

Understanding Skills for OSS Communities on GitHub

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背景 | OSS開発

| OSS開発は複雑であり，様々な人材（役割）が必要とされる

- メンテナ
 - プロジェクトの長期的な維持
- バグ報告者
 - 製品改善のための欠陥の特定
- ソフトウェア開発者
 - プログラムの作成，バグ修正

| 役割の核はスキルであり，スキルは必要不可欠

背景 | 先行研究

これまでの研究では、様々な役割における経験、知識、スキルについて調査が行われている

- メンテナ^[16], インテグレーター^[27], メンター^[5, 59] など

これらの研究の問題点

- OSS貢献者が働く幅広い状況を十分に考慮していない^[13]
- OSSに関連するスキルや、貢献者がスキルをどのように共有し、改善したいのかは明らかにしていない

[16] Edson Dias, Paulo Meirelles, Fernando Castor, Igor Steinmacher, Igor Wiese, and Gustavo Pinto. 2021. What makes a great maintainer of open source projects?. In IEEE/ACM International Conference on Software Engineering (ICSE). 982–994.

[27] Georgios Gousios, Andy Zaidman, Margaret-Anne Storey, and Arie Van Deursen. 2015. Work practices and challenges in pull-based development: The integrator’s perspective. In IEEE/ACM International Conference on Software Engineering. 358–368.

[5] Sogol Balali, Igor Steinmacher, Umayal Annamalai, Anita Sarma, and Marco Aurelio Gerosa. 2018. Newcomers’ barriers... is that all? An analysis of mentors’ and newcomers’ barriers in OSS projects. In ACM Conference on Computer Supported Cooperative Work. 679–714.

[59] Igor Steinmacher, Sogol Balali, Bianca Trinkenreich, Mariam Guizani, Daniel Izquierdo-Cortazar, Griselda G Cuevas Zambrano, Marco Aurelio Gerosa, and Anita Sarma. 2021. Being a mentor in open source projects. Journal of Internet Services and Applications 12 (2021), 1–33.

[13] All Contributors. 2022. All Contributors: Recognize all contributors. Retrieved March 11, 2022 from <https://allcontributors.org/>.

研究目的・アプローチ

研究目的

- OSSに関連するスキルをよりよく理解すること
 - スキルを組み込んだツールやプラットフォームの設計に情報を提供
 - それらを活用するためのベストプラクティスを引き出すことができる

アプローチ

- OSSに関連するスキル，貢献者とスキルの関係について調査

RQ

- | RQ1 : OSSに関連するスキルとはなにか
- | RQ2 : OSS貢献者はどのようにスキルを向上させているのか
- | RQ3 : OSS貢献者はどのようにスキルを共有し、公開しているのか

RQに回答するために、文献調査とOSS貢献者を対象としたアンケート調査を実施

調査方法 | 文献調査

OSSにおけるスキルに関連する論文をACM Guide to Computing Literatureで以下の基準により検索

- コンテンツタイプ: "Research Article"
- タイトルに以下の用語が含まれている
 - "open source", "oss", "software development", "developer(s)", "software engineer(s)"
- アブストに以下の用語が含まれている
 - "skill(s)", "expertise", "knowledge", "characteristic", "attribute"

検索の結果, 228本の論文が得られた

- ここから, ソフトウェア開発者やOSS貢献者のスキル, 属性, 特徴を明示したリストが示されているものを抽出
- 抽出の結果, 10本の論文を得た

調査方法 | アンケート調査

既存研究のGithubプロジェクトリストを利用し、
2段階に分けてアンケート対象者を選択（9,095人）

- Phase1：コミット経験に注目（3,072人）
 - 各プロジェクトのコミット数上位30名
- Phase2：issue, pullreq経験に注目（6,023人）
 - 過去12ヶ月以内にissue, pullreqを投稿したことがあるユーザ

