

From Dusk till Dawn: Reflections on the Impact of COVID-19 on the Development Practices of a R&D Project

Walter Lucas Monteiro de Mendonça, Pedro Henrique Teixeira Costa, Emille Catarine Rodrigues Cançado, Fernanda Lima, Edna Dias Canedo, Rodrigo Bonifácio, and Luis Henrique Vieira Amaral
Department of Computer Science, University of Brasília (UnB)
Brasília, DF, Brazil

waltimlmm@gmail.com, phtcosta@gmail.com, catarine.emille@gmail.com, ferlima@unb.br, ednacanedo@unb.br
rbonifacio@unb.br, luis.amaralh@gmail.com

ABSTRACT

Responding to change over following a plan is one of the Agile Manifesto's values. According to its original perspective, development teams should *embrace changes* due to a better understanding of the business domain or about the users' needs. This kind of change is well understood and explored by practitioners and researchers. However, the issue of how development teams embrace changes due to unexpected, severe, and atypical external events (like the ones we are facing during COVID-19) have not been fully discussed. In this paper, we present our experience in managing the expectations and changing the development methods to mitigate the risks of carrying out a research and development project (named Virtual Social Office-VSO) during a pandemic time. To this end, we report on an observational study that explains the main differences between the procedures we expected to follow before the pandemic and the procedures we are following. We also present the perceptions of both stakeholder and development teams about the impact of COVID-19 on VSO development. Although the development team quickly adapted itself to work from home, we observed some impact on the development plans. In particular, trying to reconcile the trade-offs between *completeness* and the *tight schedule* for the first release was a challenge, since we depended on different partners to collect the information that we need to make available in a mobile application (app) that corresponds to one of the VSO project outcomes. According to one stakeholder, the initial effort to design and prototype the VSO app (using the Design Thinking approach) before the start of the pandemic, has been considered essential to mitigate part of the threats that arose due to the COVID-19. We discuss part of these threats in this paper and the actions we have been taking to mitigate them. In addition, according to members of the development team, working remotely presents both challenges (e.g., adapt to a new routine, prepare a comfortable place, isolation feelings), and benefits (e.g., working hours flexibility, less distraction from co-workers).

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1 INTRODUCTION

We started a Research and Development (R&D) project on August 2019, named *Virtual Social Office* (VSO), a cooperation with four different institutions. This project aims to design and develop a mobile app to help people who hold criminal records to reintegrate themselves into their daily life, outside the prison. Everything was working fine. During the months from August until December 2019, we worked in a small team to understand, design, and prototype the VSO app—using a Design Thinking [13] strategy and having regular, face-to-face meetings with different stakeholders (including people who served a sentence in prison). Meanwhile, we also explored privacy concerns that are inherent to the target users of the VSO app.

We presented the main ideas of the app to the sponsors of the project on December 2019 (including members of the Brazilian Supreme Court). On March 2020 we started the second phase of the project with a team around 20 people (involving software developers, user experience (UX) designers, and researchers). Our initial plan was to have face-to-face development activities (e.g., pair programming and coding dojo) and meetings among the team members and different stakeholders. However, just after setting up the development team, the outbreak of COVID-19 prevented all face-to-face activities. Unsurprisingly, we had to deal with a new risk: *Would we be able to manage all project's expectations even in the presence of the COVID-19 pandemic?*

In this paper we present an experience report on transitioning the development processes of an R&D project to a *work from home* configuration. The main goal of this paper is to share our knowledge on dealing with this unexpected situation which demanded us to (a) rethink the scope of the VSO app and its release plan, (b) review our development procedures rapidly, and (c) change the way we used to communicate with the stakeholders. To this end, we follow both quantitative and qualitative approaches based on a case study to explain the impact of COVID-19 in the work practices

we use in our project and a survey with the participants to collect their perceptions about *work from home* in our specific scenario. Altogether, we answer the following questions:

- (RQ1) What practices have been changed during our transition from *work onsite* to *work from home*?
- (RQ2) What are the additional challenges and risks that COVID-19 imposes on our R&D project and how do we mitigate them?
- (RQ3) What are the perceptions of the development team and stakeholders about the impact of COVID-19 and the need to follow a *work from home* configuration to develop the project?

Answering these research questions is important it is still not so clear how long the pandemic will still last and how it is going to change the work practices around the world. A specific call-for-papers from the Empirical Software Engineering Journal highlights this relevance [11].

“[The COVID-19] pandemic is already reshaping the way we work, also in software engineering, and drives changes to processes, methods, the use of collaboration tools etc. More effects will likely be seen in the years to come... the empirical software engineering community can also play a role to help study and understand the effects of the pandemic and its many and broad repercussions [11].”

Our research brings several results, some of them unexpected. For instance, our findings suggest that (a) the transition to *work from home* do not impact the performance of the development team, (b) the use of collaborative software development and communication tools (e.g., Slack, Discord, and Bitbucket) are an effective replacement to face-to-face development practices, and (c) the communication with stakeholders introduces the main challenge when having to deal with the interruption of face-to-face activities.

