# Improving the Usability of Free, Libre, and Open Source Software through Understanding Participation and Power

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## Abstract

Free, libre, and open-source software (FLOSS) is a promising alternative to proprietary software in terms of availability and transparency. As the world increasingly relies on software for essential functions, the importance of FLOSS only grows. However, FLOSS suffers from a "by developer, for developer" mentality, causing the need of developers to be prioritized, low participation rates of designer and end-user stakeholders, and overall poor usability. Research has shown one method to improve usability is through facilitating participatory design (PD) during which stakeholders work together to design solutions; however, previous studies have reported numerous barriers to including designers and endusers in the FLOSS process, especially related to power dynamics between stakeholders (i.e., who has access to resources and decision making). However, most of the research on PD and FLOSS usability does not include all three stakeholders in an active PD activity, instead focusing on developers' perspectives and developer-designer interactions in FLOSS to improve usability. To address this, we conducted four design workshops with different combinations of developer, designer, and end-user participants. We seek to understand what usability challenges occur in FLOSS and how PD occurs in a FLOSS context to address these challenges. We also analyze how power dynamics manifest in their PD collaboration through the lens of Haugaard's Four Dimensions of Power theory. In this thesis, we contribute (1) a set of key observations for each stakeholder group on perceptions and experiences with respect to FLOSS usability; (2) a framework capturing the structure and activities of PD involving three types of stakeholders; and (3) empirical knowledge on behaviors demonstrating power in the PD activities. Our study can help inform future researchers and current FLOSS projects on possible interventions and design solutions for encouraging stakeholder participation to improve FLOSS usability.

# Abrégé

Les logiciels gratuits et provenant de sources ouvertes (en anglais "free, libre, and opensource software" ou FLOSS) sont des alternatives prometteuses aux logiciels privés en termes de disponibilité et de transparence. Alors que la société s'appuie de plus en plus sur des logiciels pour des fonctions essentielles, l'importance du FLOSS ne fait que croître. Cependant, FLOSS souffre d'une mentalité « créé par des développeurs, pour les développeurs », ce qui prioritaire les développeurs et qui entraîne une participation faible des designeurs et des utilisateurs finaux, et engendre une mauvaise utilisabilité dans l'ensemble. Des études a démontré que pour améliorer l'utilisabilité il suffit de faciliter la conception participative (en anglais "participatory design" ou PD). Durant la PD, les parties prenantes travaillent ensemble pour concevoir des solutions ; cependant, des études antérieures ont signalé de nombreux obstacles à l'inclusion des concepteurs et des utilisateurs finaux dans le processus FLOSS, en particulier liés à la rapport de force entre les parties prenantes (c'est-à-dire ceux qui ont accès aux ressources et à la prise de décision). Cependant, la plupart des recherches sur l'utilisabilité de PD et de FLOSS n'incluent pas les trois sortes de parties prenantes dans une activité de PD actives, et plutôt elles se concentrant sur les perspectives des développeurs et les interactions développeur-concepteur dans FLOSS pour améliorer l'utilisabilité. Pour résoudre ce problème, nous organisons quatre ateliers de design avec différentes combinaisons de parties prenantes, c'est-à-dire les développeurs, les designeurs et les utilisateurs finaux de FLOSS. L'objectif est de comprendre les défis d'utilisabilité présent durant FLOSS et comment PD occurent et règlent ces défis dans le contexte de FLOSS. Également nous sommes intéressés par comment le pouvoir se manifeste dans leur collaboration à travers l'optique de la théorie des quatre dimensions du pouvoir de Haugaard. Dans cette thèse, on peut résumés nos contributions à (1) un ensemble d'observations clés pour chaque groupe de parties prenantes sur les perceptions et les expériences concernant l'utilisabilité de FLOSS ; à (2) un cadre capturant la structure et les activités de PD impliquant les trois types de parties prenantes ; et à (3) des connaissances empiriques sur les comportements démontrant le pouvoir dans les activités de PD. Notre étude peut aider à informer les futurs chercheurs et les projets FLOSS actuels sur les interventions possibles et des solutions pour encourager la participation de chaque partie prenante afin d'améliorer l'utilisabilité du FLOSS.

# Contributions

All chapters of this thesis were written by myself (the author of the thesis). All chapters were edited by my supervisors. Unless stated otherwise, all the work in each chapter was contributed by myself after discussions with my supervisors. Chapter 1 was written by me and my supervisors provided editorial suggestions. I conducted the literature review in Chapter 2, wrote the chapter and my supervisors jointly edited the writing. Chapter 3 is an updated version of a preliminary article [29] where I am the first author. In Chapter 3 I would routinely discuss and make decisions with my supervisors on the methods to use and performed the methodology accordingly. A similar process occurred in Chapter 4; I conducted a literature review and shared my findings with my supervisors, then together, we investigated the possible methods to ultimately implement. In terms of the methodology, I recruited, scheduled, and facilitated all the workshops. For Chapter 6, the results were derived by open coding performed equally by myself and one of my supervisors. I further synthesized the results and wrote the chapter, which my supervisors then provided edits to. Chapter 7 also consisted of open coding, in which I started open coding alone, and then both my supervisors joined, and we open-coded together. Once a code book had been tentatively agreed on, I was responsible for the remainder of the open coding; my supervisors were involved in the code book refinement process by providing feedback and edits as needed. Following this process and the final results, I wrote the chapter and my supervisors jointly edited it. The work for Chapter 8 was primarily contributed by myself; I opencoded independently, my supervisors would check in periodically with the code book, and we would refine it. Then I wrote the results, and my supervisors jointly edited the writing. Finally, I wrote the remaining chapters, for which my supervisors also provided editorial suggestions. Except for the screenshots of the user study pitches, all images, sketches, prototypes, and diagrams were created by me and my supervisors provided their feedback when necessary.

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# Contents

| 1 | Intro | oductio | n   | 1  |
|---|-------|---------|---|----|
| 2 | Bacl  | kground | and Related Work                                    | 5  |
|   | 2.1   | Free/L  | ibre, and Open-Source Software                      | 5  |
|   |       | 2.1.1   | FLOSS: A software and an ideology                   | 5  |
|   |       | 2.1.2   | Structures of FLOSS                                 | 6  |
|   | 2.2   | FLOS    | S and Usability                                     | 7  |
|   | 2.3   | Partici | patory Design                                       | 8  |
|   |       | 2.3.1   | The History of PD                                   | 9  |
|   |       | 2.3.2   | PD for FLOSS  | 9  |
|   | 2.4   | The Fo  | our Dimensions of Power Theory                      | 11 |
|   |       | 2.4.1   | Dimension 1: Agency and Sources of Power            | 12 |
|   |       | 2.4.2   | Dimension 2: Structure                              | 13 |
|   |       | 2.4.3   | Dimension 3: Systems of Thought                     | 13 |
|   |       | 2.4.4   | Dimension 4: The System and Society                 | 14 |
|   | 2.5   | Summ    | ary   | 15 |
| 3 | Prel  | iminary | V Study to Understand FLOSS Designers and End-users | 16 |
|   | 3.1   | Design  | Process   | 18 |
|   |       | 3.1.1   | Target User Groups                                  | 18 |
|   |       | 3.1.2   | Design Guidelines                                   | 18 |
|   |       | 3.1.3   | Prototype Design Process                            | 19 |
|   | 3.2   | Intervi | ew Study  | 20 |
|   |       | 3.2.1   | Methods   | 21 |
|   |       | 3.2.2   | Results   | 21 |
|   |       |         |   |    |

|                      | 3.3   | Person   | as  | 25   |
|----------------------|---|--|---|--|
|                      | 3.4   | Latest   | Version of System Design  | 25   |
|                      | 3.5   | Discus   | sion  | 26   |
|                      | 3.6   | Summ   | ary   | 27   |
| 4                    | Part  | <b>icipato</b>   | ry Design Workshop: Methods   | 29   |
|                      | 4.1   | Partici  | pants   | 29   |
|                      |   | 4.1.1  | Recruitment   | 29   |
|                      |   | 4.1.2  | Stakeholder Categorization  | 30   |
|                      |   | 4.1.3  | Participants' Characteristics   | 31   |
|                      | 4.2   | Works  | hop Details   | 32   |
|                      |   | 4.2.1  | Workshop Materials  | 32   |
|                      |   | 4.2.2  | Workshop Organization   | 33   |
|                      | 4.3   | Data A   | malysis   | 36   |
|                      |   | 4.3.1  | RQ1: Focus Groups & Usability Concerns  | 36   |
|                      |   | 4.3.2  | RQ2: PD Characteristics   | 37   |
|                      |   | 4.3.3  | RQ3: PD & Power   | 37   |
|                      | 4.4   | Summ   | ary   | 39   |
|                      |   |  |   |  |
| 5                    | Resi  | ilts: Pa   | rticipatory Design Workshop Summaries   | 40   |
| 5                    | <b>Res</b><br>5.1                               | <b>ılts: Pa</b><br>Works   | rticipatory Design Workshop Summaries   | <b>40</b><br>40  |
| 5                    | <b>Res</b><br>5.1                               | <b>ilts: Pa</b><br>Works<br>5.1.1  | rticipatory Design Workshop Summaries         hop Summaries         Workshop 1: DEV-DES-EU  | <b>40</b><br>40<br>40  |
| 5                    | <b>Res</b><br>5.1                               | ults: Par<br>Works<br>5.1.1<br>5.1.2   | rticipatory Design Workshop Summaries         hop Summaries         Workshop 1: DEV-DES-EU         Workshop 2: DEV-DES  | <b>40</b><br>40<br>40<br>42  |
| 5                    | <b>Res</b><br>5.1                               | ults: Par<br>Works<br>5.1.1<br>5.1.2<br>5.1.3  | rticipatory Design Workshop Summaries         hop Summaries         Workshop 1: DEV-DES-EU         Workshop 2: DEV-DES         Workshop 3: DEV-EU   | <b>40</b><br>40<br>40<br>42<br>42  |
| 5                    | <b>Res</b><br>5.1                               | <b>ults: Pa</b><br>Works<br>5.1.1<br>5.1.2<br>5.1.3<br>5.1.4   | rticipatory Design Workshop Summaries         hop Summaries         Workshop 1: DEV-DES-EU         Workshop 2: DEV-DES         Workshop 3: DEV-EU         Workshop 4: DES-EU  | <b>40</b><br>40<br>42<br>42<br>42  |
| 5                    | <b>Resu</b> 5.1                                 | Ults: Par<br>Works<br>5.1.1<br>5.1.2<br>5.1.3<br>5.1.4<br>Reflec   | rticipatory Design Workshop Summaries         hop Summaries         Workshop 1: DEV-DES-EU         Workshop 2: DEV-DES         Workshop 3: DEV-EU         Workshop 4: DES-EU         tion on FLOSS values   | <b>40</b><br>40<br>42<br>42<br>44<br>45  |
| <b>5</b><br><b>6</b> | <b>Resu</b><br>5.1<br>5.2<br><b>Resu</b>        | Ults: Par<br>Works<br>5.1.1<br>5.1.2<br>5.1.3<br>5.1.4<br>Reflec<br>ults: Re                             | rticipatory Design Workshop Summaries         hop Summaries         Workshop 1: DEV-DES-EU         Workshop 2: DEV-DES         Workshop 3: DEV-EU         Workshop 4: DES-EU         tion on FLOSS values   | <ul> <li>40</li> <li>40</li> <li>40</li> <li>42</li> <li>42</li> <li>44</li> <li>45</li> <li>47</li> </ul>                         |
| <b>5</b><br><b>6</b> | <b>Resu</b><br>5.1<br>5.2<br><b>Resu</b><br>6.1 | ults: Par<br>Works<br>5.1.1<br>5.1.2<br>5.1.3<br>5.1.4<br>Reflec<br>ults: Re<br>Usabil                   | rticipatory Design Workshop Summaries         hop Summaries         Workshop 1: DEV-DES-EU         Workshop 2: DEV-DES         Workshop 3: DEV-EU         Workshop 4: DES-EU         Workshop 4: DES-EU         Ition on FLOSS values         Hection on FLOSS Usability         ity Challenges   | <ul> <li>40</li> <li>40</li> <li>42</li> <li>42</li> <li>42</li> <li>44</li> <li>45</li> <li>47</li> <li>47</li> </ul>             |
| <b>6</b>             | <b>Resu</b><br>5.1<br>5.2<br><b>Resu</b><br>6.1 | ults: Par<br>Works<br>5.1.1<br>5.1.2<br>5.1.3<br>5.1.4<br>Reflec<br>ults: Re<br>Usabil<br>6.1.1          | rticipatory Design Workshop Summaries         hop Summaries         Workshop 1: DEV-DES-EU         Workshop 2: DEV-DES         Workshop 3: DEV-EU         Workshop 4: DES-EU         Workshop 5: DEV-EU         Workshop 5: DEV-EU         Workshop 6: DES-EU         Workshop 7: DES-EU         Workshop 7: DES-EU         Workshop 8: DES-EU         Workshop 4: DES-EU         Ition on FLOSS values         Communication | <ul> <li>40</li> <li>40</li> <li>40</li> <li>42</li> <li>42</li> <li>44</li> <li>45</li> <li>47</li> <li>47</li> <li>47</li> </ul> |
| 6                    | <b>Rest</b><br>5.1<br>5.2<br><b>Rest</b><br>6.1 | ults: Par<br>Works<br>5.1.1<br>5.1.2<br>5.1.3<br>5.1.4<br>Reflec<br>ults: Re<br>Usabil<br>6.1.1<br>6.1.2 | rticipatory Design Workshop Summaries hop Summaries   | <ul> <li>40</li> <li>40</li> <li>42</li> <li>42</li> <li>42</li> <li>45</li> <li>47</li> <li>47</li> <li>49</li> </ul>             |

|   |      | 6.1.4     | Culture & Usability                           | 52 |
|---|------|-----------|---|----|
|   |      | 6.1.5     | Incentives                                    | 54 |
|   | 6.2  | Measu     | ring Success                                  | 55 |
|   |      | 6.2.1     | User Feedback                                 | 55 |
|   |      | 6.2.2     | Process                                       | 55 |
|   |      | 6.2.3     | Usability Priority                            | 56 |
|   |      | 6.2.4     | Community Building                            | 56 |
|   | 6.3  | Summa     | ary   | 56 |
| 7 | Rest | ılts: Str | ucture of the Participatory Design Activities | 58 |
|   | 7.1  | Goal-C    | Driented Blocks                               | 58 |
|   | 7.2  | Workir    | ng GOBs                                       | 60 |
|   |      | 7.2.1     | Working style                                 | 60 |
|   |      | 7.2.2     | Activity                                      | 61 |
|   | 7.3  | Discus    | sion GOBs                                     | 61 |
|   |      | 7.3.1     | Discussion Goals                              | 62 |
|   |      | 7.3.2     | Initial intent                                | 67 |
|   |      | 7.3.3     | Authority                                     | 70 |
|   |      | 7.3.4     | Outcome                                       | 74 |
|   |      | 7.3.5     | Speaking Style                                | 76 |
|   | 7.4  | Summa     | ary   | 76 |
| 8 | Resu | ılts: Pov | wer Dynamic in Participatory Design           | 78 |
|   | 8.1  | D-1: D    | efining Agency in a GOB                       | 79 |
|   |      | 8.1.1     | Resource Utilization                          | 79 |
|   |      | 8.1.2     | Knowledge Gap                                 | 84 |
|   |      | 8.1.3     | D-1: Past Experience                          | 89 |
|   | 8.2  | D-2: M    | Iethods of Structuration                      | 91 |
|   |      | 8.2.1     | Communication                                 | 94 |
|   |      | 8.2.2     | Technical Priority                            | 95 |
|   |      | 8.2.3     | Stakeholder Inclusion                         | 97 |
|   |      | 8.2.4     | Collaboration                                 | 98 |

|    | 8.3   | D-3: Consciousness                   | 100 |
|----|-------|--------------------------------------|-----|
|    |       | 8.3.1 Practical Consciousness        | 101 |
|    |       | 8.3.2 Discursive Consciousness       | 103 |
|    | 8.4   | Summary                              | 106 |
| 9  | Disc  | cussion                              | 108 |
|    | 9.1   | The Current State of FLOSS Usability | 108 |
|    | 9.2   | Perspectives on Achieving PD         | 109 |
|    | 9.3   | Key Implications About Our Results   | 111 |
|    | 9.4   | Limitations and Threats to Validity  | 117 |
|    | 9.5   | Future Work                          | 119 |
| 10 | Con   | clusion                              | 121 |
| Bi | bliog | raphy                                | 123 |
| Ac | crony | ms                                   | 132 |
| Aj | opend | lix                                  | 133 |

# **List of Figures**

| 3.1  | Initial Sketches of the System Design   | 19 |
|------|---|----|
| 3.2  | FLOSS Persona Dakota  | 22 |
| 3.3  | FLOSS End-user Persona Enrique  | 23 |
| 3.4  | Overview of the Prototype System Design   | 26 |
| 5.1  | Part of Design Pitch Made in W1: Links to connect each stakeholder to the appropriate mechanisms to contribute.                                     | 41 |
| 5.2  | Part of Design Pitch submitted in W2: Designers can comment and converse with end-users directly on the usability issue.                            | 43 |
| 5.3  | HTML Pitch submitted during W3  | 44 |
| 5.4  | Part of design pitch submitted during W4. The template main page for a FLOSS project on their platform containing information on how to contribute. | 45 |
| 6.1  | RQ1 Results Overview  | 48 |
| 7.1  | Overview of RQ2 Results: PD Structure, Tasks, and Details   | 59 |
| 7.2  | Working activities by workshop  | 62 |
| 7.3  | Working Activities by Stakeholder   | 63 |
| 7.4  | Goals of discussion GOBs by workshop  | 64 |
| 7.5  | Relative workshop composition by task GOB count   | 65 |
| 7.6  | Initial intents initiated by stakeholders   | 70 |
| 7.7  | GOB goals and their initial intents   | 71 |
| 7.8  | Distribution of authority-holding stakeholders in each workshop   | 72 |
| 7.9  | Authority GOBs by initiator stakeholder role  | 73 |
| 7.10 | Outcome Distributions by Workshop   | 74 |

| 8.1 | Overview of the behaviors and topics of discussion demonstrated by <i>D-1</i> agency.  | 80 |
|-----|--|----|
| 8.2 | HTML design artifact from W3 at the time of P3EU's episode of power to ideate features using <i>D-1:resource utilization</i> . | 81 |
| 8.3 | Overview of D-2 results.   | 92 |

# **List of Tables**

| 3.1 | Design Guidelines for FLOSS Designers (* indicates challenges gathered during user interviews.) | 17  |
|-----|---|-----|
| 3.2 | Design Guidelines for FLOSS end-users (* indicates challenges gathered during user interviews.) | 17  |
| 3.3 | Interview Study Participants' Characteristics   | 21  |
| 4.1 | Workshop Participants Overview  | 32  |
| 7.1 | Discussion and Working GOB by Workshop  | 59  |
| 7.2 | Working Style Breakdown by Workshop   | 60  |
| 7.3 | Initial Intent Total GOB Count  | 67  |
| 7.4 | GOB distribution of Speaking-styles across the workshops  | 76  |
| 1   | Appendix  | 133 |

As the world relies increasingly on technology, challenges with proprietary software become more pronounced. One such alternative to proprietary software is found in the Free, libre, and open-source software (FLOSS) movement. More specifically, FLOSS is software that is free to use, modify, distribute, and reproduce [17]. In the efforts towards achieving digital inclusion and accountable software, FLOSS offers much potential due to its focus on freedom of use and transparency, a fact which has led to an increase in its use and popularity [62]. However, FLOSS often suffers from poor usability, limiting the adoption of the software and its positive implications [12, 29, 3, 40].

Formally, usability refers to the attributes which determine the ease, error-prevention, efficiency, and pleasantness for an end-user when interacting with a software [12, 41]. The need for improving the usability of FLOSS becomes more pressing as FLOSS increases in popularity, maturity, and importance [62]. In traditional software development, usability concerns rest in the hands of design teams who perform activities to receive input and feedback from various stakeholders throughout the iterative lifespan of a project; the goal of these design teams and usability as a whole is to achieve a system design that responds to the needs of the end-users.

While the inclusion of the design process and user participation is vital for achieving successful usability of FLOSS, it is often pushed aside as teams adapt to asynchronous, remote working and focus on a project's code and functionality [17, 62]. Past research has found that when projects decide to monitor usability interests, the current solutions, such as

issue trackers, forums, and emailing developers directly, still pose considerable challenges to improving usability and user inclusion [62, 61, 17]. Notably, issue threads and usability discussions become long and convoluted, causing developers to struggle to understand user input [12].

Towards this end, participatory design (PD) outlines a potential method for addressing these problems by not only involving the key stakeholders - FLOSS developers, FLOSS designers, and FLOSS end-users - but including them as direct collaborators in design activities and decision-making itself [39]. First introduced in the context of the Scandinavian workers' movement to address the social implications of new technologies in the workplace [39], PD challenges existing power structures in order to best encourage total participation [33]. While past efforts have investigated motivations to participate and address usability (including from the PD perspective), they have focused primarily on the FLOSS developer and designer perspectives and experiences [11, 38, 55, 49, 52, 4, 5, 47, 48, 12, 62, 61]. Moreover, research into PD to improve FLOSS usability by including end-users is a sorely under-researched subject; there is no prior work in this area on the three stakeholders included in PD, together, in the FLOSS context [30, 31, 47]. Moreover, it is imperative to understand what specific power structures currently exist when all three stakeholders collaborate in order to successfully encourage total participation. Prior work investigating power in FLOSS as it relates to participation has primarily focused on developers, the participation of designers with developers [48, 49], and the power and motivation of those two stakeholders [47, 1, 4, 7, 45, 53]. To date, there have not yet been investigations into what power structures exist in a PD setting between all three stakeholders to address FLOSS usability.

In this thesis, we address this gap through two studies. In the first study, published as preliminary research in CHI'21 [29], we begin the exploration into achieving PD in FLOSS through first formalizing challenges experienced by designers and end-users when participating in OSS through a series of one-on-one user interviews. This led to the contributions of two sets of design guidelines for both designers and end-users and a low-fidelity prototype for asynchronous participatory design. The formalization of experienced challenges and preliminary feedback on the prototype laid the foundation for the second study. Before returning to the low-fidelity prototype to iterate on a solution to facilitate stakeholder

inclusion, PD, and improved usability in FLOSS, we needed to understand better the challenges in an actual PD setting with all the stakeholders. Thus, we pivoted to investigate this through a series of design workshops.

Specifically, in the second and main study of the thesis, we conducted four design workshops with a moderated focus group and a PD activity to investigate (1) what usability challenges FLOSS stakeholders experience, (2) how the stakeholders collaborate in the PD activities, and (3) how aspects of power influence the PD activities' outcomes in terms of participants behaviors and topics of discussion. A total of 9 participants were recruited (three FLOSS developers, three FLOSS designers, and three FLOSS end-users) for four workshops. We contribute a set of stakeholder-identified usability challenges, a structural framework of PD including the tasks, goals, and activities characterizing the PD activities, and an analysis of the underlying mechanisms through which power manifests in the PD activity through the lens of the first three dimensions of Haugaard's Four Dimensions of Power theory [25].

We find that participants identified five key challenges to participating in and addressing FLOSS usability: (1) communication, (2) documentation, (3) development, (4) culture and usability, and (5) incentives. Participants also identified that any solution should be considered successful if it improves a FLOSS's communication and culture in regard to end-user feedback and overall usability. In terms of achieving PD, our proposed framework breaks down a PD activity into smaller units that are bounded by the immediate goal a team is trying to accomplish, called goal-oriented blocks (GOB). There are two types of GOBs based on the task being accomplished: discussion GOBs and working GOBs. Each of the GOBs has its own characteristics based on the task; discussion GOBs have a goal to ultimately create the design pitch. To start efforts to reach the goal, a participant initiates the GOB by dictating their initial intent, after which a discussion ensues where one participant is an *authority* on the subject being discussed and the participants converse with a specific speaking style, the GOB ends in an outcome or the GOB is abandoned when there is no outcome. Last, we identify resources used by participants and the effects of an unequal distribution of these resources amongst the participants. The resources affect a participant's power to achieve the goals and also affect one participant's power over another participant. A participant's behavior in a GOB depends on this resource allocation

and utilization; in turn, their behavior may lead to challenges to the existing FLOSS social structures of inclusion and usability. We identified behaviors that lead to challenging the FLOSS structures were ones that demonstrated discursive discussions through logical reasoning, empathy, and self-monitoring of biases and assumptions and primarily occurred on topics of stakeholder inclusion and technical concepts, implementation, and feasibility.

Our results indicate that PD activities are possible for FLOSS projects to facilitate; PD activities also have the potential to successfully disrupt the existing social structures by affording designers more power. However, end-users demonstrated the most passive involvement due to the fact that they mostly observed the work of others in working GOBs and experienced knowledge gaps often that led to other participants, often the developers, acting with authority. However, our results indicate that if the proper resources are given to end-users, this could limit the potential for knowledge gaps and increase their potential to exercise their power and affect change in the pitch. Last, we find that the personas inspired meaningful discursive conversations that led to design pitches that challenged some structures of FLOSS; this indicates that personas are a viable resource for improving the usability and stakeholder inclusion of FLOSS. In general, our results indicate the importance of including *all* stakeholders in a PD activity in order to maximize the discursive conversations and lead to the most changes to the existing structures in FLOSS that impede improved usability.

The structure of this thesis is as follows. We begin with an exploration of the related work in the intersection of power, usability, and PD in FLOSS in Chapter 2, then we report the preliminary study in Chapter 3. Next, we describe the methodology in Chapter 4, followed by summaries of each workshop's composition in Chapter 5, then results of the focus group and stakeholder reflections on usability in Chapter 6, followed by the results of the PD activities' structure in Chapter 7, and the results of the analysis of power in PD in Chapter 8. Finally, we discuss the implications of our results in Chapter 9 before concluding the thesis in Chapter 10.

2

# Background and Related Work

This research is related to previous work focusing on (1) free/libre, and open-source software (FLOSS), (2) usability and participatory design, and (3) power dynamics between interacting social actors. This chapter provides the necessary background and related works motivating the thesis.

## 2.1 Free/Libre, and Open-Source Software

To understand why the topics of participation, inclusion, and power are inherently integral to the essence of FLOSS, we first take a look toward defining what exactly it means for software to be "free" and "open-source."

#### 2.1.1 FLOSS: A software and an ideology

Free/libre and open-source software refers to the copyright of the software that dictates the terms under which it must be distributed, but the "free/libre" focuses on the software as an ideology, too [17, 18]. For software to be "open-source," it must be distributed under a license that ensures the software can be used, modified, and redistributed and also ensures it can never be relicensed [18]. The "free/libre" part of FLOSS refers to the *freedom* afforded to *any* person to use, modify, and redistribute the software [18].