9,095人にアンケートを配布し、455人の回答を得た

- 回答率：5%

分析方法

RQ1

- 561のスキル関連項目からなるデータセットを利用
 - OSSにおけるスキルの例を挙げる設問への368名の回答
 - ソフトウェア工学のスキルに関する193件の文献
- 質的コーディングのベストプラクティス^[54]に従いコーディング
- 分析の結果より, OSSスキルモデルを作成

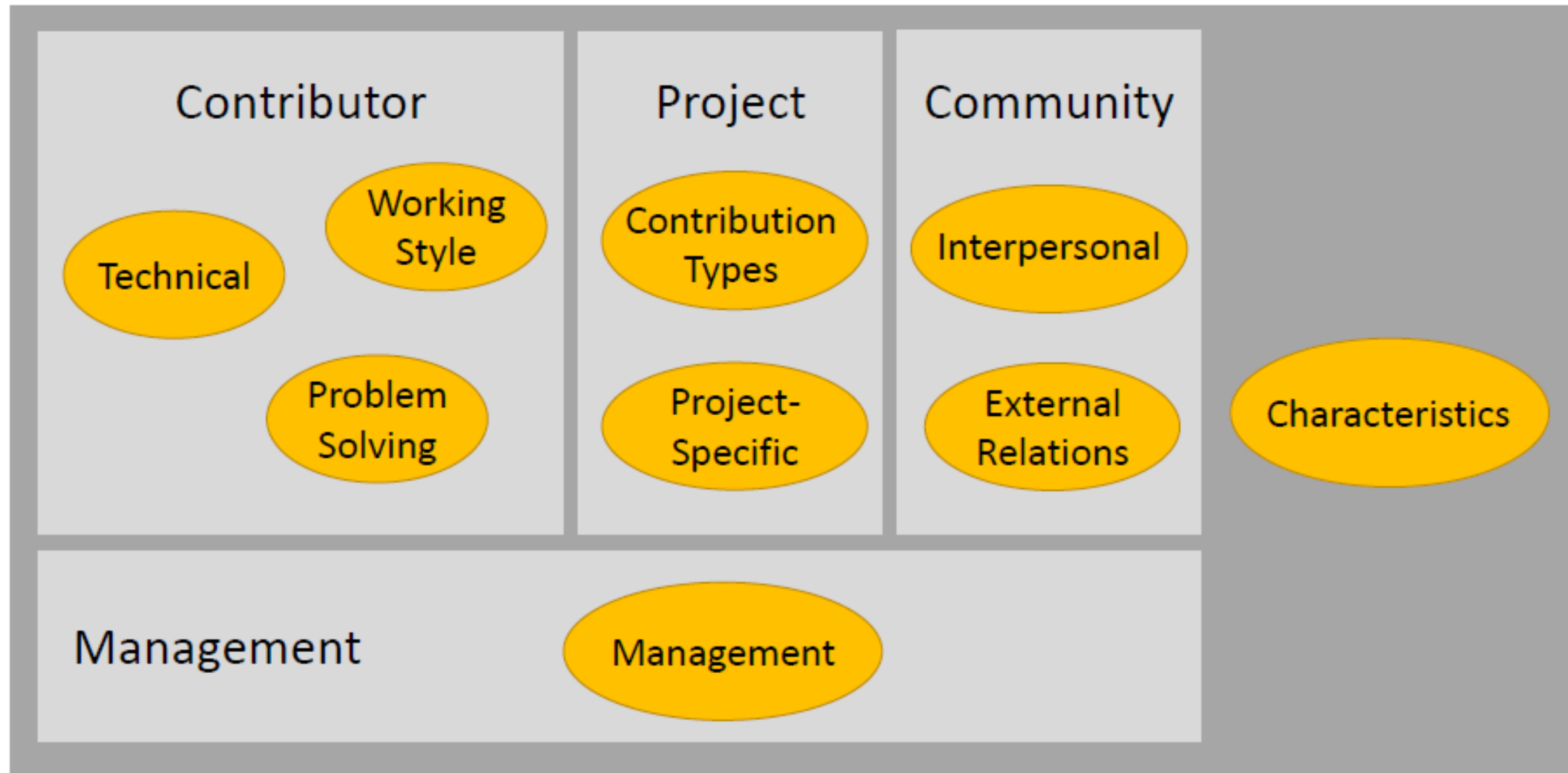
RQ2, RQ3

- オープン形式とクローズド形式の質問を組み合わせる
- オープン形式については, Kitchenham and Pfleeger^[36] の分析方法に従って分析を行う

[54] Johnny Saldaña. 2009. The coding manual for qualitative researchers. SAGE.