We present the research context in Section 2. After that, in Section 3 we detail the research procedures of our empirical study. Section 4 highlights the main findings of our research; while in Section 5 we discuss some lessons learned and the limitations of our study. Finally, Sections 6 and 7 present the research studies that relate to our work and some final remarks.

2 RESEARCH CONTEXT

This work presents an experience report on the impact of COVID-19 on the practices we use to conduct an R&D project, in particular considering the transition from *work on site* to *work from home*. This research is a collaboration project between the [Blind Review], the National Council of Justice (CNJ), the [Blind Review], and the [Blind Review] local research foundation. Besides investigating the impact of new technologies into re-socialization processes, another outcome of this collaboration is the development of a mobile application named Virtual Social Office (VSO), whose goal is to inform and assist in the post-prison re-socialization process.

The Virtual Social Office brings some of the services currently offered by the (physical) Social Offices, a recent initiative from the National Council of Justice that aims to aid people who hold criminal records and their families with information that might help in their re-socialization process. It provides the former inmates useful features such as the location and contact of public shelters,

health centers, and low-cost restaurants. The VSO also supports former prisoners by providing them with data on their prosecution status, how to access free legal assistance, and also indicates how to regularize their documentation. Finally, the Virtual Social Office also seeks to facilitate the former inmates' ability to adapt to the job market; it provides information on vocational courses, job training, job tips, among other features.

2.1 Project Timeline

The research project activities started in August 2019, with regular face-to-face meetings involving three stakeholders from CNJ and five participants from [Blind Review] (3 researchers, one user experience designer and one software architect). Initially, we articulated the research questions that would be investigated during the project and presented the techniques and tools that would be used to conduct the activities. Our initial purpose was to understand the VSO features and characteristics, as well as start the design of a prototype.

In the first stage, while we were having meetings with the stakeholders, we proposed to conduct interviews and questionnaires with former inmates and workers from the physical Social Office of Espírito Santo, the first state in Brazil to introduce this kind of social equipment. With the consent of all stakeholders, the interviews were conducted with 3 former inmates. The objective was to understand, from the end-user's point of view, the main needs to be met by the application and build them in the visual prototype. From the perspective of these users, we were able to identify relevant information regarding the functionality that the application should have. The interviews were mediated by both the CNJ stakeholders and the [Blind Review] research team, with at least one representative of each team present in each of the interviews.

In addition, we used the Blueprint of Services tool [17] to prepare a questionnaire to be answered by workers from the physical Social Office at Espírito Santo, in order to understand how they serve their audience and how the service provided could also be applied in the VSO. The answers obtained in this questionnaire allowed us to understand the needs of the former inmates from a different point of view: the one of a team that already serves them daily, making it clear for us which services and useful features the Virtual Social Office should provide. After collecting this data from the physical Social Office and from the three former inmates we interviewed, a prototype version of the Virtual Social Office application was designed and presented in December 2019.

We resumed the project activities in the beginning of 2020, and new weekly meetings were held in order to further refine our understanding about the features in the VSO prototype. Such meetings were conducted in person until March 2, 2020, just after setting up a team of software developers and 10 days before the beginning of the period of social isolation in our city, due to COVID-19. Since the isolation that took place on March 12, 2020, meetings began to be held virtually and less frequently when compared to the weekly frequency that had been previously adopted.

2.2 VSO System's Architecture

Regarding technical decisions, Figure 1 shows the architecture of the system, organized in three distinct tiers. The first tier (from left

to right) is a mobile app that we are developing using the React Native framework [9]. This is a multiplatform mobile application framework developed by Facebook. The second tier relies on a the microservice architectural style—a development approach of a single application released as a set of small services [16], each executing its own process and collaborating through technology-independent messages protocols [7]. We are implementing this tier using the Spring Boot stack [22]. Finally, the third tier represents the content providers, which are the legacy systems from external partners that make available the information that is relevant to the Virtual Social Office. We use different technologies to integrate with those legacy systems, technologies ranging from well-defined calls to web services to the simple download of spreadsheets.

3 STUDY SETTINGS

This research aims to investigate the impact caused by the transition of a research and development project from *work on site* to *work from home*, due to the COVID-19 pandemic. We focused on observing the practices we had to adopt and the risks and challenges associated with this change. We also investigate the perceptions of the software development team and the stakeholders. To this end, we used a mixed-method approach. First, we looked at the practices adopted in conducting the project and the results that followed from our choices. Second, we conducted semi-structured interviews with participants of the research project to assess their motivations, expectations, learning, time commitment and the exchange of experiences among members of the project team. We also conducted interviews with stakeholders to see how well we have met their expectations and secondly how the pandemic affected our procedures for requirements elicitation.