Since its inception, FLOSS has grown to become both a software engineering phenomenon and a social, cultural, philosophical, and even political phenomenon [17]. Indeed, the freedom of exchange has been a longstanding value in the software community for decades, even long before the term itself was coined [18], lending itself well to grow as it has into a unique community and culture unto itself. As such, in this thesis, we choose to use the term FLOSS as opposed to open-source software (OSS) because it signals the inclusion of "free/libre" in the terminology in a way that shapes the ideology and intentionality of our research to work in achieving freedom for all to use, modify, and distribute software under this license.

#### 2.1.2 Structures of FLOSS

**Organization.** For the most part, FLOSS is a fairly decentralized, democratic, and participatory community of volunteers; most projects only follow a loose hierarchy often referred to as the "onion model," where the repository owner and core developers lead the project and make most of the decisions. At the same time, everyone else plays a more peripheral role in the project. This structural organization of FLOSS has been a researched phenomenon since the inception of the movement [11, 38, 18, 58, 8]. The farther away a stakeholder is from the core developer (with designers and end-users residing on the outskirts of a project), the less decision-making power those individuals are likely to have [8, 47].

**Collaboration and Productivity.** Much prior research about FLOSS has been conducted on the unique role that social coding (a development practice focused on social collaboration) plays in the success of a project [13, 34, 38, 53, 58, 7]. Substantial prior research has been conducted on collaboration in FLOSS amongst developers to investigate aspects of communication and other social coding features and their effect on productivity in FLOSS. For example, research has been conducted on the necessity of developer collaboration in FLOSS projects due to reasons associated with the size of project architectures, limited developer knowledge, improved productivity, and better-informed decisionmaking [27, 58, 64, 65]. In terms of how developers address issues, Xuan and Filkov [64] identified how synchronous development activities in FLOSS are a good metric for productivity and communication in a project. Related, Tsay et al. [58] reported the reliance on communication with other developers as well as external users, finding that core contributors are more likely to be polite in their interactions with people who have already been involved in their projects. To reiterate, FLOSS ideologically values collaboration, but

#### 2.2 FLOSS and Usability

FLOSS core developers also prioritize who to collaborate with by prioritizing people who have already proven themselves to these core developers.

**Developer Motivation.** In terms of motivations for developers to contribute to FLOSS, Hars [1] reported on how developer motivations come from intrinsic motivations, such as altruism and personal needs or desires, and extrinsic motivations, such as participation being an investment in the future and receiving community identification. Lakhani and Wolf [34] reported on the results of a large-scale web-based survey also identifying extrinsic (career advancement) and intrinsic motivations to contribute (improve programming skills); they found that almost 40% of respondents were paid to participate in the FLOSS project and not volunteering. Von Krogh et al. [60] continued this research on motivation by expanding the intrinsic motivations to include long-term rewards and proposed a framework to explain how societal standards motivate developers to sustain the FLOSS development with high-quality software.

## 2.2 FLOSS and Usability

The subject of usability has been a topic of interest in the context of FLOSS for decades and is constantly shifting in nature. FLOSS has garnered a certain reputation for being 'by developers for developers'; prior work explored by Nichols and Twidale [40] reported a sense of 'elitism' among the FLOSS developers where pride was drawn from creating hard-to-learn but powerful products. Andreasen et al.[3] found that even though some FLOSS developers are interested in usability, it's not a priority; moreover, in most cases of addressing usability, developers only rely on "common sense" due to limited skills and resources [3]. This could, in turn, lead to further usability created for developers. Terry et al. [56] researched how some projects relied on pre-existing and direct, close interpersonal relationships between core developers and core users who were identified to closely follow the project as the source for receiving high-quality feedback and serve as the motivation for social rewards to address usability. However, over the past two decades, as the FLOSS community has grown and diversified in terms of functionality priorities, general practices, software adoption, and user base, tactics such as relying on "common sense" and pre-existing interpersonal relationships with users are not enough to ensure strong usability. Usability is important for the acceptability and sustainability of a system and a

#### 2.3 Participatory Design

FLOSS project; and recent work has sought to understand these shifting dynamics more thoroughly [40, 17, 12, 47].

Currently, many FLOSS usability practices and discussions take place in an ad-hoc manner and, especially on FLOSS platforms such as GitHub (www.github.com), within a repository's issue tracking system [18, 12, 61]. Cheng and Guo [12] found usability-specific issue threads on GitHub to be lengthy and contain over-generalized assumptions. Wang et al. [62] expressed the need for a shift to a user-centric mindset amongst FLOSS practitioners along with a standardized way to include end users in the FLOSS project.

Moreover, most previous work has focused on the practices and challenges of the FLOSS developers and/or designers [40, 62, 17, 56, 50]; little investigation has been conducted from the perspective of 'non-technical' end users. While one such study by Iivari (2009) [30] investigated user participation in FLOSS, it focused on user forums where users were not able to make decisions. Hellman et al.'s [28] empirical study into the activities and psycho-linguistic behaviors of FLOSS end-users in user forums which found that end-users, despite high levels of activity in the forums, were less confident but also reflected more open and positive emotions than the developers and organizers of the forum.

Falling into a similar pitfall is the recently released GitHub Discussions feature [59, 42, 22]. This feature is designed to replace the lengthy conversations currently taking place on issues and pull requests by creating a dedicated community conversation space within the GitHub repository. However, this feature continues to place the focus on the developers of the FLOSS community and not others. While features such as 'GitHub Discussions' could potentially be used for usability discussions, the problem remains that there is still no dedicated place for true participatory design efforts and diverse stakeholder inclusion of all three groups (i.e., developers, designers, and end-users) at the same time.

## 2.3 Participatory Design

To work towards creating these participatory design (PD) solutions, we first turn to the origins of the method, before outlining the past research on participation and PD in FLOSS.

#### 2.3.1 The History of PD

PD research began in the mid 1970s in Scandinavia as workplaces struggled to adapt to disruptions from the introduction of computers to the workplace [33, 39]. Management wanted to add in computers, but workers were worried about reduced control of their environment and not being able to make decisions. The workers' unions fought to protect the workers' interests from being neglected and maintain the workers' autonomy in their place of work [33]. However, as the changes were made and management interests prioritized over the workers' needs, unequal power balances arose and the workers, the unions, and researchers came together to combat these negative power dynamics. Together, the workers, the unions, and the researchers designed, developed, and implemented strategies and technologies to try to build up the workers' control over their working conditions and the technology being introduced [33]. However, despite these collaborative efforts from the stakeholders, workers still struggled against the embedded institutional power of management; at this point, researchers and workers began to investigate together how technology itself might be designed differently to ensure more equal distributions of power through worker participation with management [39, 33]. This incident revolutionized the understanding of social dimensions of working with technology and the general societal effects of new technologies; since the 1990s, PD has been under constant evolution with adaptations to numerous fields and countries [39].

At its essence, PD is about the inclusion of different stakeholders who have needs that aren't being met. These stakeholders must come together to design solutions that will overcome the embedded structures of power causing the problems, while also breaking down the power structures to collaborate and participate. To understand how to accomplish PD in FLOSS, we have to understand not only the embedded problems that need to be fixed but the power structures that currently restrict participation.

#### 2.3.2 PD for FLOSS

PD is not as widely employed within FLOSS. In a literature review conducted by Dawood et al. [15] to understand the research efforts in addressing and improving FLOSS usability as of 2019, a gap in the use of PD to address the issue of FLOSS usability was identi-

fied. While Dawood et al. [15] found and categorized 15 published studies on "involving usability practitioners", only a few articles sought to understand "user awareness" (which was identified as the awareness of FLOSS developers about users), and only one study was identified as using PD as a method (in this case, the developers were the intended "clients" and worked with the designers to develop a tool [35]).

**PD** with End-Users. There are a few previous research that included FLOSS end-users into the process to address and solve usability issues. Iivari [30] conducted a case study on user participation in FLOSS user forums in 2009. They reported on two types of end-user participation based on their case study, direct and indirect users, based on their activity levels; however, Iivari also noted that there were limitations to the end-users being able to participate because it was a forum where full decision making still rested with developers [30]. Then, in 2011, Iivari expands on this research by conducting two more case studies into distributed PD [5], also through forums in FLOSS, regarding user participation [31]. Iivari [31] adds to the literature by defining different roles of users in FLOSS projects where they can inform, consult, or participate in the FLOSS but notably in this study, end-users did not have decision-making power. Iivari also identified three common activities to distributed PD related to understanding, designing, and evaluating functionality and usability of the solution [31].

**PD** with Designers. Compared to PD with end users, there has been more research into including usability practitioners in FLOSS through PD. This body of literature includes research into the roles and activities in distributed design through online collaboration in the core-periphery FLOSS model [5], tool support for FLOSS participation and trust building for designers [4], and studies investigating pseudo-participation to characterize participation with agency in relation to their relative power [44]. In particular, we motivate our research from two respective studies published by Rajanen et al. [48, 47]. In 2012, Rajanen et al. [48] investigated how usability activities could be introduced into FLOSS development and how can usability practitioners participate in FLOSS so these activities have an impact; they found that usability practitioners had to adapt to the established norms and working culture of FLOSS in terms of tools used, but there was a clear improvement in the usability of the FLOSS after the usability practitioners began participating. Then, in 2015, Rajanen et al. [47] continued this investigation into understanding the theoretical treatment

of power and empowerment of developers and designers in FLOSS with the intention to help future HCI research address the issues of power and politics.

Previous work establishes our motivation for our research in a few manners. (1) No prior research investigating PD has included designers *and* end-users in a participatory capacity with developers in a FLOSS context. (2) The PD investigated is in much of the past contributions have been focused on distributed PD through user forums or in an existing repository. Using forums for PD poses significant impediments because, as Iivari [31] reported, the end-users do not have much power and agency, ultimately lacking the ability to make impactful decisions beyond the roles of informant and consultant. In terms of designers participating in a FLOSS project to introduce usability activities, as Rajanen et al. [48, 49] indicated, designers also struggle to exercise their power. As such, our research into PD in FLOSS intentionally includes FLOSS developers, designers, and end-users in design workshops outside of the current modes of FLOSS collaboration to seek to identify how these aspects of power manifest when that barrier has been removed.

## **2.4** The Four Dimensions of Power Theory

For participatory design to truly occur, methodologies must be considered and employed carefully and purposefully to strive for maximum empowerment of all the stakeholders involved. To design successful solutions to enable this empowerment and overall participation (which has been proven to improve usability [15, 50, 48]), we need a better understanding of specific ways in which power manifests with all three stakeholders and how those stakeholders will, in turn, interact with other stakeholders.

The research and literature on power are well established in the fields of philosophy and psychology, with more than a half century's research building onto the modern theoretical understanding of power amongst social actors [37, 14, 32, 25, 2]. In the literature of PD and FLOSS usability, the most notable work, as already stated, was Raganen and Iivari's [47] theoretical framework of power derived from their empirical case studies from real-world projects. In their work, Raganen and Iivari utilized Hardy and Leiba-O'Sullivan's [21] theory of *Four Dimensions of Power* to propose the framework in the context of FLOSS usability. Because their proposed framework is specific to developerdesigner interaction and is not in the context of PD activities, we contribute a novel empirical analysis of power through a similar theory. After inspecting the origins [37, 32] of Hardy and Leiba-O'Sullivan's theory [21], we then researched applications and updated interpretations of their proposed framework; here we found Haugaard's theory of *Four Dimensions of Power* [25, 23, 24, 26], which is a widely cited and modern "rethinking" on power as something that does not only lead to conflict and adapts more recent theories of empowerment from feminist thought [2]. Moreover, the Four Dimensions of Power theory (both [21] and [25]) has been used in many other fields for understanding power [10, 16, 26, 36].

The first three dimensions (and the ones ultimately focused on in this thesis) were originally contributed by Lukes [37] and the fourth dimension by Foucault [32]; however, at the time when these theories were proposed in the 1970s and 1980s, they were considered strictly as dimensions of one social actor's domination and power over another [37, 23, 24]. Recent theory into power has rethought these dimensions through other lenses, such as empowerment and authority [2, 23, 24, 26, 25]. As such, we use Haugaard's theory of the *Four Dimensions of Power* as the basis for our empirical analysis of PD. We provide a summary of each dimension of power according to Haugaard's theory and analysis [25, 24].

#### 2.4.1 Dimension 1: Agency and Sources of Power

The first dimension of power focuses on the *execution of power*. For each interaction between two or more actors, there will be an execution of power that affects their interaction and its outcomes. This is an *episode of power* where someone demonstrates their agency to do something. The result of an execution of power is either violence, coercion, authority, or some combination. This result is dependent on the resources available, how these resources are distributed, and any factors affecting an actor's authority within the situation of an episode. An actor's agency is their power to act in a way that affects change in their environment in a way that would not have occurred otherwise. An actor also can have agency by exercising power over another actor in a way that causes them to affect change in the environment; the action and the resulting change wouldn't have occurred if not for the powerful actor exerting their power over the other.

#### 2.4.2 Dimension 2: Structure

The second dimension of power illustrates the sources of conflict in the episode of power (from Dimension 1) with respect to social structures. Episodes of power play out in a context that has a social construction. These social constructions were made by decisions to include or exclude things, people, norms, and more into or from the status quo. The social structures that are included or excluded are what decides whether episodes of power are freedom-enhancing or restricting. This process of deciding what to include or exclude in social structures is referred to as *structuration*, which is the continuous rebuilding and recreating of existing social structures. There are two contrasting processes of structuration: confirm-structuration is the process when an actor affirms a structuration (i.e., the actor agrees to continue with the same structures), whereas de-structuration is when an actor decides not to accept an aspect of the social construct. The choices to confirm-structure or de-structure will result in either a consensus as the social structures and norms are accepted or a conflict where the social structures and norms are challenged.

#### 2.4.3 Dimension 3: Systems of Thought

The third dimension is about why patterns of structuration continue to occur, even ones that might be unreasonable or unjust. Dimension three explains how an individual's tacit social knowledge (and thus a society's) is directly related to the reproduction of social structures (structuration). What is tacitly deemed acceptable to include or exclude in social structures is inherently informed by the society's time in history and anthropological context.

As individuals, we have two types of systems of thought and consciousness that define our ability to step out of the acceptable norms and social structures: (1) discursive consciousness and (2) practical consciousness. The latter is understood to be the tacit knowledge crucial to the process of structuration due to it being an actor's source of meaning and the understood "natural order of things." Discursive consciousness is what an actor is "relatively discursively aware of" rather than intuition; it is the active logic and knowledge an actor utilizes. Over time, discursive consciousness often turns into a practical consciousness. In general, social structures that are now practical and agreed on as the "natural order" even if it is upholding unfair power relations, often began as discursive. The key is to shift the practical consciousness of a flawed social structure to a discursive consciousness – thereby allowing actors the ability to reflect (Dimension 3) and exercise agency (Dimension 1) to change the natural order and status quo (Dimension 2).

#### 2.4.4 Dimension 4: The System and Society

The fourth dimension indicates how the systems in which we live support the continual re-establishing of norms dictating what is permissible and what is abnormal. The fourth dimension says that these systems are inescapable. There is a power dynamic inherent to the systems we live – all humans are constantly being studied by all other humans to gain knowledge and understanding about what is acceptable in terms of how to act, behave, and generally *exist* in the world. Therefore, in this system, every human is under observation while also conducting the observations of every other human. Because these systems are inherent and we are always being studied, we continuously establish these norms, no matter what; making the effects of power and social structures themselves inescapable.

The Panopticon thought experiment is frequently used to represent this dimension. There exists a set of prisons with prisoners inside them; all the prisoners are visible to each other and there is an "all-seeing eye" that the prisoners are conscious of, but there are no jailers. Because of these two facts, the prisoners see themselves through the eyes of the other prisoners and the all-seeing eye. As such, the prisoners subject themselves to a perceived "normal" and internalize judgments that would result from following or breaking this norm. As these judgments are internalized, often coupled with an understood disciplinary consequence (i.e., when an action is negative, the prisoners and the all-seeing eye will know and there will be a consequence). Over time, the internalizing becomes subconscious, and the judgments that are followed become the new social norms. Often, common education of actors that inform what is deemed acceptable is key to a "successful" Panopticon. In short, dimension four represents the continued internalization of judgments by an actor, thereby upholding societal norms, due to their inherent living in a society where people watch you and judge your actions.

## 2.5 Summary

To conclude, research into FLOSS has been ongoing since the early days of the movement. FLOSS ideologically expands on the license requirements of OSS (use, modify, distribute) to ensure the freedom for all to take to do so. Structurally, FLOSS is a community of volunteers who prioritize collaboration and are motivated to contribute for both intrinsic (e.g., personal need, improve skills) and extrinsic (i.e., career advancement). However, as FLOSS has developed and the decentralized structures solidified, new hierarchies developed where core developers make most of the decisions, including who is allowed to contribute to a project. In terms of usability, research has shown that usability does not get prioritized due to limited resources, a lack of usability skills, and a sense of pride and elitism over hardto-use products. Moreover, when end-users try to report usability issues in issue-tracking systems, the issues themselves are often lengthy and assumption based, making it hard to understand how to address the root problem. In terms of PD, past investigations have been conducted into the inclusion of end-users and designers in an existing FLOSS project. End-user participation is typically limited to a consultation-based role without decisionmaking capacity while designer participation occurs by designers adapting to developer tools. However, it was found that designer participation *does* improves the usability of a project.

There is currently no research into participatory design with developers, designers, *and* end-users in FLOSS. Moreover, all prior research has been conducted in user forums or git repositories that situate the power of decision-making and inclusion with the core developers. This motivates our research to conduct design workshops with all three stakeholders to participate in a PD activity. And to understand how power manifests in such a context, we use Haugaard's Four Dimensions of Power theory [25], which provides a framework for understanding an actor's agency, how social structures are made and changed, the systems of thought that influence those structures, and systems of power as being inescapable. Applying this lens of power will allow a better understanding of the nature of what future solutions could be implemented to ensure more equal empowerment and improve usability.

# 3

# Preliminary Study to Understand FLOSS Designers and End-users

This paper is adapted from my CHI EA '21 Late Breaking Work titled "Facilitating Asynchronous participatory Design of Open Source Software: Bringing end-users into the Loop" [29].

In traditional software development, usability concerns rest in the hands of design teams performing activities that involve various stakeholders in the iterative lifespan of a project to achieve a system design that responds to the needs of the end-users. While user participation in the design process is vital for achieving successful usability of a FLOSS, it is often pushed aside as teams adapt to asynchronous, remote working and focus on a project's code and functionality [56, 62].

Take for example GitHub, one of the most successful FLOSS hosting and development platforms. Due to its affinity for supporting various asynchronous activities, GitHub has enabled a vibrant community for remote collaboration and development of FLOSS projects. While many tools can potentially be used for monitoring usability interests on GitHub FLOSS projects, such as Issue tracking, there is currently no mature method for end-user community collaboration [62, 61, 56]. Consequently, if any design decisions are made through input from end-users, there are difficulties with properly communicating these decisions to other team members due to a lack of design artifacts clearly documenting the process. Many FLOSS projects, as a result, are designed without direct input from

#### Preliminary Study to Understand FLOSS Designers and End-users

Table 3.1: Design Guidelines for FLOSS Designers (\* indicates challenges gathered during user interviews.)

| No. | Description   | Targeted Challenges                     |
|-----|---|---|
| D1  | FLOSS-D are able to easily engage with end-users and understand their needs.  | User Needs [62]                         |
| D2  | The system integrates design practices into an existing development pipeline. | Mindset [62]; Pipeline*                 |
| D3  | FLOSS-D are able to generate artifacts from interacting with end-users.       | User Diversity [62]; Tracing Artifacts* |
| D4  | Design for a project can happen at any stage of an FLOSS project's lifecycle. | Development [62]                        |
| D5  | The system encourages community-wide involvement in an FLOSS project.         | Mindset [62]; User Needs [62]           |
|     |   |   |

Table 3.2: Design Guidelines for FLOSS end-users (\* indicates challenges gathered during user interviews.)

| No. | Description  | Targeted Challenges            |
|-----|--|--------------------------------|
| EU1 | FLOSS-EU should easily learn how to collaborate on a project.                    | Inclusivity*, Learnability*    |
| EU2 | FLOSS-EU should interact with the FLOSS team through asynchronous discussions.   | Development [62], Mindset [62] |
| EU3 | FLOSS-EU should be able to draw attention to current usability issues they face. | Mindset [62], User Needs [62]  |
| EU4 | FLOSS-EU contributions should be recognized.                                     | Transparency*, Recognition*    |
| EU5 | FLOSS-EU should feel motivated to collaborate on a project.                      | Inclusivity*, Transparency*    |
|     |  |                                |

end-users. While prior work explored the pitfalls of end-user community involvement in FLOSS design [62, 3, 50, 56], as of yet, there has been little contribution to the open source community offering a solution to this problem.

In this paper, we address this gap by conducting interviews with FLOSS designers and end-users to understand what barriers they face when getting involved in FLOSS projects - when contributing to the design and usability of a project *and/or* when providing feedback on the usability of a project. Through this study, we contribute an initial set of personas and design guidelines for designing platforms that promote end-users' participation in asynchronous, participatory FLOSS design, as well as a preliminary tool to achieve this objective.

This work iterates on prior research investigating the challenges when addressing FLO-SS usability. While prior work focuses on the developer's perspective of community involvement and usability, we focus on the perspectives of FLOSS designers and end-users. The contributions of this study and the preliminary feedback on the proposed tool highlight the need to better understand the current context of multiple stakeholders working in a PD context and motivate the later chapters of this thesis.

## **3.1 Design Process**

In this section, we detail how we explored the tool design by presenting the target user groups, the usability goals and heuristics, and the ideation and overall design process.

#### **3.1.1 Target User Groups**

To understand the context of when and where issues will be faced during asynchronous participatory design as well as the nature of those issues, we defined two target user groups of our intended system: (1) FLOSS contributors focusing on the design aspects of FLOSS projects (FLOSS-D) and (2) non-technical end-users of FLOSS projects (FLOSS-EU).

We selected FLOSS contributors focused on design (referred to as FLOSS designers from here on) as the first User Group because: (1) these individuals are the ones most impacted by the lack of standardization in FLOSS design practices; (2) they would have the most insight into current barriers facing participatory design integration in asynchronous FLOSS work. In regards to the second user group, we are interested in the case where the end-users of the FLOSS are not the technical contributors to the FLOSS project but rather the direct user of the end product. These target audiences were used to (1) direct our design decisions and (2) guide participant selection for the user interviews (see Section 3.2).

#### **3.1.2 Design Guidelines**

Once the target audiences were finalized, we created a set of design guidelines to support the exploration of the system design. Defining these guidelines was an iterative process. The initial set of guidelines was distilled from Wang et al.'s [62] recent work about challenges in addressing FLOSS usability. Then the guidelines were revised as more information was gleaned through the user interviews of preliminary prototypes (see Section 3.2). When creating these guidelines, we particularly concentrated on the aspects that can facilitate asynchronous participatory design in the FLOSS context. The final design guidelines for the system are summarized in Tables 3.1 and 3.2, as well as the corresponding challenges identified either by Wang et al. [62] or our user interview study.



Figure 3.1: Initial Sketches of the System Design

#### 3.1.3 Prototype Design Process

We design the preliminary system that can be integrated into existing FLOSS hosting services, such as GitHub<sup>1</sup>. While those services include various asynchronous collaboration features that are widely adopted by FLOSS communities, they generally fall short of delivering the same level of benefits for asynchronous, social *design*.

Designing the prototype of the system had three overlapping phases. First the research team brainstormed, sketched, and discussed the system design based on the initial design guidelines. Some initial sketches are shown in Figure 3.1. These sketches focused on the following main features that reflected the design guidelines.

- End-user Involvement (see Figure 3.1) This feature captures the guidelines D1, D5, EU1, EU2, EU4, and EU5 and provides a portal, separated from the rest of the code management system, for designers to define target end-users and their roles, for end-users to sign-up for collaborations, and facilitate direct and intuitive interactions between designers and end-users.
- Pipeline Integration (see Figure 3.1) This feature captures the guidelines D2, D4, and EU3 and provides the ability to integrate the proposed system within existing

<sup>&</sup>lt;sup>1</sup>https://github.com

FLOSS development pipelines through the creation of associated 'Issues' from discussions of usability concerns with end-users.

Collaborative Design Artifact Generation (see Figure 3.1) - This feature captures the guidelines D3 and EU4 and facilitates the co-creation and feedback collection of design artifacts with the end-users. This feature can be utilized to achieve *Pipeline Integration* and provides transparency to both FLOSS end-users and other members of the project team (e.g. developers and maintainers).

Second, we evolved the sketches with initial feedback from FLOSS designers and endusers. During these initial user interviews, two personas of the target users were created to guide further design stages and serve as an official set of artifacts for improving the usability of FLOSS projects moving forward. Due to the novelty of the system, we chose to develop the detailed personas in parallel to the prototype exploration so that we could perform iterations as needed while examining the proposed system design. In the third phase of prototype design, we built an interactive prototype of the tool using Framer (www.framer.com) based on the evolved sketches and guided by the personas. This prototype - though initially meant to be used for further user feedback through another round of studies - received prleiminary feedback that motivated the need to more closely investigate PD in an FLOSS context.

In the following sections, we detail the interview study we conducted in the second phase of design, present the personas we created, and then present the latest version of the prototype.

## **3.2 Interview Study**

We conducted a preliminary interview study with two FLOSS designers and two FLOSS end-users to get feedback on the initial sketches and to iterate the early versions of the prototype. This interview study was approved by the Ethics Board of the institution of the researchers.
| Participant ID | Target Group   | Experience   | Current Occupation            |
|----------------|----------------|--|-------------------------------|
| P1D            | FLOSS Designer | Decades working in FLOSS in the public health sector                     | Design Director/Lecturer      |
| P2D            | FLOSS Designer | About one decade working in FLOSS as lead designer in social enterprises | Design Lead                   |
| P3EU           | FLOSS end-user | Casual FLOSS end-user of Mozilla Firefox, Audacity                       | Project Coordinator Assistant |
| P4EU           | FLOSS end-user | FLOSS end-user Notepad++, Audacity, Gimp                                 | PhD Candidate/Lecturer        |

 Table 3.3: Interview Study Participants' Characteristics

# 3.2.1 Methods

Participants were recruited from both personal networks and the Open Source Design forum; Open Source Design is a community of designers and developers committed to improving design in FLOSS<sup>2</sup>. The characteristics of the participants are summarized in Table 3.3. Among the four participants, one was non-binary, one was female, and two were male. Both FLOSS designers had considerable experience with FLOSS design projects; all their latest design projects were utilized by non-technical end-users.

We used two different sets of interview questions for the designers and end-users, respectively, during the one-on-one video conferencing calls. The FLOSS Designer interview focused on the participants' (a) experience and roles, (b) current tools and processes used to achieve FLOSS participatory design, (c) current challenges faced in making design decisions, and (d) open-ended feedback on the sketches. Similarly, the FLOSS end-user interview included specific questions regarding (a) general experience and roles, (b) utilizing FLOSS, (c) becoming involved in FLOSS development and challenges that were faced, and (d) open ended feedback on the sketches.

The interviews were recorded and then inductively coded to analyze themes [20]. Following the analysis, a summary of the main insights was drafted and used to (1) modify the design guidelines of the proposed system, (2) evolve the design of the proposed system, and (3) create the personas to capture the user needs.

