Evaluating the Impact of Collaboration Modes on Software Delivery Efficiency in Open-Source Projects

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1. Motivation

- **Modern software systems** are **growing in size and complexity**, increasing the need for **efficient collaboration** to sustain development speed and quality [1].
- In **open-source software (OSS)** projects, diverse contributor backgrounds and asynchronous workflows introduce **challenges in managing collaborative, communicational, and human aspects**.
- **Prior research** has linked **team** size, experience, and **communication** patterns to **developer productivity** [2,3].
- OSS projects increasingly rely on **efficient delivery pipelines**, yet the **impact of collaboration** modes on **delivery** efficiency remains **underexplored**.
- Understanding the **socio-technical dynamics** of OSS teams could inform better **project governance, contributor onboarding, and tooling decisions**.

2. Research Questions

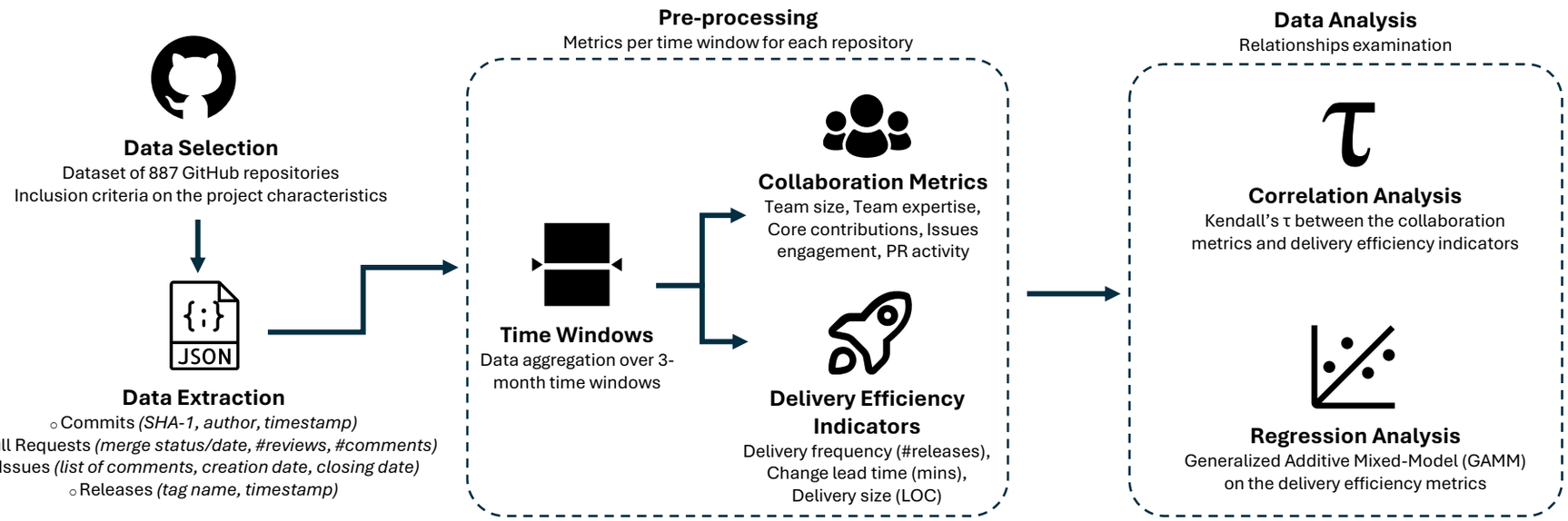
How do collaboration modes affect software delivery efficiency in open-source projects?

RQ1: How do team size and expertise influence delivery frequency and size?

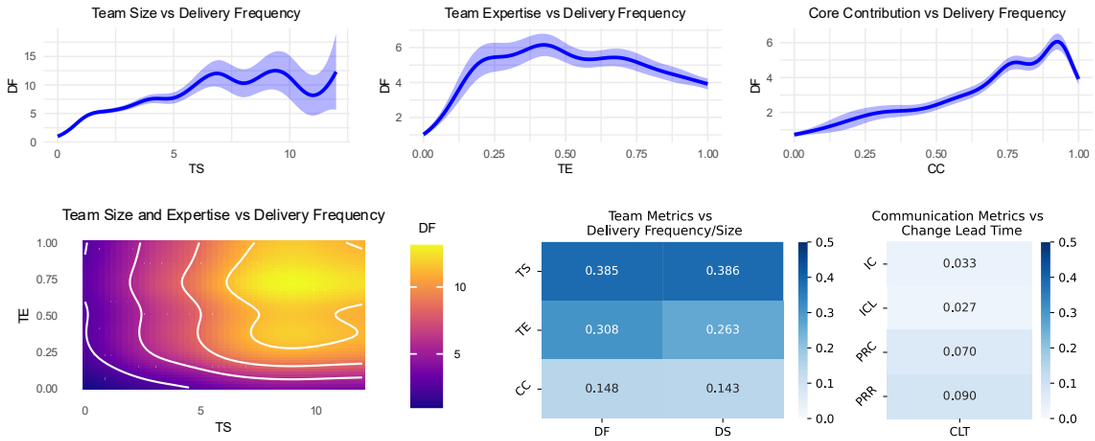
RQ2: Does the fraction of core developer contribution impact delivery frequency and size?

RQ3: Is change lead time affected by the amount and depth of developer communication activities on issues and pull requests?

3. Methodology



4. Results



- **Team size** shows the **strongest associations** with both delivery frequency and delivery size, with the gains levelling off at around **7 developers**.
- **Team expertise** and **core contribution** show moderate **positive effects** on delivery efficiency, with the effects being **nonlinear and time-dependent**.
- **Communication activities** show **no pronounced relationship** with change lead time, with the influence being **weak and inconsistent** over time.

5. Discussion

- **Coordination costs** and **productivity trade-offs** require **adaptive team structuring** rather than simple scaling.
- The effect of **expertise increases over time**, indicating the increasing **value of deeper project knowledge**.
- **Communication** volume **lacks explanatory power**; **quality**, **context**, and **sentiment** could also be analyzed.
- **Confounding factors**, like project **governance**, **domain**, or **policies** could also be studied in **future research**.
- Findings can guide **adaptive CI/CD practices** and **team structuring** in evolving OSS projects.

References

[1] Les Hatton, Diomidis Spinellis, and Michiel van Genuchten. The long- term growth rate of evolving soft-ware: Empirical results and implications. 2017.
[2] Bogdan Vasilescu, Yue Yu, Huaimin Wang, Premkumar Devanbu, and Vladimir Filkov. Quality and productivity outcomes relating to continuous integration in github. 2015.
[3] Nicole Forsgren. Octoverse spotlight: An analysis of developer productivity, work cadence, and collaboration in the early days of covid-19. 2020