[36] Barbara A. Kitchenham and Shari Lawrence Pfleeger. 2008. Personal Opinion Surveys. In Guide to Advanced Empirical Software Engineering, Forrest Shull, Janice Singer, and Dag I. K. Sjøberg (Eds.). Springer, 63–92.

RQ1 | OSSに関連するスキル



9カテゴリ45スキルからなるOSSスキルモデルが構成でき、
貢献者の特性が他のスキルの基礎となることがわかる

RQ2 | OSS貢献者のスキル向上する理由

Table 2: Reasons why participants learned new skills with over 20 occurrences; for the full list, please refer to the supplemental materials [39].

Reason	Count
Amount of resources available or difficulty to learn the skill	68
Benefitting themselves or professional career in the future	56
Importance and usefulness of the skill on the OSS community, teammates, and world	45
Improving areas of weaknesses identified by the contributor or others	42
Personal interest in an area or project that requires the skill	39
Personal goals	28
What is required for their current roles in OSS projects	28

OSS貢献者は、自分の興味、キャリアに役立つこと、ニーズ、時間などのリソース、発見した改善点に基づいて、新しいスキルを学んでいる

RQ2 | OSS貢献者のスキル向上方法

Table 3: Examples of how participants considered growing their skills with at least 40 occurrences; for the full list, please refer to the supplemental materials [39].

Example	Count
Continued efforts to keep learning	90
Contributing & helping maintain a project	86
Actively practicing skills to grow	83
Reading code committed by others	54
Reading non-code content including blogs and documentation	64
Reading over code reviews as well as reporting & fixing bugs	63
Actively engaging with the project and community	61
Consistently challenging oneself	47
Observing experts and finding mentors across projects	44
Networking & forming strong connections w/ peers	44
Staying curious & creative by tinkering	43

OSS貢献者はスキルを向上させるために、単独作業から共同作業まで、様々な方法を用いている

RQ2 | OSS貢献者のスキル向上に関する考え

Table 4: Percentage of respondents who contribute to an OSS project based on what they can offer vs. what they gain.

I choose to contribute to an OSS project based on...	
the skills that I can offer to the project.	80%
the skills that I can gain from the project.	50%
I would choose to contribute to a project if I knew...	
they were looking for contributors with a skill I have.	69%
it had a collaborator who was strong at a particular skill.	42%

OSS貢献者は、新しく習得できるスキルや、
自分の提供できるスキルにもとづいて
プロジェクトに参加している

RQ3 | OSS貢献者のスキル共有理由

Table 5: Motivations for why participants would share their skills with others with over 20 occurrences; for the full list, please refer to the supplemental materials [39].

Motivation	Count
Improving career prospects	58
Building a profile of who they are as a contributor	55
Promoting transparency and building trust with others	49
Improving reputation and self-confidence through recognition	43
Finding experts or being considered as an expert by others	42
Finding new opportunities to contribute to on OSS platforms	39
Becoming motivated to improve themselves or others	30
Helping others, especially via knowledge sharing	27
Expanding social network	25
Comparing to others and “gamifying” the skills system	23

キャリアの将来性の向上, 評判や自身の向上など,
OSS貢献者は自分自身のためにスキルを
共有したいと考えている

RQ3 | OSS貢献者のスキル公開方法

OSS貢献者はGitHub(74%)やLinkedIn (54%)を利用している

GitHub

- 公開リポジトリ(90%)
- OSSプロジェクトへの積極的な貢献(80%)
- プロフィール記述(62%)