3.1 Procedures of the first study: A case study

To answer the research questions RQ.1 and RQ.2, we report on our observations of the activities carried out by the development team during the period of social isolation. Our aim is to identify which work practices have been changed, as well as what challenges and risks were faced by the team during this period. We also observed how the interactions with the stakeholders have been affected, since the stakeholder team started to assume other responsibilities during this period. That is, in this case our main focus is to report the impact of COVID-19 in the interactions between development teams and stakeholders, which surely might compromise not only the productivity of teams, but also the quality of the products. Although research in this area is recent, we believe that we are the first to explore the perspective of the relationships between development teams and stakeholders.

We use a *mining software repository* [14] approach to characterize the work practices of the development team. To this end, we leverage the facilities of the *git log* tool [8] to find out the frequency of the development team contributions and to find out whether or not the *work from home* situation leads developers to work at unusual hours.

3.2 Procedures of the second study: interviews

To answer the third research question (RQ.3), we conducted semi-structured interviews [15] with members of both development and stakeholder teams.

Participants Selection. We invited the main stakeholders directly involved in the project to participate in the interview; at that time, only three people. Furthermore, all members of the development team participated and we were able to interview ten participants, in total (one stakeholder could not participate). Table 1 shows demographic information. We built two different interview scripts, one for the members of the development team and another for the stakeholders. The first two interviews with developers were conducted in a pilot format, with the aim of evaluating the scope of the interview script and its duration. Afterwards, we reviewed the interview script and made minor adjustments to improve the questions. In total, we interviewed 8 participants of the development team and 2 stakeholders. The interviews with the stakeholders were not on the same day. Furthermore, we discussed our protocol after the first interview and we decided to keep the same questions for the other stakeholder. A pilot was not conducted due to the small number of participants and also the fact that the questions were not changed.

Interview Process and Analysis. We carried out semi-structured interviews using an audio conference software (Skype). We explained to the interviewees that their participation were voluntary and that they could stop participating at any time during the interview. We asked participants for permission to record the interviews in order to allow us to be able to listen to them later, if necessary, during the analysis of the interviews. The interviews were conducted and analyzed in the first week of June 2020. The 10 interviews lasted 23 minutes on average (min: 14 minutes; max: 45 minutes).

The interview script consisted of three stages. In the first, we asked each interviewee about the experience he/she had with software development and if he/she already knew the technologies used in the project. In the second stage of the interview, we asked each participant how many hours (on average) he/she dedicated to the project activities and what were his/her expectations at the beginning of the project. In addition, we also asked what the strengths of working remotely are and the problems/challenges that *work from home* brought.

Finally, in the third stage of the interview, we investigated how the participants dealt or how they are dealing with the problems/challenges faced by working remotely; if they had any difficulty adapting to develop their activities at home; and how they assessed their motivation during the period of social isolation. We also asked if the tools we are using to interact with the project members are meeting the communication needs. If not, where do these tools fall short of expectations. Finally, we inquired whether they would be interested in continuing to work on the project remotely and why, once the period of social isolation ends.

We listened to the audios of the interviews and transcribed the information. Initially, this activity was carried out by two of the authors and subsequently validated by another author. We aimed

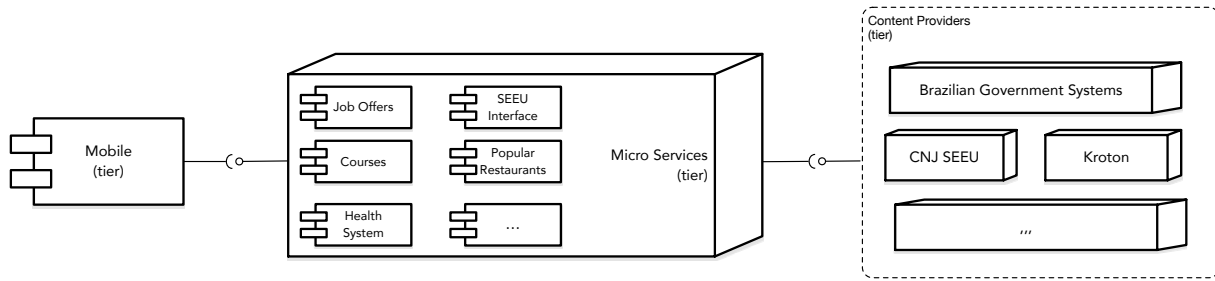


Figure 1: Overall architecture of the VSO system

ID	Role	Development Exp.	Technologies Exp.	Remote Exp.	Work Environment	# of Children	# of People
P01	Software Architect	17 years	Yes	Yes	Shared room	None	Five
P02	UX Designer	4 years	Yes	Yes	Exclusive	None	One
P03	Scrum master	5 years	None	Yes	Exclusive	None	Two
P04	Developer	4 years	Yes	None	Exclusive	None	One
P05	Developer	4 years	None	None	Exclusive	None	Two
P06	Developer	2 years	Yes	None	Exclusive	None	Two
P07	Developer	Less than one year	Yes	None	Exclusive	One	Four
P08	Developer	Less than one year	None	None	Shared computer	One	Three
P09	Stakeholder	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
P10	Stakeholder	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Table 1: Profile of the development project team members and stakeholders

to verify whether we wrote down all relevant information for understanding the perception of participants, in relation to the issues investigated.

