want installed...* *…I do realize that this discussion might be a little early in the product lifecycle because most of the features built and being built are pretty generic. But we might want to think about how we are going to continue adding features to mifos…* *…(for developers) when we submit a patch and base it on a revision, by the time the patch is applied the database version and app version might have been different because of other patches in queue. Once we have more and more people participating this might get tedious. So if we based upgrades on feature set, and check conditions against that feature…it might be easier…"* Soham's post dates back to Feb2008. Only version 1.0 was then available, as 1.1 was yet to be released (see Analysis Chap III). Van's reply was not encouraging: *"This is a topic that we have been thinking about and it will be one of the areas that we look at after the 1.1 release".* Let me here give you a brief reminder about the situation and history of Mifos that preceded this post. GTC contractor Aditi, was then the major code contributor. Version 1.0 was designed based on GK lending methodology. In the meantime, the Mifos source code started to change again, as Oxia was adding new features on

behalf of Enda-Tunisia. However, Mifos 1.1 was delayed for several months, as Oxia left and ThoughtWorks were contracted by GTC to finish off the release. Mifos 1.1 was then declared the first stable release and so called version beta (instead of 1.0). Yet, Mifos 1.1 was not anywhere near the modular design that was required to leverage its development across community users.

GTC administrators were seriously concerned about the project’s future. They knew about Mifos ‘weak’ code, as they had already received negative echoes from developers, Mifos friends and MFIs. But, Instead of opening up the debate, they preferred to discourage what they considered ‘premature talk’. ‘How should the Mifos community reconsider its development strategy?’ or ‘what is Mifos future going to be like?’ were questions that remained unvoiced in the MLs. However, on the 23rd of July 2008 –a few weeks after 1.1 release- Emily broadcasted the following:

> *“Now that v1.1 has shipped, we'd like to update you on our product plans going forward. While working on v1.1, it became very clear to the Mifos team and many of our contributors that the current code base is extremely difficult to work in. As you may be aware, the original code for Mifos was all written by developers who are no longer part of the project, and in many cases was done in a way that is difficult to maintain and improve. Because of this, it took more effort and time to get to a stable release of Mifos v1.1 than should have been the case…*
>
> *In order to become better equipped for maintenance, rapid improvements, and product support in the longer term, we are also pursuing a strategy of completely re-architecting Mifos. Re-implementing the functionality of Mifos using open source standards, consistently high code quality, intentional APIs, and clean service layers will make it much simpler and faster for the team of developers (both internal and in the extended community) to add new functionality.*
>
> *We are just getting underway selecting the framework and tools for this project, and will continue to communicate openly with the extended community as we do this. We plan to use Spring's application framework, security subsystem, and other components to accelerate development and provide greater flexibility.*
>
> *We are evaluating Maven as a new build system, Freemarker as a new template system, TestNG as a new unit test system, Quartz for scheduling, and JPA as a new object-relational API. Not all of these decisions are final, and we certainly welcome community feedback, especially if you have*

> *relevant experiences with these technologies or other ones we should consider. They are mentioned here to give a sense of how we are trying to bring the Mifos technology up to date with mainstream open source Java development, and to use existing and mature open source solutions rather than writing custom code for basic operations.*
>
> *The codename for this project is "Cheetah". Our target is to release Cheetah sometime in the second half of 2009, but the final target date and schedule will not come until later."*

Despite Soham's early intervention, Emily's post was meant as an 'update'. The decision to re-engineer Mifos code was taken by GTC. Yet, Emily also invited experienced volunteers from the 'extended' community to share their knowledge and participate.

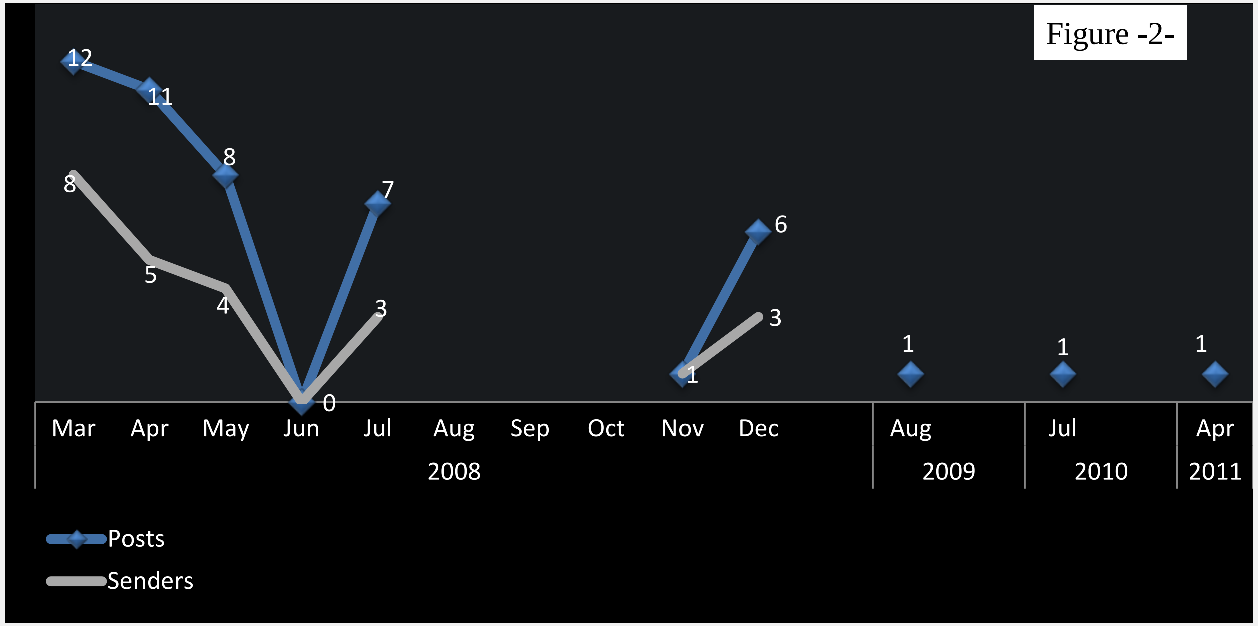
I found it indeed surprising that Emily talks on the one hand about the necessity to use OSS standards and designing more openness, while on the other, she announces the Mifos road map without prior discussion or voting. From what her post reveals, it is clear that GTC administrators have separated between, on the one hand, the tools/design approach that 'symbolise' or encapsulate the open source approach and on the other, the social stuff (the project's governance).

Based on that, It seems that GTC believe that open source software is defined primarily through the tools that enable modularity and the use of open standards. These are seen as sort of non-human delegates which materially pull together the participation of distributed players and translate them into working code. For GTC, such tools are crucial to ensure continuous re-design and so the continuity of the software development. However, mechanisms enabling public decision, like MLs' debates and voting are set aside for strategic decisions.

This point is also echoed in J. Dailey post that followed Emily's announcement and the social event that ensued:

> *"Hi all - So, it is good to see the effort by GF to engage the community of developers with the new strategy - the meeting earlier tonight was good for that I think.* ***More is needed, and not just for the developers who know what Spring MVC Is*** *[emphasis added], but also for the constituency that is the eventual market. As an innovative open source model, much still needs to be done to improve the community transparency - who is getting mifos working, what are their challenges, how are they overcoming them, what is the future role of the GF/Mifos team?*

			When we dreamed up the Mifos concept with our friends at MFIs around the world, there seemed to be an appetite to shoulder some of the effort themselves. ***That dream, where the end users are also the developers –at least in the broad sense- should still be kept going*** *[emphasis added].* ***Those who have a vested interest make the best participants long term and meeting their needs (developers within MFIs, external vendors, etc) is paramount (…)*** *I would like to ask:* ***what makes the Mifos Chetah approach fundamentally different from the technology-strategy approach of before? Beyond Spring and reworking the architecture, what does it say about the Mifos value proposition****? [emphasis added] (…)* *…Configurability, Approachability, Deployability, Extensibility - and since we love acronyms CADE - this was the message that came out of our analysis of the original effort in 2006, we needed much much more of CADE. But, I would add something more - until Mifos has a solid core that the vendors around the world can make a profit on, we won't get to a critical mass of participants/customers. Seeding that eco-system has been a long and arduous task, but more frustrating perhaps for some supporters out there, is knowing when certain elements of CADE will be available (…)“* J. Dailey has also picked up on the inconsistency between the open design tools, a more modular architecture and the absence of open governance, as he asks what makes Mifos design strategy in any way different from the previous one. He thus highlights the significance of end user participation. He claims that those who have a vested interest make the best participants in the long term. Through this claim, he has also pointed to the importance of user gradual appropriation of Mifos technology in ensuring technological sustainability. In this sense, the participation of MFIs and their IT local IT partners is equally important to that of experienced developers, as it should guarantee the continuous re-use and development of Mifos code and its objects. For this reason, it must be cultivated through open governance.

I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-26		**Gbolahan Asnoubi**: Mifos Specialist Local IT vendor- Nigeria	This illustration is based on over 70 posts, which are in threads that contain the words 'Mifos Mobile'. It would not be possible to cite all the posts here, but I shall provide a comprehensive overview on the content of the posts and the general direction of the discussion over time.  As Figure 2 shows a discussion sbout Mifos mobile that started with 12 messages and 8 posters in March 2008. The number of posts and discussants dwindled over the three months that followed. In June 2008, there was no posts on the subject; it picked up again with three posters in July. There were no exchanges on the subject after that, until a come back in Nov and then Dec. This discussion is concomitant to the release of version 1.1 in July 2008 and GTC's decision to freeze Mifos feature development (decided early in 2008 and announced after the release).