# 3.2.2 Results

In this section, we summarize the key insights from our user interviews. We begin with the insights from the interviews with the FLOSS designers:

<sup>&</sup>lt;sup>2</sup>https://discourse.opensourcedesign.net/

## 3.2 Interview Study

|   | <b>Dakota - OSS Designer</b><br>Dakota works in an asynchronous OSS organization in the energy sector whose<br>source code is hosted on GitHub. They are currently volunteering their time, but in<br>the past has been paid to work as a lead designer in OSS projects. Dakota is trained in<br>HCI practices and is officially working with end users through various means on<br>designing the best system to suit the end user needs. |  |  |  |
|---|---|--|--|--|
|   | Challenges  |  |  |  |
|   | Dakota works hard to incorporate design decisions into the project's development<br>pipeline, but finds it <b>difficult to explain to developers the reasoning behind their</b><br><b>proposed changes based on user feedback</b> via their traditional communication<br>changels of Stack and GitHuk Issues threads. Dakota's <b>tram members do not</b>   |  |  |  |
| Age: 32   | channels of stack and Github issues threads. Dakota's team members do not   |  |  |  |
| Pronouns: They/Them                               | of the OSS despite the creation and delegation of tasks. Additionally, the<br>conversations between Dakota and the end user community are frequently  |  |  |  |
| <b>Education:</b><br>Masters of Industrial Design | dispersed among many different platforms and grow to be quite inconsistent;<br>this leads to more reluctance from the rest of the OSS team to sift through<br>conversations. While Dakota is willing to find time to schedule a call to explain design  |  |  |  |
| Occupation:<br>Design Lead                        | decisions to the developers, the asynchronous, remote nature of their work makes this extremely challenging.  |  |  |  |
| -   | Goals   |  |  |  |
| Location: Ottawa, ON                              | Single Channel for Addressing Usability Concerns - Dakota desperately wants to<br>find a way to streamline the process by consolidating the ways in which they interact<br>with end users.  |  |  |  |
|   | <b>Communicate Design Decisions</b> - Dakota needs an indisputable way to communicate the decisions to the rest of the team.  |  |  |  |

Figure 3.2: FLOSS Persona Dakota

- There are no current standards for addressing usability concerns with FLOSS endusers and community members. P2D mentioned that each project they worked on utilized different design methods to practice participatory design. Both P1D and P2D utilized many different platforms and tools to practice participatory design (e.g., Figma, Airtable, screen recorded demos, Twitter, emails, Slack, Discourse, video conferencing, etc.).
- 2. Two major consequences resulting from *Designer Insight 1* were bottlenecks in the pipeline from addressing usability and difficulties in communicating ideas to different groups of people on various tasks. Especially with the asynchronous culture in which P2D works, there wasn't a set process for providing design artifacts and necessary changes on the software design were not always accomplished.
- 3. The FLOSS designers positively received the idea of moving usability discussions and interactions between designers and end-users out of 'Issues', which is already an overloaded feature on FLOSS platforms [61]. P2D mentioned that the developers they collaborated with frequently ignored issues flagged as usability concerns and

## 3.2 Interview Study



Figure 3.3: FLOSS End-user Persona Enrique

argued with P2D against proposed changes resulting from end-user discussions. P2D believed that decluttering the 'Issues' would lead to less aggravation of developers, potentially resulting in a mindset shift towards being more receptive to usability issues.

- 4. Participants discussed that integrating and tracing the visual design artifacts in the FLOSS collaboration platforms such as GitHub would be helpful. P1D said: "Feels like a no-brainer to have a more visual asset visualizer... on GitHub. Our team would greatly benefit in SEEING artifacts that are inherently visual."
- 5. Participants also emphasized the importance to "keep the core GitHub repo concepts" where "the Design Layer should not "interfere" with core engineering activities" (P1D). They expressed that any additional feature should be consistent with the existing engineering culture and use of the collaboration platforms.

Interviews with the FLOSS end-users brought to light many important distinctions for our system design that had previously gone unconsidered. Listed below are several key insights.

- From the end-user's perspective, a major barrier to contributing to an FLOSS was not knowing how. While P4EU had found the GitHub repository for one FLOSS through their website, they expressed difficulty in understanding how GitHub works and how to word their comments to ensure mutual understanding. For this, P4EU stated GitHub was overwhelming and intimidating. P3EU felt an ideal way to be included in the design would be through surveys, feedback, or being contacted for participating in a conversation.
- 2. To address the above issue, the onboarding pipe-line for end-users to the proposed system needs to prioritize simplicity. After viewing the initial sketches, P3EU felt overwhelmed by the onboarding pipeline starting from landing on the main page of a GitHub repository while P4EU expressed minimizing the initial steps an FLOSS end-user would need to perform to provide feedback is crucial to maximize end-user involvement (such as not requiring an account, see Figure 3.1).
- 3. It is important for the tool design to indicate to FLOSS end-users that they are welcome and that their opinions/experiences are valid and helpful. Several key features in the sketches can help to accomplish this, as indicated by P4EU, including the 'end-user tag' features (see Figure 3.1) and the informality of the conversation format (see Figure 3.1). Following on this, P4EU also discussed the importance in terminology used throughout the system design; in many cases, P4EU felt that the tone of a selected word would deter them from participating in feedback. For example, the use of 'Contribute' (see Figure 3.1) was received negatively.
- 4. Both end-user participants felt that it is valuable to see that concrete actions are taken by developers based on their conversations on usability concerns. They valued the feature of linking design artifacts to the discussions (see 3.1), considering that it would enhance their experience in collaborating and would motivate them for continued efforts.
- 5. The two interviews brought some insights that can be used to further refine the original target audience description for the FLOSS end-users. At first glance, the initial conclusion drawn from the prior insights is that the interviews demonstrated that this group needs to possess characteristics of early adopters and innovators of technol-

ogy [19, 18]. The rationale was that these user groups traditionally are the ones that provide critical usability feedback in non-FLOSS contexts and are more likely to be technologically literate. However, upon further reflection, we reject this conclusion because it would reinforce the current status quo regarding who is involved in creating FLOSS technologies.

# 3.3 Personas

During the exploration of the initial design of the system, we developed two personas, one for FLOSS designers and one for FLOSS end-users, and iterated them based on the interview study results (see Figure 3.2 and Figure 3.3). The FLOSS Designer persona is Dakota, a lead designer who struggles to manage the various platforms for interacting with their end-user community and communicating the decision outcomes from those interactions to the rest of their FLOSS team. The FLOSS end-user persona is Enrique, a community coordinator for a local non-governmental organization (NGO) who is using an FLOSS to coordinate volunteers; Enrique has experienced issues with the FLOSS when coordinating volunteers with special needs and he faces difficulties communicating these issues with the FLOSS team.

We envision that these personas will serve as artifacts to support the design of this system as well as similar systems that aim to facilitate FLOSS user-designer communication. We use these personas in later stages of research in this thesis as critical documents for facilitating PD workshops (see Chapter 4). See Appendix C for the most recent iteration of the personas derived from this thesis.

# **3.4** Latest Version of System Design

The user feedback on the sketches resulted in a few notable changes to the prototype design. The workflow of the latest version of the interactive prototype is summarized in Figure 3.4. To emulate a more familiar conversational interaction for the FLOSS end-users following insights from P4EU, the design of interaction between FLOSS designers and end-users resembles platforms such as Slack and other asynchronous messaging platforms with features to react to a comment and start a thread (Guidelines D1, D5, EU1, EU2, EU4, EU5);

### **3.5 Discussion**



Figure 3.4: Overview of the Prototype System Design

see Figure 3.4 step 5. The addition of an 'end-user Collaborator' section underneath the standard 'Contributors' list for a repository should encourage activity due to visible recognition of their efforts and display of FLOSS end-users as valued members of the FLOSS community (Guidelines D5, EU4, EU5); see Figure 3.4 step 3. Clear buttons to create new software issues from resulting design artifacts of a conversation are now incorporated for seamless integration into the existing pipeline of an FLOSS project; this feature provides the ability to link the relevant artifacts in an issue directly and indicate in the conversation which individual has been assigned to work on the new issue to ensure transparency and traceability (Guidelines D2, D3, D4, D5, EU4, EU5). The system design is also guided by several usability heuristics (e.g. consistency, minimalist design, and flexibility [41]) to achieve an effective and efficient interaction.

# 3.5 Discussion

Overall, the feedback received during the user interviews was overwhelmingly supportive of our goals to understand key barriers experienced by FLOSS end-users participating in

### 3.6 Summary

participatory design efforts and to create a tool that facilitates successful, asynchronous participatory design. However, despite generally positive feedback on the sketches and the early stages of the prototype, the proposed design poses some challenges illuminated by the study participants. For example, participant P2D indicated that every time a new platform for communication is introduced to their end-user community, switching costs are incurred as not all end-users "*want*" to learn new technology. In this example, P2D recounted their FLOSS challenges when moving from Discourse to Slack; both platforms were active at the time of the interview. It is important to further explore this dimension with the next round of user interviews. In particular, exploring how to integrate this system with existing tools and workflows effectively would be important.

Furthermore, the current design of the system for a new end-user to join or start a conversation solely through the FLOSS repository might prove to go against some of the usability concerns. This was indicated by both of the FLOSS end-user participants' ambivalence toward the GitHub-influenced design. A potential change to the system might need to include a dedicated FLOSS end-user-facing portal or interface to make it as easy as possible for diverse user bases to join participatory design efforts.

While the current prototype had some positive feedback, these problems illuminated the need for a more exhaustive study into the broader context. Specifically, due to the initial feedback that the prototype does not solve the communication and standardization challenges, we need to focus future efforts on better understanding the root of these problems and how they are experienced at a larger scale. Moreover, the *End-user Insights 1, 3, and* 4 all dealt with issues of empowerment and motivation to participate in some manner. To better design solutions to encourage participation, we must investigate the underlying aspects of power that currently hinder participation. This is a critical part of participatory design theory that needs further exploration in order to design solutions that can encourage empowerment.

# **3.6** Summary

In summary, the work in this chapter contributes a set of design guidelines and two personas through a user-centered exploration of a prototype tool for FLOSS designers and

### 3.6 Summary

end-users in collaboratively addressing usability concerns. Our preliminary interview study confirmed a need for a standardized method to facilitate user-designer interactions that prioritize efficient communication of usability concerns to other FLOSS team members. However, while these findings provide a base understanding of their needs, to design successful solutions, we need to conduct further research with all three stakeholders (FLOSS designers, end-users, and developers), on how they participate, communicate, and work together regarding FLOSS usability. Following this, needs also emerged for an interface design that uses concepts and terminology that is inclusive of FLOSS end-users with diverse technical backgrounds. We conclude that this motivates further research conducted into aspects of power in a FLOSS participatory design context that currently prohibits this inclusivity.

In the next chapters, we report on our investigations into the root problems and needs surrounding challenges to address FLOSS usability (Chapter 6), how the three stakeholders currently participate all together (Chapter 7), and the role that power plays in this participation (Chapter 8).

# 4

# Participatory Design Workshop: Methods

To investigate how to improve FLOSS usability and stakeholder inclusion, we conducted four participatory design workshops. Each workshop had a unique combination of participant stakeholder roles to understand the different concerns of the stakeholders when contributing to FLOSS and the way they work together in a PD setting. In this chapter, we report on the recruitment process, the workshop set-up, and the data analysis methods used to achieve the research objectives. This study was approved by the McGill University Ethics Board.

# 4.1 Participants

We recruit three types of FLOSS stakeholders for our PD workshop study: developers, designers, and end-users. The recruitment process is described in Section 4.1.1, the participant stakeholder categorization process in Section 4.1.2, and the participants' characteristics in Section 4.1.3.

# 4.1.1 Recruitment

In this study, we focused on three types of FLOSS stakeholders: developer, designer, and end-user. To recruit participants in the three roles, we posted recruitment ads in three pri-

### 4.1 Participants

mary channels: the Open Source Design (OSD) forum; the Sustain Open Source Software (SustainOSS) forum; and multiple open-source subreddit communities (See Appendix A for the recruitment ad). The OSD community is an active network of design practitioners, working and volunteering in the FLOSS community, offering a strong pool of candidates from which to recruit designers. The SustainOSS network publishes an official podcast, hosts regular events, and holds work groups all to support "sustainers" of OSS<sup>1</sup>. Sustain-OSS defines sustainers as an "individual or organization who is concerned with the current state and future of highly-used and impactful open source projects." Here we hoped to recruit participants who could satisfy any of the stakeholder types, but especially developers and designers. Lastly, we targeted FLOSS subreddits, such as *r/foss*, *r/freesoftware*, *r/opensource*, and *r/degoogle*, to recruit mainly end-users and developers. The decision to recruit through free and open-source specific Reddits was made after a couple of unsuccessful attempts to recruit by reaching out directly to FLOSS contributors and community groups. After gaining approval from the subreddit moderators, these subreddits presented the largest, most accessible pool of potential end-users.

The recruitment advertisement (Appendix A) included a pre-study survey on potential participants' experience with FLOSS followed by scheduling-related questions. In particular, they were asked to write about their experiences (a) contributing to FLOSS, if applicable (including listing their contributions, tasks performed, etc.); (b) using FLOSS (including listing the purpose for using the FLOSS, issue reporting or providing feedback, etc.); (c) listing the specific FLOSS they contributed to; and (d) listing the specific FLOSS they used. We also asked them to self-identify as one or more stakeholder categories they felt they best fit into: developer, designer, end-user, other. Once participants filled out the survey, we contacted them with the consent form to sign outlining the study's purpose and study procedures.

# 4.1.2 Stakeholder Categorization

We organized each workshop with different combinations of stakeholder roles so that we could understand how participants acted and interacted with other stakeholders. This is an essential step in understanding how to improve stakeholder inclusion when addressing

<sup>&</sup>lt;sup>1</sup>https://sustainoss.org/

### 4.1 Participants

### FLOSS usability.

We use the participants' self-identification in the pre-study survey as the primary indicator of what stakeholder group a participant belongs to. Participants were allowed to select more than one stakeholder. We found that our participants who self-identified as a developer or a designer also often identified themselves as an end-user; in some cases, they self-identified as all three stakeholders. When a participant identified as a developer, we categorize them as **DEV** regardless of the other stakeholder roles they self-identified as. This decision was based on the assumption that a participant's self-identification indicated their perceived knowledge, skill level, and experience within the context of FLOSS, thus serving as a suitable metric to organize the workshops based on stakeholder roles. For the same reasons, participants who identified as a designer and not a developer were categorized as **DES** regardless of their end-user identity. And participants were categorized as an **EU** *only* if they identified as a FLOSS end-user and nothing else.

We additionally verify our categorizations against the participants' answers related to their experience. A few end-users who did not identify as developers listed that they regularly use FLOSS traditionally associated with more technical literacy (e.g., FLOSS operating systems). For these participants, we still categorize them as **EU**, but for the purpose of our study, we did our best to prioritize end-users who do not have development experience and who primarily used FLOSS with a graphical user interface (GUI). This decision was made because we felt this would be a better representation of the "average" end-user. Finally, once participants were categorized as a stakeholder, we organized the groups by stakeholder combinations and logistical availability. Participants were then sent consent forms and the workshops were scheduled.

# 4.1.3 Participants' Characteristics

In total, 37 people responded to the interest form from a total of 16 different countries across multiple continents, including North America, South America, Europe, Africa, and Asia. There were 11 developer responses, 14 designer responses, and 32 end-user responses.

For the four workshops in this thesis, we recruited nine participants for a total of three

### 4.2 Workshop Details

|             | Participant | Stakeholder Role | Occupation                       |  |
|-------------|-------------|------------------|----------------------------------|--|
|             | P1DES       | Designer         | Product Designer                 |  |
| Workshop 1  | P1DEV       | Developer        | FLOSS Developer                  |  |
|             | P1EU        | End-user         | Undergraduate Student            |  |
| Washah an 2 | P2DES       | Designer         | Independent Interaction Designer |  |
| workshop 2  | P2DEV       | Developer        | <b>Engineering Professor</b>     |  |
| Wankahan 2  | P3DEV       | Developer        | Recent CS Graduate               |  |
| workshop 5  | P3EU        | End-user         | Tech Support                     |  |
| Workshop 4  | P4DES       | Designer         | Freelance Designer and Animator  |  |
| workshop 4  | P4EU        | End-user         | IT Support                       |  |

Table 4.1: Workshop Participants Overview

developers, three designers, and three end-users. All participants were male; five participants were from North America, two participants were from Europe, one participant was from Africa, and one participant was from Southeast Asia.

# 4.2 Workshop Details

All workshops followed the same organization and structure. Each workshop was conducted by one facilitator. There were four combinations of stakeholders: Workshop 1, DEV-DES-EU; Workshop 2, DEV-DES; Workshop 3, DEV-EU; and Workshop 4, DES-EU. The workshops were organized in this manner to understand how the different stakeholders interact with each other to identify and address usability issues in FLOSS.

Each workshop lasted about three hours; they were conducted remotely using the Microsoft Teams video conferencing platform. Participants were compensated \$60 for their participation in the study. Participants were provided with materials before the start of the workshop and instructed to submit a final written design pitch resulting from the design activity.

# 4.2.1 Workshop Materials

Participants received a PDF document before the start of the workshop containing the following information: the questions for an icebreaker activity, the design activity instructions, and a set of three personas. Participants could review the materials beforehand, but they were told there would be dedicated time during the workshop to review them. The details of the workshop materials are explained below; all the original materials can be found in the Appendices.

### **Design Objective**

The design objective document, see Appendix B, informs participants of the hypothetical context of the design activity, the overall objective, and the deliverable they need to submit. Specifically, participants are instructed to imagine they have been asked to work with some peers to design a new tool to support the inclusion of FLOSS stakeholders when addressing usability issues. They must work to identify a specific problem, design a concept to resolve the problem, and create a written design pitch. The participants are provided with some elements to consider including in the pitch (e.g., problem statement, wireframes, etc.) but are told that they do not need to follow those suggestions.

## Personas

The document also included a set of three personas, one for each stakeholder role. The designer and end-user personas, Dakota and Enrique, respectively, were adapted from Chapter 3.3. The third persona, the Developer persona named David, is created based on prior research investigating developers' attitudes towards usability in OSS communities [62]. All three personas are available in Appendix C. <sup>2</sup>

# 4.2.2 Workshop Organization

The workshops consisted of three sections: an icebreaker activity, a focus group session, and a design activity. Each workshop followed the same set-up; they were organized to allow participants a chance to discuss and share perspectives on FLOSS usability and then work together to address problems specifically hindering stakeholder inclusion. If consent had been provided, participants were asked to keep their cameras and microphones on for the duration of the workshop. The workshops were all recorded using Microsoft Teams recording feature and the design activity was screen recorded in cases where participants

<sup>&</sup>lt;sup>2</sup>A discussion on the impact of the personas' racial and gender identities can be found in Chapter 9.4.

### 4.2 Workshop Details

did not share their screens.

### **Introductory Icebreaker**

Due to the workshop's focus on discussion and cooperation, the icebreaker activity was designed to introduce the participants to each other and ease them into conversing prior to the start of the focus group and other activities. Participants were instructed to go around and share their name, job title and responsibilities, an overview of their experience using and contributing to FLOSS, and then share their thoughts on why they believe FLOSS is important.

### **The Focus Group**

Following the icebreaker, there was a facilitated guided focus group with a duration of about one hour. For details on the focus group, see Appendix D. The focus group had four main sections: individually reading and reviewing the personas; discussing and reflecting on the personas together; proposing ideas updating or changing the personas; and discussing the design objective.

The questions for reflecting on the personas prompted the participants to consider and share their initial impressions of the personas, to reflect on the personas they identified with, to share their own experiences as they related to the personas, and to discuss any follow-up questions as needed. By prompting participants for changes to the personas, we were able to get explicit validation on the personas and proposed updates for further iterations.

For the final discussions of the focus group, participants read through and discussed the design objective; the design objective was also included in the supplementary materials. Participants had an opportunity to ask clarification questions followed by more moderated discussions. Participants were guided by questions intended to inspire the connecting of their earlier focus group discussions to the task at hand. They considered ideas such as how the FLOSS challenges might be solved, how possible solutions could be considered successful, and what existing solutions might already exist. This final section of the focus group allowed participants to enter the next phase - the design activity - with a shared understanding of the direction the group would work towards.

### 4.2 Workshop Details

### **Design Activity**

The focus group was followed by the design activity, which had two components and lasted for about one and a half hours. In the first component, participants worked together to decide on collaboration tools and channels. Once they made a decision, they set up their work environments. At this stage, the facilitator was present only to facilitate the instructions, answer questions, and help create the work environments or share invitations to the work environments, if needed.

The second component of the workshop was the participatory design (PD) activity. For the PD activity, the facilitator informed participants that she would be turning her camera and microphone off (so as not to distract or directly influence the outcome of the pitch<sup>3</sup>) but will be present if there are any questions. For the remainder of the workshop, the participants had free reign to work however they wished, unmoderated, to accomplish the design objective. Participants could use whatever resources they wished to create any kind of solution to the design objective.

The design activity was structured in such a way for two primary reasons. First, the activity would allow participants to cooperate to create a conceptual tool (a design pitch) to include different stakeholders to work together and improve the usability of a FLOSS; these pitches will, in turn, be analyzed by the researchers. Due to time and resource constraints, the design pitches – provided in Appendix E – are not yet analyzed; in future work, the researchers will perform rigorous analysis of the design pitch outcomes to understand what features might be able to be used in FLOSS development to improve the agency of the stakeholders, especially end-users, and to improve the usability of FLOSS. Second, the activity allows the researchers to investigate *how* PD will transpire. There is currently no baseline understanding of how these three stakeholders work together in a PD setting; organizing the PD activity in the workshops allows us to obtain such an understanding.

<sup>&</sup>lt;sup>3</sup>The fourth dimension of power is intrinsically present for the duration of the workshop, but especially the design activity. While the decision for the facilitator to turn off her camera and microphone during this time was made to not be too much of an influencing presence, the participants *did* know the facilitator was watching them and that they were being recorded. Moreover, the knowledge that the facilitator is working towards improving usability, compounded with the knowledge that she (and, later, other researchers) would watch them, likely influenced their behaviors and decisions. Thus, the fourth dimension of power occurred in the workshops.

Although PD is traditionally moderated by individuals familiar with PD, we intentionally structured our activities without a moderator. By having the PD activity unmoderated, participants could use collaboration tools of their own choosing and work together to design a solution without external interference. The underlying assumption is that the activity will be a more realistic simulation of what a remote, synchronous brainstorming session might feel like within a FLOSS context. While we cannot ensure total generalizability, the intention is that our PD set-up could be feasible for any FLOSS to replicate, if desired.

# 4.3 Data Analysis

The workshop studies yielded the following data for each workshop: an approximately three-hour-long video recording, the associated transcript, and the official design pitch. We performed a grounded theory analysis to address the research objective and answer three key research questions. Below, each research question is provided along with the details of the associated methodology utilized.

# 4.3.1 RQ1: Focus Groups & Usability Concerns

The first research question is as follows:

RQ1 How do different stakeholders reflect on the challenges and practices of FLOSS usability?

To answer **RQ1**, we perform thematic analysis on the focus group transcripts. One researcher first completed a round of open-coding on one focus group transcript by reading and summarizing the conversations with respect to the participants' experiences addressing usability. After a preliminary round of grouping these codes by experience and by the stakeholder role of the participant talking, all three researchers, including the author, discussed and agreed on the initial groups of experiences with FLOSS usability. Then the author and the first researcher independently performed the same open-coding process on the remaining focus group transcripts by dividing and conquering the remaining workshops. These codes were merged and ultimately organized into the existing groups by the author. We then refined the groups into two overarching themes related to FLOSS usability: key challenges addressing usability and how to measure the success when addressing these challenges. We discuss how the identified themes answer RQ1 in Chapter 6.

# 4.3.2 RQ2: PD Characteristics

The second research question is as follows:

RQ2 What are the characteristics of the participatory design activity in terms of structure, conversation habits, and the types of tasks accomplished by different stakeholders?

To answer **RQ2**, we open-coded the video recordings to capture non-verbal and verbal cues and interactions essential in a collaborative work setting (e.g., periods of silence, interruptions, performing actions, etc.). To start, all three researchers independently opencoded one workshop. We then discussed the codes and did a few rounds of live open-coding together. This yielded the finding that the PD activity comprises goal-oriented blocks, referred to as **GOB**, where the boundary of each GOB is defined by its **goal**. The author formalized this initial GOB and goal framework and continued open-coding the same PD activity, paying attention to the collaboration habits and refining the framework as needed.

All three researchers then discussed this framework and agreed on the following set of codes to characterize the common habits while collaborating: working GOBs with collaboration styles and activities; and discussion GOBs with a GOB initiator, their initial intent, the outcome of the GOB, how the participants conversed throughout the GOB, and the presence of authority during the GOB. The author then wrote an initial draft of the code book according to this framework, which the other two researchers reviewed and agreed on. Using the code book, the author then coded the remaining workshops and refined the definitions of the codes as needed.

# 4.3.3 RQ3: PD & Power

The third research question is as follows:

RQ3 How does power manifest in the participatory design activities? This question can be decomposed into the following two parts:

- RQ3.1 How do the behaviors of the participants demonstrate the presence of each dimension of power?
- RQ3.2 For each dimension of power, how do these behaviors affect the PD activities and the pitches?

To answer **RQ3**, we start with two PD activities' video recordings, focusing on the discussion  $GOBs^4$  (identified in Chapter 7). For each of these GOBs, we identify the presence of the three dimensions of power via deductive analysis, guided by the following interpretation of the first three power dimensions [25]:

- **D-1** This dimension is an execution of power that is dependent on resource allocation. This code is used for any situations in a GOB that resulted in some form of conflict.
- **D-2** This dimension is the confirming or de-structuring of existing social structures and norms. This code is used for any reflection of this structuration process.
- **D-3** This dimension occurs whenever someone is exhibiting tacit consciousness or whenever someone is bringing tacit thought to the forefront in such a way that it becomes discursive. This code is used when participants exhibit this difference in consciousness.

Based on these guidelines for D-1, D-2, and D-3, the author performed a round of coding on the two PD activities and found that each dimension of power manifested through unique sub-dimensions. After discussing this finding with the other two researchers, we formalize the following structure for the three dimensions of power in our design activity. D-1 manifests through one of three sub-dimensions: (1) resource utilization, (2) past experiences, and (3) knowledge gap. D-2 manifests through two sub-dimensions: (1) confirmstructuration and (2) de-structuration. Last, D-3 manifests through two sub-dimensions as well: (1) practical consciousness and (2) discursive consciousness. At this stage, we had a theoretical understanding based on the literature (See Chapter 2.4) regarding the methods of manifestation for each sub-dimension, but further analysis was needed to concretely identify how the sub-dimensions occur in an actual PD environment.

<sup>&</sup>lt;sup>4</sup>The decision to code the power dimensions on only the discussion GOBs was made because there was insufficient data to investigate during the working GOBs due to the nature of remote work (i.e., limited or no body language) and the lack of dialogue.