4 RESULTS

In this section we present the results of our research. First, in Section 4.1 we highlight some observations of the impact of COVID-19 on the development of the Virtual Social Office system. We focus on three distinct perspectives: impact on managerial aspects, impact on the design and requirements elicitation aspects, and impact on development practices. Second, we present the results of our survey with the development and stakeholder teams.

4.1 Results of the First Study: A case study

4.1.1 Impact on the Project Management. Regarding the impact of the pandemic on management, the main influence of the COVID-19 was on the communication with the stakeholder team, as well as on the establishment of partnership with possible organizations that could feed relevant and curated information to the Social Virtual Office.

The face-to-face meetings with the stakeholders suddenly ended, as soon as the first cases of COVID-19 arose in [Blind Review]. We tried to substitute these encounters with online meetings, with the same frequency, but unfortunately it did not happen. The main reason for this problem is that the stakeholder team had to assume new demands during the COVID-19 time, and the availability of the stakeholders decreased. As such, scheduled interactions were

cancelled many times. The main consequence of that was the postponement of face-to-face activities for both requirements elicitation and validation. To mitigate this problem, the project's coordinators started a couple of actions, including:

- Being more proactive in terms of proposing, designing, and prototyping the requirements of the VSO.
- Finding official, government providers of freely available pieces of information that we could use to populate the VSO databases.

These decisions imposed additional risks to the project, but to keep the project on time, they had been necessary. As a side effect, these decisions not only increased the efforts of the development team, but also demanded us to throw away part of the implementation of an already developed feature. Besides that, the lack of established partnerships with external information providers demanded us to review the order of the features' implementation, and use information that might not be the ideal—which might compromise the quality of the product in the first releases. Besides all of that, these actions allowed us to keep the schedule on time.

The impact of COVID-19 on the project management was significant, even though reviewing the priorities and assuming part of the stakeholders duties allowed us to keep the project on time.

Furthermore, currently we cannot continue the development of the VSO project without the involvement of the stakeholders in similar basis of the first phase of the project. In the case we do not fix our communication, we expect some delays in the development plan.

4.1.2 Impact on the Work Practices of the Requirements Team. From the point of view of design and requirements elicitation, the biggest challenge of working remotely was the distancing from the stakeholder team. With the beginning of the pandemic, the team responsible for collecting data to populate the application and mediate contact with the former inmates was unable to continue dedicating the same priority to the VSO. Therefore, some features had to be temporarily limited due to lack of data.

As we are no longer able to meet the stakeholder team with the same frequency as before the isolation period to collect the information, we were unable to validate all the requirements specifications that were carried out during this period. This resulted in some problems, such as, for example, an extremely important functionality for former inmates, related to the type of housing they could access through the application. We searched the information necessary for this functionality on government websites, suggested by the stakeholders and we carried out the requirements elicitation. After the specification, the UX designer built the prototype of the functionality and we presented it to the development team. After the developers' understanding of the prototype, the proposed solution was implemented.

When the stakeholder team accessed the developed functionality, some questions were asked and several changes were proposed. The level of granularity proposed by the stakeholders team was of a high level and did not need to be as detailed as we had developed. Thus, these changes led to a rework by the development team and the UX designer. This probably would not have happened if we had managed to access to the stakeholders earlier to validate the prototype.

In addition, a challenge still to be faced will be the user tests with former inmates, who have the most diverse profiles. On the other hand, communication between the design and development team has been making great progress, made possible by the use of platforms such as Figma (for the prototyping of screens)¹ and Discord (for meetings). The use of e-mail and WhatsApp for timely and fast communications also collaborates a lot with efficiency.

4.1.3 Impact on the Work Practices of the Development Team. We mined the source code repositories of the project to identify the work practices of the development team. During the months of March until June 2020, the development team implemented six services (out 18 envisioned services), which count 20 586 lines of Java code (698 Java source files, excluding test cases). This code comprises everything that is necessary to implement the services (including the code that loads external data in the service's databases), though ignores code that implements concerns that cut across different services, such as service discovering and API gateways. Regarding the code that implements the mobile tier, we have developed 9248 lines of JavaScript code, in the same period. We argue that our team is somewhat productive during the pandemic time, not only when considering the amount of lines of code we are producing, but also because we are on time with the initial schedule.