			Sam –GTC engineering manager- is the first to post about Mifos Mobile. He refers to a previous thread, including Gbolahan (a Mifos specialist, and head of a local IT company in Nigeria) and Tom_M (a representative of a famous US-based mobile venture called P2P cash). Originally, Tom_M did not address the Mifos community directly. An extract of his off-list email was forwarded by Adam, who invited him to join the functional ML and start working on a proof of concept for a Mifos-enabled mobile cash API. Yet, Tom did not join, so there are no posts from him later. In fact, the thread that Sam mentioned was in majority by GTC developers, even though Sam seemed to believe otherwise: "*The community input towards a mobile banking interface to Mifos keeps growing. There seems to be several different organizations interested in working on this. This would be great functionality to add to Mifos, although the internal team may not be able to focus on it as a feature area during 2008…*" Gbolahan is almost the only one (from the extended community) really keen to advance work on this feature. He believes that Mobile banking can reduce operations costs and so wants Mifos to go mobile. He writes: *"While the MIFOS internal team may not be interested in the Mifos Mobile concept, I think the community can take a step to it. If you know the starting point, kindly point us to it. For others who may be interested, we may need to put in more efforts behind the scene*". Sam is next, he writes: *" Hi Gbolahan , I hope to get to meet you in person someday. To be clear, the Mifos internal team is VERY interested in having a mobile phone interface to banking operations in the Mifos system. Like everyone in this community, we have lots of big dreams, but only limited time and resources to pursue them all…* *We, the internal team of developers, need to concentrate our efforts on improving the underlying architecture of the product and community backbone to facilitate this type of project and many more like it in the future...Here is how I suggest we move forward.* ** We at the Grameen Technology Centre would encourage and support you, Gbolahan Oshonubi, to be the project leader for the initial phases of Mifos Mobile.* ** The project leader should reach out to all the people in the community who have expressed interest in*

			contributing to this project, and coordinate with them on goals… ** The project leader should set up a way for the project team to communicate. I would strongly recommend that you use the existing Mifos community tools, which will improve over time [link Mifos.org], [link IRC], these mailing lists, the Mifos issue tracker, etc…* ** I would also encourage you to follow the principles of open source: Liberty, Openness, Transparency, Deliver Early and Often, Community.* ** You may even be able to obtain funding for the project from interested investors, that is really not my area of expertise so I cannot help you with that.* Before Gbolohan had time to answer, Andres Pacheco, a volunteer, and discussant of the MLs, replies : *"Sam, What a wonderful statement! I think that's the whole point of an open source project,* ***that it is not limited to the roadmap of its direct sponsors and gatekeepers, but rather that it can grow by leaps and bounds depending on the interest and commitment of the open source community at large*** [emphasis added]. Andres' remark seems to be out of place, and a little odd. So let me place it first in context. In the last illustration I commented on GTC's decision to re-architecture Mifos code internally (see Chap III). I did not then study the thread, because there was no real discussion following the announcement. However, Andres Pacheco did reply to Emily's post as follows: "*make sure you copyright "Cheetah" or else Apple will do, and sue you for retroactive infringement!;-{) There is a high probability of that feline name being part of their OS X product roadmap!;-{)*" I first discarded Andres' post, because it is not really what I call an exchange of information. In fact he was indirectly mocking GTC for their increasingly top-down and copyright-like development style. He even made an analogy with Apple. Andres' meaning is ambiguous and equivocal, so it may be interpreted in different ways. However, Sam answers: *"Emily has very clearly laid out our product strategy here,* ***please be sincere*** *in advising.* [emphasis added] *This is something to which we are very dedicated…"*

			The thread ends with Andres's answer: *"…that was not advise, just a funny remark on the choice of name for the new release.. not everything has to be serious in life!"* Andres's comment was loaded. He clearly pinpointed the turn in tone in the GTC administrators' responses. Indeed, GTC administrators want to show that members of 'the extended' community can still continue Mifos feature enhancements, in spite of their own plan to re-architecture the code and freeze the current features. So Sam somehow 'theatrically' has nominated Gbolahan as Mifos Mobile lead, which should be seen by the community as being in the 'OSS spirit'. Andres does not linger any longer in 'records-settling' with Sam. He moves on to voice his own opinion on what he considers 'the core of a mobile technology'. He writes: *"…The cellphone is the most widespread terminal for the delivery of Web 2.0 apps (in the sense of the CRT [Cathode-Ray-Tube] Terminal of the mainframe days). This requires a paradigm shift for the cellphone role, compared with the current commercial vendors: their focus is on making the cellphone a "personalized application delivery device", pretty much like a "fat client" in the old days of the client server paradigm, which we all know is dead; instead, I believe in "MIFOS and a lot of other mass applications" A mobile initiative would entail from the start the concept of the cellphone as a browser: a common, simple, controlled, device-independence, mass platform for the delivery of web 2.0 apps to individual end-users. In this case, device-independence means that no matter what cellphone you happen to be using, you can leverage it as an access device to your own "world", be it MIFOS or the myriad other applications that you may need at any point in time and place."* Tim is another subscriber who also joins the thread. He works on another GTC program called 'Village Phone'. Sam has introduced him in his first post: *"…Tim was very interested in getting to a proof of concept and eventual full implementation of mobile banking with Mifos. He has done some work on defining some initial usage scenarios".* So, Tim attaches to the thread a document that outlines some usage scenarios and issues around mobile banking and mobile interfaces for Mifos. Edward, Mifos community lead, also posts his encouragements and support to Gbolahan and the new group that is

emerging. He writes:

> *"Gbolahan, To facilitate the ease of collaboration on the Mifos Mobile Project and help the community drive it forward, I've set up a couple pages on our Wiki - I pulled all of Tim's document out into an introduction page* [link] *and also set up a Project Page to make ongoing work public to the Mifos community,* [link]*."*

Gbolohan replies.

> "*I really **appreciate** the efforts everyone has put in to get the topic of Mifos Mobile to a point of interest to the community. While I have gone into discussions underground with various community members, I am positive that the project will success based on the **enthusiasm expressed by the interest group**. Having thought of the proposal by Sam, I am pleased to **accept the responsibility of being the project leader** for the initial phases of MIFOS Mobile **based on Sam's early assurance of support from Grameen Technology Centre**. However as you know the task ahead of us is not much if we believe in it. To this extent, I **seek everyone's support to make the project a success..***. [Emphasis added]".

He then reviews subscribers' contributions so far. He acknowledges Tim's document; announces that they might have a pilot user case (Jitegemea); informs community members that Saurahb –SunGuard developer- has drafted a technical document to get the project going; reports a call that he had with Tom_M, etc. He finally suggests a possible integration with a large scale micropayment application and throws in questions at the end.

Gbolohan's post shows a real effort to compile enough information and interest to kick start Mifos Mobile. He has no experience though in leading this kind of project and his English is poor and sometimes misleading –which is one of the reasons I did not quote the whole message (see **PostFile-M100)**. Besides he was asking questions, which GTC administrators could not possibly answer. For example Gbolohan asked whether to invite representatives of major and well-known microfinance institutional experts like CGAP, InfoDev, etc to this discussion. The latter may have 'diplomatically' avoided Mifos lists before, because of ongoing political struggles between Gramenn and these institutions (Grameen and some microfinance corporate experts are competitors, their goals sometimes overlap, while they do not necessarily share the same views, policies, etc.)

Almost all Gbolahan's questions were implicitly addressed to GTC. He was obviously seeking their approval on different matters related to the project's broader governance that were not really discussed in the MLs before. Based on the way GTC had led Mifos until thrn and how they administered the MLs, Gbolohan 'knew' that Mifos is their ‘baby’ and he could not go past his ‘privileges’, by inviting for example people with whom GTC might suffer differences of opinion.

For this and other reasons, he also asked about creating a new ML for Mifos Mobile. He clearly wanted to create a space for himself and the people interested in this project. A separate mailing list means that it is relatively shaded away from mainstream attention. Only directly interested people would subscribe, so Gbolahan could more easily orchestrate exchanges. But a separate mailing list is also a folder that can be closed in case the discussions fail to progress and so it can be easily forgotten. In this regard, it is Aliya, another GTC administrator, who answers Gbolohan. She writes

> *“Thank you for taking on this project with such dedication. I was thinking about your request for a new mailing list. I think that … since the discussions will start from a functional perspective, it might make sense for you to just use that particular channel to start with, rather than a new mailing list.”*

Gbolahan disagrees. He clearly believes that Mifos Mobile should be separate. The wide range of ongoing topics that are simultaneously taking place in the functional list, he believes, are getting subscribers’ attention away from this sub-project. He argues that the noise in the ML is responsible for the absence of progress on the discussion.

This might indeed be a reason, and the stepping back of GTC –as I have mentioned above- might be another. The fact that Mifos 1.1 was still not released and the risk that the whole ‘dream’ might be jeopardised are also good candidates.

In fact, there was not much of a discussion on this topic over the following months, except for Gbolahan’s posts and some of GTC’s that mainly aimed to re-organize or re-administer Mifos online spaces. Gbolahan reports in his post to Aliya that there is “no contribution apart from GTC staff”.