#### 4.4 Summary

For each GOB's sub-dimensions of power, we then performed open-coding to answer **RQ3.1** (how participants' behaviors demonstrate each sub-dimension) and **RQ3.2** (how their behaviors affect the PD activity and project pitch). The codes for each sub-dimension indicated a short description of what transpired and the stakeholder role of the participant involved.

Once the codes were complete, the author performed two types of groupings; (1) to identify the behaviors used for manifesting the sub-dimensions (**RQ3.1**) and (2) to identify the themes within which the sub-dimensions manifested (**RQ3.2**). After discussing and agreeing on the groupings with all three researchers wrote a preliminary code book and coded the remaining workshops, refining the code book as needed.

# 4.4 Summary

To summarize, we conducted four workshops with different combinations of FLOSS stakeholders to participate in a focus group and a participatory design (PD) activity. The focus group was moderated by the thesis author, who used the personas as guiding documents, and thematically analyzed through open-coding to (RQ1) understand how different stakeholders reflected on the current practices and challenges in FLOSS usability. The PD activity was unmoderated and participants were instructed to work together to design a tool to support the inclusion of stakeholders when addressing usability. We analyzed the PD activity to derive the (RQ2) characteristics of the PD in terms of structure, tasks, and conversation habits through open-coding methods. Finally, (RQ3) to understand how participants behave within these structures in a way that highlights how power dimensions are manifested and their effect on the PD activities, we perform a combination of deductive analysis and open-coding on the results of RQ2 through the lens of the first three dimensions of power. Before discussing the results of our research questions, we provide more details on the composition of each workshop in Chapter 5 by presenting a detailed overview of the participants, reporting the collaboration tools used in the PD activity, and summarizing the pitches.

# 5

# **Results: Participatory Design Workshop Summaries**

This chapter provides details on all the workshops' participants, the collaboration environment used by the participants for the design activities, and an overview of the proposed pitches as outcomes of the workshops. All the images of the pitches are available in Appendix E.

# 5.1 Workshop Summaries

# 5.1.1 Workshop 1: DEV-DES-EU

**Participants.** The first workshop (W1) consisted of a three-person team where each participant was a representative from each stakeholder group. The developer, **P1DEV**, was a long-time OSS developer with 15+ years of experience and is currently working in an OSS startup. The designer, **P1DES**, is a product designer with one year of design experience who has been contributing to FLOSS since the beginning of 2022 and has experience performing usability audits. The end-user, **P1EU**, is a first-year undergraduate student majoring in a non-STEM field, but minoring in computer science. P1EU has daily experience with FLOSS using software such as Linux, its surrounding packages, LibreOffice, and Musescore. P1EU has also submitted bug reports and feature requests for the FLOSS they used.

## **5.1 Workshop Summaries**



Figure 5.1: Part of Design Pitch Made in W1: Links to connect each stakeholder to the appropriate mechanisms to contribute.

**Collaboration environment.** The participants decided to use Miro, which was suggested by P1DES, as their collaboration tool despite P1DEV initially suggesting Excalidraw (FLOSS alternative to Miro). After access links were made and shared for both of the design tools (by the facilitator), P1DEV and P1EU tested Miro and both decided they liked Miro more. Only P1DES was familiar with the tool prior to the workshop. According to Miro's version history which tracks the actions of users through edits, deletions, and additions, P1DES performed the most actions (240) compared to P1EU and P1DEV (16 and 10 actions, respectively).

**Design pitch.** For much of the design activity, P1DEV and P1EU discussed the design objective amongst themselves while P1DES translated these discussions into the Miro board as wireframes. This accounts for the significantly higher number of actions for P1DES, who performed most of the design-related tasks and took the responsibility for Miro. The final design pitch submitted by Workshop 1 only included their wireframes with a verbal explanation of the design decisions made. W1 participants submitted a design concept to improve the community by creating a central hub for all FLOSS. This hub will support a personalized landing page for each FLOSS that follows a set standard and allows for abstracting away GitHub. This decision was made to improve the inclusion of the non-developer community. Figure 5.1 is a sample of the wireframe made in W1 and Appendix E.1 contains the full pitch visuals.

# 5.1.2 Workshop 2: DEV-DES

**Participants.** The second workshop (W2) had two participants, one designer, and one developer. The designer, **P2DES**, is an independent interaction designer and user researcher for primarily FLOSS-based companies and organizations; P2DES came from an engineering background but does not know how to code. He has been contributing to different FLOSS projects since around 2012. The developer, **P2DEV**, is an associate engineering professor who identified himself as having minimal coding skills despite owning and maintaining his own open-source survey instrument for educators to place students in groups. Additionally, P2DES stated that they try to use FLOSS wherever they can and P2DEV explicitly mentioned using Audacity and LibreOffice.

**Collaboration environment.** Participants of W2 also made the decision to use Miro, which was suggested by P2DES. Similar to W1, only P2DES was familiar with Miro prior to the workshop. According to Miro's version history, P2DES also performed the bulk of the actions (82) while P2DEV performed 18 total actions.

**Project pitch.** As stated in their submitted pitch, W2's design concept seeks to "facilitate two-way communication between these three sets of people to address usability issues in a FLOSS system." W2 participants designed their pitch referencing the personas the most out of the four groups. The concept has the end user open an issue where there will be fields for image and video uploads, this issue is then displayed only to the designer where the two will have a conversation. If the designer determines the issue is a usability issue, they make a git-style issue summarizing the discussion and any expected design changes; this is then sent to the developer. Figure 5.2 shows part of the wireframe made in W2 and Appendix E.2 contains the full visuals of the design pitch.

# 5.1.3 Workshop 3: DEV-EU

**Participants.** The third workshop (W3) had two participants, as well, a developer and an end-user. The developer, **P3DEV**, recently completed his undergraduate degree in computer science. He has been a part of the FLOSS community for about 10 years, transitioning from a user to a contributor over time. The end-user, **P3EU**, is a tech support employee at Salesforce and has been a regular user of FLOSS since around 2019, using FLOSS alter-



Figure 5.2: Part of Design Pitch submitted in W2: Designers can comment and converse with end-users directly on the usability issue.

natives to social media applications, google, and password managers.

**Collaboration environment.** The participants of W3 used two tools to create their design pitch; Google Docs - suggested by P3EU - and a local HTML editor - suggested by P3DEV. According to the version history for Google Docs, which shows the edits, deletions, and additions (a new version is marked either whenever a new person starts writing or every couple minutes of consistent writing), shows that P3EU and P3DEV contributed about equally to the document (28 and 36 edits, respectively). The HTML editor, SeaMonkey Project<sup>1</sup>, was not collaborative and, as such, P3DEV had sole control over that part of the collaboration environment.

**Project pitch.** The participants' design pitch in W3 is "a simple feedback form, which takes the input of the stakeholders, will be designed for everyone to communicate their suggestions and concerns about the software." The pitch is designed to reduce the technical barriers to participation when providing feedback by simplifying the amount and types of information to submit. Once feedback is submitted, the burden transitions "to developers and anyone else directly involved; end users hardly have to do any work." Figure 5.3 shows the rendered HTML pitch made during the workshop and Appendix E.3 contains the written document submitted, as well.

<sup>&</sup>lt;sup>1</sup>https://www.seamonkey-project.org/

| New Open Save Pu   | abish Browse Print Link Image Table Spell |
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| Paragraph 👻 🖷      | * A   B / U   = = = • • • = = = • • • •   |
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| Solutions (If any) |   |
| Solutions (if any) |   |
| Solutions (If any) |   |

Figure 5.3: HTML Pitch submitted during W3

# 5.1.4 Workshop 4: DES-EU

**Participants.** The fourth workshop (W4) had two participants with one designer and one end-user. The end-user, **P4EU**, is an IT support employee for a company that sells phones, computers, and tablets; P4EU is also a regular FLOSS user, using software such as GIMP, OPS, and LibreOffice. The designer, **P4DES**, is a freelance animator, illustrator, and designer. P4DES is also a regular FLOSS user, but in his free time contributes to the user experience and testing of applications.

**Collaboration environment.** W4 participants used Google Docs and Figma, both proposed by P4DES. P4EU was only familiar with Google Docs prior to the start of the workshop. According to the version history of Google Docs, P4EU made 26 actions, while P4DES made 17 actions. For designing the wireframes in Figma, P4DES performed most of the actions (the version history for the free version of Figma, which this team used, was not available to analyze).

**Project pitch.** Participants of W4 created a design concept for a platform that focuses on community building by connecting different types of contributors to FLOSS projects and teaching projects how to improve their community involvement. The W4 participants' design pitch includes a mockup wireframe platform for (1) finding FLOSS projects to improve, (2) diverse searching and filtering options, (3) searching for people to get involved/job postings, and (4) FLOSS education resources. The design also provides a list

### 5.2 Reflection on FLOSS values

| Home                            | All projects J   | obs Education   | About This Pro                                     | <u>ject</u>  |
|---------------------------------|--|---|--|--|
|                                 | Name o   | f the Proje   | ct   |  |
|                                 | Donec in ultricies m<br>pulvinar molestie nil<br>sagittis, euismod | igna. Ut quis elit venenatis,<br>h, a porta ipsum iaculis vit | , commodo nibh eget, i<br>ae. In ac congue erat. I | consequat eros. Nunc<br>Morbi tincidunt ex a ipsum |
| How to contribute Cod           | e Hou  | r to contribute Code  | How  | to contribute Code                                 |
| How to contribute Desi          | ign Hov  | r to contribute Design  | How  | to contribute Design                               |
| (                               |  |   |  |  |
| Best Practices for<br>Marketing | Best Practices for Test  | Best Practices  | for CSS Bes  | t Practices for Logo<br>Designs                    |
| Select Ev                       | aluate Desi  |   |  |  |

Figure 5.4: Part of design pitch submitted during W4. The template main page for a FLOSS project on their platform containing information on how to contribute.

of existing resources for finding FLOSS jobs, education resources, and finding FLOSS projects to use. Figure 5.4 shows part of the wireframe made in W4 and Appendix E.4 contains all written documents and wireframes.

# 5.2 **Reflection on FLOSS values**

In response to the last icebreaker question ("I believe FLOSS is important because ... "), three key topics were mentioned in the workshops: innovation, transparency, and availability. Regarding innovation, W1 and W2 discussed FLOSS's ability to facilitate innovation. P1DEV specifically mentioned that FLOSS allows "*people opportunities to build and expand on stuff where proprietary software [does not]*", a sentiment echoed by P2DES.

Transparency was mentioned in W1, W2, and W4 by the designers. P1DES mentioned that FLOSS is essential for supporting transparency as the "*world switches to web3*". P2DES said that the transparency of seeing how the software actually works is an essential

part of changing how it works. Tangential to transparency concerns are privacy concerns and P4DES mentioned that FLOSS provides options to people who are concerned with privacy.

The most discussed topic for FLOSS's importance was related to the availability and ownership of the software. These reasons were discussed in all four workshops and were mentioned at least once by a representative of each stakeholder group. All the end-users participants' (P1EU, P3EU, and P4EU) reasons for why FLOSS is important were exclusively related to this topic. P1EU said that FLOSS is important because "*it gives users full ownership of what they're using*." P2DES, P3EU, and P3DEV mentioned that FLOSS removes the reliance on proprietary and single-vendor software. P3EU continued to add that this lack of dependency on a single vendor is essential for "*everyone [having] access to [software], whatever their economic or social status is*". This importance of access to quality technology regardless of socioeconomic status was also mentioned by P2DEV, P2DES, P3EU, and P4DES.

# 6

# **Results: Reflection on FLOSS Usability**

In this chapter, we discuss the results of the analysis performed to answer **RQ1**: How do different stakeholders reflect on the challenges and practices of FLOSS usability? In the analysis, we identify five main categories of usability challenges mentioned by the participants based on their experiences with current practices of FLOSS usability. We also identify four potential ways to measure successful solutions to these challenges. Figure 6.1 depicts an overview of RQ1 results.

# 6.1 Usability Challenges

There are five categories of challenges that participants reflected on during the focus group: (1) communication, (2) documentation, (3) development, (4) culture & usability, and (5) incentives. In this section, each category will be summarized by stakeholder group.

# 6.1.1 Communication

Reflections on communication centered on challenges relating to using communication channels, providing user feedback, and different communication styles encountered. Overall, participants discussed user feedback challenges related to barriers experienced by different stakeholders when submitting user feedback or reading user feedback. Challenges about communication channels included participant experiences using the existing channels for communication in FLOSS and the problems they encountered. And communication



Figure 6.1: RQ1 Results Overview

tion style challenges encompassed the participants' experiences interacting with different types of communication styles in FLOSS.

EU participants mostly discussed their own experiences, such as feeling deterred from communicating due to hostile communication styles in forums, a lack of confidence when speaking to developers, not knowing the language or terminology to communicate, pre-ferring to communicate directly with developers, and not knowing the best way to submit their feedback. For example, in W1, P1EU discussed his experience in user forums where he expressed that while end-users who have been involved in the forum for a while are adept at describing their issue, he has seen many new users - himself included - who "don't really know how to ask a question or ... don't really know, even, what's going wrong. And that kind of generates a lot of this confusion."

DES participants reflected on these communication challenges from the perspective of potential causes. DES participants felt that developers and end-users struggle to communicate with each other often because developers lack the skills necessary to engage with user feedback, in addition to end-users feeling unacknowledged when they try to get involved. For example, in W2, P2DES mentioned how developers often become overwhelmed by diverse requests because as they attempt to design, they find that "*they don't know sort of what they're doing, so they're reacting to everything and everybody's got a different problem and they're continuously changing it. Which leads to the [a situation of]: What are we supposed to do?*" DES participants also discussed the need for FLOSS communication channels to be more inclusive toward all types of contributors. For example, when P1DES was talking about the importance of communication that abstracts away from the code;

he added that instead of technical aspects of communication, such as a configurable IRC, "*it should be closer to communication channels that anybody that does not have any idea about the development world can also participate in, for example, Discord.*"

DEV participants discussed the need for issue templates despite acknowledging how overwhelming they might be for end-users; DEV participants also mentioned how the templates can require irrelevant information. For example, P1DEV mentioned that he believes the problem stems from the fact that "sometimes the [issue] templates don't match the problem that the user is having and then they're filling in stuff for the sake of filling in stuff." P1DEV suggested that one solution to this problem is to include multiple templates, but "then the user has to pick the right template. So again, you just compound the problem." DEV participants also discussed how going through user feedback is time-consuming for them and, despite all of that, users often fail to provide sufficient information.

Regarding problems in developer-specific communication channels, such as issue tracking, DEV participants discussed how too much priority is given to functionality which cause communication styles to often fall prey to online disinhibition effects, deterring overall participation. For example, P1DEV mentioned that "with internet forums in general …, any kind of discussion on the internet can quickly degrade. … Picking on people or putting them down because they don't agree with them … the feeling of anonymity that you get with just being a username on a forum somewhere as opposed to talking to people in real life."

# 6.1.2 Documentation

Participants discussed documentation related challenges, such as being hard to use, the lack of onboarding documentation, and documentation as a resource intended solely for developers. In particular, all roles discussed how there is insufficient non-developer documentation. For example, P1DES specifically noted a situation where he reached out to a project for usability documentation and a maintainer responded by saying "most of [that project's] current docs are majorly focused just on developers;" this sentiment was directly echoed by both of his teammates during the workshop, P1DEV and P1EU. P1EU said that "very few pieces of software have had actual user interface documentation" and P1DEV further suggested that this lack of diverse documentation is largely related to the lack of

technical writers involved in FLOSS.

DES participants also cited the need for better onboarding and contribution instructions as well as the importance of a FLOSS project's documentation to be more inviting for non-technical users. For example, in W4, P4DES suggested the need for "*some kind of guidelines* [on] how to invite more people inside of the project or even maybe guidelines *like how to make your project toolset more inviting for non-technical users because that's another thing I noticed that if you want to contribute, it's heavily, heavily, heavily skewed to the technical side.*" Also in W4, P4EU touched on the need for all documentation to be contained in a central location because it's often too hard to find what they need. Lastly, P1DEV discussed how the lacking non-developer documentation has led to an increase in non-traditional documentation, such as tutorial videos, but these "*are a lot of times superficial and incomplete, too, because they don't give you all [the ways] of going through the software.*"

# 6.1.3 Development Process

Participants discussed their perspectives on the development process of FLOSS not being inclusive of different types of stakeholders. These challenges centered around three specific topics: (1) development tooling, (2) expertise, and (3) complexity.

**Tooling.** Regarding tooling, participants discussed how development tooling (i.e., Git-Hub, IRC, and Linux were specifically mentioned) poses significant barriers to participation despite designers and end-users wanting to get involved. These barriers are largely due to the usability concerns experienced by non-developers when trying to use these tools. Specifically, DEV participants expressed their belief that designers and end-users struggle to become involved because of these tools; P2DEV said that he thinks that users will choose the tools that they are most comfortable with and how his FLOSS project primarily gets user feedback via email despite linking to an issue tracker. P2DEV specifically adds that "*the GitHub issue tracker, I think, is pretty off putting. It's pretty confusing … my user base is people that aren't coders at all, so I think probably, they just see the email address and think I'll just send an email if it's important."* 

DES participants discussed how the existing tools directly deter designers and end-

users from becoming involved despite expressing the potential for the tool to support both stakeholders; for example, P2DES said he feels a lot of designers struggle to interact with FLOSS projects because most this reliance on issue trackers doesn't work for designers. P2DES cited this reason: "designers don't think in issues [...] The way I think is visually and I'm moving stuff around on a wall and I'm drawing things out, so all the stuff looks like a mess. P2DES says this is the reason why developers often feel issues are long and unimportant.

EU participants discussed how they are aware of the tools but don't use them because the participants are not familiar with the tools, they are hard to use, or they are inconsistent between projects. For example, in W4, P4EU said that he believes it would help end-users participate if there was "*a degree of consistency among the tools [to allow for] switching from one project to another project or work sort of similar, like a word processor.*"

**Expertise.** The reflection on expertise included perspectives about developers *lacking* the expertise to address usability and users, similarly, don't have the expertise to get involved at all. For example, P1DEV said that a reason for FLOSS projects' poor usability is because the projects often start from one person wanting to solve their own problem; these people typically have "*a certain set of skill sets, but usability and designing user interfaces is probably not one of them.*" DES participants also mentioned how developer contributors expect all other contributors to have developer skills; P4DES said his experience has often been that"*most of the developers expect [designers] to just go to terminal and write Git and clone the repo*" but the *tooling* poses a barrier for designers despite developers expecting them to be able to handle it. EU participants acknowledged similar sentiments about developers and end-users. P3EU discussed his experience as a non-technical individual and how sometimes he doesn't "*understand how to install or how to use the open source software.*" despite developers expecting him to.

**Complexity.** Last, participants discussed their perception of how complexity (e.g., assumed expectations, resource constraints, and scaling problems) factors into addressing and solving usability challenges. DEV participants discussed how despite the importance of improving usability in FLOSS, it is an ambitious and challenging problem to solve. P1DEV said that it is "*pretty ambitious*" to try and solve the problem because it requires a largescale redesign of the current workflows that are currently developer-centric for countless

different types of people. DES participants expressed that a reason for poor usability stems from the fact that the "scratch an itch" mentality in FLOSS doesn't scale well that leads to situations where user expectations and projects resources don't match. P2DES explained that the current approach to FLOSS is acceptable when it's only one or two peoples "itches" but when "*it's eleven peoples' itches and actually you [the repository owner] are now in the minority of the usage of people with that itch*" but there is no support for the other peoples' itches in the project, people will search for alternatives. Last, EU participants indicated that while they need FLOSS to scale to their needs in a usable way, they understand there are limitations due to complexity and resource constraints and don't necessarily feel like they should ask for more. For example, P4EU said that in his experience working for a large organization, end-users mostly "*want things to be fixed as soon as possible*" but they are "*willing to allow for certain things if it's free and open source [because] they don't have to necessarily invest as much into it.*"

# 6.1.4 Culture & Usability

Participants discussed their experiences addressing usability, participating in the FLOSS pipeline, and general barriers to community building that resulted from the development-centric culture of FLOSS. All participants encountered a community focused on functionality that stemmed from the FLOSS culture defined by the **development process challenges**. Participants discussed how they believe this is largely responsible for users' lack of trust that their input will be valued.

DEV participants expressed that although they (and other developers) are interested in usability, when the "by developer, for developer" mentality is compounded with increased demands, the result is functionality and developer needs are prioritized. For example, P3DEV said that, in his experience, a major problem with FLOSS projects is they tend "to fulfill the needs of the developer more than the users" and that there is "some selfishness" involved when developing these features on the part of the developers. DES participants discussed how usability competes with other concerns and how the overall culture of FLOSS views usability as an "add-on" feature. P2DES said that, in his opinion, it makes sense that developers don't prioritize learning how to address usability because project contributors already have so many other responsibilities that are likely "a lot more interesting

to learn and watch and read than the newest usability evaluation method". P2DES continued to say that in his experience, many developers will often say "I don't really care or [improving usability could require] a lot of change and we don't have enough resources" as the reason to not address it. EU participants indicated that, based on their perception of FLOSS culture, end-users' concerns are not prioritized unless designers are involved. When discussing how he contributes to projects as an end-user, P4EU acknowledged the fact that, although it's quite rewarding for him to help a developer out, "[usability] is something that the designer is concerned with".

Regarding the FLOSS pipeline, participants discussed how projects need to shift their process first to identify problems before coding features, adopt an increased focus on designers in the pipeline, and improve the onboarding stages to get involved in a project. These challenges were primarily identified by the DES participants. For example, P1DES mentioned how, from the beginning of a project, the pipelines do not factor in designers: *"when a project grows, it increases in developers but there's nobody concerned about the UX or whether the software is actually usable."* 

Last, discussions of community building touched on the barriers participants experienced when engaging in community building and included their suggestions for improvement. DES and EU participants both agreed that designers need to be involved in FLOSS because they are the key to solving many of the identified communication challenges. DEV participants discussed the need for FLOSS projects and contributors to adopt more inclusive attitudes overall to attract diverse people to participate. For example, P2DEV mentioned that, as an educator, he "is always trying to broaden perspectives about, specifically, who can be an engineer [and] who is an engineer" in terms of what their race, gender, and ethnicity and for that reason, he was excited to see that some of the personas reflected this diversity. In terms of attracting diverse stakeholders, P4DES specifically advocated for adopting a trust-building mentality, saying "it's about building the community and they [the users] need to trust you and then are usually quite happy to be involved." Finally, EU participants said that although they would like to be invovled in a FLOSS community - and have tried to in the past - it is hard to find how and where to get involved. For example, P3EU explicitly said that he often" can't find where to get involved [in a project] and frequently assumes that "developers [are] so technical that they don't take into consid-

*eration how usable their software is*" and therefore P3EU doesn't feel as motivated to join the community.

# 6.1.5 Incentives

The last category of challenges participants discussed was on the subject of incentiverelated issues and how they affect the usability of FLOSS projects. Discussions centered around key challenges hindering stakeholders from feeling motivated to act outside of their norm. In turn, participants then discussed possible mechanisms to solve these challenges by enacting financial incentives through donations and pricing schemes.

EU participants mentioned that they find it motivating to talk with developers directly and feel like they helped out a project fix some issues, but ultimately they don't deserve to ask for more because the software is all free and created by volunteers. For example, P3EU said that he sometimes "feel[s] embarrassed in raising my concerns since they, as developers, are volunteers and 'we made the software for you for free.' So it's like who are you to demand more from software? ... They developed the software for free. So who am I to complain?" However, EU participants also mentioned that they are willing to donate despite cost being a motivating factor for using FLOSS. P4EU mentioned this after he already mentioned cost being a major motivator for him to use FLOSS, but he mentions that whenever he recommends a FLOSS to others, he will mention that there is a donation option. On the topic, P4EU said, "honestly, I've been surprised how often people are like: no, if it works, I will give them the \$30 that I would have been paying [elsewhere], and they're happy to be able to just give something one time on their terms and their amount to just make it work." However, EU participants clearly specified that all donated money should go directly to developers.

DES participants discussed the lack of incentives as a reason that developers do not address usability issues and any other problems they deem boring; however, one DES participant mentioned that donation buttons are not a sufficient fix to this problem due to the fact that donations are not always given to the developers in reality. P4DES elaborated saying that "money is not spent on development [in many organizations], basically, it's spent for another thing, infrastructure." DEV participants agreed with the others, confirming that the lack of funds is a primary factor affecting the motivation and incentives for developers to address usability. P2DEV said that because there is a lack of incentives and "[developers are] going to work on the things that they're passionate about and curious about" and that may or may not include design elements.

# 6.2 Measuring Success

After participants discussed their challenges regarding usability in FLOSS, they then discussed how successful solutions could be measured. Participants identified the following four metrics to measure this success in a FLOSS context: (1) improved user feedback, (2) more design-centric FLOSS process, (3) increased usability priority, and (4) improved community building. Each metric of success is described below.

# 6.2.1 User Feedback

Participants identified improving the user feedback process as a good way to measure a successful solution to addressing usability in a FLOSS project. P3DEV elaborated that if the solution leads to more positive and **consistent user feedback**, then it is successful. P2DES said that a solution leading to **fewer user complaints** could be considered successful. A couple of EU participants also mentioned similar measurements on improved user feedback; P3EU said that success occurs when a high amount of **users' concerns are addressed** and there is **high satisfaction** rating after any communication, while P4EU said **survey feedback** from users saying it's easier to contribute is a good metric to success.

## 6.2.2 Process

P2DEV and P1DES indicated that a solution could be considered successful if it positively affected the process of creating a FLOSS. P2DEV said that the **longevity of the project** should be improved in terms of "*how long [the project] stays*" and P1DES said that there should be a positive impact and improved integration between the **design and development process** as a whole by ensuring "*they include all the feedback to make improvements in the project*.". No EU participants identified metrics of success in this category.

# 6.2.3 Usability Priority

P2DES indicated that success should be measured by an increase in the amount of how usability is prioritized. Specifically, he said that this could likely be quantified by the percentage of **usability issues addressed** as well as by the **overall improved usability** of a project and that the project is used.

# 6.2.4 Community Building

The last metric of success, **community building**, was discussed by each stakeholder group. P2DEV specified having a **larger user base** while P1DEV said that success could be measured by the increase in non-developers contributing to a project. P4DES said that success should be measured by the overall number of **new people joining the project**. And lastly, P1EU believed said the degree to which the solution encourages **users to contribute** is a good indicator of a successful solution.