Considering the team of developers working in the mobile tier, we realized that the development team is uniform regarding the number of contributions to the source code (in terms of commits) [3]. Figure 2 shows the distribution of commits from the development

team working in the mobile tier. During these three months (from March to June 2020), developers contributed with 51.4 commits on average (min. 39 and max. 68 commits, with a standard deviation of 13.35). By analyzing the git log from March to June, our development team's productivity increased when considering the number of commits, as shown in Figure 3. The development started with 46 commits in March, and we pushed 59 commits to our repository in April. In May, we had 84 commits. Finally, 111 commits were made in June by our development team. Nonetheless, it is difficult to conclude that this increase in the number of commits is only due to the work-for-home scenario. Interestingly, we found that most of the contributions to the mobile tier have been implemented after 3PM, with several contributions confirmed at night or even from dusk till dawn (see Figure 4a). Therefore, we believe that the need for *work from home* might have changed the working hours of the development teams, and this support some of our findings about the benefits *work from home*, as we discuss in the next section. Finally, we also realized a number of contributions made during the weekends, even though Tuesday is the day of week with the highest number of contributions (see Figure 4b). This is somewhat expected, since our weekly meetings occur on Wednesday.

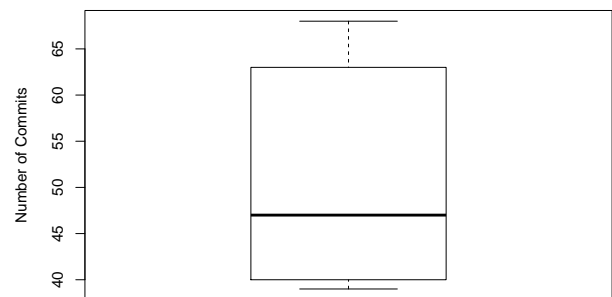


Figure 2: Distribution of commits over the developers of the Mobile Tier

The impact of COVID-19 on the team productivity was small. Almost 30KLOC of code have been developed during the period of March and June of 2020, and all features we have initially planned to this period have been developed.

Nonetheless, we found that the team started to work on unusual working hours during the pandemic time.

4.2 Results of the Second Study: Interviews with the Development and Stakeholder Teams

Here we report the perceptions of the development and stakeholder teams about the impact of COVID-19 pandemic on the VSO research

¹www.figma.com

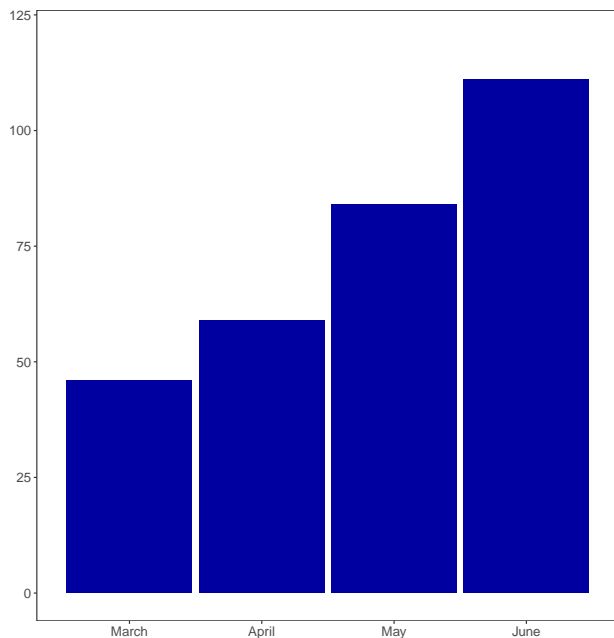


Figure 3: Distribution of commits over the months from March to June

and development project. We first present the perspective of the developers, and then we detail the perceptions of the stakeholders.

4.2.1 Results of the Interviews with Developers. The general perception of the development team is that changing the development plans to start *work from home* did not compromise the expectations and the performance of the team. Surely, some challenges arose in, at first. For instance, communication imposed a clear risk to the project, since we would have to share all knowledge from the first phase of the project with the development team. Nonetheless, the use of tools such as Slack and Discord mitigated the possible limitations of adopting virtual communication. Yet, the communication with the stakeholders led to a more significant challenge, mostly because the stakeholder team had new demands during the COVID-19 period, and the frequency of meetings between the stakeholders and development teams decreased.

“I think the productivity of the team is excellent. For myself, I did not feel any change because I already have worked from home. The only change was the lack of contact with the stakeholders, which caused the need to spend more time looking for information that they would provide and making sure it was accurate.”

Another challenge we faced relates to the practices of our development team, which used to be collaborative, including development practices like pair programming and coding dojos. One of the developers considers that *work from home* hindered these practices, though the technical leaders were able to partially mitigate this problem.

“I believe that the part of the work related to coding dojos would have benefited from on-site interactions. However, without this possibility, the team managed to make the dojo sessions also work remotely.”