I think this was the case even at the beginning of the discussion in March. The apparent interest around Mifos Mobile that Sam noticed was not grounded in any concrete proposition, except for Tim’s. Not only Tim is another GTC employee, working on a different program, but GTC internal developers explicitly stated that they planned to limit their involvement in future development. Gbolahan was certainly motivated and keen to orchestrate, but he did not really create ‘something’ to start with.

Gbolahan perseveres. He continues his efforts to infuse life into Mifos Mobile. In April, he tries to ‘mobilise’ again

			GTC people and connect the discussion online with some concrete, material events offline. This way, he believes, should create a new dynamic that certainly cannot fail to draw in other people into the project. He writes: *"…I am aware that Grameen Foundation is planning training in the Philipines this month. To this extent, I would like to know if Grameen Technology Centre is planning to send a representative to the programme. If yes, can we look at integrating a discussion on MIFOS Mobile concept at the training and see how MIFOS Mobile can further impact positively on the Village phone.* *Some of the issues to consider in the model include how we can use MIFOS Mobile along with Village Phone as a banking channel, social and economic implication and possibly regulatory implications".* Gbolahan's idea is to build on Tim's document and integrate it with another technology program of Grameen Technology Center (Village Phone). Again there is no response to his participation on the MLs. Later, Gbolahan becomes aware that he needs to put in more material. So he sends a post to Sam, asking him to open new online spaces where he can make his documents available and publications by other microfinance experts, like CGAP – which is also known to have done work on Mobile technology for microfinance. Gbolahan also felt dependent on GTC because he thought he needed login rights to access and modify the project's online data repositories, which is not the case. Indeed Edward's first post had already specified that anyone interested could upload material to the wiki pages, to which he provided a link. In spite of this, Edward sends again a second post where he re-explains in more detail how documents can be uploaded. Gbolahan succeeds this time in uploading general documents on Mobile banking that he hopes "will give the project a direction." His post is confusing though with regard to where exactly the documents are to be found. Edward replies, he posts a link and clear information on this material. April goes by and there is no proof that progress is made, except for one post where Saurabh, SunGuard developer, asks about an error trying to access the Link, and Edward promptly answers. In May, things change. One of Mifos former active volunteers from 2006 and 2007 replies with a lengthy post. He provides advice and suggests a few tips to kick start Mifos Mobile again: *"You might have done this exercise with Sam Birney and others at GTC... Anyway, I think it'd be helpful for*

			the community to understand the use cases in more details, in terms of the specifics, the priority. Having such understanding could help to better understand the gap (with MIFOSv1.1) and could help the GTC folks to prioritize the post v1.1. roadmap to support /enable mobile scenario (probably as some form of add-on on the of the core).” He also asks questions that opens up the discussion, for instance if there are MFIs looking into Mobile usage and what the scenarios are, etc. Gbolohan replies. He provides answers and informs the community that he is in contact with MFIs in Nigeria, which are interested in mobile payments as a banking channel. He also provides detailed practices and gives an insight on the country regulatory framework with regard to Mobile Payments. However neither Sam Lee, nor Gbolahan succeed in attracting other subscribers to the discussion. Sam Lee does not post again on the subject. But Gbolohan posts another message. He shares new information. He thinks that the community can probably re-cycle the code of a mobile payment application that was designed by a private company. He informs the community that he studied its code and he thinks it can work. He knows of other IT companies that did it. He personally downloaded this application code, ran it on his system and worked on it for two months. He writes that he found it difficult to receive support from the code owners and asks GTC to have a look at the type of licence. Gbolahan’s last post was sent late May 2008. Sam’s answer quickly follows: *Sam: “looking at the RTS license, it looks like we are not allowed to redistribute it with Mifos. But, it seems that MFIs could download it separately and use it internally without redistributing it. Since it does not look well-supported and is not open-source, I would look around for an active open-source package that has similar functionality, instead.”* *Gbolahan: “Thanks for the response. I would like to think its an opensource application. Meanwhile, I will appreciate if you can come up with an application that can perform the task. We need to come up with a solution as soon as we can to make it work along with mifos v1.1.”* The discussion trails off. Gbolahan reports the experience of another MFI. He wants to “investigate”, but no answers. Then a week later, Adam writes: *“Those of us in the Grameen Foundation are focusing all of our resources on the upcoming release of version*

			1.1. We'll continue to follow the plan here" The discussion has stopped momentarily. A month later, it is rekindled again. It is June; Gbolahan addresses the community. His post is long. But it needs to be quoted in its entirety. "HI ALL, *It's a good news to hear the release of MIFOS v1.1. While the release took a great deal of the community's time, we had a reason to suspend the MIFOS Mobile project at least to be focused on getting MIFOS v1.1 released before today the expected date. As you are aware, the community was looking at further expansion of the banking channels beyond teller for MIFOS and that brought about the birth of MIFOS Mobile.* *Various enthusiasts within the community have made so many suggestions that are worth noting. Meanwhile, since MIFOS v1.1 has been released, I feel this a good time to bring in MIFOS Mobile in anticipation of MIFOS 2.0. As informed earlier, we have developed some code which we have tested with MIFOS with respect to loan webservice and it worked well.* *We are delighted to release this code to the community for further development.* *Beyond this, its a vision to see MIFOS having it integrated with other banking channels like EFTPOS, telephone banking and Internet banking to metamorphose MIFOS Mobile to MIFOS Channel Manager, which will a common platform to add more banking channels on MIFOS Platform.* *To this extent, I will encourage the community members who are interested in being part of this project to kindly join it. Remember, the success of this project is a plus for MIFOS as we hope the MIFOS will become the de facto MIS solution for the microfinance subsector.* *Many thanks to […]*." Gbolahan has 'worked out' some code with the assistance of Saurabh that he proposes to add to the Mifos collective source code. Kazeem, a Nigeria-based IT consultant and Mifos expert, is first to send a congratulation post. Adam is next, he writes: *"It's great to hear that you have some code to share! We should get this looked at by as many people as*

			possible as soon as possible. Where is the code, and what license is it available under? Using Apache 2.0 License would reduce any license impediments for contributors, and makes sure the code is truly open source. We're also working on a contributor agreement--more on that soon.” More posts follow over July. Adam encourages community members to try what he calls “this example application, a gracious gift from our friends overseas.” Gbolohan also posts to confirm that the code is under the Apache Licence. Surprisingly, there are no posts after that until November 2008. Then, Viswanath, a developer who works at a local Indian IT vendor company posts to the thread a long list of questions after going through Gbolahan’s code. Here is a sample: *”…1. What kind of functionality are we planning to expose in the mobile platform? 2. Typing on mobile devices is not very comfortable. Are there any good ideas to reduce amount of typing on certain entries? 3. Can we let users create some kind of shortcuts for certain clients/accounts so that they can jump right into them?...”* Again, his post remains un-answered. In fact, November 2008 also corresponds to the release date of the last code enhancements on Mifos 1.1 (Rhino) before GTC’s planned freeze and the new Cheetah code. Finally the discussion restarts in December, this time with a post from Edward. It is addressed to Gbolahan and shows that there were over the previous days a few other offline exchanges between the two that are not directly related to Mifos Mobile. Briefly, these exchanges show that the interruption in Mifos Mobile discussion and code progress were mainly caused by the release of version 1.1 and then Rhino. Gbolahan is the IT partner of a few MFIs in Nigeria. For this reason, he too was busy localising Mifos 1.1. In his off-list discussion with Edward, he writes that the deployment of Mifos 1.1 for his MFI client is more difficult than he expected, which explains why he is not active anymore on the MLs. He explains that the Nigerian microfinance-related regulatory framework forces local MFIs to adopt accounting and cash management modules that are integrated with their loan tracking system (in this case Mifos). So, Gbolahan and his team were busy developing new code to implement Mifos locally and achieve his clients’ required legal integration.

			In the discussion that took place between the two, I discovered that Gbolahan knows a lot about the microfinance and IT market in Africa. He leads a rapidly growing IT company that is dedicated to software production for the financial sector and particularly microfinance. His messages are spontaneous and direct. For example, he asks Edward why Grameen does not promote the Mifos application more aggressively in Africa (and particularly Nigeria), which should help create a critical mass of users and reduce deployment costs for African and Nigerian MFIs. Edward replies that GTC does not have enough resources to support local IT companies like his on an individual basis, but that they are "*working as hard as we [they] can to build this capacity through the community by providing tools and materials to help in deploying Mifos*". Gbolahan writes that he is still determined to leverage Mifos use in the local market independently. He and his team have succeeded in designing what he calls a complete 'financial module' that he is planning to integrate with Mifos. He writes that he is having some difficulties in this regard. Edward encourages him to keep asking for technical support through the MLs. The two men also discuss the future of Mifos Mobile. Gbolahan complains mainly about the community's "inertia". He writes that there was no "critiques" of his code and no contributions, because of the bad timing. He is convinced that Mifos Mobile should be a great extension that cannot fail to interest microfinance and Mifos people. So, he comes back to the idea of a separate mailing list for Mifos Mobile. He thinks that it can leverage progress, as there is now code to be tested. Gbolahan also asks Edward why GTC developers don't contribute now with code, as they used to. Edward avoids the question. Yet Edward sends a post to the functional mailing list, mainly addressing Gbolahan. He invites Mifos volunteer developers to step in. He also informs that one GTC developer has reviewed Gbolahan's code. He publishes his feedback to help encourage participation and interest. He writes: > "*It's a great start but we need to know more of the intent and purpose behind Mifos Mobile: - Better documentation - what does it run on? Who is the intended user? - Clarification - it's operating at a sub-server level - how is that attached to Mifos? - Additional code - do you have any additional code that will help in showing what its intended functionality is?*" Ryan, another GTC developer joins in. He suggests to start working on Mifos Mobile functional specification. He

announces that GTC developers have worked out a template that will be soon added to the Mifos website.

