Understanding Productivity of Colombian Development Teams Working on Remote Environments

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Abstract. *This project is a collaborative effort to understand and address productivity challenges in remote development teams, employing a multifaceted approach that integrates software engineering, psychology, and design thinking methodologies. The initial focus has been on developing a tool for mining GitHub repositories, laying the groundwork for subsequent phases of the research.*

1. Introduction

During the pandemic, the restrictions imposed by health organizations forced software companies to make an accelerated transition from their in-person operations to fully/partial remote environments . The World Health Organization (WHO) declared the end of the global health emergency due to Covid-19 in May 2023. However, remote work has not finished, instead it has become the new "normal" in the software industry.

Although there are several theoretical benefits of remote work, such as flexibility for employees and savings on the normal commuting time to the workplaces [Ipsen et al. 2021], previous work has shown that the productivity [1] of development teams has changed significantly [Almeida et al. 2023, da Mota Silveira Neto et al. 2022, Bao et al. 2022, Smite et al. 2022, Russo D. 2021]. It is worth noting that we did not find a consensus in the literature about which indicators should be considered to evaluate productivity. For example, some works [da Mota Silveira Neto et al. 2022] use indicators that are calculated from repositories/planning tool activity (e.g., commits, pull-requests, issues). In addition, industry companies may use financial indicators such as project profitability.

Despite the efforts made by some software development companies, they recognize that the improvement in productivity is still a challenge and that new approaches are required to create best work environments where employees feel safe, supported, and productive. At the moment, there is a lack of certainty about the factors that caused positive/negative impact on the productivity of the development teams who work in remote

[1]In the context of this project, productivity is understood as the relationship between effectiveness and efficiency, not only evaluating the quantity of contributions but also their quality.

environments. A Colombian company, whose name we are unable to disclose, brought this problem to our research group.

When reviewing the literature, we found various studies [Bao et al. 2022, Ralph et al. 2020] that address this problem at a global level, pointing out that, especially for extensive projects, physical presence in the office favors team cohesion and improves communication, crucial elements for greater productivity. It is likely possible that some of the results found at global level would be applicable to Colombian development teams, but we believe that other factors may appear considering our social/economic/cultural situation.

Given that, we decided to formulate a project where the problem is investigated by industry practitioners and professors/students from the System and Computing Engineering Department and the Psychology Department. The project objectives are: (i) to determine the factors that impact the productivity of development teams in remote environments; (ii) propose a set of new practices to mitigate the impact of the factors identified above.

2. Proposal

The phases of the project are: indicators scoping, mining of software artifacts, focus groups/surveys and co-creation. Such phases are described below.

2.1. Indicators scoping

The purpose of this phase is to select which indicators should be considered to evaluate productivity in remote environments. Each company may have its own indicators but we believe that it is important to reflect on how the remote modality has change software development activities, such as, problem solving, coding, communication, messages management, meetings participation, testing and so on [Russo D. 2021]. As a result, we select indicators from the most relevant activities and explore where these indicators might come from. Some of them may already be available in company systems but others might require mining of software artifacts.

2.2. Mining of software artifacts

We propose mining code repositories or other useful artifacts in the company's development process to have objective information (i.e., KPI's and visualizations) that can be used in the discussion of the ofcus groups and in the design of the survey. For example, based on the repositories, we could analyze team productivity in terms of commits/pull-requests/issues during a time-window of interest (pandemic period with lockdown, post-pandemic period, etc.), taking into account developer experience. Some indicators are given below for illustration purposes:

- The number of commits needed to solve a bug and the number of issues created and resolved will demonstrate the ability of developers to solve problems and to prioritize development activities, which is essential for efficient project management.
- The total number of pull requests will allow us to have a vision of the speed and efficiency of reviewing and merging the code.

- The number of closed pull requests will indicate the degree of team collaboration and the quality of the code review process.
- The time developers have spent in the repository will allow us to evaluate the experience accumulated in the project and their way of acting in the face of different circumstances, such as: their ability to resolve bugs efficiently, the way in which they transmit the knowledge (evaluated through participation in code reviews).

Aforementioned indicators could motivate questions for the focus groups and in the survey. For example, suppose that repository metrics show a decrease in the number of commits that resolve issues. This finding can motivate questions such as: what are the causes of this decreasing behavior since developers are working remotely?

2.3. Focus groups and surveys

In a nutshell, the focus groups and the survey will allow us to collect the perception of development team members regarding the impact of remote work on productivity.

In particular, the objective of the focus group is to improve understanding of the problem and to determine additional elements that can be measured in the study. Different people will be invited to focus groups to have different perspectives on the situation under study, for example, people with the following characteristics: i) living in Bogotá or outside; ii) had having a process of onboarding and work 100% remote; iii) working in the company under a face-to-face modality since before the pandemic; iv) participating in projects with high or low profitability; v) having dependents or not, etc.

For the design of the focus groups, the insights obtained in the *mining of software artifacts* will be taken into account. The information from the focus groups will be transcribed, organized and analyzed to guide the design of the survey.

The survey seeks to collect perceptions through guiding questions that are aligned with the priorities of the research. The surveys are aimed at a wider audience than those who participated in the focus groups in order to have a significant volume of data to analyze.

Both the execution of the focus groups and the application of the survey will be chaired by the University researchers and that the information collected will be disclosed in aggregate form at the project level and not at the individual level, in order to provide a safe environment for participants to share their opinions.

2.4. Strategies co-creation

We propose socialization meetings aimed at all members of the company where the results will be shared and a collective reflection will be made on what strategies could help improve productivity, taking into account the particularities of the stakeholders identified in the study. Finally, the project includes the approach of how to follow up on the strategies that the company decides to implement.

3. Results

So far the project progress has been the development of a tool to mining Github repositories. The reason to choose this kind of artifact is that repositories are one of the main

artifacts that shows software development productivity. In addition, they are many open-source Github repositories that can be used to evaluate the tool prototype. The tool architecture consists of the following nodes:

- A client node hosts critical components such as Tableau Desktop and a Web user interface which provides the ability to interact with the data effectively. This node authenticates with Github Authentication API to guarantee a secure interaction with repositories.
- A server node, composed of Uvicorn and FastApi, supports the extraction and transformation of the repositories data which is available by accessing the Github API. In addition, it helps on efficiently delivering the data to the client node.
- A PostgreSQL node stores the extracted data.

The tool has been evaluated in two manners: i) experiments to test that the tool is functional when analyzing different open-source repositories; ii) a survey to evaluate the usability perceived by industry users. The remaining phases of the project are ongoing work.

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