Another challenge the development team reported relates to trying to keep discipline and working hours during the pandemic. Regarding these aspects, the participants perceived a more significant impact of the *work from home* approach at the beginning of the pandemic, when they had to familiarize themselves with the technologies used in the project. For some participants, technical questions were not promptly answered by their peers. After a short period of adaptation, most of the participants agree that *work from home* does not impact on development productivity, even though it was difficult to manage the working hours: *“it is very hard to have discipline to organize my schedule.”*

To attenuate this problem, the development team argue that it is necessary to setup a working place at home, free of interruptions. This might be a challenge too, since not all developers are able to isolate themselves at home. One of the participants states that *“he has set up his own work place and nobody interrupts him; and using earphones also helped to concentrate”*. A quote from one of the participants makes this point clear.

“...regarding the remote work during the pandemic, I believe that it interfered negatively in the beginning due to the adaptation difficulties regarding the involved technologies. Although, nowadays, there is no difference in the speed of the team’s activities, working remotely or onsite.”

Previous experience with remote work could impact our adaptation process, so we asked team members. Our findings shows, in Table 1, that none of the developers had prior involvement with collaborative software development remotely, which could be a threat to our development process. Moreover, we collected from the participants other aspects that could also affect the productivity of our team such as the number of people at home, number of children and whether the workplace environment was shared or exclusive [1]. As shown in Table 1, most participants (75%) work in an exclusive environment — one participant shares the workspace, and another shares the personal computer — which can somewhat affect their productivity. Besides, only 25% of the participants have children at home; 6 of the developers answered no. Finally, 62% have up to two people at home while three respondents have 3, 4 and 5 people respectively.

A few practices we are using helped the development team to keep focused, after the adaptation period. First, it is important to notice that, during the months of March and June 2019, we were implementing the first release of the app—which we had just made available to the stakeholders for internal testing only. That is, during this period, we were mostly developing new features—instead of implementing bug fixes, for instance. Accordingly, it was possible to perceive the product *growing up* in every Sprint and it seems to us that this scenario had an effect on the development team’s motivation. *“...currently, my motivation is high because the work is*

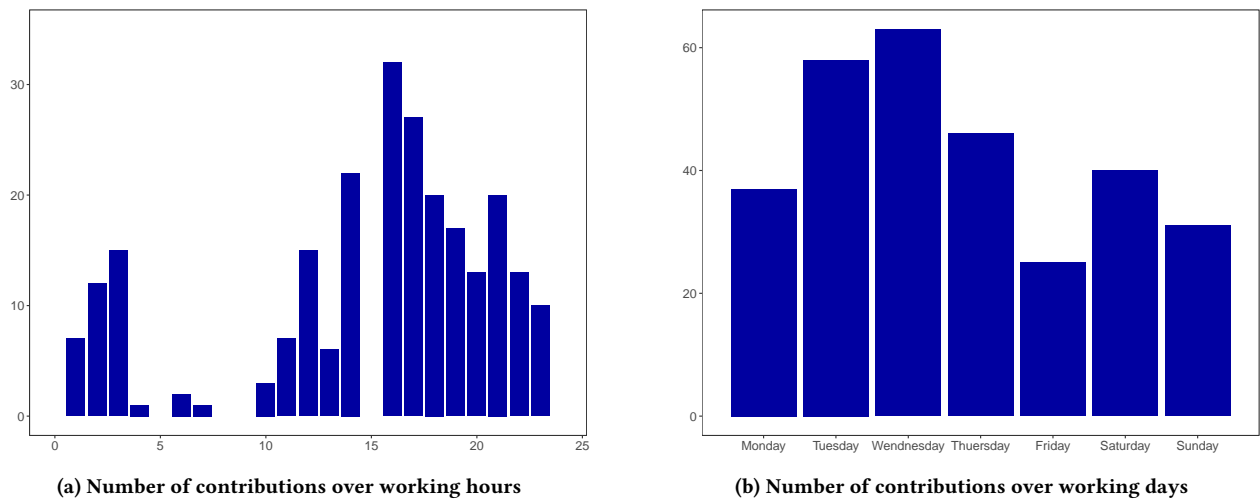


Figure 4: Characterizing the practices of developers in terms of day / hour of source code contributions (Mobile Tier only).

flowing well, involving a heterogeneous team, and the app might lead to a significant social impact.”

Moreover, we follow short development cycles with iterations that last two weeks. During the aforementioned period, in every iteration the development team contributed to one or two features, and some design decisions during the very first weeks of the development cycle enabled the team to reuse components of the user interface (the characteristics of the app facilitates this). Only during one or two smaller Sprints (one week long) the development team decided to focus on reviewing design decisions and refactoring the source code. In addition, the development team has regular on-line meetings. Every Wednesday the technical leaders review the sprint goals and check whether or not they are feasible to achieve. Almost every Monday the development team join a remote programming session (like a coding dojo), which allows them to discuss technical decisions and clarify questions.

“...nevertheless, some members of the team had difficulties and did not look for help, sometimes causing task delays. A strategy to deal with this problem was to carry out coding dojo sessions, which led to an improvement in our internal communication and allowed us to solve questions effectively.”