Gbolahan finally replies to the ML. He is still busy working on the Mifos customisation in Nigeria, but he answers the questions about his code and concludes as follows:

> *“The source code is an insight to the menu of the application. The functions are not yet defined. The desired goal is to let the community take it up from here and get it developed. So far it is only servicing as a guide to the expected functionality”.*

The story is now closer to its end, which should also bring this long illustration to its conclusion. After the post he sent on the 11th December 2008 , Gbolahan stopped participating to the exchange on Mifos Mobile. Ryan sent another post with the classic problem-solving format that I observed so often in previous messages, i.e. breaking questions and providing detailed answers/questions separately. Another GTC member also uploaded a functional requirement template. But Gbolahan kept replying to everyone that he is “busy and expects to get back on track with Mifos Mobile soon”.

Epilogue: in 2009, a volunteer wrote:

> *“I am new to mifos. But the projects being handled in Mifos and the Mobile banking feature impressed me. I am pretty excited to work on this and would like to know more on this. I found that there has been some submissions on this. I wanted to know the present status of this feature. Is the Mifos API already developed??”*

I did not check, but I would like to think that his message got a positive answer. Other volunteers in 2010 and 2011 posted attempts to develop a new prototype for Mifos Mobile, referring to the work done in the past. Today there is an mpesa- plugin for Mifos (mpesa is a well-known Mobile Banking venture in Kenya). This can be freely downloaded from the Mifos Website. It can be used by MFIs or other developers for private or open purposes.

This illustration is about Gbolahan’s journey, or his attempt to create and sustain interest in the development of a new Mifos feature. Gbolahan is what I call an active member and contributor to the Mifos community. His ‘presumed’ Mifos Mobile leadership has unearthed deep power struggles and ‘North-South-Divide’ issues. Yet, I am interested here in documenting his behaviour in terms of knowledge building, sharing and learning in the mist

			of a real in-situ process of collaboration and collective software production. Undoubtedly, Gbolahan is an experienced developer who not only has software knowledge, but also a profound experience of MFIs' practices, the Nigerian regulatory environment, as well as the aptitude to situate this specific macro-economic background in the global context of the microfinance industry and International Development in general. In this sense, he is probably a prototype of the 'Mifos Specialist' and 'User' and a good candidate for Mifos long-term development. His story shows that participation in Mifos development is a complex and spread-out process, where developers continuously mimic behaviour and attitudes of leaders and information brokers in order to assimilate practices and learn. In this sense, Gbolahan first copied what appeared to him as an attractive aspect of open source participation and production, in terms of dynamism of discussions, the epistemic ethos of knowledge brokers, and the online practices of data sharing and collaboration. This was crucial to ensure knowledge transfer and learning. He has thus gradually learnt the necessary practices of distributed collaboration, in terms of the need to have material tokens of information that can be read, examined, and made sense of in order to generate collective value and produce knowledge. Even though, he could have learnt more about this feature and its design if intellectual exchange had really occurred, including with GTC people. Sam Lee, who is an experienced open source developer has somehow blamed GTC administrators in his earlier post for not providing the necessary support that would have helped Gbolahan and others 'formalise' and channel participants' implicit knowledge and experience to understand Mifos Mobile feature use cases, translate them into objectives and then requirements. From what he says, I conclude that contributing code to Mifos source code cannot be an input per se. The main reason is that code is the outcome of a construction process, where participants engage in order to build common understanding about a feature's requirements, and the way to design it. The code in itself only crystallises through this process. Because of the general inertia and especially the absence of administrators' support, Gbolahan felt forced to come up with code in order to kick-start Mifos Mobile. Therefore, his code cannot be a contribution to the Mifos project, but a "generous gift", as Adam put it. Arguably, Gbolahan felt that it was the price to pay for being the leader. As a proof of his commitment to the project, he thought he must deliver some output to 'all'.

			Indeed, Contributing to OSS is not about code gifting, or altruism (Bergquist & Ljungberg 2001). It is mainly about collectively negotiating meaning and generating knowledge. This process often culminates in a product or service that is produced and that others can use. However, this does not mean that they are finite. As users localise code, report errors and bugs, and once patterns of use start to emerge, the production of code and the development of its objects continue through a circle of continuous redesign and re-use.

I-Ref.	Msg. Date and Ref.	Profile Group & Information about the Poster	Messages/Threads Story
I-27	15/07/2009 **Annexl-105**	**Dusmant Kumar:** is an MIS programmer executive at Adhikar Microfinance, an Indian MFI. He contributed actively to the newsgroup in 2009 only. **Polly Gikonyo**: is IT project manager at Nuru International, a Kenyan MFI. She had been an active contributor in 2009 and 2010 **Kay Chau:** is a project administrator at GFUSA Tech-Centre. He joined in mid 2008 and worked on a number of translations and projects specific to certain MFIs. He has been an active contributor to the newsgroup.	Dusmant posts about how to set up Fee dates. He explains that he wants to configure fees irrespectively of the meeting date with the client –which Mifos feature does not really allow. Polly, another MFI user answers the following: *“Can you try running the collection sheet. In our case we are able to pay the upfront fees through the collection sheet.”* According to Polly Nuru was able to implement Mifos and configure the fee date feature, so as to make it possible for credit agents to collect fees before they start repayments. Although this does not ‘resolve’ Dusmant problem, it shows that it is possible to dissociate between payment dates and fees dates. Dusmant replies. He writes: *“I tried it, if you observe my case(which I explained here), I am able to view the fee as due. But when I tried it through collection sheet it shows the fee cannot applied on the particular date. If I try it through individually the amount for payment is shown zero & is not editable.”* Kay Chau, a GTC administrator intervenes in the discussion; she takes on the problem from there and tries to help Dusmant.
I-28	14/10/2010 **Annexl-106**	**Polly Gikonyo** **Fanon Gacao:** is MIS specialist at Mashariki Solutions, a Kenyan local IT expert. He contributed actively to the newsgroup from mid-2010.	This thread is an example of peer-support between the IT intermediaries of two MFIs. Polly posts about an error. She explains that Nuru International uses Mifos in a decentralised way at the branches’ level. She adds that staff in branches is getting errors when they try to access the client dashboard. She writes: *The model we have in our MFI is that all the branches have their own Mifos installations and we send database dumps every week to update at their site. Support is through phone calls and they have little IT skills so its very hard to get tomcat error logs from some of these*

		Keith Woodlock: Active subscriber of the MLs. He joined the Mifos project in 2009 as volunteer. In 2010, he was contracted by GTC. Awarded Star Contributor for June 2010. He was part of the "Evolve-Mifos-Code-Base' schema, moving to a more modular structure based on Spring application and defined set of SPI and APIs. **Ryan Whitney** GTC administrator MFIs contact person in the Mifos team	*sites. They sent me this error that they get when they try to access the client dashboard. Can anyone assist with where the problem is? Polly.* Fanon answers. Her institutions have experienced the same error and by the end they got through. She writes: Hello, *"I have experienced the problem with a hosted installation and from > my experience it seems to be more or less delayed execution of query it kind of times out. Once we had used our server for a while and gone through all the pages (queries) the problem did get solved. In fact the hosted application now responds faster than the local host installation. It would help to check the server log for exceptions and post them. Thanks."* The end of the thread shows a post that is sent by Keith. He actually thinks that the error might dissimulate a bug and tries to explore more. Ryan also answers. He gives a tip to Polly that allows her to fix the error. The solution has worked, as Polly answers back Ryan and thanks him

Appendix 6: Subscribers' Profiles

The table below aims to provide selected information about the profiles of the contributors to the Mifos Mailing Lists which have been referred to in the Analysis chapters and their appendices.

It lists the organisations, geographical locations and roles in the Mifos community of 276 participants in the Mailing Lists. It also presents the number of posts they made and replies they received as well as their period of participation. It is extracted from a more comprehensive and detailed database I had compiled based on information available in the public domain in the Mifos website and the participants and their organisations' websites as well as in the content of the messages they exchanged and that are available for public consultation in the Mifos Mailing Lists archives.