# 6.3 Summary

Participants reflected on five types of challenges when addressing usability: communication challenges, documentation challenges, development process challenges, culture and usability challenges, and incentive-based challenges. Regarding **communication**, participants reflected on how developers lack the proper skills to communicate with end-users, and end-users struggle to communicate because they can't find where to get involved, lack confidence, often get overwhelmed by feedback forms, and don't know what language to use. In general, participants all agreed that communication channels needed to be more inclusive. In terms of **documentation**, participants all agreed that there was a need for more inclusive documentation for non-developers to get involved in software that is easier to find. When reflecting on the **development process**, participants discussed how resource constraints in FLOSS limit the ability of projects to maintain their usability as projects scale, development tooling is hard to use, it limits designers and end-users from becoming involved, and developers lack the appropriate skills to address usability. When discussing **culture and usability** of FLOSS, participants talked about how functionality and developer needs are prioritized over usability and end-user concerns, how this makes usability an
#### 6.3 Summary

after-thought and causes end-users to lack trust in the participation process, how designers need to be included for successful communication to occur, and how FLOSS culture needs to change so it's more inclusive and easier to get involved. Finally, participants reflected on the role of **incentives** in FLOSS and identified how developers lack incentives to address usability, how end-users are often happy to donate, and how their motivation is affected. Specifically, despite end-users being motivated to help developers, they don't always feel motivated to provide feedback because the software is free, and they don't deserve to ask for more. When asked about metrics of success, participants identified the following: **user feedback** that is more consistent, positive, and addressed in a timely manner; the **FLOSS process** is improved in terms of a project's longevity and the design and development processes are integrated; **usability is prioritized**; and the **community** of a project grows by an increasing user base and more types of stakeholders joining as contributors.

# **Results: Structure of the Participatory Design Activities**

7

After identifying and discussing their experiences, challenges, and perceptions about FLOSS usability in the focus group, participants transitioned to the participatory design (PD) activity. Here, their objective was to identify a specific problem preventing the inclusion of stakeholders from achieving usable FLOSS and designing a solution.

Prior to our research, no formal investigation had been conducted on participatory design in FLOSS to improve usability through diverse stakeholder inclusion. Towards this end, the second research question (RQ2) seeks to formalize the structure, tasks, and conversation habits to accomplish such an activity and achieve the objective. In this chapter, we describe the results of the analysis, where we identified the structure of PD building on goal-oriented blocks (GOBs), the two types of tasks performed (working tasks and discussion tasks), and the details for both. For an overview of RQ2's results and the identified structure of PD, see Figure 7.1.

# 7.1 Goal-Oriented Blocks

Each PD activity is around an hour and a half long, in which the participants were working together to accomplish a single design objective. To analyze the structure of the activity, we decomposed each design workshop session into a series of **goal-oriented blocks**, referred

#### 7.1 Goal-Oriented Blocks



Figure 7.1: Overview of RQ2 Results: PD Structure, Tasks, and Details

|                | Workshop1 | Workshop2 | Workshop3 | Workshop4 |
|----------------|-----------|-----------|-----------|-----------|
| Discussion GOB | 57        | 46        | 75        | 84        |
| Working GOB    | 5         | 9         | 26        | 26        |
| Total GOB      | 62        | 46        | 75        | 84        |

Table 7.1: Discussion and Working GOB by Workshop

to as GOBs. Each GOB is identified by the *goal* it seeks to achieve. As such, the boundaries of the GOB are defined by the points when the participants started to approach a goal and when the goal was resolved (either achieved or abandoned). GOBs could be nested within another larger GOB, if necessary. These GOBs worked as building blocks of the activities, allowing participants to reach their ultimate objective of creating the design pitch.

There are two categories of GOBs: working GOB and discussion GOB. A GOB's is "working" if the main activity of that GOB was to write, design, and/or implement any part of the design pitch submitted at the end of the workshop. A GOB is considered "discussion" if the main activity was verbal information exchange among the participants. See Table 7.1 for a breakdown of working and discussion GOBs for each workshop. As a result of our coding process, we categorize discussion GOB by seven potential goals: (1) decide on strategy, (2) organize logistics, (3) identify existing problems in FLOSS, (4) ideate features,

#### 7.2 Working GOBs

|          | Workshop1 | Workshop2 | Workshop3 | Workshop4 |
|----------|-----------|-----------|-----------|-----------|
| Separate | 5         | 7         | 26        | 14        |
| Together | 0         | 2         | 2         | 12        |

Table 7.2: Working Style Breakdown by Workshop

(5) discuss design limitations, (6) communicate updates, and (7) sharing knowledge; we discuss these goals in details in Chapter 7.3.1.

# 7.2 Working GOBs

Working GOB occurs when participants are actively performing actions to create, design, write, and/or implement the final design pitch submitted at the end of the workshop. A working GOB's duration varied; the longest working GOB was in W1 at roughly 20 minutes, while the shortest working GOB occurred in W4 at about 12 seconds. Most of the time, when participants worked, they did not communicate with each other; if they did talk, it was primarily a participant mumbling to themselves as they worked, which limited the amount of information we could glean. As a result, we focused on the concrete actions that the participants performed during these GOBs, including their actions in the workspaces of the collaboration tools being used. Based on those actions, we identified two types of characteristics of working GOBs: (1) working style and (2) activity.

# 7.2.1 Working style

When participants collaborated in working GOBs, they either worked together or worked separately. When participants **worked together**, they were actively working on the same part of the design pitch by actively building on each other's work. For example, in W4, P4DES and P4EU both worked at the same time on writing the problem statement by adding to and refining each other's ideas in the same section of the document.

On the other hand, participants **worked separately** in two primary ways. First, both participants were actively working, but they were working independently on different parts of the pitch. This frequently occurred in all the workshops where a participant, usually the designer, would handle wireframing while another participant, often the end-user, would

take charge of writing based on their discussion. For example, in W3, P3DEV and P3EU predominantly worked separately while P3DEV made the HTML front-end of their design and P3EU wrote the pitch in the Google Document. The second-way participants worked separately occurred when one participant would work while another participant observed. This also happened in every workshop, and the participant who observed was typically the participant with less agency (more on agency in Section 8). For example, in W1, there are only five working GOBs in total and all are separate; while P1DES was designing alone for most of the PD activity, there was one GOB in particular where P1DEV and P1EU were observing his work and having interspersed discussion between themselves. In general, across all the workshops, participants mostly worked separately. A breakdown across the workshops by working style is in Table 7.2.

# 7.2.2 Activity

The second characteristic of the working GOB is the activities performed by each participant. We found eight different types of activities: (1) designing/wireframing, (2) programming, (3) writing the design pitch, (4) observing another participant's work, (5) reviewing their work, (6) organizing/editing the design pitch, (7) performing external research (i.e., searching on a search engine for external documentation), and (8) miscellaneous activities. Miscellaneous activities occurred when a participant was performing an activity that was not clearly communicated through verbal commands (i.e., mumbling about what they are doing as they work) or visible actions (i.e., the participant has changed their activity from the previous GOB but the facilitator could not see the new activity and the data were not cached). A breakdown of the activities by workshop is in Figure 7.2 and by stakeholder type in Figure 7.3.

# 7.3 Discussion GOBs

In discussion GOBs, the participants focused on verbal exchange of their ideas to achieve the GOB's goal and, eventually, the design objective as a whole. In addition to the **goal** of the discussion GOBs, we identified several other characteristics, including who **initiated** the GOB, what their **intent** was at the beginning, what the **outcome** was, whether one



Figure 7.2: Working activities by workshop

participant held **authority** as the outcome was achieved, and what kind of **speaking style** arose during the GOB amongst the participants.

## 7.3.1 Discussion Goals

We identified seven types of discussion goals that are described below. Figure 7.4 provides the breakdown of each GOB goal by each workshop's GOB count; Figure 7.5 illustrates the composition of each workshop's goal based on its percentage of the workshop's total number of GOB.

**Decide on Strategy.** Throughout the workshop, participants needed to make decisions on how they would approach the design objective. This led to GOBs with the purpose of planning and strategizing how to accomplish the design task. In those GOBs, participants discuss how they should start answering the design objective, if their proposed design pitch needs more details, and declaring the end of the PD activity. For example, in W1, P1DES says to his teammates "*Let's say we have a landing page. Can we start fleshing out what a landing page could probably look like? Let's just assume that we are going ahead with the landing page idea. Can we move forward with that? ... What would the features be? What would it look like and stuff like that, so we don't stall?" In this case, the participants of W1 had been discussing possible features for a while without a clear direction; this* 



Figure 7.3: Working Activities by Stakeholder

GOB is initiated by P1DES not only to settle the main feature of the design pitch but, more specifically, to decide on what the next tasks the team should do next based on the guiding questions (i.e., main features and design) posed by P1DES. P1DES's suggestion was accepted, and the team clearly understood what to do next.

**Organize Logistics.** Participants needed to *organize the logistics* related to collaborating and working together. Once they had already decided what collaboration tools they would use, the discussions that followed were often related to setting up the workspace, how to use the workspace, coordinating activities amongst the participants, how to manage their time, etc. As such, these GOBs explicitly focused on the details of organizing and implementing the logistics to support achieving other tasks, such as following the strategy or performing the working activities. For example, in a GOB in W2 after the participants had been working for a little bit, P2DES instructed P2DEV how to use some Miro features by saying "*if you double click on that shape, you'll be able to - yeah, yeah, exactly, yeah.*" As P2DES was explaining to P2DEV how to perform the action, P2DEV did so successfully; he was able to perform the rest of the actions he wanted to in following GOBs, which he verbally signaled by saying "*OK, something like that*" as he worked in Miro.



Figure 7.4: Goals of discussion GOBs by workshop

**Identify Existing Problems in FLOSS.** Although the focus group discussions were meant to solidify the primary concerns participants would like to solve regarding usability in FLOSS, participants needed to identify further and refine the *existing problems in FLOSS* they wanted to address in their pitch. Some workshops required more discussions to identify existing problems; notably, W1 and W2 had six and three GOBs, respectively, to identify problems, whereas W3 and W4 had one and four GOBs, respectively. An example of such discussion can be seen between P4DES and P4EU in W4; as the participants narrowed down their idea for the design pitch, they decided they wanted to investigate if their idea had already been implemented. As they performed *working activities* of researching, they were discussing to identify the shortcomings in the existing solutions and what was working, what wasn't, and what had room for improvement.

**Ideate Features.** The most common task in the PD activity was *ideating features*. In these GOBs, participants intend to ideate new features, concepts, or ideologies to eventually be implemented in their design pitch. The features participants discussed were not always present in the final submission of their pitch because they were often iterated upon or even removed if the perceived limitations were sufficient. This type of discussion could also occur while participants were working. An example GOB of participants ideating as they



Figure 7.5: Relative workshop composition by task GOB count

were working frequently occurred in W3 where P3DEV was coding or designing and would think of an idea, which he would then share with P3EU to get his opinion; they would have a short discussion and then decide what to do. In this GOB, P3DEV shared with P3EU that he just thought of the idea to not "*expose too many extraneous form[s], only the bare minimum needed to get information across so [the end-users] won't become overwhelmed.*" P3EU responded by agreeing that it's a good idea and added the same justification, but in his own words. The feature is then included in the pitch.

**Discuss Design Limitations.** These GOBs' purpose is to discuss and identify the perceived limitations of any proposed ideas, features, and/or the whole design pitch itself. Many of these GOBs' conversations were related to the scope of an idea and whether the proposed concepts were feasible to implement. For example, in W1, in conversation with P1DEV, P1EU brought up the fact that "this, [their design idea,] may be a lot for a project to handle. Like you [P1DEV] said earlier, a lot of open-source projects are one guy usually and you can't really expect one person to maintain an open-source project and also maintain a website with a forum. Like I think the most we should really ask for is a static

*site.*" P1DEV responded with his idea on how to handle this perceived limitation, but no solutions were reached.

**Communication Updates.** As the design workshop progressed and participants worked on the design pitch, participants would take time to communicate their updates to each other. Notably, these GOBs included a single participant telling the other participants in the workshop summaries and detailed updates of their work, designs, and actions. Update communications took place in two primary ways: (1) after a long period of independent work, such as in W1, where P1DES spent about 20 minutes designing and wireframing alone (one working GOB) and then spent about 6 minutes over two GOBs to communicate the updates (these GOBs were separated by a few otherGOBs to ideate features further with his teammates and then returned to communicating the updates); and (2) interspersed as participants worked, such as in W4, P4DES and P4EU performed many working activities and jumped back and forth between working separately and working together. As they did so, P4DES would start some GOBs by asking P4EU to explain why he had designed as he did in Figma; this led to P4EU communicating the updates to P4DES about what he designed, how it would work, and his justification for how end-users would interact with the design. This second style of working and communicating updates accounts for the higher number of GOBs in the later two workshops. This is also reflected in the longest duration communicate updates GOB, of all workshops, lasting 4 minutes 12 seconds in W1 (the other *communicate updates* GOB in W1 had a duration of roughly 1 minute 30 seconds), while in W4, all the communicate updates GOBs except for two were under 45 seconds, with the two longest lasting roughly 3 minutes and 1 minute<sup>1</sup>, while the shortest was about 8 seconds.

**Sharing Knowledge.** This last goal occurred when a GOB's main purpose was a participant seeking information from or providing information to another participant. Because knowledge gaps and knowledge sharing were embedded throughout the PD activities, many GOBs had elements of sharing knowledge that were used to achieve a different goal but were not the main purpose of that GOB; due to this, GOBs were only identified as *sharing knowledge* if it was the sole purpose. An example of this occurred in W2 when P2DES and

<sup>&</sup>lt;sup>1</sup>The 3-minute *communicate updates* GOB was longer than the rest of these goals' GOBs because P3DEV introduced a new tool (Mozilla Sea Monkey Browser), and spent time explaining his actions to P3EU regarding the tool.

| Initial Intent        | GOB Count |  |
|-----------------------|-----------|--|
| Acknowledgment        | 17        |  |
| Checking-in           | 17        |  |
| Inviting to Work      | 4         |  |
| Seeking Approval      | 4         |  |
| Seeking Clarification | 21        |  |
| Sharing Work          | 25        |  |
| Suggesting            | 62        |  |
| Thinking Out Loud     | 44        |  |

Table 7.3: Initial Intent Total GOB Count

P2DEV were ideating features surrounding alternative ways for end-users to submit issues, but P2DES deviated from the *ideate features* GOB to start a new GOB to *share knowledge*. This was characterized by an abrupt change in the sentence of the earlier GOB to begin the new GOB when P2DES said "*I'm straight away, my mind kind of goes to something between a GitHub issue tracker and a - have you heard of Loom*?" P2DES then continued the new GOB to share what Loom is (a screen recording tool allowing comments on the videos at specified timestamps) so that P2DEV had sufficient information. P2DEV concluded the *sharing knowledge* GOB by verbally indicating this understanding ("*mh-hmm*"). This was followed up by P2DES transitioning back to the earlier GOB when he asked himself "*Why was I saying that? I was that - yes, because - so we've discussed* ..." and resituates himself and P2DEV on the previous task at hand. A deeper analysis of how knowledge sharing occurs and how it affects the GOB and the power dynamics between participants is discussed in Chapter 8.

# 7.3.2 Initial intent

The beginning of a GOB has an initiator who speaks first, and what they say is categorized into a specific type of initial intent; this intent may be directly related to the goal. We group the intent a participant has to begin a GOB into the following eight themes. See Table 7.3 for a total breakdown of initial intents.

**Suggestion.** The initiator begins by suggesting a new idea, a concept, a plan, etc.; a suggestion is a structured, coherent, and formulated intent. For example, in a W2 GOB to

ideate features, P2DEV started the GOB by suggesting the following new communication feature for the pitch: "I guess when the issue gets categorized as a usability problem, that's when we really bring in David, huh? And then we start having a conversation among the three of them."

**Acknowledgement.** An initiator begins the GOB by making an acknowledgment on the actions they performed, actions a teammate performed, or the overall state of the pitch. For example, in W1, P1DES began a GOB when he acknowledged P1DEV's actions to organize stakeholders' needs in the Miro workspace by saying "*OK. Thank you for these notes, it is really helping.*"

**Thinking Out Loud.** An initiator can start a GOB by thinking out loud; thinking out loud is characterized by a lack of clear structure or coherent thought and some examples include long, run-on sentences, frequent pauses, and/or a stream of conscious thought as they figure out what to do or as they work. For example, in W2, P2DES initiated a GOB to ideate features in the middle of a larger working GOB. P2DES said, "*My - this is a ... sort of like ... this isn't a super-super major question but I ... looking back at [the end-user persona] ... umm ... and I mean, this isn't an important question to ... this isn't important, but it does help, it [will] sort of lubricate the-the-the process if [the end-user] sort of understands?"* 

**Sharing Work.** The initiator can also begin a GOB by sharing their work; this includes any explanations or making sure another participant has seen the work the initiator has done. For example, in W3, P3DEV designed a feature to limit potential trolling in the pitch without discussing the feature with P3EU, first. After writing it down in the Google Document, P3DEV shared his work with P3EU by reading out loud the sentence he wrote to P3EU to make sure P3EU saw the idea, discuss it more, and achieve the goal of the GOB to ideate this feature further. Specifically, P3DEV initiated the GOB by sharing the following statement from their pitch aloud, "*CAPTCHA implementation may be needed*." (This sentence can be found in the participants' pitch, under "Why Decisions Were Made" heading.)

**Checking-in.** Next, an initiator can start a GOB by checking-in with their teammates to make sure everyone has the same understanding in regards to accomplishing the de-

sign objective. For example, in W2, a GOB to decide on strategy occurred within a larger GOB to identify existing problems in FLOSS. P2DES was discussing how potential endusers would report and categorize usability issues when he paused to check-in to see what P2DEV thought about their strategy after P2DEV had been quiet for a few GOBs. P2DES checked-in by asking P2DEV the following: "*Are we - is this helpful? Are we ... should we change tactics? Should we change direction?*"

**Seeking Clarification.** An initiator can also have the initial intent to seek clarification from a teammate who typically holds the authority for that specific GOB. This intent is frequently in the form of a participant seeking help or looking for more information to accomplish the goal. For example, in W4, P4DES and P4EU had been designing in Figma when P4DES interrupted the working GOB with a discussion GOB when he asked P4EU, "*What are you trying to do here with these rectangles?*"; P4EU responded by explaining his intention with the design and communicating the updates he made to P4DES.

**Invitation.** An initiator can start a GOB by inviting their teammate to work. For example, after a short working GOB in W2, P2DES initiated a new GOB when he invited P2DEV to work by saying "*If there's something here, just, you know, just jump in and change things. I'm* ... *I'm just gonna make it up as I go along.*"

**Seeking Approval.** An initiator can seek approval from another teammate. While seeking approval is similar to checking-in, it indicates a difference in power and authority; the latter indicates that the initiator holds authority, while the former indicates the participant from whom the initiator is seeking approval holds the authority. For example, after a few discussion GOBs in which P1DES communicated updates to the other two participants in W1, P1DES then began a new GOB where he asked his teammates "*So … does this resemble what you in mind?*"

Identifying the initial intent of the initiator is critical because it sets the tone for the rest of the workshop and provides a structure to characterize the evolution of intention during the course of the activity. For example, if an end-user started a GOB by seeking clarification from the developer, the end-user treated the developer as an authority source.

In Figure 7.6, a breakdown is provided of initial intents based on the stakeholder who



Figure 7.6: Initial intents initiated by stakeholders

initiated them. All participants initialized GOBs most by making suggestions. Figure 7.7 shows how different types of Discussion GOBs are initialized. Interestingly, we found that participants frequently *thought out loud* and *made suggestions* to start all the GOBs discussion tasks, but especially used these two tactics to start GOBs with the goal of *sharing knowledge, identifying existing problems in FLOSS,* and *discussing design limitations*. Also, while participants often start a GOB aimed for *communicating updates* with the intent of *sharing work*, this initial intent also frequently used to start GOBs aimed to *ideate features* and *organize logistics*.

# 7.3.3 Authority

We have identified that in each GOB, there is a participant who becomes an authority as a credible, knowledgeable, and experienced source on a subject. This was identified by the researchers through either a participant explaining concepts or answering questions in their area of expertise, and acting like a gatekeeper by approving, challenging, vetoing, changing, or questioning proposed ideas from other participants before allowing them to be included in the pitch. An example of this occurred in W4, in one GOB after a period of



Figure 7.7: GOB goals and their initial intents

wireframing, P4DES asked P4EU to clarify an idea P4EU had included in the pitch. P4DES then challenged the idea based on his experiences in working with FLOSS directly and P4EU accepted P4DES's critiques without pushing his idea further. In this GOB, P4DES was identified as the authority. This trait of GOBs follows Huagaard's formalization of authority existing when an actor both considers themselves an authority and their authority is recognized by other actors within the context [25]. In the example with P4DES and P4EU, P4DES acts in a way that indicates his authority and P4EU's consequent actions indicate that P4EU recognizes this authority. Figure 7.8 illustrates the distribution of authority amongst the participants and Figure 7.9 shows the relationship between the authority and the initiator of a GOB.

**Authority: DES.** We found that across the four workshops, the DES held authority in most GOBs, with 91 GOBs in total. An example of a GOBs where the DES held authority occurred in W1 when P1DES communicated updates by sharing their designs. P1DEV and P1EU treated P1DES as an authority within the context of designing; both P1DEV and P1EU were unsure of what next steps they should perform because both lacked experience in designing. Therefore, when P1DES (*initiator*) started sharing their work (*initial intent*) to communicate the updates (*goal*), P1DEV and P1EU paid close attention to P1DES as an authority.



Figure 7.8: Distribution of authority-holding stakeholders in each workshop.

**Authority: DEV.** The DEV held the authority next most with 56 GOBs. An example of DEV holding the authority occurred in W2, where the *goal* was to ideate features that directly dealt with integrating developers. P2DEV came across as confident due to his active discussion and ideation on the topic of his stakeholder group; this, coupled with P2DES's acceptance of P2DEV's ideas, is how P2DEV counted as the authority in this GOBs.

**Authority: EU.** Last, EU participants held the authority for three GOBs. An example of the EU participants holding authority occurred in W4: GOB 22 where the *goal* was to identify existing problems in FLOSS. As P4EU finds an external resource from their search engine results, P4DES asks P4EU for information to inform P4DES's next steps. Because P4EU had access to the resources and P4DES did not (See D-1: Resource Utilization in Chapter 8), P4EU was accepted as the authority on the topic of the external resource, and P4DES's resulting actions were informed by P4EU's answer.

Authority: Shared. Authority was shared between participants in every workshop but occurred most in W4 between P4DES and P4EU as they designed and worked on their



Figure 7.9: Authority GOBs by initiator stakeholder role

pitch. Authority was shared least in W2; an example occurred during a GOB *goal* to ideate features. As P2DEV is thinking out loud and formalizing his thoughts on what the key features should be, P2DES agrees with P2DEV and writes down the ideas and other notes. This is what ultimately leads to shared authority; P2DES's perception of P2DEV and his ideas - accepting P2DEV as an authority - along with P2DES's agency to begin writing the design pitch, are what characterize the shared authority in this GOB. Moreover, the follow-up GOB confirms the shared authority of the aforementioned GOB because the authority passes strictly to P2DES. In this follow-up GOB, P2DEV *initiates* by acknowledging P2DES for notetaking and explicitly says: "thank you for taking the notes ... I'm less skilled with Miro." In this follow-up GOB, P2DEV accepts P2DES as the authority within the context of Miro and designing, highlighting his limitations.



Figure 7.10: Outcome Distributions by Workshop

# 7.3.4 Outcome

The outcome of a GOB is the result as the GOB concludes with the goal either being achieved or abandoned. There are four types of outcomes to a GOB that are described below. Each outcome type is described below; Figure 7.10 shows the distribution of the outcomes across workshops.

**No Outcome.** A GOB had no outcome when the GOB was inconclusive (it is unclear if there is an outcome), nothing was decided on, no actions were executed, or the outcome was one participant indicating they "understand" but there is no lasting effect on the GOB or the pitch. For example, the *sharing knowledge* GOB (described in Section 7.3.2) where P2DES shared information with P2DEV about the tool, Loom, has no outcome. In this GOB, P2DES was actively explaining the tool to P2DEV, who was listening and indicated at the end that he understands by saying "*Mh-hmm*." That is the conclusion of the GOB because the purpose has been reached, P2DEV confirmed that he understands the concept, and P2DES moved on to discussing a different goal - signaling the start of a new GOB. The outcome did not immediately affect the design pitch by any action being made or deciding

to include a new feature. Thus this GOB has no outcome.

**Accept.** A GOB ends in acceptance when one participant's idea, suggestion, or work is accepted by another participant without contributing anything further to the GOB. This signals the goal has been achieved and the GOBconcluded. For example, in W4, P4DES and P4EU were ideating features when P4DES iterated on a proposed idea suggested by P4EU of a roadmap feature from the previous GOB. P4EU had changed his mind about it being a good feature to include in that previous GOB, but in this GOB, P4DES initiated by suggesting "actually, that's not a horrible idea because it would likely inspire them like 'ohh, I want to work on this thing,' but from my experience, roadmaps are super not real healthy." In response, P4EU said "that's fair, that's fair." The GOB goes on as P4DES continued to justify including roadmaps and, ultimately, came to the decision that "It's a good idea" to include the feature. The GOB concluded when P4EU accepts P4DES's argument by saying "Mh-hmm, OK" and the roadmap feature is included in the pitch without any further input from P4EU on the matter.

**Decision.** A GOB ends in a decision when a final choice is actively made together by at least two participants to achieve the goal. For example, in W1, while P1DES was writing the pitch, P1EU and P1DEV discussed ideas for integrating the stakeholders in their landing page pitch. P1EU suggested including "within the directions for each of the three [stakeholder] groups, - like, say users would have links to discuss with designers and with developers, and then designers would likewise have links to discuss..." P1DEV responded by adding "I see where you are going with this, you don't want to segregate, we want to include. You also have to give the individuals the tools that they need. Each of the other [stakeholders] have to have their specific tools to be more inclusive." P1EU concluded the GOB by adding, "Precisely," indicating that both participants have come to this decision together and agreed that their landing page will have this feature. Though P1DES does not participate during this GOB, his design reflects the inclusion of this feature.

Action. A GOB's outcome is an action when an acceptance or decision is executed in one of the following ways. An outcome is an action if, at the conclusion of the workshop, an action is executed that either alters the collaborative workspace state in some manner (i.e., the participant begins writing) or alters the state of a participant's action (i.e., a participant was wireframing at the beginning of the GOB and then goes to search for information

#### 7.4 Summary

|             | Workshop1 | Workshop2 | Workshop3 | Workshop4 |
|-------------|-----------|-----------|-----------|-----------|
| Monologue   | 30        | 18        | 20        | 40        |
| Turn-taking | 22        | 19        | 27        | 18        |

Table 7.4: GOB distribution of Speaking-styles across the workshops.

online after the GOB). For example, in W3, P3DEV spent most of the workshop in working GOBs and often his discussion GOBs acted as a transition between his actions. For example, during one GOB, P3EU initiated the GOB to P3DEV by saying "[1'm] not sure what we should put here in 'why decisions were made' questions" and P3DEV responded with "I can do something about that." P3DEV proceeded to switch from designing the HTML pitch to writing the Google Doc pitch.

## 7.3.5 Speaking Style

The final characteristic of discussion GOBs is their *speaking style*. As participants aim to achieve a goal, a speaking style arises that defines the dynamics between the participants in the GOB. The two types of speaking styles are **turn-taking** and **monologuing**. When the speaking style of a GOB is turn-taking, it indicates that there was at least one back-and-forth exchange between at least two participants. W1 had 22 turn-taking GOBs, W2 had 19 turn-taking GOBs, W3 had 27 turn-taking GOBs, and W4 had 18 turn-taking GOBs.