LinkedIn

- プロフィールのスキル欄(80%)
- プロフィールのプロジェクト欄(61%)
- プロフィールの経験欄(56%)

結論

OSSの開発を支えるスキルについて調査

- 9カテゴリー45スキルからなるOSSスキルモデル
- OSS貢献者がどのようにスキルを向上させているのか
- OSS貢献者がどのようにスキルを示したいのか

本研究による利益

- OSS貢献者
 - 自身のスキルの向上を推進することができる
- 研究者
 - 本研究を拡張して、新しいツールを構築したり、OSSにおけるスキルの研究をさらに推進したりすることができる

所感

| 分析手法で理解できなかった部分があった

- 抽出した10本の文献リストと193本の文献の存在

| RQ2の結果について自分の経験とあっているように感じた

- 「最初は自分のスキルアップのために始めて、その後自分のスキルを人の役に立てたいと思うようになった」

補足資料

補足 | アンケートの質問事項の一部

SURVEY QUESTIONS

- ★ How do you define skills in the context of OSS? What are some examples of such skills?
- ★ What are your strategies to grow your skills in the context of OSS?
- ★ What factors influence which skills you want to improve on?
- Do you use GitHub to display skills and experiences that are relevant for OSS development?
- Do you use LinkedIn to display skills and experiences that are relevant for OSS development?
- As a maintainer, do you use GitHub to determine what skills a potential contributor has?
- Which of the following information about your skills would you display on GitHub to just yourself, your collaborators, and the public?
- ★ What motivates you to share skills information with others?
- ★ Can you give examples of when it would be helpful to share skills information with others?

Figure 1: A subset of the survey questions. Open-ended questions are indicated with a star (★). The complete survey instrument is in the supplemental materials [39].

補足 | OSSスキルモデルの詳細①

Table 1: A list of skills based on the literature review and analysis of survey responses. 🧑 = 1-10 survey mentions, 🧑🧑 = 11-20 survey mentions, 🧑🧑🧑 = 21-50 survey mentions, 🧑🧑🧑🧑 = 51-100 survey mentions, and 🧑🧑🧑🧑🧑 = 100+ survey mentions.

Skill & Description	Sources	
	Literature	Survey
Technical Skills		
<i>Programming.</i> Has skills in basic programming (e.g., testing, code comprehension, debugging)	[38], [47], [63]	🧑🧑🧑🧑🧑
<i>Software engineering.</i> Has skills in good software engineering practices (e.g., software design, software architecture, requirements, refactoring, writing maintainable code)	[6], [29], [38]	🧑🧑🧑🧑
<i>Technologies.</i> Is familiar with specific programming languages, tools, technologies, or frameworks	[6], [34], [38], [47]	🧑🧑🧑
<i>DevOps.</i> Has knowledge in DevOps to deliver software quickly and efficiently		🧑
<i>Domain.</i> Has domain-specific knowledge or expertise	[16], [38], [47]	🧑🧑
<i>Version control systems.</i> Has basic version control knowledge (e.g., resolving merge conflicts)	[47]	🧑🧑🧑
Working Styles		
<i>Excellence.</i> Strives to achieve excellence or produce high-quality work by paying attention to smaller details; takes pride in one's work	[6], [16], [29], [38], [43], [63]	🧑🧑
<i>Available.</i> Has time available and is present to answer questions or work with others	[6], [12], [16], [34], [38], [47]	🧑
<i>Organized.</i> Keeps things in order; works in a systematic way		🧑
Problem Solving		
<i>Creative.</i> Ideates creative solutions to solve a problem	[29], [38]	🧑
<i>Initiative.</i> Takes initiative to solve problems; executes on the steps to address problems	[34], [38], [43], [63]	🧑🧑
<i>Analytical.</i> Is able to analyze, apply logical reasoning to, or critically think through problems and solutions	[29], [34], [38]	🧑🧑
Contribution Types		
<i>Bug triaging.</i> Determines the severity of a bug		🧑🧑
<i>Bug reporting.</i> Finds and reports defects in software		🧑🧑
<i>Code review.</i> Reads through and provides feedback on code contributions		🧑🧑
<i>Documentation.</i> Writes content to convey technical information to broad audiences (e.g., documentation)	[16], [63]	🧑🧑🧑🧑
<i>Visual design.</i> Creates visuals for the OSS project (e.g., graphics, UI/UX)		🧑🧑
<i>Translation.</i> Translates content to another language (e.g., localization)		🧑
Project-Specific Skills		
<i>Purpose.</i> Understands and believes in the purpose and societal impacts of the project or OSS development at large	[16], [34], [38], [43], [63]	🧑🧑🧑
<i>Organization.</i> Understands the file and team structure of a project	[31], [34], [38], [63]	🧑🧑
<i>Processes.</i> Follows project processes and rules	[16], [29], [31], [34], [38], [47]	🧑🧑