Participants	Location	Organisation	Role in the Community	First post	Last post	Number of posts	Number of replies
Abdel Karim Mardini	Egypt	OpenCraft	Local IT Specialist	1/9/06	1/7/07	1	1
Abdul-Quadri Dauda	Lagos-Nigeria	Intelligent Network Services	Local IT Specialist	1/1/08	1/2/09	50	44
Abhishek Sharma	Noida Area-India	SourceFuse.com	Local IT Specialist	1/2/09	30/4/09	6	10
Abiodun Awe	Nigeria/UK		Volunteer	1/2/09	28/2/09	1	2
Adam Balcerzak	Gdynia-Poland	SolDevelo Sp z o.o	IT Contractor	1/8/10	1/1/11	3	1
Adam Feuer	Seattle-USA	GFUSA-TechCenter	Project Admin/Engineering Director	1/5/08	1/4/11	499	333
Adam Monsen	Seattle-USA	GFUSA-TechCenter	Project Admin/Project Manager	1/10/07	1/1/11	1692	810
Adao Saranga	Mozambique	Tchuma	MFI user/IT Manager	1/10/06	31/12/06	4	4
Aditya Bhat	Bengalore-India	Visvesvaraya Technological University	Volunteer	1/8/09	30/8/09	1	1
Aditya Shah	NewYork-USA	Goldman Sachs	Volunteer	1/2/07	1/5/09	17	16
Ajay Kumar	India	Grameen Development Services	volunteer	1/4/10	30/4/10	3	3
Akinola Temitope	Nigeria	Seatop Systems Network	Local IT Specialist	1/10/08	1/4/09	8	11
Ali Abdel Aziz	Egypt	OpenCraft	Local IT Specialist	1/12/06	1/4/07	24	25
Aliya Walji	Seattle-USA	GFUSA-TechCenter	Project Admin/Technical Program Officer	1/3/07	1/2/11	583	351
Alv Gullbrand Lia	Oslo-Norway	Freelance	Volunteer	1/12/08	1/5/09	21	25
Amar Jirole	NewYork-USA	Goldman Sachs	Volunteer	1/6/06	30/6/06	2	1
Amiruddin Nagri	Bangalore-India	ThoughtWorks	IT Contractor/Mifos deployment	1/12/07	1/7/08	104	87
Amit Jain	India	Digamber Finance	MFI user/Executive Director	1/1/10	1/1/11	29	50
Amit Levy	Seattle-USA	GFUSA-TechCenter	Mifos deployment/Technical	1/4/07	1/8/07	65	51

Participants	Location	Organisation	Role in the Community	First post	Last post	Number of posts	Number of replies
Amit Srivastava	Bangalore-India	Aditi Technologies	IT Contractor/Development	1/2/06	1/7/06	59	50
Amy Bensinger	Bangalore-India	GFUSA-TechCenter	Mifos deployment	1/8/07	1/3/08	142	83
An Hoang	Singapore	First Meta Pte Ltd	Volunteer	1/3/10	30/4/10	8	9
Ananth Kambhammettu	Hyderabad-India	Parishkaar Advisory Services	Local IT Specialist	1/4/08	1/6/08	14	21
Anbu Raja	India	Quidel Software Chennai	Local IT Specialist	1/3/08	30/4/08	14	14
Andres Pacheco	Mexico/USA		Volunteer	1/6/07	1/7/08	10	9
Andrew Hapke	India	Development NGO-India	Potential MFI user	1/3/07	30/3/07	3	1
Andrew White	La Ceiba-Honduras	Fondacion Adelante	MFI user/Project Manager	1/8/07	1/5/08	32	40
Andy Posner	Rhode Island Area	Capital Good Fund	Volunteer	4/8/09	4/8/09	2	2
Angshuman Sarkar	Bangalore-India	ThoughtWorks	IT Contractor/Mifos deployment	1/5/10	1/1/11	73	60
Anna Liza Engracia	Philippines	ASKI IT OIC	Local IT Specialist	29/1/09	29/1/09	2	1
Anousak Souphavanh	Cambodia	Anakut-IT Spe	Volunteer/Translation	1/5/09	30/6/09	8	6
Anuradha Jairaj	USA	SCDOR	Volunteer	1/12/10	30/12/10	3	6
Aravind Deivendran	Bangalore-India	SunGard	IT Contractor/Mifos deployment	1/8/09	1/1/11	29	28
Arpita Adhicary	Bangalore-India	IBM India	IT Contractor/Mifos deployment	1/12/07	1/7/08	31	46
Artur Siekielski	Gdynia-Poland	SolDevelo Sp z o.o	IT Contractor	1/9/10	1/1/11	41	33
Arun Kanabar	Bangalore- India	MFTech	Local IT Specialist	1/4/06	5/1/07	53	33
Avdhesh Yadav	India		Volunteer	1/6/09	30/6/09	4	3
Avniel Dravid	Seattle-USA	Ojas Venture Partners	Volunteer	1/8/07	30/9/07	10	6
Bamidele Oyebolu	Lagos-Nigeria	Lavender Microfinance Bank	MFI user/Director	1/8/10	1/8/10	1	2
Bapiraju Naga Gade	India	MNC	Local IT expert	1/4/08	30/4/08	4	4
Bart Berning	Nairobi-Kenya	GFUSA-TechCenter	Mifos deployment	1/8/07	1/7/08	48	38

Participants	Location	Organisation	Role in the Community	First post	Last post	Number of posts	Number of replies
Bart de Rijk	Kenya	Global Business Assist_Mifos Light	Local IT Specialist	1/7/09	1/9/09	13	11
Beth Mazur	Seattle-USA	GFUSA-TechCenter	Mifos deployment	1/12/07	1/9/08	34	28
Bharat Ahluwalia	Bangalore-India	Aditi Technologies	IT Contractor/Development	1/7/07	1/10/07	6	1
Biju K.A	Bangalore-India	Grameen Koota	MFI user/IT administrator	1/5/10	30/10/10	13	11
Binny Gopinath	Bangalore-India	GFUSA	Mifos deployment/Technical	1/9/10	1/1/11	7	39
Biren Patnik	Irland-UK	IBM	IT Contractor	1/12/07	1/5/08	18	16
Bruno ken Shiozawa	Sichuan-China		Local IT Specialist	1/10/08	30/10/08	5	6
Carlos Paredes	Peru		Potential MFI user	1/10/07	28/2/09	6	3
Chandan Rao	Bangalore-India	SunGard	IT Contractor/Mifos deployment	1/8/09	1/1/11	100	82
Chandi Datta	Bangalore-India	IBM India	IT Contractor/Mifos deployment	1/8/08	1/7/08	10	13
Chico Charlesworth	London-UK	IBM	IT Contractor	1/2/08	1/7/08	70	65
Chiman Sachdeva	Netherlands	Logica.com	Local IT Specialist	1/7/09	30/7/09	4	3
Chiradeep Chhaya	UK	Goldman Sachs	Volunteer	1/8/09	30/9/09	2	4
Daniele Jammes	Africa-unknown	fafa-microcredit.com	MFI user/Translation	1/1/09	30/1/09	2	2
David Fono	Nigeria		Potential MFI user	1/2/07	30/3/07	2	3
Deepak Pandiyarajan	Bangalore-India	SunGard	IT Contractor/Mifos deployment	1/11/06	30/3/07	2	3
Deependra Solanky	India	MFI-Drishtee	MFI User	1/7/09	30/8/09	4	11
Derek Jean-Baptiste	London-UK	Goldman Sachs	Volunteer	1/11/06	1/4/10	67	47
Dhanushka Kottegoda	Sri Lanka	Freelance	Volunteer	1/3/10	1/6/10	13	18
Diane	Rwanda	GoIT Solutions Ltd	Local IT Specialist	1/12/08	30/3/09	5	12
Dion Dodgen	South Africa	Sadalbari	Local IT Specialist	1/11/07	1/2/08	60	31

Participants	Location	Organisation	Role in the Community	First post	Last post	Number of posts	Number of replies
Dusmant Kumar	Orissa-India	Adhikar Microfinance	MFI user/Project Manager	1/1/09	1/11/09	23	44
Edward Cable	Seattle-USA	GFUSA-TechCenter	Project Admin/Mifos Community Manager	1/2/07	1/1/11	179	146
Ellen Nadelhoffer	Seattle-USA	GFUSA-TechCenter	IT Contractor	1/9/08	30/12/08	15	11
Emily Tucker	Seattle-USA	GFUSA-TechCenter	Project Admin/Director, product management	1/4/05	1/1/11	681	595
Eric Deshayes			Volunteer	1/11/07	30/11/07	9	16
Eric Du	China	Comverse-Mobile Techno	volunteer	1/5/07	1/6/07	63	39
Eric Renaud	San Francisco-US	CollabNet	Volunteer	1/9/09	30/11/09	6	7
Eugene Pavlenko			Volunteer	13/3/08	13/5/08	15	12
Ferenc Kovács	Hungary		Volunteer	1/8/09	30/11/09	7	6
Francis Vidal			Potential MFI user	17/7/08	24/3/10	10	9
Frank	Cote D'Ivoire-Africa	Alternix Computers	Volunteer/Local IT specialist	1/1/09	30/1/09	1	1
Frank Ogwaro	Lagos-Nigeria		MFI user	1/8/09	30/8/09	1	7
Gabriel Metz	Paris-France	HORUS DEVELOPMENT FINANCE	Microfinance Consultant	1/1/07	30/3/07	5	6
Gangadhar Nittala	India		Volunteer/Local IT specialist	1/4/10	30/6/10	11	5
Garry Blanco	Philippines	IDEASoft/CGAP IT	Local IT Specialist	1/10/07	1/12/08	37	33
Gary Weberg	Colorado-USA	Opportunity International	Volunteer	1/9/07	1/1/08	57	37
Gayl Kennedy	Irland-UK	Fantsuam Foundation	Volunteer	1/7/10	1/12/10	92	134
Gbolahan Oshonubi	Lagos-Nigeria	Intelligent Network Services	Local IT Specialist	1/1/08	1/1/11	131	65
Geetha Krishna	Bangalore-India	ING Vysya Bank	Volunteer/Mifos deployment	1/4/09	1/5/09	4	6
Geoff Crocombe	UK	Goldman Sachs	volunteer	1/8/09	30/9/09	9	6
George Conard	Seattle-USA	GFUSA-TechCenter	Project Admin/Executive Director	1/3/06	1/1/11	64	150