Monologuing occurs when only one participant spoke in a monologue style for the duration of the GOB. A few GOBs began with a prompted question from one participant to another; this led the answering participant to monologue their answer. W1 had 30 monologue GOBs total, W2 had 18 monologue GOBs, W3 had 20 monologue GOBs, and W4 had 40 monologue GOBs total. A breakdown of the speaking styles in each workshop is in Table 7.4.

# 7.4 Summary

In Chapter 7, we report our findings about the structure of the PD activity. The PD activity can be broken down into incremental goal-oriented blocks (**GOB**) within which partic-

#### 7.4 Summary

ipants collaborate together to achieve the broader workshop design objective. There are two types of tasks - **working** GOBs and **discussion** GOBs. In working GOBs, participants demonstrate a **working style** where they either work together or separately as they each perform **activities**, such as wireframing, writing, researching, programming, observing, etc. In discussion GOBs, each GOB is defined by a **goal** and is initiated by a participant who has an **initial intent**, and the GOB's conversation is characterized by the participants **speaking style** – monologuing or turn-taking – as the participants collaborate and reach an **outcome** for the GOB. The goals define the type of tasks performed during GOBs and they are the following: deciding on strategy, organizing logistics, identifying existing problems in FLOSS, ideating features, discussing design limitations, sharing knowledge, and communicating updates.

This contributes to a formal understanding of how PD occurs in a FLOSS context with respect to the main goals and activities that need to be facilitated and the degree of each stakeholder's participation in achieving them. In particular, our identification of the authority led us to further investigate how an authority arises, other aspects of power between the participants, and its impact on the PD activity and the final pitch. In the next chapter, we report our investigation into these manifestations of power through the lens of the first three dimensions of power from Haugaard's *Four Dimensions of Power* theory [25].

# 8

# **Results: Power Dynamic in Participatory Design**

After analyzing the structure of PD, we investigated the underlying mechanisms through which power manifested in the PD activity. The third research question (RQ3) seeks to answer how participants' behaviors demonstrate power through the lens of the three dimensions of power from Haugaard's interpretation of Lukes' Theory of Power [25]<sup>1</sup>. We focus on how power is present, applied, and/or utilized through the PD activity.

We find that each dimension of power is demonstrated through unique sub-dimensions, and each sub-dimension is exhibited by behaviors that impact the GOB and/or the pitch. Though we report each of the D-1, D-2, and D-3 dimensions of power (and consequent sub-dimensions) individually in this chapter, it is important to note that they exist together in most interactions. This is why we investigated power at a granularity level of a single GOB and each GOB could have any number and any combination of the sub-dimensions present.

There are three important concepts to reiterate: an exercise of power, an episode of power, and potential power. We utilize these concepts, as theorized by Huagaard [25], to frame and discuss the results of power and agency. To start, when a participant *exercises* 

<sup>&</sup>lt;sup>1</sup>Regarding the fourth dimension of power (D-4), while the author of the thesis was a facilitator and not a participant, she was present in the PD activity and the participants were aware of this presence. This can be viewed as a literal representation of the D-4 panopticon and was consistently pervasive throughout the activity. Therefore, we do not analyze the D-4 in **RQ3** but will discuss it in Chapter 9.

*power*, this means they are making a difference in their world through an action (agency) which causes a change that would not have occurred otherwise. An *episode of power* occurs when a participant exercises their power; in other words, an episode occurs when a participant does something that changes the PD activity *and* this change would not have occurred if the participant had not acted. *Potential power* is the capacity that a participant has to act, or the potential for a participant to exercise power, but the participant is not currently acting. In other words, potential power is the capacity of a participant to exercise their power in the future.

In this chapter, we report the sub-dimensions, the behaviors characterizing each dimension that are used by the participants, and how the behaviors affect the PD activities and design pitches. We report how participants achieve the goal of a GOB by defining their potential power and then act by exercising their power through specific behaviors in each of the three dimensions.

# 8.1 D-1: Defining Agency in a GOB

The first dimension of power occurred in the PD activities when participants engaged in episodes of power that demonstrated the extent of their agency to accomplish the goal of the GOB. We identified sources of the participants' agency and ways in which those sources affected the power dynamics between participants. We identify the primary source of agency to be the (1) *resources utilized* to exercise agency in the present. When the resources are unequally balanced, this primarily resulted in (2) *knowledge gaps* between participants which cause power imbalances and directly impacted their agency. We also found that participants (3) shared *past experiences* using a resource to either establish authority or use as a teaching device. An overview of the D-1 results is in Figure 8.1.

#### 8.1.1 Resource Utilization

The first sub-dimension of D-1 occurred when a participant demonstrated agency through *resource utilization* in the present. The potential power of a participant was characterized by the resources they had available to use. When a resource was utilized actively during a GOB, that participant was engaged in an episode of power. In this episode of power,

#### 8.1 D-1: Defining Agency in a GOB



Figure 8.1: Overview of the behaviors and topics of discussion demonstrated by D-1 agency.

their intention was to achieve the goal of the GOB<sup>2</sup>. Their agency to achieve the goal depending on using their resources; these actions, in turn, directly impacted the PD activity. The three types of resources used during the workshop to perform the PD tasks were the workshop artifacts, external documentation, and stakeholder skill sets (developer skills, designer skills, and collaboration tool skills). Below, we describe each resource utilized.

**Workshop Artifacts.** A participant demonstrated their agency to participate in a GOB by using artifacts that were either provided to them (see Workshop Materials in Chapter 4.2) or made by the team during the workshop. Specifically, participants exercised their power to achieve specific GOB *goals* – such as deciding on a strategy, identifying existing problems in FLOSS, and ideating features – in episodes where they used the personas

<sup>&</sup>lt;sup>2</sup>It is important to note, that technically all GOBs have episodes of power because, as the fourth dimension states, power is inescapable. However, some GOBs were too short for us to properly identify all the dimensions at play and, for D-1, we focus on resources utilized.



Figure 8.2: HTML design artifact from W3 at the time of P3EU's episode of power to ideate features using *D*-1:resource utilization.

and the design objective instructions to inform opinions, make decisions, etc. For example, in W2, P2DEV summarized the challenges experienced by the personas so he could identify what problems in FLOSS (*goal*) the team should address in their pitch. Similarly, in some episodes, participants used design artifacts they had created earlier in the PD activity to exercise power and achieve the goals, such as ideating features, deciding on the strategy, performing working activities, and communicating updates. For example, in W1, after P1DES finished designing the wireframes, he communicated the updates to P1DEV and P1EU. To help him communicate the updates to his teammates successfully, he relied on the initial problems identified by the teammates at the start of the PD activity (these were in sticky note format in Miro, See Appendix E.1). By doing so, he clearly indicated to his teammates why he made the decisions he made. After, he organized the sticky notes into problems the pitch addressed and problems the pitch didn't. He concludes his updates by adding "So I feel these are the only questions and problem statements we've not really [addressed]."

**External Resources and Documentation.** Another way in which GOBs were influenced by resource allocation occurred in episodes where a participant leveraged public documentation as an exercise of power. The external documentation was obtained by a participant from outside sources and search engines; the documentation provided participants with the agency to accomplish GOB goals. For example, in W4, after P4EU and P4DEV decide to identify the problem they want to address, P4DES suggested they should research whether solutions already connect potential contributors to open-source projects and/or instruct how to grow an inclusive FLOSS community. The following GOB consisted of both participants researching to see if any solutions already exist. When P4DES begins to look at a website designed to help businesses connect with and hire professionals (programmers, designers, customer support, etc.) found by P4EU, he remarks that the solutions are more in a "commercial sense," P4EU agrees "it's very commerce heavy" and P4DES asks P4EU if he "can find open-source projects there?" P4EU responds by saying "I don't know if you can filter by open-source." P4DES is satisfied by P4EU's answer, counting him as an authority of that resource. In this example, P4EU demonstrated active agency in the search for resources (existing FLOSS solutions) and making informed decisions about them that affect the direction of their pitch. Following this GOB, the two participants continue their search.

**Skill Set.** The last resource utilized during the PD activity was skill sets. Specifically, there were three skill sets leveraged to accomplish PD GOB goals: development skills, collaboration tool skills, and design skills. The participants' agency to achieve the goals was influenced by the degree to which they possessed the relevant skill set. Each skill set is explained below.

(1) Development Skills. The potential degree to which participants could exercise their power in a GOB frequently depended on their development skills. These skills largely revolved around the possession of different types of technology and software development knowledge before the start of the workshop; some examples include conversations that required prerequisite knowledge on technical terminology and subjects such as privacy technology, cloud infrastructure, and git practices. Participants demonstrated their agency to discuss these subjects or perform related working activities in episodes where they drew from their developer-specific skills to accomplish tasks. The degree to which they could accomplish the task depended on their developer-specific skills. When a participant possessed insufficient development skills to draw from, this was reflected in one of two types of episodes: either (a) the participant was not able to exercise power at all (i.e., no agency and did not participate), leading to the other participant to have power over the GOB or (b) the participant exercised their power in a GOB in a way that stemmed from their direct lack of developer skills, often which led to a different perspective. For example, P3EU

suggested a feature to include non-developers in their feedback form's drop-down field for users to assign themselves a role. P3DEV had made a few key design decisions for the pitch that prioritized a traditional developer-centric perspective up to this point. This episode between P3EU and P3DEV illustrates how this feature would have been ignored if P3EU could not exercise the power stemming from his identity as a non-technical end-user and his unique capacity to act.

(2) Workshop Collaboration Tool Skills. Participants also exercised power by using the workshop collaboration tools. In these episodes, the participants' agency was directly associated with the availability of the collaboration tools at their disposal and their capacity to use those collaboration tools during the PD activity. An example happened in W1 when P1DEV experimented with Miro for the first time, thus gaining experience, skills, and comfort using the tool. While this episode is not an exercise of P1DEV's power over someone else or his power to perform an action that makes a lasting change in their pitch, it does demonstrate how P1DEV is gaining new potential power to act in the future. Another example occurred in W3 where P3DEV used a local HTML editor to create the pitch for the duration of the PD activity. In doing so, P3DEV exercised control over the collaboration tool and, to a certain degree, over the HTML prototype itself.

(3) Design Skills. Last, participants exercised power by utilizing UI/UX design skills. Similar to developer skills, participants' agency to participate in the PD activity was influenced by the skills they held before the start of the workshop. Some participants, mostly the DES participants, were able to accomplish goals by drawing from their design skills to ideate, design, or strategize; in doing so, they guided the design process, while other participants' lack of design skills prohibited them from participating to the same degree in the design process. For example, in W1, an episode occurred in a GOB when P1EU struggled to discuss design limitations facing their pitch. As P1EU and P1DEV discussed the limitations present if they were to implement the design in real life and what they could do to fix the limitations, P1EU said he was too focused on the small details and that he thinks he "*may have gotten a little lost in the weeds.*" P1EU continued that he couldn't quite figure out the next steps the team should take to recover from these identified problems. However, prior to this GOB, P1DES had been consistently designing and incorporating all the ideas suggested by P1EU and P1DEV as the discussion GOBs ensued (including the one being

discussed in this episode). Contrary to P1EU's experience, in W2, P2DES began the PD activity (the first GOB of the PD activity) by immediately copying over the instructions and personas to set up the Miro space for the two participants to work; P2DES said, "*the first thing I always do in these kind of cases is any sort of … indication of what we need to do, I will put it up on the same set of white board so we can reference back to it.*" The first example illustrated how P1EU's skill set leads to an episode where his lack of pre-existing design skills affected his agency to work towards the design objective, while P2DES's skill set enabled him to immediately demonstrate his agency to lead the workshop with a clear plan of action and establish the strategy.

## 8.1.2 Knowledge Gap

The second sub-dimension for D-1 occurs when one participant exhibits a gap in knowledge compared to another participant. An episode of power due to knowledge gap demonstrates an unequal distribution of resources between two or more participants – specifically knowl-edge stemming from the *D-1: resource utilization* of skill set. This unequal distribution of knowledge is one factor that leads to an episode where one participant exercises power over another participant to achieve the GOB goal and/or exercises their power to achieve the GOB goal independently. While the *D-1: resource utilization* of skills focuses on the use of resources in real-time during the GOB, *D-1: knowledge gap* adds an additional layer where these skills are specifically used in a manner that highlights not only the presence or absence of such a skill, but also the unequal distribution of knowledge and skills leading to the power imbalance between two or more participants.

The exercise of power through D-1: knowledge gap occurs by a participant exhibiting one of the following three types of behaviors: (1) the participant is not an authority on the subject and does nothing to obtain the missing information from the authority (demonstrating a lack of power to exert agency); (2) the participant is not an authority on the subject and seeks to obtain the missing information from the authority (demonstrating power to exert agency); and, (3) the participant is an authority on the subject and shares, teaches, provides information to a participant who is not an authority (demonstrating power over another's potential agency). Below, each behavior of the D-1: knowledge gap is explained in terms of what a participant does to exercise their power and how this demonstrates their degree of agency.

1 Doing nothing to obtain missing information. A participant does nothing despite lacking information; in this situation, participants experience barriers to achieving the GOB's goal because they lack the necessary information and skills, which to a reduced capacity to act - and did not exercise their power to obtain it from the participant they perceive as the authority. In episodes of power where a participant exhibits missing information, this person knows that other participants may be more knowledgeable and therefore an authority on the matter; however, they do not exercise their power to obtain the missing information. As a result, their participation becomes limited and, therefore, limits their potential power to achieve the GOB goal. Some examples include episodes where a participant acknowledges they don't have a solution to achieve the goal because they are not a specific stakeholder type, a participant makes a suggestion to achieve the goal but second-guess their solution because they don't know enough about the topic and convey as much to their teammates, and a participant asks a teammate to perform the task that achieves the goal instead of attempting to achieve it themselves.

An example episode of power where a participant has limitations on their capacity to act occurs in W1 after P1DES concluded communicating his updates to P1DEV and P1EU; P1EU followed up by acknowledging to P1DES how P1DES's design likely solves the identified problem related to including designers and then suggested an additional idea, using hesitant language. At the end of his suggestion, P1EU concluded by saying his suggestion "*might make it pretty easy to work their contributions into [a project]* ... *maybe*." This episode illustrates how P1EU lacked the capacity to utilize designer skills and, though P1EU demonstrated his agency to suggest an idea, he does so hesitantly and qualifies his suggestion by adding on "*maybe*" at the end, exhibited potential signs of lack of confidence.

2 **Obtaining information.** A participant performs obtaining information when, in an episode of power, they demonstrate their power to obtain the necessary information so that their overall capacity to act is increased (i.e., they now have a greater capacity to act due to an increase in knowledge resources). When a participant performs this behavior, they often explicitly seek to obtain the missing information from a partic-

ipant who they count as an authority within the context of the GOB goal and topic being discussed. For example, in an episode of power within a W2 GOB, P2DEV, who had limited prior knowledge of usability concepts before the workshop, and consequently had limited potential to act, counted P2DES as an authority on usability up to this point in the PD activity. In this GOB, P2DEV initiated by asking P2DES to clarify if "*categoriz[ing] the issue as usability problem or not[, means] we accept this as a thing for us to work on or .. or not, right? Or is it different from that?*" By asking for P2DES to clarify the topic of categorizing usability issues, P2DEV simultaneously demonstrated how he continued to count P2DES as the authority on this topic in addition to exercising his own agency to obtain more information. P2DEV's behavior in asking for more information afforded him the opportunity to be more informed on the concept, which increased his capacity moving forward to act and make decisions on the topic of categorizing usability issues moving forward.

3 Sharing information. In certain episodes of power, a participant who is an authority on a subject in that they have a superior capacity to act and possess more information resources than another participant, may exercise their power to share or teach information to another participant. When a participant exhibits this behavior, there is another component present: the participant exercises an authoritative power over the other participant about the topic they are teaching, causing the other participants, who accept them as an authority, to react accordingly. For example, in W3, an episode of power occurs where the GOB's goal was to communicate updates, and while doing so, P3DEV used his power to explain technical concepts to P3EU, unprompted, related to programming HTML and how front-end versus back-end development works so that P3DEV's actions could be understood. In doing so, P3DEV demonstrated his authoritative power over P3EU and P3EU accepted this authority and reacted by using the information to accept P3DEV's work and the state of the pitch.

The participants exhibit the above-mentioned behaviors to execute power when they are conversing on a specific topic in a discussion-GOB. We identified five types of topics that are described below.

**Stakeholder Perspectives.** Participants exhibited behaviors exercising power related to the knowledge gap when they discussed stakeholder perspectives related to experiences,

knowledge, vocabulary, and/or skill. For example, an episode of power where the participant's behavior was missing information but didn't seek to obtain it occurred in W1; in this GOB, the goal was to ideate features. P1EU initiated the GOB by suggesting an idea; after suggesting the idea, P1EU then said, "I'm not a developer, I don't have a clue what I'm saving" - exhibiting a lack of power to achieve the goal while demonstrating some selfcensorship and acknowledging their limited capacity to act in this context. Consequently, this restricted their authority. However, P1EU did not ask P1DEV to share his insights on the matter. Another example arises in a later W1 GOB when P1EU discussed some design limitations of their concept as it related to his perceptions of developer behavior. At the end of sharing his concerns, P1EU said he did not know how the concern could ultimately be addressed and did not ask for more information, exhibiting the first type of behavior. However, at this stage, P1DEV does decide to step in to assuage P1EU's concerns by sharing information about his developer stakeholder group; together, P1DEV and P1EU decide to resolve the concern based on P1DEV's developer perspective. This illustrates two types of knowledge gap behaviors: (1) P1EU is missing information about the perceived design limitations but restricts himself based on his capacity to be an authority on the developer experience, and (2) P1DEV exercises his power to share information on that experience so that the limitations can be addressed based on personal perspectives. Here P1DEV's power to share their knowledge and achieve the GOB's goal is compounded with his authoritative power over P1EU. Because P1DEV was considered an authority in this GOB's context, P1DEV had the power to control how the knowledge was disseminated and, ultimately, the final decision at the outcome of the GOB.

**Communication Concepts.** Participants also exhibited knowledge gap behaviors when discussing communication in FLOSS, specifically regarding communication channels. While most episodes about communication channels occurred referencing past experiences (see section 8.1.3), an example did occur in W1 when the team was identifying existing problems in FLOSS related to communication challenges and P1EU acknowledged that he hadn't used Discord or Slack much. In this episode of power, first, P1EU asked P1DEV about the search features on both channels in order to contribute more meaningfully in the GOB and second, P1DEV shared information about communication channels. P1EU treated P1DEV as the authority from whom P1EU could improve his capacity to act; in the

end, P1EU reacted to P1DEV's authoritative power-over him and made a suggestion based on P1DEV's answer.

Technical Concepts. Participants exhibited behaviors related to the knowledge gap when they discussed about technical concepts necessary to accomplish the design task, such as skills to perform actions, ideas on technical features, and knowledge about the implementation and feasibility of the pitch. For example, in two GOBs of W1, participants were discussing technical concepts when episodes arose related to the knowledge gap. Particularly, P1EU demonstrated their limited capacity to act due to a lack of developer skills and specific technical knowledge in both GOBs. However, in one GOB, P1EU specifically asks P1DEV for more information (in this case, how to implement user forums), while in another GOB, P1EU's behavior exhibited his missing information and no actions to obtain it, thus maintaining a limited capacity to act on the topic moving forward. Particularly in the second GOB, P1EU suggested an idea about software repositories but lacked background knowledge on the topic; he ended the GOB by saying "This could be a terrible idea, I'm not very familiar with the structures of repositories like this." In this example, although P1EU demonstrated the power to ideate ideas, he appeared less confident in his ideas. Despite clearly indicating his lack of knowledge through language that suggested he felt his idea could be inferior, he does not attempt to gain further information from the authority.

**Usability Concepts.** Participants also exhibited behaviors related to the knowledge gap in discussions about usability concepts, specifically as they ideated features to accomplish the design objective. Some examples of usability concepts include episodes of power where participants made design decisions and discussed the fundamental usability concepts, such as what usability issues are and how to classify them. For example, in W2, P2DES and P2EU were working to identify existing problems in FLOSS when P2DES took it upon himself to explain to P2DEV the nuance of usability issues, a concept initially introduced in the personas (such as a formal definition of what counts as a usability issue, what doesn't count as a usability issue, and examples). In this GOB, P2DES was not prompted to teach, share, or explain any concepts, but did so regardless, indicating his agency to share the usability information as the authority on the subject and causing him to have power over how the usability information is disseminated to P2DEV.

PD Tools and Decisions. The final subject in which knowledge gaps behaviors arose

was in discussions about specific collaboration tools used and design decisions made in the PD activity. For collaboration tools, participants exhibited behaviors related to the knowledge gap when they discussed the use of the collaboration tools. In terms of workshop decisions, participants exhibited behaviors related to the knowledge gap when the discussions ensued on what the design decisions are, why they were made, and how they should be documented. For example, in W3, P3EU and P3DEV were working to organize logistics of the PD activity; P3DEV exhibited the information-sharing behavior in two separate episodes of power to achieve the goal for one GOB. First, as P3DEV set up the PD workspace, he shared information about his actions with P3EU; second, P3DEV informed P3EU about what the Sea Monkey Browser HTML tool is. In this GOB, P3DEV's first episode illustrated his power to inform P3EU about the decisions P3DEV made regarding the Sea Monkey Browser HTML editor tool and why it was chosen, while P3DEV's second episode demonstrates his power to share the information about the tool and his power over P3EU to up the tool.

#### 8.1.3 D-1: Past Experience

The last sub-dimension for D-1 appears when a participant's behavior references a past experience as a resource on its own. Specifically, when participants draw on experiences using *D-1: resources utilization* from the past with the intent to achieve the goal of the GOB, they are exercising their power in an episode while also formally establishing their potential agency on that subject. As such, the participant's behavior related to past experiences establishes the participant as an authority on the subject. Participants demonstrate *D-1: past experiences* behavior by explicitly referring to an experience in the past, signaled through the use of a variation of the phrase "*in the past*", "*I've used [X] before*", or "*we did [x] in the past*". A participant's behavior to rely on past resources is used in one of three ways as participants are engaged in discussion GOBs. The three ways in which past experience behaviors are wielded may exist in an episode on their own or intertwined as the participant demonstrates past experience behavior in the exactly the same way that they utilized a *D-1* resource in the present. To clarify, the participant exercises their power to achieve the goal in the present by utilizing the past. For example, in W3, P3DEV

was explaining to P3EU that his HTML feedback form pitch at the time of the GOB and explained that "*[the form] might be more in the style of some 'contact-us' forms that I've seen across some websites.*" This illustrated that P3DEV used his past experience with contact-us forms to guide his early ideation stages and ultimately to exercise his power to make design decisions.

Using the past to establish authority. A participant's past experience serves as a mechanism (either intentionally or consequentially) to establish their credibility and trustworthiness when the participant asserts themselves as an authority on a subject. For example, in W1, P1DES suggested implementing a weekly synchronous meeting in their design pitch. P1EU, however, was doubtful and suggested that he doesn't "know if an opensource project could implement a weekly meeting like that, it would be great if they could [though]." In response, P1DES justified his claim, and consequently his credibility on the subject, by sharing his experience. P1DES explained "Yeah, [my FLOSS company] does it well. They've done this thing where there's a calendar so the meetings have been planned out to be recurring. So if you're a new contributor, [all] you need to do is just add the calendar to whatever calendar you're using and it reminds you [beforehand]." However, there was no outcome to this conversation due to P1DES experiencing a temporary internet issue and the other participants switched the conversation to ask if they had lost him from the call. When P1DES returned, the conversation turned towards logistics and then communicating updates. Despite this, before P1DES lost connection, P1DES's behavior illustrated how he exercised his power to argue for the inclusion of an idea he suggested – in the present – by establishing credibility for his idea from his past experiences.

Using the past as a teaching aid. The final way a participant's behavior used their exercise of power in the past to achieve a goal in the present occurred when they wanted to share information in a *D-1: knowledge gap* episode of power. When participants used their behavior in this manner, it allowed them to confirm their authority on the subject by reiterating their potential power through personal examples in addition to allowing the personal examples to act as a teaching aid to help the participant with authority exercise their power to share their knowledge. For example, in W1, P1DEV discussed identifying design limitations related to maintaining documentation in a project when P1EU asked if "anybody happen[s] to have examples of good open-source documentation off the top of

their head?" Before P1EU's question, P1DEV had been talking more hypothetically about maintaining documentation (i.e., "so, so you know you ... you release a version of software and you've got great documentation. Then you make some breaking changes to it and documentation doesn't get updated ... "). To answer P1EU's question, P1DEV exhibited the sharing information behavior related to the knowledge gap (section 8.1.2) by saying "well, the project that I'm working on has a whole separate repo just to do the documentation. It's fairly extensive, but that - that is the problem that we've run into where the documentation doesn't always match the software there, so you know ... [the documentation] doesn't have as high a priority as the software itself." P1EU responded by verbally confirming that he understood by saying "Mhh-hmm;" however, no outcome was reached during this GOB. While P1DEV exercised his power to share the information with P1EU through sharing his experiences, it is possible that P1DEV's power over how the information was taught to P1EU (in that it was presented as a problem that experienced professionals have yet to fix) led to the design pitch not suggesting solutions to documentation challenges – despite all the participants in W1 discussing the gravity of such an issue in a project throughout all stages of the workshop.

# 8.2 D-2: Methods of Structuration

While D-1 contextualizes *how* the participants' agency was actualized to achieve their design goals, the next dimension of power reports our observations on the participants' behaviors that led to changes in FLOSS's social norms. To investigate the extent to which the participants considered and ultimately decided on changes to these norms, we analyzed the discussion GOBs based on the second dimension of power (D-2). D-2 refers to the process of structuration; structuration defines how people's decisions continually accept the existing status quo and cyclically rebuild the social structures (i.e., structuration) in place – this is called the reproduction of structures. There are two components in D-2 that are essential to the process of structuration: *confirm-structuration* occurs when an episode of power reproduces the existing social structures and confirms the status quo, while *de-structuration* does not reproduce the existing social structures and the status quo is either challenged or changed.

Following the same premise as D-1, each GOB can have zero to many episodes of



Figure 8.3: Overview of D-2 results.

power comprising it as the participants work to achieve the GOB's goal. Once the participants in an episode exercise their power, there is some resulting outcome to the GOB itself or the design pitch as a whole. In practice, D-1 and D-2 do not exist independently in an episode but rather happen congruently (it is also possible for an episode to have behaviors that de-structure and confirm-structure different parts of FLOSS social structures). However, for clarity, we report and analyze them separately. An overview of our results for D-2 can be seen in Figure 8.3.