The participants also claim that a sense of shared responsibility and collective ownership improved the performance of the team. We use an online Kanban board (integrated as a plugin into our Bitbucket repository) with the tasks backlog, which makes the activities visible to the team. During the planning of each Sprint, the requirements are evaluated, and the Kanban board is used to identify which requirements will be implemented during the next sprint. A particular decision improves the sense of collaboration: “...at first it was noted that allocating the tasks per developer was not a good strategy; and currently each developer is allowed to choose the tasks they want to implement.”

Developers also argue that, after the COVID-19, they would like to continue working from home. For instance, one participant state

this preference, though highlighting a possible negative impact on rapid feedback.

“...I would like to keep working remotely, since I do prefer to work during non-usual working hours. However, this might have a negative impact in terms of the feedback agility obtained during on-site communication.”

“During the isolation time my motivation was very low, because I didn’t want to do many things at the same time, such as study and develop. A month ago, my rhythm improved, and I feel more motivated, begin able to watch educational videos and developing code faster.”

“...I had a hard time adapting and concentrating, because I was missing the on-site work environment, thinking I would be more productive there.... I was very dispersive at home, with some eating disorder.... To deal with these problems, I changed my room to make it my new working environment, which allowed me to concentrate more, organize myself better, and fell being more productive.”

4.2.2 Results of Survey with Stakeholders. The project’s stakeholders started working with the conception of the VSO in January 2019. Since then, they started to implement strategies to work with the incarcerated, and former prisoners, in regard to issues that confront them when they leave prison. Their goal was to create a place to access information relevant to former inmates. This information today is spread in many places. This creates invisible barriers, making it difficult for former inmates to access.

In recent interviews, the stakeholders indicated that they were very motivated about the expansion of the brick and mortar offices and the innovative app that deals with the concerns of the former inmates. During the isolation phase that resulted from the pandemic, the main stakeholder said that her motivation increased as she

observed the unfolding of the project. With respect to expectations about the project quality, she stated that she was happily surprised. She had expected a solution with less functionality. The interactions between the teams (stakeholders and university members), she realized, created a more useful solution.

In the interview, the stakeholders commented that they were concerned about meeting deadlines. Initially, they believed that the application would be delivered in a few months. However, there were elements internal to the stakeholders' agency that delayed the project. As a result, transfer of resources were delayed. However, these issues did not decrease the quality of the deliverables.

Due to pandemic, CNJ took on new duties, and this reduced the frequency of interactions between both teams (stakeholders and researchers). CNJ stated that this reduction of interactions harmed the development, but the impact was not too severe. Prior to the pandemic, the project proceeded in a fast rhythm due to frequent meetings.

One stakeholder stated:

"... The frequency of the interaction between the university team and the stakeholders team diminished. The meetings used to happen weekly."

Another stakeholder said:

"... The frequency of the interaction between teams is satisfactory. There were some problems inside the stakeholders' company delayed the project."

They noted that the development team continued to productively during the isolation phase.

"... For me, the isolation did not interfere with the progress of the project, mainly due to the university team's commitment. The team kept working on the application, finding alternative ways to communicate. In several situations, we were able to answer questions."

There is still a big concern regarding the application evaluation. When the project was first started, there was a well-defined plan for evaluating the app. The plan included focus groups and usability tests to be applied to user groups, and both involved former prisoners with different levels of literacy and technological knowledge. However, due to the pandemic, such testing is not possible. It is a central challenge of the moment to find a new way to evaluate the app. Our present goal is to put the application in the hands of 10 former inmates, in order to observe how well the app meets their needs.

The stakeholders also expressed that it would be useful to include, in the application hygiene instructions created by the Health Ministry. It would be important to share this information in a simpler and accessible way. Examples of information would be: in case bleach is unavailable, use soap; in case of a need for quarantine, show a list of places that the former inmate can go.

5 DISCUSSION

5.1 Lessons Learned

Our main concern when the social isolation started was related to the productivity of the teams. We were not sure if the participants would adapt themselves to a *work from home* configuration. Fortunately, we found out that the software development team was able to conduct their activities according to what we have planned before we had to stop our face-to-face activities. Some particular aspects of the project might have helped us. First, we had spent an initial effort to understand and prototype the main features of the Virtual Social Office system, before starting the development of these features. Without this initial effort, and considering that our interactions with the stakeholder team have diminished considerably during the pandemic time, it is likely that our project would have been discontinued.

We also owe the current success of the project to the technical leaders and software developers, who quickly adapted their procedures to the pandemic time. We are not completely sure if these results could be generalized to other software development teams, however, the collaborative tools we are using (e.g., Slack, Discord, Bitbucket) fixed all possible limitations of the remote communication. In addition, it became clear to us that this team performs better working on unusual working hours, and without having to spend long periods of time in traffic jams. It is important to note that this is the first time we are developing a project using only remote interactions. This represented a challenge for us, since our group used to carry out collaborative, face-to-face development sessions (like pair-programming and coding dojos).