Participants	Location	Organisation	Role in the Community	First post	Last post	Number of posts	Number of replies
George Lteif	Beirut-Lebanon	Al Majmoua	MFI user/IT Manager	1/12/09	1/1/11	13	11
Geraldine O'Keeffe	Kenya	GrowthAfrica Ltd	MFI User	1/11/09	30/8/10	12	19
Gigi Gatti	Makati-Philippines	GFUSA-TechCenter	Mifos deployment/Cloud project Manager	1/5/10	1/9/10	2	2
Girish Naik	Bangalore-India	Grameen Koota	MFI user/IT administrator	14/12/07	14/12/07	1	2
Gnana Prakash	Bangalore- India	MFTech/ Grameen Koota	Local IT Specialist	9/12/06	9/12/06	1	3
Gourav Bhatia	India	Freelance	Volunteer	1/10/10	30/10/10	1	0
Graeme Ruthven	New Zealand	Datacom Systems Limited	Volunteer	1/1/08	1/1/11	138	101
Greg Steffensen	Washington D.C.-USA	GFUSA-TechCenter	IT Contractor	1/3/07	30/6/07	27	20
Hari Priya	India	Freelance	Volunteer	1/3/10	30/6/10	3	10
Henrik Esbensen	USA	Creocore	MFI user/Project Manager	4/1/11	3/7/11	1	2
Jaganathan Srinivasan	Bangalore-India	IBM India	IT Contractor/Mifos deployment	1/7/07	30/3/08	8	7
Jakub Stawinski	Gdynia-Poland	SolDevelo Sp z o.o	Volunteer/IT Contractor	1/9/09	1/1/11	84	95
James Dailey	Seattle-USA	GFUSA-TechCenter	Project Admin/Founder	1/1/06	1/11/07	270	162
Jasmine Sandhu	Providence-USA	MIT	Volunteer	1/7/10	1/1/11	47	35
Jason Kaye	Rhode Island	Capital Good Fund	MFI user/IT Administrator	1/5/09	30/9/09	2	2
Jebose Andrew	Lagos-Nigeria	Intelligent Network Services	Local IT Specialist	1/8/08	30/9/08	13	5
Jeff Blue	Washington-USA	SEM	Volunteer	1/4/08	1/4/09	61	43
Jeff Brewster	Seattle-USA	GFUSA-TechCenter	Project Admin/Quality Assurance Manager	1/2/08	1/4/11	532	357
Jessica Cheng	China	GFUSA	Mifos deployment/Translator	1/2/10	1/1/11	18	23
Jim Kingdon	Seattle-USA	GFUSA-TechCenter	Mifos deployment/Technical	1/8/06	1/7/07	388	291
Jitendra Vasanthu	NewDelhi-India	SATIN	MFI user/Founder	1/8/09	1/9/09	20	20

Participants	Location	Organisation	Role in the Community	First post	Last post	Number of posts	Number of replies
Joe Terry	US	Picocredit.com	Local IT Specialist	1/12/08	30/3/09	8	6
Joel Shuflin	Ghana	Global Business Assist_Mifos Light	Local IT Specialist	1/10/09	30/6/10	4	1
Joey Tuvilla	Seattle-USA	Freelance	Volunteer	1/10/07	1/11/07	10	13
Johan Hilding	Stockholm-Sweden	Freelance	Volunteer	1/7/09	1/8/09	15	18
John Woodlock	Melbourne-Australia	GFUSA-TechCenter	Volunteer/Developer	1/6/09	1/1/11	280	236
Jonathan Heinberg	NewYork-USA	Goldman Sachs	Volunteer	1/9/06	1/2/08	9	16
Jorge Gonzalez	Mexico	creditor.com	Local IT Specialist	26/10/09	21/11/09	9	7
Kalonji Kabongo	Boston-USA	Thomson Reuters	Volunteer	1/7/10	30/8/10	6	6
Kalyan Akella	Bangalore-India	ThoughtWorks	IT Contractor/Mifos deployment	1/5/10	1/1/11	40	32
Karim Ratib	Egypt	OpenCraft	Local IT Specialist	1/9/06	1/7/07	35	41
Karuna Krishnaswamy	Bangalore-India		Local IT Specialist	1/1/06	30/8/06	43	32
Katrina Torres	Philippines	MicroBiz-One	Local IT Specialist	5/5/10	31/8/10	6	7
Kavita Viswanathan	Bangalore-India	SunGard	IT Contractor/Mifos deployment	1/9/10	28/2/11	5	5
Kay Chau	Seattle-USA	GFUSA-TechCenter	Project Admin/Developer	1/6/08	1/1/11	370	213
Kazeem Durodoye	Lagos-Nigeria	KKD Consulting	Local IT Specialist	1/3/10	1/7/10	23	9
Keith Pierce	Seattle-USA	GFUSA-TechCenter	Volunteer/Developer	1/1/08	1/5/10	167	154
Keith Randall	USA		Volunteer	1/4/09	1/1/11	21	25
Keith Woodlock	Irland-UK	GFUSA-TechCenter	Project Admin/Developer	1/7/09	1/1/11	211	217
Kelechi Micheals	Kafanchan-Nigeria	Fantsuam Foundation	MFI user/Programs Operations Manager	1/3/10	1/1/11	22	18
Kevin Kimani	Nairobi-Kenya	X-Emplar Technologies	Local IT Specialist	1/6/09	1/1/11	19	19
Khadija Shamte	Nairobi-Kenya	Adpet Systems	Local IT Specialist	1/11/06	30/1/07	16	2

Participants	Location	Organisation	Role in the Community	First post	Last post	Number of posts	Number of replies
Kimloan Ho	Seattle-USA	Freelance	Volunteer	1/6/07	1/10/08	97	68
Kimseng Sieng	Cambodia		MFI user	1/1/10	1/1/11	12	15
Kiran Chakravarthy	Bangalore-India	Aditi Technologies	IT Contractor/Development	1/3/06	1/11/06	87	59
Koh Tze Yong	Singapore		MFI user	1/12/09	1/3/10	24	22
Kojo Gambrah	Accra-Ghana	Freelance	Volunteer	1/4/10	1/12/10	49	57
Kollam Rajesh	Bangalore-India	SunGard	IT Contractor/Mifos deployment	1/8/09	1/1/11	2	5
Krishnan Mani	Mumbai-India	Girivraja	Local IT Specialist	1/7/09	1/6/10	78	52
Lasith Sameera	India	Freelance	Volunteer	1/4/10	30/4/10	13	7
Lassaad Ben Hadj	Tunis-Tunisia	Enda	MFI user/IT Manager	1/1/07	1/1/11	10	32
Leah Morgan	Ghana	Chapter 58 Trust	MFI user/IT Administrator	1/6/09	30/9/09	6	10
Li Gao	Beijing-China	ThoughtWorks	IT Contractor	1/8/07	1/9/07	89	33
Lisa Retief	South Africa	Sadalbari	Local IT Specialist	1/7/07	30/10/07	22	12
Lokesh Sajjan	India	Conflux Technologies	Local IT Specialist	1/7/10	30/11/10	21	11
Loojah Bajracharya	Nepal	Magnus Consulting Group	Local IT Specialist	1/4/10	30/4/10	4	9
Maheswari Selvakumar	Bangalore-India	SunGard	IT Contractor/Mifos deployment	1/8/09	1/1/11	2	8
Maina Wachira	Nairobi-Kenya	Adept Systems	Local IT Specialist	1/10/09	1/7/10	57	45
Malik M. Sarfaraz	Pakistan	Sapphire Consulting Services	Local IT Specialist	1/1/09	30/1/09	1	1
Malini Gowrishankar	Bangalore-India	ThoughtWorks	IT Contractor	1/8/08	30/8/08	4	5
Malini Krupa	Bangalore-India	ThoughtWorks	IT Contractor/Mifos deployment	1/6/08	1/12/08	19	16
Manesh G	Bangalore-India	Aditi Technologies	IT Contractor/Development	1/1/06	1/11/06	88	58
Mangala Rao	India		Potential MFI user	1/11/09	30/11/09	3	2
Manoj Sharma	Nepal	Magnus Consulting Group	Local IT Specialist	1/5/10	1/1/11	79	44