**Confirm-structuration behavior.** When participants discussed ideas or made suggestions and decisions that were confined by their perception of what "should" happen because of the status quo in FLOSS (such as ideas that fall into the usability challenges – RQ1 – pitfalls they identified in the Focus Group), then this episode of power resulted in a confirm-structuration. For example, in W1, P1EU and P1DEV were discussing the design limitations of their final design. P1EU raised the following concern: "*My only worry, I guess, regarding developers is that they would probably default to going to GitHub rather than this landing page … I guess it would be pretty easy to link this page in the ReadMe, um, so if they needed information from this … I would hope that [the landing page fea-*
# 8.2 D-2: Methods of Structuration

tures] could be synched with the repository, but I do not know how that could be done." In response, P1DEV said, "well, it could be done. You could build in web hooks or something that, when somebody submits something in some other areas of [the landing page], it ties to an update [in] the GitHub repository, so that is pretty doable. It would [require some effort] on how you would do it, but it is definitely doable." P2EU concluded the GOB by saying "that resolves the concern then" and the episode of power resulted in a solution that would allow developers to remain on GitHub. To clarify, in this GOB, the outcome of the decision is to solve the design limitation by providing developers with a mechanism that allows the continued separation of developers from the other stakeholders. This separation of stakeholders was identified by all three participants as a key challenge in FLOSS, but despite this, the discussions and the decision of this GOB confirmed the status quo of stakeholder separation.

De-structuration behavior. On the other hand, when participants' suggestions, discussions, and decisions actively went outside of boundaries set by the status quo of FLOSS, the episode's outcome reflected this breaking from the norm as a de-structuring of those FLOSS-related norms. In W2, an episode of power transpired, which exemplified participants making decisions that change the status quo, also related to stakeholder inclusion. P2DEV initiated the GOB to ideate features related to when to include which stakeholders; P2DEV suggested the following idea: "I guess when the issue gets categorized as a usability problem, that's when we really bring in [the developer]. And then we start having a conversation among the three of them ... or do you think it's still a two-person conversation at that point?" After considering this suggestion and his follow-up question, P2DES said "I - yeah - no, no, you're right. Because I'm kind of falling into my own thing that I complain about designers where they don't involve the developers until the very end." P2DES then returned to the persona documents to revisit the identified usability concerns before finally making a decision and saying to P2DEV that "if [the developer] wants to be able to advocate for usability changes, then he needs to be involved earlier on .. so, you're right." P2DEV concluded the GOB by agreeing with P2DES's decision and P2DEV added on that this solution will allow the developer to discuss the usability issue after the designer has already "phrased [it] more concretely, hopefully in a way that [the developer], you know, can understand a bit better and more clearly." This episode's conclusion features a decision that was made to directly challenge the norm for developers not to be involved in usability discussions – as such, this episode de-structures these aspects of FLOSS's status quo.

As participants in the workshops discussed ideas, made suggestions, and made decisions that either stuck to the status quo of FLOSS or changed it, we observed that the social structures in question were related to specific topics. Therefore, the nature of the behavior demonstrated by the participants was confirmed within or changed related to one of those specific topics of social structures. Participants discussed ideas and made suggestions and decisions that demonstrated either two methods of D-2 when they (1) discussed aspects of communication in FLOSS, (2) discussed features in the pitch, (3) discussed stakeholder inclusion, and (4) performed methods of collaboration that confirmed or changed the structures of FLOSS collaboration. Identifying whether the decision was confirming the structures related to status quo of FLOSS or changing them was based on the baselines established both in prior research and the results of RQ1 (Chapter 6). Each topic is described below.

# 8.2.1 Communication

During the workshops, we observed that a participant, regardless of their roles, may destructure or confirm the structures dictating the existing FLOSS communication norms. In terms of communication-related confirm structuration, participants were sometimes confined within or confirmed the existing structure of how communication "should" occur in FLOSS. For example, in a GOB in W1, the participants aimed to identify existing problems in FLOSS. As P1DEV thought out loud about the limitations of existing communication channels (specifically Discord), P1EU suggested a potential solution could be implementing a user forum. User forums are a widely used practice in FLOSS (i.e., the status quo); despite previously claiming he did not like the hostility of forums during the Focus Group, P1EU still suggested this as a solution. This suggestion, though ultimately not included in the final wireframe for W1, was accepted at the end of the GOB and demonstrates how P1EU confirmed existing structures related to communication channels. Additionally, in many GOBs, participants also confirmed the structures related to the type of feedback that is commonly accepted in FLOSS (i.e., bug reports instead of usability issues). For example, in W3, participant P3DEV was working on and ideating features for the HTML form. In one GOB, he created a drop-down field for a person to specify the type of issue they are reporting in the form. P3DEV only specifies "*feature request, bug report, and other*" as possible options. P3DEV's decision to only include these three options for the feedback form confirmed the FLOSS norms to ignore usability issues.

In terms of changing the status quo, the ways in which communication was de-structured occurred when participants proposed and discussed ideas that deviated from the current FLOSS communication norms, often aimed at achieving synchronous, accessible, and/or inclusive communication. Continuing the previous example in W1, P1DEV and P1EU continued the conversation about the limitations posed by existing communication channels and how these limitations result in a lack of stakeholder integration when communicating. In a later GOB, P1DES joined the conversation by suggesting a new idea to improve stakeholder integration and communication through the use of synchronous video calls. P1DES's behavior and the resulting idea from this episode challenged the status quo of FLOSS communication as only asynchronous.

# 8.2.2 Technical Priority

During the workshop, a participant could either confirm-structure or de-structure the existing FLOSS social structures that prioritize technical features, functionality, and developer needs over usability. In terms of confirming technical priority norms, participants suggested or discussed ideas and made decisions that were confined by the norms prioritizing the inclusion of technical features, developer needs, and resource constraints due to the participants' perception of what "should" be prioritized in FLOSS or what is "possible" to implement. For example, in W1, a GOB occurred where P1EU was ideating features for the pitch. The GOB began when P1EU suggested that the "*landing page could act as a front end for GitHub.*" While this statement illustrates a suggestion for making GitHub easier to use (which is inherently de-structuring developer tools), it also demonstrates how the overall idea being discussed by the participants (not only P1EU) was still centered around GitHub at this time. In other words, keeping GitHub/git repositories at the core of FLOSS which confirms the norms that FLOSS activity must cater to developers and their tools rather than bringing the developers to other tools. Following this, P1EU continued to discuss ways this GitHub front-end feature could be implemented but concluded his suggestions when he shared an argument for not implementing his idea. P1EU's reservations about the idea stemmed from the perceived effort and resources it would require to implement, despite the hypothetical nature of the PD activity (conforming to the resource constraint mindset that defines FLOSS). In response to P1EU's suggestions and reservations, P1DEV stepped in and said in response "but there are more and more tools that allow you to link stuff like that. For example, there is a tool called Kitemaker that is a Kanboard tool and allows you to automatically ad GitHub issues into the backlog." P1DEV also continues by adding that to do so requires set-up and he finished by discussing how "you" would want to restrict who has access to this board and provide an export of the backlog. P1DEV's discussions and suggestions illustrate confirming structures related to resource constraints (raising the issue of set-up), assuming technical familiarity (i.e., terminology such as backlogs), and suggesting features such as Kanboards and backlogs which are common in agile and software development project management and likely require a certain degree of developer and technical knowledge. On this last point, P1EU did, in fact, have to say to P1DEV "I'm not quite sure I follow ... " after P1DEV's discussions on Kitemaker, Kanboards, and backlogs, further illustrating how the reliance on these more technical solutions confirms structures of FLOSS focusing on technical priority.

Alternatively, episodes of power that result in de-structuring the FLOSS norms of prioritizing technical needs occurred when a participant made decisions or suggested an idea that was intentionally moving the pitch away from these structures, such as not requiring technical skills, or in episodes where the participants adopted an ideation-focused mindset. In terms of ideating non-technical features in the design pitch, when participants made explicit suggestions or decisions to move away from developer tools (e.g., git, GitHub, IRC, code, etc.), they chose not to prioritize technical needs over usability-based needs (destructuring). For example, also in W1, in a GOB P1DES where he explained why he made his design decisions to P1DEV and P1DES, he stated that the major barrier he designed around was "[FLOSS] projects being only on GitHub" and the reality that "at the end of the day, still not every user can use GitHub." P1DES further explains how he decided to move the design pitch away from GitHub and any code because it can 'make people feel like 'woah, how can I interact with that.'" Thus, P1DES de-structured the norm that technical skills are traditionally required to become involved in FLOSS while trying to preserve other important information (such as the contributors). In terms of an ideation-focused mindset, participants decided to change the social structures of FLOSS by including ideas that can help focus on usability regardless of the resources required to implement them in real life. This is demonstrated, again, in a GOB in W1 when after P1DES finished sharing his work and communicating the design decisions to his teammates when he acknowledged that "*[the design] is really big [...] because I'm trying to factor in all of these personas.*" This episode in the GOB illustrates how P2DES did not limit his ideation or design despite the scale of the proposed pitch and the resources that would be required to implement it. P1DES still created a "big" design pitch by adopting an ideation-focused mindset instead of the normal FLOSS mindset of focusing on resources constraints.

# 8.2.3 Stakeholder Inclusion

We also observed participants make decisions that confirm-structured or de-structured FLO-SS norms related to the inclusion of multiple stakeholders in the entire FLOSS process. In terms of confirming the norms related to stakeholder inclusion in the FLOSS process, a participant discussed, made suggestions, or made decisions not to include all stakeholders in the design pitch. For example, in W3, as the PD activity progressed, the design decisions made (primarily by P3DEV) did not build a dedicated role for designers in their pitch pipeline to act as an in-between role for users and developers. In one GOB, P3DEV communicated to P3EU a design decision P3DEV made to the pitch that "the burden of any work [to address issues] is shifted to developers and anyone else directly involved" so that "[the end-users] hardly have to do any work. While no guarantees can be made that anything can be acted on, at least it will be likely read and responded to." P3EU accepted this idea by saying "that's OK" and the GOB concluded. This decision is listed as a key feature in the written pitch. P3DEV's decision to design the form so the burden is on the "developers and anyone else directly involved" and not specifically include designers or end-users in the discussion to address possible usability solutions is a direct confirmation of the status quo in FLOSS where end-users submit usability issues, developers struggle to address it, and designers – though they can help – are often not supported in the FLOSS process and pipeline.

# 8.2 D-2: Methods of Structuration

In terms of changing the status quo, the participants' pitch de-structured the norms related to including stakeholders in FLOSS processes when ideas and discussions were proposed that sought to change the current practice. In the workshops, this typically was accomplished through discussing mechanisms for facilitating interaction and integration amongst the stakeholders, making sure the stakeholders were equally considered in the pitch, and expanding what it means to be a "contributor" in a project. Contrary to the example above with P3DEV, in a GOB in W2, P2DES and P2DEV were ideating features based on the personas and their perception of the end-users' needs. While ideating the role an end-user should take in their pitch, P2DES first summarized the end-user persona goals and his interpretations of it which were focused on the end-user wanting a decision to be made regarding his problem. P2DEV then said "it says under 'Talk to Someone' on the document we were given that the [end-user] wants to have a conversation. So I think [the end-user] wants to provide input back and forth, you know, to be able to explain what they mean to say ... [and] how it could be better ... I guess to be involved in the conversation about what could make this system, this piece of software better." This suggestion is ultimately included in their design pitch. In doing so, the result of this episode - P2DES and, especially, P2DEV's ideas and discussion - challenged the status quo of FLOSS inclusion of stakeholders who are typically involved in discussions, not only to identify the problems in a software but also to be involved possible solutions and the future direction of the software.

# 8.2.4 Collaboration

Finally, as participants collaborated in the workshops to discuss, suggest, and make decisions on the FLOSS status quo related to communication, technical priority, stakeholder inclusion, and collaboration habits, the participants also demonstrated behaviors that either confirm-structured or de-structured the norms related to collaboration and decision making in FLOSS. A participant confirm-structured the structures of collaboration in FLOSS when an authority participant in an episode of power behaved as the primary decision maker and/or exercised their authority to determine which ideas should ultimately be approved and included in the pitch. This demonstrated confirm-structuration because, as previously established, FLOSS projects traditionally follow the onion model, where a core developer exercises final control over what ideas and decisions are implemented. An example of this occurred in W4 where the goal of the GOB was to ideate features. P4EU suggested the inclusion of a compensation feature to P4DES but phrased it as a question in the following manner: "What about the compensation aspect? Should we include that in the website where they're offering compensation ... or should that just not be a factor?" This is the first time an idea was suggested regarding compensation in their pitch (they had previously discussed it in the focus group, but in the PD activity), and the way that P4EU frames the suggestion indicates that he counts P4DES as the authority on the matter and wants his approval on whether the idea should be included in the pitch. P4DES responded by deciding "I think it should be a feature, but it shouldn't be baked in" without further discussion with P4EU on the matter. This episode is concluded by P4EU agreeing with this decision. The dynamics between P4EU and P4DES in this episode of power illustrate how the way in which the participants collaborated loosely resembles the existing structures in FLOSS where the more powerful person – usually the developer, but in this case, it is the designer – has the final decision making power on the inclusion of a feature in the project.

An episode of power resulted in de-structuring norms related to collaboration in FLOSS when the participant intentionally worked to collaborate equally when making decisions about the pitch and its design. For example, after a working GOB in W3, P3DEV initiates a discussion GOB to organize logistics by asking P3EU: "Should I remove the monotype form in the [document] since I now have my HTML implementation?" P3EU responded by saying "its OK" and justified that because the form was running in HTML and P3DEV was sharing his screen, it was OK to delete it from the document. While the magnitude of impact resulting from this decision may not be large, it exhibits a de-structuring of norms that end-users are not included in making decisions regarding collaboration and workspaces in FLOSS. Already in an earlier GOB in W3, P3DEV had made the decision to use the HTML editor on his own without consulting P3EU about it. So in this episode of power where P3DEV does choose to consult P3EU shows how participants (P3DEV in this case) can perform both types of structuration methods within a workshop. Moreover, because all the discussion GOBs' are with the encompassing goal to collaborate on the design objective, every GOB inherently confirmed the collaboration and decision-making norms of FLOSS or challenged them (sometimes both occurring within a single GOB). It is

essential to remember here that the process of structuration is continuous – for the structure to change indefinitely (in this case, how collaboration happens between the participants), it has to become the new status quo. The ways in which the status quo changes is dictated by the type of consciousness used when making decisions.

# 8.3 D-3: Consciousness

With D-1 power explaining how participants exercise their power to act (agency) in an episode and D-2 power explaining how those episodes change the status quo of FLOSS, we now turn our attention to understanding *why* certain episodes result in changes to the status quo and others do not by investigating the thrid dimension of power (D-3) in the PD activities. Regarding D-3, we observed and report on the roles that participants' *subconscious* and *consciousness* played in exercising agency to change or accept the status quo.

To reiterate, the two types of consciousness present when people act are practical consciousness – one's subconscious thought – and discursive consciousness – one's conscious thought. Practical consciousness is the information engrained in our subconscious and is readily available as we live our day-to-day lives; practical consciousness is informed by societal norms and is the information we take for granted and implicitly informs the way we view the world. As such, practical consciousness is an essential part of confirming social structures. Discursive consciousness, on the other hand, is any active thought and information discussed that is put into words. Discursive consciousness must be informed by something and it is important to note that discursive consciousness can be informed by the status quo or it can be informed by other sources. In other words, D-3 is a cyclical process where a person is actively thinking about something in conscious thought (discursive) and over time these thoughts become second nature (practical). The person reaches a point where they don't need to actively think about the thought anymore to act on it (practical) and the thought will forever stay that way until they actively think a new or contrary thought (discursive) and the cycle continues. When changing the social structures in place, the type of thought a person relies on is what informs whether the structures will be confirmed or de-structured.

In the workshops, participants demonstrated both types of consciousness as they exercised their agency in episodes to achieve the GOB goals. While practical consciousness was the most challenging to identify because, by nature, it is not the information that is vocalized, participants did elude to their practical consciousness throughout the workshops. We report the behaviors demonstrated by the participants as they relied on and utilized the two types of consciousness as well as the topics of conversation in which they most frequently applied the two types of consciousness.

# 8.3.1 Practical Consciousness

As previously stated, practical consciousness is a person's tacit understanding of how the world works and occurs when participants rely on this knowledge without actively thinking about what they are relying on. Because of this, every GOB and subsequent episodes of power had some level of practical consciousness involved whether it was dictating social etiquette (i.e., all the participants acted respectfully), cultural or regional norms, or an underlying force guiding the ideation process. We focus on identifying the practical consciousness that influences behaviors within the context of achieving the GOB goals (e.g., organizing logistics, deciding on strategy, identifying existing problems, ideating features, etc.) and the design pitch.

Formally, we characterize an episode of power that exhibits a participant's tacit knowledge as that which is immediately known and often "taken for granted", thus allowing the natural order (i.e., status quo) to carry on (i.e., confirm-structuration). Because it is immediately known, participants are not performing explicit indicators that they are relying on practical consciousness. For this reason, practical consciousness was the most challenging to identify without performing much speculation. However, we rely on the way to consistently identify the presence of practical consciousness in the PD activity by distinguishing when participants verbally indicated their reliance on their practical consciousness. This occurred when a participant used their practical consciousness to make assumptions or make arguments based on assumptions. One such example occurred in W1. Revisiting an earlier example where P1EU initiated a GOB to discuss design limitations, we focus on a statement he made when he shared the following concern in response to a suggestion for synchronous video meetings proposed by P1DES. P1EU said "*I don't know if an open*-

### 8.3 D-3: Consciousness

source project could implement a weekly meeting like that. It would be great if they could." In this episode, P1EU argued against P1DES's proposed idea based on an assumption that FLOSS projects are unable to support synchronous meetings.

We found the most common practical consciousness assumptions that were made occurred when participants discussed stakeholder behaviors and technical capabilities of the participants. Below we provide some examples for both of these categories.

Stakeholder Behaviors. When discussing topics related to the behaviors of specific stakeholders, participants occasionally demonstrated their practical consciousness by relying on assumptions about the nature of how the stakeholders "will" behave according to how that participant perceived the status quo of that stakeholder. For example, in one GOB in W1, P1EU initiated a discussion on possible limitations to the design when he shared the following concern, "My only worry, I guess, regarding developers is that they would probably default to going to GitHub rather than this landing page." While this episode indicates P1EU is actively aware of the norms in FLOSS for developers not to get involved in usability-related tasks, he does not identify the information source to support his assessment or the underlying cause of this perceived behavior. Therefore, the concern also indicates P1EU's readily available knowledge that something is preventing developers from being interested in using their pitch, despite having designed features for the developers to use. Revising another example already described from W3 where P3DEV communicated to P3EU a design decision P3DEV made to the pitch. In this GOB, P3DEV explained how he decided that "the burden of any work [to address issues] is shifted to developers and anyone else directly involved" so that "[the end-users] hardly have to do any work. While no guarantees can be made that anything can be acted on, at least it will be likely read and responded to." This decision was based on P3DEV's subconscious belief that all end-users will not want to be involved or do work while he also assumed that the developers will read and respond to the feedback provided to the forms.

**Participant capabilities.** Throughout the workshop, participants also demonstrated their assumptions about their fellow participants' capabilities. For example, in W1, P1DES responded to a suggestion made by P1EU about finding a way to include design contributions into their landing page. P1DES began by saying that he thinks the only two cloud-based design tools are Figma and Invision and proceeds to state that "*Figma is very easy* 

to use, it's very easy to use for anybody. I can share with you the link right now to use, it's very easy." In this situation, P1DES's assertion is based on an assumption that the design tool (Figma) is easy for anyone to use. This might not be true for everyone, especially if they have no prior experience with design tools and don't know what to expect.

# 8.3.2 Discursive Consciousness

An episode of power exhibits discursive consciousness when the knowledge that is being communicated by a participant is readily put into words. Participants accomplish this by shifting their abstract and subconscious thoughts that tacitly understand information, to their conscious mind so that the thoughts are now concrete. Because the nature of the workshop (both the focus group and the PD activity), was meant to inspire critical thinking on the usability challenges in FLOSS and how to fix them, many of the discussion GOBs and the episodes of power to achieve them exhibit discursive thought as the participants actively brainstorm and collaborate to achieve the goals.

For this reason, we focused on participant behavior that demonstrated deeper levels of engagement due to their discursive consciousness. Specifically, we observe that participants demonstrated their discursive consciousness by using their concrete understandings and knowledge when they applied logical reasoning, exercised empathy, employed methods of self-monitoring, and drew from episodes of D-1: resource utilization. In turn, we identified two topics of discussion in which participants applied their discursively informed behaviors: technical conversations and stakeholder inclusion. Below, each behavior is described and the section concludes with descriptions of the behaviors applied to the two discussion topics.

**Logical Reasoning.** A participant demonstrated their concrete knowledge by actively applying logical reasoning on a subject through behaviors such as arguing, convincing, investigating, and justifying. For example, in W4, P1EU has ideated a feature for including a roadmap in the platform to help connect stakeholders together. P1DES asked P1EU to explain what he meant by "roadmaps." P1EU responded to P1DES by starting to explain what he mean but ultimately verbally applying new logic to ultimately reject his idea; here is how P1EU demonstrated the behavior of logical reasoning: "*I think I'm … I'm maybe* 

# 8.3 D-3: Consciousness

looking at the other side of it. So our website is for helping contributors find projects ... Yeah, so the road map wouldn't work there." P4DES concluded the GOB and the episode by saying "Yeah" in agreement. In this episode, P1EU uses the concrete thought of their website's purpose as the reason for justifying not including the feature in the pitch. However, another example of logical reasoning being applied occurred in the follow-up GOB where P4DES changed his mind about including this feature. P4DES used his discursive consciousness to argue and justify the necessity of roadmaps in their pitch. P4DES initiated this GOB when he said the following: "But actually, that's not a horrible idea because it would like ... inspire them. Like, 'oh, I want to work on this thing', but from my experience, like these road maps are super not real, I would say." P4EU responded by saying "that's fair," but then P4DES ultimately decided to include the roadmap feature after he applied the following final justification based on his concrete thoughts: "like, we are seeing this [pitch] as a platform. We can allow projects to have the roadmaps and these roadmaps can inspire contributions to [the roadmaps]."

**Empathy.** A participant demonstrated their discursive consciousness by applying empathy to try to better understand other people and other stakeholder groups as it related to the discussion topic and guide the evolution of the design pitch. When participants used their discursive consciousness to actively empathize, they did so by using phrases such as "if I'm a [STAKEHOLDER TYPE] ..." followed by the sentiment or statements where the participant puts themselves in the shoes of another stakeholder. Participants utilized empathy most frequently to imagine the needs of an end-user or a non-technical individual more than any other stakeholder during the workshops. For example, in W1, P1DEV initiated the GOB by acknowledging his approval of P1DES's design. P1DEV did so by empathizing with non-technical end-users, saying that the design "get[s] away from GitHub scaring people off, [makes] it more user friendly."

**Self-monitoring.** A participant demonstrated their concrete knowledge through behavior that self-monitored their reliance on tacit knowledge, especially as it related to their biases. In episodes where a participant self-monitored, they typically verbally acknowledged their own biases, which were often related to their perception of other stakeholder groups. To revisit an example GOB from W2 discussed earlier in this chapter, we can see how a participant used his discursive consciousness to identify when they have relied on incorrect

# 8.3 D-3: Consciousness

tacit knowledge by self-monitoring. In this example, P2DES and P2DEV were ideating features to figure out where to include the developer in their pitch's proposed pipeline for addressing usability issues. As P2DES made a suggestion, he caught himself being complacent in confirming the norms of FLOSS developers not getting involved in usability and design. Here, P2DES said "*I'm kind of falling into my own … My own thing that I complain about designers where they don't involve the developers until like the very end.*" P2DES changed his mindset by shifting his tacit beliefs on how developers "should" act within the confines of FLOSS social structures to the "ideal" way developers could act (according to P2DES) that break out of the confines of the FLOSS status quo (de-structuration). Following this, P2DES continues to ideate features by empathizing with developers through using the personas documents.

**Resources as a tool of persuasion.** The final behavior where we observed the presence of discursive consciousness was when a participant exercised a type of *D-1: resource utilization* as an instrument of persuasion. In doing so, the participant used the resource to convince themselves or another participant of something. Some examples of this include the use of design artifacts, personas, and external documentation or past experiences using these resources to persuade. For example, revisiting the previous example seen in the W4 GOB where P4EU and P4DES were discussing whether to include a roadmap feature in the pitch, we can add another layer to how this decision was made. When P4DES asked P4EU what he meant by "roadmap," P4EU started to explain his idea so he could convince P4DES about the idea, but P4EU changed his mind and decided not to include the roadmap by the end of the GOB. Part of why P4EU changed his mind in this GOB is because he had returned to a design artifact the participants wrote earlier in the PD activity and used this resource to make the decision by applying his active logic to the design artifact.

Participants demonstrated these behaviors as they used their discursive consciousness when discussing two key topics. We identified these topics as stakeholder inclusion and technical concepts, both are summarized below.

**Stakeholder Inclusion** When participants were making decisions to ideate features, discuss design limitations, and identify problems in FLOSS related to stakeholder inclusion, they demonstrated their discursive consciousness by exhibiting one of the behaviors on the topic of facilitating the inclusion of diverse stakeholders. Specifically, a participant's

# 8.4 Summary

behavior showed their use of active and discursive thought when they discussed how best to include different stakeholders in the design pitch and how to facilitate integration among them. For example, in W4, P4EU had ideated a feature to facilitate the identification of a contributor type to help facilitate the inclusion of more stakeholders, which he titled "hierarchy of position." In the following GOB, P4DES iterated on this idea by applying a combination of logical reasoning and self-monitoring to the topic at hand. Initially, P4DES suggested moving away from the term of hierarchy by applying his active thoughts on the terminology and power dynamics in FLOSS by arguing that "hierarchy" has a "negative connotation." However, P4DES then self-monitored what he had just said by acknowledging that this negative connotation is inescapable because hierarchies of power within FLOSS projects are impossible to get rid of. P4DES demonstrated his conscious thoughts by formally acknowledging that "developers hold the most power because they literally type the code. But projects should have as flat a hierarchy as possible."

**Technical Discussions** When participants were actively discussing and reasoning about anything related to technical tools, aspects of development and programming, the feasibility of implementation, and/or the overall priority of functionality over usability, they were demonstrating their use of discursive consciousness. A participant's behavior used their active and conscious thought when they discussed what technical features to implement in the design pitch, the specifics of how to implement the features, and the feasibility of implementing the pitch in real life. For example, in W1, P1DEV applied his concrete thoughts about technical concepts when discussing potential design limitations of the pitch which had just been shared with him by P1DES (who had made the wireframe alone). P1DEV ultimately approved of the design, but before coming to that conclusion, he demonstrated logical reasoning behavior to justify the merits of the design from an implementation perspective because it could be deployed in the real world in pieces. In doing so, P1DEV also empathizes with other developers to try to understand what aspects of the design would be important to consider for that stakeholder group.