補足 | OSSスキルモデルの詳細②

Interpersonal Skills		
<i>Kind.</i> Empathizes with others and show kindness	[12], [29], [34], [38], [47]	👤👤👤
<i>Communication.</i> Clearly communicates with others in written and oral forms	[6], [12], [29], [31], [34], [38], [47]	👤👤👤👤
<i>Asking for help.</i> Knows how to ask for help when one needs it	[29], [38]	👤
<i>Giving help.</i> Actively helps others when they need it; mentors, guides, or teaches others in the team	[6], [16], [29], [31], [34], [38]	👤👤
<i>Conflict resolution.</i> Resolves conflicts between people	[29], [34]	👤
<i>Collaboration.</i> Works with people from diverse backgrounds to achieve a shared goal	[29], [31], [34], [38]	👤👤👤
External Relations		
<i>Stakeholders.</i> Works with stakeholders to coordinate OSS development	[16], [29], [31], [34], [38], [63]	👤👤
<i>Marketing.</i> Promotes the project to broader audiences	[31], [63]	👤
<i>Licenses.</i> Understands the process of obtaining a license for the OSS project	[63]	👤
<i>Funding.</i> Obtains funding for the OSS project	[63]	👤
Management		
<i>Community.</i> Cultivates an engaged, healthy community; is involved in community governance	[12], [16], [29], [31], [34], [38], [63]	👤👤👤
<i>Project.</i> Is a project leader and directs the completion of a project (e.g., setting standards, meeting deadlines)	[16], [34], [38], [43], [63]	👤👤👤
<i>Planning.</i> Plans the next steps for what is ahead	[16], [38], [63]	👤👤
<i>Delegating.</i> Effectively assigns tasks to others	[34]	👤
<i>Time.</i> Manages one's time effectively given the tasks at hand	[12], [38], [63]	👤
Characteristics		
<i>Adventurous.</i> Is willing to take risks	[12], [29], [34]	
<i>Open-minded.</i> Is open to new ideas and viewpoints	[6], [16], [29], [34], [38]	👤👤
<i>Patient.</i> Accepts unexpected delays or problems without being upset	[6], [16], [29], [47]	👤👤
<i>Adaptable.</i> Adapts to changes in the environment	[29], [38]	👤
<i>Curious.</i> Is eager to learn or know new things; continuously learns	[6], [16], [29], [38]	👤👤👤
<i>Reliable.</i> Is reliable and consistent between one's actions and words	[29], [34]	👤
<i>Persevering.</i> Consistently works through difficult or unexpected situations independently and with a positive attitude	[29], [38]	👤
<i>Diligent.</i> Works hard to complete tasks; is committed and focused	[16], [29], [34], [38], [43], [47]	👤👤
<i>Self-aware.</i> Assesses one's situation and makes corrective actions; is transparent and accountable to one's actions; displays confidence based on an accurate understanding of abilities	[6], [16], [29], [38]	👤