Participants	Location	Organisation	Role in the Community	First post	Last post	Number of posts	Number of replies
Marie Valdez	Nairobi-Kenya	GFUSA-TechCenter	Mifos deployment	1/5/07	1/4/11	28	38
Mark Kavanagh	Irland-UK	IBM	IT Contractor	1/9/07	1/4/08	16	19
Martyn Cooper	UK	Rogers.Com	Financial Expert	1/9/06	30/9/06	4	4
Massimiliano Parlione	Irland-UK	IBM	IT Contractor	1/9/07	1/6/08	40	37
Matanmi Femi	Lagos-Nigeria	Intelligent Network Services	Local IT Specialist	1/3/08	1/3/08	10	6
Mayank Upadhayay	Bangalore-India	SunGard	IT Contractor/Mifos deployment	1/5/07	1/3/08	76	67
Michael Hsieh	NewYork-USA	Goldman Sachs	Volunteer	1/6/09	1/7/09	8	10
Michael Kimani	Kenya	Sacco in Kenya	Potential MFI user	1/11/09	30/11/09	1	2
Michael Vorburger	Lausanne-Switzerland	Odyssey Financial Technologies	Volunteer	1/10/09	1/1/11	78	65
Micheal Abobade	Lagos-Nigeria	www.cisnig.com	Local IT Specialist	1/2/09	28/2/09	6	3
Miguel Joia Santos	Mozambique	SBS - Soluções em Banca e Seguros	Local IT Specialist	1/2/10	1/1/11	10	10
Mike Tarimo	Kenya	Efulusi.com	Local IT Specialist	1/11/08	28/2/09	4	4
Mo Li	Beijing-China	ThoughtWorks	IT Contractor	1/3/07	1/3/07	42	13
Mohammad Arshad	Pakistan	VIT	Volunteer	1/1/09	30/1/09	5	2
Mohammed Nyamatullah	Bangalore-India	Aditi Technologies	IT Contractor/Development	1/3/06	1/10/06	44	29
Nabeel Gillani	Connecticut US	Capital Good Fund	Volunteer	1/8/09	30/8/09	2	4
Nagalakshmi Chandrashekar	Bangalore-India	Grameen Koota	MFI user/IT administrator	28/9/10	28/9/10	1	3
Nagananda Kumar	Bangalore-India	Grameen Koota	MFI user/IT administrator	1/6/06	1/6/10	55	69
Nagesh Pulluru	Irland-UK	IBM	IT Contractor	1/12/07	1/9/09	27	25
Nandini Yadalam	Bangalore-India	ThoughtWorks	IT Contractor/Mifos deployment	1/3/08	1/8/08	14	16
Narcisa Maria Pantilimon	Eastern Europe		Volunteer	1/8/10	30/3/11	7	10

Participants	Location	Organisation	Role in the Community	First post	Last post	Number of posts	Number of replies
Natu Lauchande	Mozambique	Afrisis	Local IT Specialist	1/2/10	1/1/11	12	21
Nayan Ambali	India	Conflux Technologies	Local IT Specialist	1/9/10	1/1/11	41	26
Nazir Lajdel	Tunis-Tunisia	Oxia	Local IT Specialist	1/4/07	1/6/08	112	71
Neil De la Cruz	Philippines	Microbiz-One	Local IT Specialist	1/5/10	1/8/10	28	27
Nesrine Madhkour	Tunis-Tunisia	Oxia	Local IT Specialist	1/2/07	1/3/08	83	71
Niall Loughnane			Volunteer	1/7/06	30/7/06	12	16
Nigel Lazarus	India	ESAF	MFI user/Development	1/9/07	30/9/07	5	8
Noel Anil	India	Profound Infotech	Local IT Specialist	31/12/07	31/12/07	1	2
Ofer Matan	Seattle-USA	GFUSA-TechCenter	IT Contractor/Development	1/10/07	1/9/08	64	53
Omar Bilani	Lebanon		Potential MFI user	1/11/07	30/12/07	29	31
Oskar Himmelreich	Amsterdam	Musoni.eu	Potential MFI user	1/11/09	30/12/09	6	3
Owoeye Sunday	Lagos-Nigeria	Intelligent Network Services	Local IT Specialist	1/1/08	1/9/09	56	34
Pandiyarajan Deepak	Bangalore-India	SunGard	IT Contractor/Mifos deployment	1/11/06	1/2/07	15	21
Parthasarathy Thanda	Bangalore-India	SunGard	IT Contractor/Mifos deployment	1/8/09	1/1/11	27	32
Parul Vipparthi	Bangalore-India	Aditi Technologies	IT Contractor/Development	1/6/06	1/7/06	21	20
Paul Browne	Irland-UK	IBM	IT Contractor	1/1/08	1/6/08	3	4
Paul Heffels	Netherlands	Logica.com	Local IT Specialist	1/11/08	28/2/09	2	4
Paul Were	Kenya		Local IT Specialist	1/3/07	30/6/07	7	9
Peter Davey	Australia		Volunteer	1/11/06	1/6/07	10	7
Peter Kron			Volunteer	1/4/08	30/4/08	2	1
Polly Gikonyo	Nairobi-Kenya	Nuru International	MFI user/IT Manager	1/7/09	1/1/11	53	37
Polly Najori	Nairobi-Kenya	Jitegemea Credit Scheme	MFI user/IT Administrator	1/7/09	1/9/11	5	4
Pooja Chauhan	NewDelhi-India	Anduril Technologies	Local IT Specialist	1/10/07	1/6/10	10	8

Participants	Location	Organisation	Role in the Community	First post	Last post	Number of posts	Number of replies
Prabaharan Gopalan	Bangalore-India	SunGard	IT Contractor/Mifos deployment	1/8/09	1/1/11	12	12
Prachi Malhorta	Bangalore-India	SunGard	IT Contractor/Mifos deployment	1/7/09	1/9/10	15	27
Pradeep Kumar Panda	Orissa-India	Adhikar Microfinance	MFI user/Project Manager	1/2/10	1/1/11	37	34
Pramod Biligiri	Bangalore-India	ThoughtWorks	IT Contractor/Mifos deployment	1/1/08	1/8/08	88	78
Prathasaray Thanda	Bangalore-India	SunGard	IT Contractor/Mifos deployment	2/9/09	14/6/10	1	2
Praveena G	Bangalore-India	Grameen Koota	MFI user/IT administrator	27/9/10	28/12/10	2	0
Priscilla Dosiou	Seattle-USA	GFUSA-TechCenter	Project Admin	1/6/07	1/10/07	6	5
Priscilla Glenwright	Seattle-USA	GFUSA-TechCenter	Project Admin	1/7/06	1/9/06	3	3
Puspadhar Das	Assam-India	ASOMI	MFI user/IT Manager	1/8/08	1/1/11	43	18
Raghavendra Bhandari	Bangalore-India	SunGard	IT Contractor/Mifos deployment	1/8/09	1/1/11	47	57
Rahul Vipparthi	Bangalore-India	MFTech	Local IT Specialist	1/3/06	30/6/06	7	10
Rajender Saini	Bangalore-India	Aditi Technologies	IT Contractor/Development	1/10/05	1/11/06	3	0
Ramya Theja	India	TCS	Potential MFI user	1/11/09	30/11/09	2	4
Ramya Toshniwal	Bangalore-India	SunGard	IT Contractor/Mifos deployment	1/2/10	1/1/11	28	38
Ravi Chinoy	US	Freelance	Volunteer	1/4/10	31/12/10	18	17
Ravi Kutaphale	Irland-UK	IBM	IT Contractor	1/2/08	1/7/08	61	48
Renju	Bangalore-India	IBM India	IT Contractor/Mifos deployment	6/9/07	21/9/07	15	10
Riki Kurniawan	Indonesia		Volunteer/Translation	1/1/10	1/3/10	15	15
Riskebiz	Kenya	Riskebiz Internet Services	Local IT Specialist	1/7/09	1/9/09	1	1

Participants	Location	Organisation	Role in the Community	First post	Last post	Number of posts	Number of replies
Rituparna Buragohain	Guwahati-India	Asomi Finance	MFI user/IT Manager	1/6/09	1/6/10	19	15
Roberto Musso	Luxembourg	IBM	IT Contractor	1/2/08	1/5/08	66	24
Rodrigo Reyes C	Chile	Freelance	Volunteer	1/1/10	30/3/10	8	10
Romero Carlo	NewYork-USA	Goldman Sachs	Volunteer	1/12/06	1/6/10	65	70
Ruth Frowein	Seattle-USA	Freelance	Volunteer	1/10/07	1/4/10	12	10
Ryan Whitney	Seattle-USA	GFUSA-TechCenter	Project Admin/Developer	1/4/08	1/1/11	908	472
Sam Birney	Seattle-USA	GFUSA-TechCenter/Kiva.org	Volonteer/IT contractor/Developer	1/10/07	1/8/10	199	153
Sam Lee (Wai Kwong)	Seattle-USA	Amazon.com	Volunteer	1/3/06	1/4/09	90	54
Santosh Shah	Nepal	Magnus Consulting Group	Local IT Specialist	8/9/10	13/10/10	3	1
Satriadi	Indonesia	Bank Tabungan Pensiunan	MFI user/IT Manager	1/6/10	1/1/11	63	33
Saurabh Kumar	Bangalore-India	SunGard	IT Contractor/Mifos deployment	1/6/07	1/5/08	77	62
Saurabh Tandon	Bangalore-India	Aditi Technologies	IT Contractor/Development	1/6/06	1/7/06	11	15
Selim Lachiheb	Tunis-Tunisia	Oxia	Local IT Specialist	1/1/08	30/6/08	5	8
Senthil Ramachandran	Bangalore-India	IBM India	IT Contractor/Mifos deployment	1/9/07	30/11/07	2	3
Sergio S. Gomez/Shekko	Mexico	Banking Sector	MFI user/Development	28/12/09	30/8/10	50	40
Shahiduzzaman	Victoria-Australia	Freelance	Volunteer	1/4/08	1/1/11	28	22
Shahzada Hatim	Sweden	Freelance	Volunteer	1/3/10	1/10/10	56	43
Sherry Hom			Volunteer	1/8/06	30/3/07	21	23
Shrikant Bijapurkar	Pune-India	SunGard	IT Contractor/Mifos deployment	1/8/08	1/8/08	4	4
Simon Ndungu	Kenya	Alpha Capital	Potential MFI user	1/11/08	30/12/08	1	6
Simon Padgham	Thailand		Potential MFI user	1/5/09	30/5/09	2	2