# 8.4 Summary

In this chapter, we report our observations of how the participants achieved the PD tasks and, more specifically, the GOB goals through the lens of the first three dimensions of

# 8.4 Summary

the Four Dimensions of Power Theory. We find that each GOB has one or many episodes of power that define how a participant achieves the goal of that GOB. In an episode, a participant uses resources available to them to achieve a goal, these resources are either presently available to them in the workshop or a participant shares a past experience using them. When there is an unequal distribution of knowledge resources, this affects a participant's agency to achieve the goal and causes one participant to have power over another participant. The five areas where participants demonstrated a knowledge gap was in conversations about other stakeholders than their own (i.e., an EU participant talking about developers), communication concepts, technical concepts, usability concepts, and collaboration tools used and decisions made in the PD activities. When participants made suggestions, discussed ideas, and made decisions, they did so within the normal social structures of FLOSS. These social structures dictate the status quo with respect to structures of communication, technical priority, stakeholder inclusion, collaboration tools, and collaboration habits. When a participant's behavior accepted these structures, it **confirm-structured** the status quo. However, if these behaviors challenged these structures, it was considered a de-structuration of the status quo. Last, we identified that participants demonstrated practical consciousness when their behaviors were based on assumptions, primarily in regard to stakeholder behaviors and the abilities of other participants in a workshop. And participants demonstrated discursive consciousness when they used logical reasoning, empathy, self-monitoring of biases, and persuasive methods of communication when they had technical discussions and stakeholder inclusion discussions.

# Discussion

This chapter presents a consolidated overview of the main results, their implications, the limitations of the study, and proposed future work.

# 9.1 The Current State of FLOSS Usability

To answer RQ1, we analyzed participants' reflections in the focus group. Participants used the personas to reflect on their experiences and perceptions of challenges in FLOSS related to communication, documentation, development processes, culture and usability, and lacking incentives. The participants identified these as all contributing to barriers facing stakeholder inclusion and leading to overall poor usability.

All participants agreed that FLOSS needs to be more inclusive of different types of stakeholders in general, and in doing so, this will help to improve its usability. Adding to the literature, particularly the contributions of Wang et al. [62] and Cheng and Guo [12], we found that all the participants across the three stakeholders' roles felt there needs to be a focus on community-building efforts, inspiring trust in the FLOSS process, and lowering the barriers to onboarding and contributing in terms of easier to use tooling and communication channels, and more understandable documentation that is easier to find.

In terms of addressing usability challenges in a project, DEV and DES participants reflected on developers' lack of skills to adequately address usability, especially in cases where a project was started to "scratch an itch" but then scaled beyond the capabilities and resources of the owner, ultimately causing developers to prioritize functionality; this directly supports the existing research and indicates that this has been a longstanding problem [3, 50, 12]. Similarly, some DES participants mentioned how some FLOSS projects were proud to have "hard to use" interfaces and experienced resistance when they tried to get involved as designers; this directly supports Nichols and Twidale's [40] results from 2003, two decades later. EU participants' reflections during the workshops supported the findings from our preliminary research reported in Chapter 3; in particular, their deterrence to participate due to not knowing how to communicate with respect to proper terminology, how to write issues, or where to get involved. Moreover, reflections from EU and DEV participants on the challenges related to forums – specifically in terms of perspectives with hostility, disinhibition, and end-users lacking confidence in forums – contribute a qualitative perspective to the quantitative analysis of psycho-linguistic behaviors when end-users and developers contribute to more than 1.3 million posts in four FLOSS user forums identified in Hellman et al.'s [28] study.

We also contribute stakeholder-identified metrics for measuring successful solutions for achieving stakeholder inclusion and improved usability of a project. All the participants' answers were related to improving the culture and communication in FLOSS. Precisely, a successful solution or tool could be measured by the degree of a project's shift to prioritize usability, their integration of design into development processes, an increase in a project's end-users, an increase in non-developer contributors, and the improvement of user feedback.

# 9.2 Perspectives on Achieving PD

**Conducting PD.** To answer RQ2, we find that the structure of the PD activity can be decomposed into goal-oriented blocks (GOB) with two main tasks, working GOBs and discussion GOBs. The working GOBs are defined by periods of working without discussion and are characterized by the participants' working style (together or separate) and their activities (e.g., designing, writing, observing, etc.). The discussion GOBs are defined by a goal that is initiated by a participant (e.g., suggestion, thinking out loud, seeking clarification, etc.) and concludes when the goal has been accomplished or abandoned, which is indicated by the outcome of the GOB (e.g., no outcome, acceptance, decision, action). Each

# 9.2 Perspectives on Achieving PD

discussion GOB also has a speaking style (monologuing or turn-taking) and a participant who is the authority.

Manifestions of Power in PD. To answer RQ3, we find that (D-1) participants exercise their power to act in a GOB by using resources (e.g., workshop artifacts, external documentation, and developer skills) available to them. Any unequally distributed resources, especially with respect to knowledge and skill sets, lead to an authority for that GOB and cause this authoritative participant to have greater power to act in addition to obtaining power over the other participants and the GOB outcomes. (D-2) These actions, initial intents, and outcomes in the GOBs are all types of behaviors. These behaviors occur in relation to specific topics (e.g., communication in FLOSS, affording technical priority, the nature of stakeholder inclusion, collaboration tools and habits) that are formed by the existing social structures of FLOSS. These social structures have been formally defined by prior research and were established by each of the workshops' teams during the focus group. Therefore, the participants' behaviors as they make suggestions, discuss ideas, and make decisions related to those topics in FLOSS are made within the confines of these FLOSS norms and confirm the status quo (confirm-structuration) or are made with the intent to challenge the FLOSS norms and change the status quo (de-structuration). (D-3) Participants' likelihood of exhibiting behavior that de-structures the norms related to FLOSS usability depends on their ability to discursively think about those norms and challenge their practical knowledge. Practical knowledge was demonstrated predominantly through relying on assumptions about the expected (a) behavior of different stakeholders interacting with their proposed design and (b) the capabilities of the participants in the workshop. Discursive knowledge was used when participants demonstrated specific behaviors (active reasoning, empathy, self-monitoring for biases, and using resources as tools of persuasion) when discussing stakeholder inclusion and technical discussions.

In comparison to Rajanen and Iivari's [47] proposed framework of power, in particular, their empirical findings on empowerment based on their case studies, there is a similarity in our results, but the overlap of our findings lies in the requirements for the empowerment of usability specialists identified by Rajanen and Iivari [49]. In terms of D-1, we both identified the role that access to resources has, and we both identified expertise and access to tools (right to commit in the case of [47]). In terms of D-2, Rajanen and Iivari focused on

the "decision-making arena" and the act of consciousness-raising whereas we find that this dimension is dependent on the nature of the decision with respect to the status quo. Because Rajanen and Iivari's research is centered on the degree of conflict between developers and designers in FLOSS whereas our research focuses on the degree to which proposed ideas solve the design objective, this difference in our frameworks is understandable. We want to inspect what stakeholder behaviors in regards to which FLOSS topics will change or confirm the structures whereas Rajanen and Iivari [47] want to know this purely within the context of designers interacting with FLOSS developers in a repository. In terms of D-3, we both identify the role of discursive consciousness, but similar to D-2, while we have identified this role within the context of achieving the design objective (and the individual GOB goals), Rajanen and Iivari focus on the degree to which developers value usability and designers are aware of the developers' attitudes and advocate for the inclusion of usability [47]. The nature of our design workshop study and the PD activity means that the traditionally more powerful stakeholders (developers) who participated in our study, were self-selected by a general interest in achieving usability (this was made clear in our recruitment posts and consent form). For this reason and because our PD activities were not taking place in a repository, much of our overlap with Rajanen and Iivari's empowerment framework is in their "Requirements for empowerment of usability specialists" criteria. While our insight (presented below), supports this claim that our DES participants were empowered, there is a disconnect, now, on what requirements we need for empowerment of end-users in a PD activity.

# 9.3 Key Implications About Our Results

This PD GOB structure provides insight into the specific tasks, goals, activities, and outcomes that are essential to conducting a PD activity in FLOSS. Moreover, accomplishing successful PD relies on disrupting the hierarchical structures in place so all stakeholders can equally participate in the design process. Disrupting these hierarchical structures requires understanding the current structures and how they are infused in the PD activities. Through this understanding of the aspects of power that limit participation, our work identifies the areas that suffer the most and design interventions to solve those areas. Below we present some insights that highlight those areas.

# 1. A dedicated PD activity has the potential to disrupt the existing social structures and afford designers more power.

Past research in PD investigated how well end-users and designers integrated into existing FLOSS structure, reporting that how the stakeholders had to adapt to FLOSS tools and struggled to exercise their power in addition to having limited capacity to make decisions [31, 48, 47]. Our results offer a counter perspective. Figure 7.9 shows the relationship of GOBs' authority compared to the initiator stakeholder type. We found that DES participants were most often the authority of GOBs they initiated. In contrast, DEV participants were the authority about an equal amount in GOBs initiated by DEV and EU participants. The high rate of DES-authority GOBs initiated by DES participants can likely be attributed to the PD activity itself; we set up the PD activity to be open-ended, but intentionally made the objective a design task. This meant that the DES participants had the proper skills to draw from to achieve the goals and can likely account for the DES participants initiating the most GOBs. This indicates that the PD structure we implemented in our study successfully disrupted the traditional FLOSS collaboration structures (discussed in Chapter 2 and Chapter 6) where developer stakeholders have the power.

# 2. The proposed structural framework for the PD activities can be used to facilitate future PD in FLOSS projects and research.

If future FLOSS stakeholders wish to use a similar design workshop method within their own projects to improve stakeholder inclusion and usability, the identified GOB goals can act as a resource to guide future PD activities. Moreover, these goals (combined with the focus group discussions as they inspire sharing experiences and, ideally, empathy), resemble key stages associated with established ideation and design thinking processes used in countless fields [51, 43] While we provided some example items for the participants to include in their pitches (such as identifying the problem, key features, why decisions were made, etc.), we did not instruct or facilitate the participants in the design workshop; participants organically broke down the design objective into the tasks and goals we identified in RQ2. This demonstrates the potential for the PD structure to be applied successfully in other settings with minimal barriers.

It is also possible that providing the goals as a resource for potential FLOSS stakehold-

ers participating directly in the PD activity (and not only future facilitators) could also help to encourage agency from non-designer stakeholders who don't have design-related skills to draw from. While more research would be needed to support this claim, two examples of where having these resources could have helped improve the agency of non-designer stakeholders occurred in W1 and W3 where the participants either struggled to identify and follow a strategy (W1) or skipped straight to creating a solution (working GOBs) before identifying problems and discussing solutions. If these workshops had access to the PD goals as a resource, we hypothesize, based on the results from RQ3, that this would increase their potential power to participate and achieve the design objective.

# 3. Engaging in turn-taking conversations can lead to more inclusive decision-making processes.

We also found a correlation between speaking style and outcome of GOBs; participants reached decisions together at a higher rate when they engaged in turn-taking conversations, while monologuing GOBs more often led to GOBs where the result was accepted by the non-monologuing participant. Suppose future FLOSS stakeholders engaging in PD are cognizant of their speaking styles, especially ones used to reach goals like identifying existing problems in FLOSS and ideating features. In that case, this could have the potential to lead to more of a participative and equal decision-making process.

# 4. Not all stakeholders know how to make use of personas when designing.

When asked, all the participants agreed with the personas and had little to no feedback about the personas, indicating their validity in their current state. However, the types of reflections reported in RQ1 were not equally discussed across focus groups or used in all the PD activities. Using personas in design activities is a standard HCI method to help guide decision-making [46]. By providing participants with personas, we were able to establish a baseline for the participants' knowledge before the design activity; this also ensured the participants had a common set of resources to draw from while performing activities to achieve the tasks and goals of the PD activities. Moreover, through engaging critically on the personas, in addition to the act of drawing from their own experiences, the workshops were set up in such a way that they would encourage the initial stages of turning their practical consciousness into discursive consciousness before the design stages commenced.

In turn, this would ideally enable participants to begin the design activity with a better idea of what challenges they should tackle.

However, not all workshops used the personas to the same degree. For example, W2 was the only PD activity in which the participants designed the solution for "David, Dakota, and Enrique" rather than for "developers, designers, and end-users". In contrast, participants in the other three workshops would only reference back to the personas, albeit less frequently than in W2, in a more abstract manner ("*it says*" or "*in the document they gave us*") as they needed a reminder of the usability challenges and goals, inspiration for ideas, or help to justify their decisions.

Despite this, the persona documents were still identified as a critical resource that participants used to exercise their power – primarily related to the GOB goals of identifying challenges in FLOSS, ideating features, and discussing design limitations – and through which they demonstrated discursive behavior. Therefore, we conclude that there is an opportunity for further research on what alternative strategies may be employed to better use the personas in stimulating discursive behavior and achieving the GOB goals.

# 5. Expanding the personas will allow more discursive behavior through inspiring well-informed, critical reflections about the different actions, experiences, and goals of the different stakeholders.

We observed a dissonance between the practical assumptions (RQ3) generalizing stakeholder behavior and the actual behavior of the participants belonging to those stakeholder groups when engaging in working activities (RQ2). This highlights the need for expanding the existing stakeholder personas (David, Dakota, and Enrique) into more detailed, taskbased personas based on the inconsistencies in activity and behavior [66]. This was most evident for David and Enrique, the developer and end-user personas. David, for example, struggles with understanding, representing, and making informed decisions about usability issues, but he wants a way to improve that. We did not say in this persona that David would not use tools that are outside the norm for developers. Still, participants frequently made assumptions about the likelihood of developers using the proposed tools in the submitted pitches.

In particular, W1 decided to employ webhooks to automatically update GitHub when

non-developer documents get updated on their landing page, W2 designed their tool in a way where the developer wouldn't have to leave the issue tracker at all, W3 designed a feedback form that streamlines the feedback directly to the developers, and W4 intentionally didn't want to "redesign the wheel" and decided to make a platform for connecting contributors to projects with a focus on teaching non-developers how to get involved in FLOSS. It seemed that even though the DEV participants resonated with David and his challenges – and the DEV participants even went out of their way to volunteer to participate in a design workshop study – when it came time to design their solutions, everyone was designing solutions for a different type of developer who would not want to leave their normal context at all. Suppose we can create more personas that are more specific, better detailing the behaviors, activities, and key personality traits of the FLOSS stakeholders. In that case, future participants in a PD activity will be able to create more targeted solutions and there will be more resources for participants to use and exercise their power to act. Not only that, but if we have a whole spectrum of personas with their own agency and power, we can use them in our future research as tools in speculative design [57, 63].

# 6. Discursive conversations *before* PD teams contribute to the decisions resulting in a structural change to FLOSS usability and stakeholder inclusion.

The focus groups ensured a large-scale demonstration of discursive behaviors before any participants started the PD activity. As such, the reflections in the focus groups were critical for the participants to concretely think about and discuss any issues which, at the start of the workshop, had likely been in their practical consciousness. This allowed the participants to identify the issues they wanted to address in the PD activity and, therefore, this heavily influenced the pitch outcomes.

For example, W1 participants reflected more on the role of poor documentation in discouraging participation and the challenges developers face in writing good development (lack of technical writers in FLOSS). Oppositely, W3 participants discussed more on the lack of motivation for developers to prioritize non-developer needs and end-users to struggle to provide user feedback. These differences in challenges discussed between W1 and W3 focus groups were ultimately reflected in their pitches. Participants in W1 designed a landing page for FLOSS projects' stakeholders to find their respective documentation and appropriate links for getting involved easily. In contrast, the participants in W3 designed a "Simple Feedback Form" that reduces the amount of work an end-user has to do to a "bare minimum" and this way "the developers and anyone else involved directly [can] read such feedback in a more accessible and consistent fashion."

While all the workshops had elements of confirming structures of FLOSS with respect to usability and inclusion, workshops also had discussions in GOBs that de-structured these norms. A relationship can be traced between the challenges identified in a workshop's focus group and the topics discussed discursively in that workshop's PD activity GOBs. Notably, this included discussion GOBs to identify issues in FLOSS, ideate features, and discuss design limitations. related to conversations about communication, abstract and concrete technical ideas, and stakeholder inclusion. In the future, providing more resources about these topics and encouraging discursive behaviors could positively impact the PD process and achieve the identified GOB goals.

# 7. Having all stakeholders participate in PD activities is essential for minimizing practical conscious behaviors and designing solutions that challenge the norms of FLOSS.

In workshops where a stakeholder was absent, there was more reliance on practical consciousness and assumptions about stakeholder behaviors. One example occurred in W3 – the only workshop without a designer stakeholder present – which relied quite a bit on practical consciousness. The focus groups' conversations were based exclusively on P3EU's and P3DEV's experiences and perceptions as end-users and developers, respectively. There were almost no conversations about the role and inclusion of designers in FLOSS, meaning that fewer behaviors demonstrated the use of discursive consciousness on the topic. We hypothesize that this is why there seemed to be a lack of intentional inclusion of designers in their pitch, leading to a solution that confirm-structured the structures in FLOSS with respect to designer inclusion. For example, their pitch frequently writes, "developers and anyone else involved" were the intended group for a couple of features related to decision making. While on the one hand, this starts to de-structure the belief that only developers are involved in the decision-making process. However, on the other hand, without intentionally designing features that include designers, the pitch does not directly propose features that challenge the FLOSS structures that currently exclude designers.

# 9.4 Limitations and Threats to Validity

There are a few potential limitations of this thesis. First is the researcher bias. While for RQ1 and RQ2 researcher bias was mitigated by multiple researchers performing iterative rounds of open coding, discussing codes, and repeating until a desirable solution was reached, RQ3 was open coded by only the main author. To be more specific, this bias could have manifested in a couple of ways. First, when interpreting the source material. When the three authors were selecting what theory of power between social actors to use, we eventually selected Haugaard's theory of the Four Dimensions of Power through the process indicated in Chapter 2.4 [25]. While the three researchers familiarized themselves with the theory and discussed their understandings and interpretations, it is possible that some bias was introduced into this process of interpreting the meaning of each dimension, especially due to the abstract nature of the theory itself. The second area where potential bias could have been introduced is during the open coding process performed by the main author to identify occurrences of each dimension of power in the PD activities. The author's identity is relevant to this discussion of the author introducing bias; the author has an interdisciplinary background (computer science, HCI, and humanities) that has led her to identify as each of the stakeholders, personally, as well as having extensive interactions with people who have design skills, programming skills, and neither. As such, she posits that this allowed her to empathize with each of the stakeholders and allowed her to stay tuned for subtle nuances demonstrated throughout the workshops. However, this could also have had the opposite effect and introduced bias based on her perspectives. Therefore, to combat that bias, the author strived to open code manifestations of power that she interpreted as rooted in tangible, visual, and/or audible behaviors. The third way the researcher could have introduced potential bias was through the consequent analysis of the open codes. However, the other researchers mitigated this by verifying the codebook, sample codes, and examples.

Another limitation of our study comes from our participant recruitment and diversity. While our participants were geographically and ethnically diverse (spanning multiple continents, nationalities, and ethnicities), our participants were all male. We acknowledge that this is a severe limitation, especially because of the implications surrounding the role of power in gender-related social structures in FLOSS [9, 11, 45, 55, 54]. We hypothesize

that part of this discrepancy comes from the fact that we recruited for end-users primarily on Reddit. A Pew poll [6] found that Reddit users are more likely to be male. Part of our reason for recruiting through Reddit was the access it gave us to a large number of people. We hypothesize that this is why we received such diverse participants regarding other characteristics (age, location, profession, etc.). More research must be conducted to understand the effects of power, PD, stakeholder inclusion in FLOSS, and FLOSS usability, such as gender, nationality, and race.

Moreover, when deciding what to analyze, we chose not to include aspects such as individual personality, race, culture, or nationality of the participants despite the fact that this choice might have influenced the dynamics and outcomes the individual workshops. Some of these factors are rooted in complex, often colonialist histories, and are intrinsic to all the dimensions of power in a participatory setting, even within our context. Normally in FLOSS, people are remote, asynchronous, and have the option to be anonymous. We conducted a remote but synchronous workshop where people were encouraged to leave their cameras on. For this study, we did not analyze these features under the justification that we are analyzing FLOSS culture and social structures first. However, it is important to acknowledge that FLOSS exists in the real world, and future research should investigate how power manifests itself in PD according to other factors.

Another possible limitation lies with the racial and gender identities of the personas. For all personas, gender was not explicitly stated so most participants assumed the gender identities based on their own experiences. While in terms of race, the two personas with less power typically (designer and end-user) were people of color, while the developer persona was identified as a white man. This could have influenced participants' perceptions about the stakeholders, including the power dynamics between the personas themselves, which in turn could have affected the interactions amongst participants in real life by reinforcing beliefs about who holds power. In future iterations of our personas, we will further explore this aspect of our personas to better understand how the racial and gender identities of these artifacts can be used to ensure improved participation and mitigate negative power imbalances.

Additionally, in terms of our PD activity set up, we have identified three potential limitations. First, PD is usually moderated by a professional with experience in PD and contains

## 9.5 Future Work

structured activities [39]. In doing so, the PD moderator can help mitigate negative power imbalances and the PD participants can have more guidance. However, we intentionally designed the PD activity's set up not to include a moderator and have a loose activity structure in the hope of better understanding how the power structures and design pitches would manifest organically. Although, we might consider introducing a moderator and more structured activities in the future as a possible direction to explore ways to level the playing field among participating stakeholders.

Our final limitation is related to the generalizability of our results. Our study centers on the operation of a dedicated and synchronous PD activity. While we believe that the contributed structural framework for PD and the associated analysis on the role of the first three dimensions of the *Four Dimensions of Power* theory are feasible for any FLOSS project to employ if they wish, we cannot ensure that FLOSS projects will choose to put in the time and effort to organize such an activity. However, our research contributes findings that can help inform FLOSS projects on how to work towards becoming more inclusive.

# 9.5 Future Work

Our future work is three-fold. First, with a proper understanding of how power manifests in a PD activity, along with how that PD activity structurally occurs, we can begin to research mechanisms to achieve empowerment of *all* three stakeholders in a PD activity by transitioning from a theory of power to a theory of empowerment [2]. Part of this empowerment would be through the lens of capacity and agency building of the end-user stakeholders, ideally placing more priority on non-technical end-users.

Second, further analysis of the participants' pitches is needed. We were not able to investigate the pitches according to how well they would achieve the design objective due to time constraints, but that is also future work to be conducted. Along with this task, we will endeavor to create a prototype tool enabling PD to be integrated into existing FLOSS pipelines. Ideally, the participants' design pitches that successfully achieved the design objective would be used to iterate and improve on our initial prototype from Chapter 3.

The third area of future work stems from the preliminary analysis of the design pitches and the results of RQ3. Particularly, the D-2 and D-3 results; these results indicated that the

# 9.5 Future Work

participants often remained within the boundaries of what is considered normal for FLOSS social structures. We often perceived ambivalence on the part of the participants to break out of those structures, for example, practical assumptions about what developers will do or designing concepts that are feasible to implement. As such, we believe that employing speculative design would be an interesting approach to challenge the current norms. Through speculative design, we can intentionally create studies where the stakeholders involved in PD will have to push the boundaries to conceive of drastically improved futures in that work to break the norms.

# **10** Conclusion

This thesis reports the findings of a user study conducted to investigate stakeholder inclusion and usability in FLOSS. While prior efforts have been made to address usability in FLOSS, this research contributes a novel analysis of participatory design with FLOSS developers, designers, and end-users as a way to improve the usability of a FLOSS project. In our study, we conducted four workshops; each workshop began with a moderated focus group discussion followed by an unmoderated participatory design activity.

We analyzed the focus group and PD activity to identify (**RQ1**) how stakeholders reflect on challenges facing usability in FLOSS, (**RQ2**) how participants would work together to achieve the PD activity, and (**RQ1**) how the dimensions of power manifested in their behaviors and outcomes as they collaborated to accomplish the design objective. Our results provide an analysis, from the perspective of the stakeholders as they reflect on the current state of FLOSS, of the barriers that impede different types of stakeholders from being included and participating in improving FLOSS usability. We also comprehensively investigate the agency, resources, power dynamics, and social structures at play when FLOSS stakeholders collaborate in PD. Our results provide an understanding of critical nuances involved in facilitating PD in FLOSS; we believe the contributions will help future researchers and FLOSS projects make better-informed decisions to design and implement solutions to problems facing stakeholder inclusion, collaboration, and poor usability in FLOSS.

Our results indicate that the status quo for addressing usability in FLOSS and including

# Conclusion

non-developer stakeholders has not changed much in the recent decades [17, 3, 12, 30, 49]. However, our results illustrate the potential of PD activities to challenge these existing structures in FLOSS because they enable designers to have more power than in traditional FLOSS repositories and developer tools, thus providing them with more access to make decisions and increasing their capabilities to exercise their power overall. To achieve successful PD activities with respect to FLOSS usability and inclusion, it is vital that conversations encouraging critical and discursive reflections are facilitated between all three stakeholders so that those involved in the PD do not rely on assumptions and create solutions that do not actually change the status quo. Moreover, our results still found that, though end-users participated actively in the workshops, they were rarely an authority and "observing" the work of the other participants was their most common activity in the working GOBs. This indicates that further research is needed to explore what types of resources can be provided to achieve more empowerment among all participants. We will focus our future research on answering this question by focusing on expanding the personas, identifying new potential resources, and investigating speculative design methods.

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# Acronyms

- FLOSS Free, Libre & Open-source Software
- OSS Open-source Software
- PD Participatory Design
- DES Designer
- DEV Developer
- EU End-user
- GOB Goal-oriented Block
- D-1 First Dimension of Power; agency and exercise of power [25]
- D-2 Second Dimension of Power; process of structuration [25]
- D-3 Third Dimension of Power; consciousness [25]
- D-4 Fourth Dimension of Power; panopticon [25, 47]

# Appendix

All supplemental materials are located in the GitHub repository found at this URL https: //github.com/jazlynhellman/MSC-Appendix. Below is the Table of Contents outlining the Appendix materials.

| Appendix | Name             |                               | Link                    |
|----------|------------------|-------------------------------|-------------------------|
| А        | Recruitment      |                               |                         |
|          | A.1              | Advertisement                 | advertisement.md        |
|          | A.2              | Interest Form                 | interest-form.md        |
| В        | Design Objective |                               | design-objective.md     |
| С        | Personas         |                               |                         |
|          | C.1              | FLOSS Developer: David        | developer-david.pdf     |
|          | C.2              | FLOSS Designer: Dakota        | designer-dakota.pdf     |
|          | C.3              | FLOSS End-user: Enrique       | end-user-enrique.pdf    |
| D        | Workshop Script  |                               |                         |
|          | D.1              | Introduction and Icebreakers  | icebreaker.pdf          |
|          | D.2              | Focus Group                   | focus-group.pdf         |
|          | D.3              | Selecting Collaboration Tools | collaboration-tools.pdf |
|          | D.4              | PD Activity                   | pd-activity.pdf         |
| E        | Desig            |                               |                         |
|          | E.1              | Workshop 1 Pitch              | W1Pitch                 |
|          | E.2              | Workshop 2 Pitch              | W2Pitch                 |
|          | E.3              | Workshop 3 Pitch              | W3Pitch                 |
|          | E.4              | Workshop 4 Pitch              | W4Pitch                 |
|          |                  |                               |                         |

Table 1: Appendix