Participants	Location	Organisation	Role in the Community	First post	Last post	Number of posts	Number of replies
Soham Dhakal	Nepal	Magnus Consulting Group	Local IT Specialist	1/8/06	1/1/11	124	94
Song Zhang	Beijing-China	ThoughtWorks	IT Contractor	1/8/07	1/9/07	20	7
Sothyvorn OK	Cambodia	Anakut-IT Spe	Volunteer/Translation	1/5/09	30/6/09	9	7
Srikanth Nutigattu	Bangalore-India	ThoughtWorks	IT Contractor	18/10/10	5/1/11	17	16
Srinivassan P	India	MCT	Local IT Specialist	1/6/10	30/7/10	9	9
Stanley Kwok	Vancouver-Canada	Freelance	Volunteer	1/6/10	1/1/11	41	45
Stefan Van Oss	Netherlands	Logica.com	Local IT Specialist	1/6/09	30/8/09	5	5
Stephen Horgan	Irland-UK	IBM	IT Contractor	1/1/08	1/6/08	37	55
Stephen T Kaufman	Ghana	Global Business Assist_Mifos Light	Local IT Specialist	1/8/08	1/11/10	27	23
Steve Mushero	China	GLOBALTECH	Volunteer/Local IT specialist	1/3/06	1/10/06	75	52
Sumeetha E. Cherian	Bangalore-India	Aditi Technologies	IT Contractor/Development	1/4/07	1/7/07	58	52
Sumit Bagchi	Philippines	JSPL/CGAP IT	Local IT Specialist	1/3/07	1/5/07	9	11
Sumit Shah	Seattle-USA	GFUSA-TechCenter	Project Admin/Developer	1/11/10	1/5/11	4	2
Swati Rathi	Bangalore-India	Aditi Technologies	IT Contractor/Development	1/3/06	1/11/06	39	41
Swetha Banwa	Bangalore-India	Grameen Koota	MFI user/IT administrator	1/5/10	30/5/10	1	1
Tejus Datta	Bangalore-India	ThoughtWorks	IT Contractor/Mifos deployment	1/6/10	1/12/10	8	6
Terry Wong	Boston-USA	Cydeology	Volunteer	1/3/06	1/9/07	89	67
Theodor Kurz	Lachen-Switzerland	L X I Technologies GmbH	Volunteer	1/11/08	1/1/09	44	53
Thien La	NewYork-USA	Goldman Sachs	Volunteer	1/1/07	30/1/07	5	3
Tiger Wang	China	GLF Software Information	Local IT Specialist/Translation	1/3/10	30/3/10	1	4
Todd Farmer	US	fivefarmers.com	Volunteer	7/7/09	10/7/09	7	6
Tom Bostelmann	Seattle-USA	GFUSA-TechCenter	Volunteer/IT Contractor/Developer	1/7/07	1/1/08	195	133

Participants	Location	Organisation	Role in the Community	First post	Last post	Number of posts	Number of replies
Tom Meredith	USA	P2P cash	Mobile expert	1/1/12	31/12/12	1	4
Tracy M	USA	Freelance	Volunteer	1/4/10	30/4/10	21	11
Trilok J. Pandya	Gujarat-India	Light_Microfinance	MFI user/IT Manager	1/7/07	1/1/11	94	56
Udai Gupta	Bangalore-India	GFUSA-TechCenter	Project Admin/Developer	1/5/09	1/4/11	752	423
Upma Sharma	Bangalore-India	Aditi Technologies	IT Contractor/Development	1/7/07	1/10/07	48	49
Vadim Orange Mile	US	Orange Mile Developer Network	Volunteer	1/6/09	30/11/09	5	4
Van Mittal Henkle	Seattle-USA	GFUSA-TechCenter	Project Admin/Developer	1/12/06	1/1/11	846	521
Vasu Veeramachaneni	Bangalore-India	Aditi Technologies	IT Contractor/Development	1/3/06	1/10/06	31	20
Vijay Katariya	Amsterdam	Musoni.eu	Potential MFI user	1/11/09	30/12/09	3	4
Vinod C John	Bangalore-India	ThoughtWorks	IT Contractor/Mifos deployment	1/5/10	1/11/10	23	24
Vinodh Nandakumar	Bangalore-India	Aditi Technologies	IT Contractor/Development	1/3/07	1/5/07	21	18
Virender Singh	London-UK	Celeridyn Inc	Volunteer	1/4/10	1/7/10	14	13
Vishnu Vardhan	Hyderabad-India	Freelance	Volunteer	1/1/10	1/6/10	11	17
Viswanath Durbha	Bangalore-India	Cognizant Techno. Solutions	Volunteer	1/11/08	30/12/08	13	14
Vivek Singh	Bangalore-India	ThoughtWorks	IT Contractor/Mifos Deployer	1/11/10	1/12/10	49	57
Vivian Lu	Nyanza-Kenya	Nuru International	MFI user/IT Manager	1/9/10	1/1/11	9	8
Wai Kwong Sam Lee	Seattle-USA	Amazon.com	Volunteer	1/3/06	1/4/09	7	2
Wasim Ahmad Khan	Pakistan	FFO	MFI user/IT Manager	1/8/08	1/9/08	10	14
Wayne Chang	Beijing-China	ThoughtWorks	IT Contractor	1/3/07	30/3/07	2	1
Wenjing Luo	Beijing-China	ThoughtWorks	IT Contractor	1/5/07	1/8/07	200	23
William Pietri	San Francisco USA	Scissor	IT Contractor	1/1/06	1/11/07	168	105
Youssef Assad	MENA Region	GFUSA-TechCenter	Mifos deployment	1/3/06	1/7/07	29	29
Zheng Ye	Beijing-China	ThoughtWorks	IT Contractor	1/5/07	1/8/07	4	3

Appendix 7: Mifos Newsgroups

Mifos.org/Mailing List page (Last accessed Feb. 2010) provides the following list of newsgroups where subscribers can register.

- ✓ **Announcements**: This list broadcasts major releases/upgrades (unidirectional) Google Groups Web Interface | Archives (GMANE)
- ✓ **Developers**: This is an online space to participate in design decisions, suggest approaches, provide feedback on code quality, respond to design questions, etc. Developer Mailing List Signup | Google Groups Web Interface | Archives (GMANE) | USENET, RSS feeds
- ✓ **Functional:** The functional mailing list allows users and designers to discuss functional requirements; get clarifications, and suggest new features. Functional Mailing List Signup |Google Groups Web Interface |Archives (GMANE) | USENET, RSS feeds: This mailing list
- ✓ **Users Discussions:** Here are discussions on how to get and run Mifos. The user mailing group also discusses practical usage on a daily basis and shares best practices. Aimed towards users of all technical levels, the latter mailing list is a sort of help line providing support to and from the community. Sample discussion topics include discussion on installation and configuration issues, advice on database administration, security, and network setup, basic troubleshooting and resolutions to common errors, etc. Users Mailing List Signup | Google Groups Web Interface |Archives (GMANE) | USENET, RSS feeds
- ✓ **Issue tracker** keeps up to date information about changes in the code source. This is a read only list. Issue Tracker Change Notifications Signup | Archives | (mirror 1, mirror 2) | USENET, RSS feeds:
- ✓ **Source Code Commit Notifications:** monitors and tracks commits to the source code. This is a read-only list. Signup | Archives | (mirror 1, mirror 2) | USENET, RSS feeds

Mifos posts can also be accessed through MailArchives, MifosSourceForge, or Gmane. Email archives can be read on the web either by using a blog-like, flat interface, or using frames and threads. They can also be read using an NNTP newsreader, or RSS feeds. Developers, Functional and User mailing lists mirror those on SourceForge which indicates that emails can be retrieved in Mifos-on-SourceForge. Mifos Gmane's advantage is then to offer enhanced reading facilities that makes it searchable as well as an archive data repository for the Mifos community.
First, Mifos Mailarchives (Last accessed Feb. 2010) is an email repository that turns mailing lists into searchable archives. This website does not contain the full set of Mifos mailing lists and is not updated. The oldest email in functional list goes back to 2007/10/30 (Mifos-functional). In Mifos-issues, the oldest email in users list goes back to 2008/10/24. In Mifos-users, the oldest email in issues list goes back to

2010/01/19.The GMANE website (Last accessed Feb. 2010) contains the following instances

- **Developers mailing list: 7622**
- **Functional mailing list:1460**
- **Issue tracker mailing list: 13368**
- **SCM Notifications: 6610**
- **Users Discussions: 607**

Mifos SourceForge website (Last accessed Feb. 2010) shows the following table:

Name	Nb. of MSG	Nb. of Subscribers	Period of coverage	Description
mifos-announce Archives	11	88	Nov2008-Dec2009	Low-volume outbound mailing list to announce new releases and security fixes
mifos-builds Archives	32	4	Jan2010-Today	Build notifications
mifos-developer Archives	7805	392	Jan2006-Today	Developers' discussion
mifos-issues Archives	683	4	Jan2010-Today	Issue notifications
mifos-functional Archives	1472	259	Jan2007- April 2010	Discussion of current and future features/functionality in Mifos
mifos-users Archives	692	160	Oct2008-Today	Discussion regarding practical usage, installation, and Mifos best practices
mifos-news (not yet archived)	-	-	-	Bi-weekly outbound newsletter providing updates on deployments and development

Mifos.org contains also links to a former Mifos java.net page that contains information about Mifos homepage; wikis… Mifos was managed through java.net until a couple of years ago. Today the SourceForge project host is Mifos host production site, which makes Mifos java.net page a repository for a bulk of documents and files that are no longer updated. This website is disregarded from the current analysis.