We had to fix some practices in the first weeks of the remote work. We realized that the designer expert should participate in the weekly remote meetings with the development team. Besides requirements clarification, this decision facilitated some choices about the features that would be addressed at every Sprint. We believe that this decision also helped to accommodate the impact of the *work from home* period, allowing us to mitigate some problems that would have happened if decisions were made without involving UX experts. For example, some developers reported difficulties in implementing some screens due to either some details in the layout or the lack of experience. After recognizing the problems, the meetings were held with the UX designer, who noticed that some of these details might actually not improve the user experience, and that they could easily be replaced by a simpler alternative. Through the remote meetings, it was possible to observe that improving the communication between the UX designer and the development team could make their work easier and less stressful, avoiding problems and conflicts that could have arisen later on.

Moreover, when working with a Scrum based methodology [12, 20], tasks might be blindly assigned to developers by the technical leaders. Some developers may be given tasks that they have a hard time doing, making work tiring and stressful. Allowing the developers themselves to choose the demands they want to work increases the overall motivation of the team. The work becomes less stressful and the pressure on the team reduces, once the demands are executed according to the skills of each developer. This practice seems to have influenced and improved the motivation of the developers. The Scrum master reported having fewer problems after adopting

this approach, and just after start working from home, developers are now deciding which tasks to perform from a Kanban board.

Having said that, we had to make some compromises with the stakeholders to keep the project on schedule. First, we prioritize features that we could develop without much interaction with the stakeholders. Although we had to re-implement a specific feature, this problem could have occurred even if we had kept the face-to-face meetings with the stakeholders—we cannot discard that this problem was actually originated from conflicting ideas about this particular feature. Nonetheless, the features that we are about to start the development will require regular meetings with the stakeholder teams, and we are currently trying to make this point clear. As such, the main problem that we are facing during the pandemic time relates to the external communication with stakeholders, and based on our experience, companies working with software development could successfully transition to a home office settings. Indeed, most of our team argue that they prefer to *work from home*.

Another challenge that we realized, together with the stakeholders, relate to the validation procedures that we will have to adopt with the former prisoners. We used a design thinking strategy in our project, and the validation procedures we envisioned before the pandemic will have to change. We are still considering which techniques and tools we will employ to remotely validate the VSO system in cooperation with target users of the system.

Finally, the result obtained from the interviews with the project's development team is an important aspect to consider. We will need to assess whether, after the social isolation phase, a period of adaptation by the R&D team will be necessary, in relation to the resumption of face-to-face activities. We know that it is likely that several security measures will be adopted and that they should occur in stages. We believe that social and psychological aspects may influence the behavior of the participants in this period, and that we may need to have some help and understanding of the situation to continue following our project schedule.

5.2 Answers to the Research Questions

Regarding our first research question (RQ1), the main changes we observed after the transition to *work from home* relates to the way we assign tasks to developer (now each developer is free to select a task he/she wants to implement), the way we explain the requirements to the developers (with an active participation of the UX designer in the weekly remote meetings), and our relationship with the stakeholders, that used to occurs in regular basis, and now we have a small number of meetings with the stakeholder team. Surely, this last item also corresponds to one of the additional risks (research question RQ2) the COVID-19 time brought to the project. Another challenge for us, that we do not fully understand how we are going to address, relates to the procedures we are going to take to validate the product with the target users (former inmates) during the isolation period.

Finally, regarding our third research question (RQ3), the main impact reported by the stakeholders relate to the need to reduce the dedication to the VSO project, since they had to assume new responsibilities during the pandemic. This impacted on the availability of the stakeholders team not only to participate on requirement

elicitation tasks, but also to establish new partnerships with organizations that could provide relevant information to the VSO system. At last, the development team was able to adapt their procedures to the COVID-19 time, and to date we did not perceive a negative impact on the team's productivity.

5.3 Threats to Validity

Threats to Internal Validity. The interviews with the project development team were conducted by a team member, which could introduce some bias. To dealt with the anonymization problem and mitigate this threat, a PhD. student who was not directly involved in the development process conducted the team interviews. Then, the PhD. student transcribed the interviews and sent them to the researchers without informing the developer's name. Besides, after the pilot, we decided not to have neither a team leader nor the professors during the interviews, so the developers would be more comfortable answering the questions. Likewise, we informed participants that their personal data would not be published and that the information would be anonymized.

Threats to External Validity. The threats to external validity are related to the generalization of our findings. Since in our study we evaluated the perceptions of a single team and a single R&D project, we cannot generalize our findings to different contexts. Nonetheless, although our findings involved only a single team of developers, they corroborate the results of the research developed by Bao et al. [3], about the strengths and weaknesses of *work from home*. Indeed, our goal is not to generalize our results, but actually to report the practices that we are using and the challenges we are facing during the COVID-19 time. Nonetheless, we believe that part of our findings might be of interest to practitioners working in different scenarios.

6 RELATED WORK

Recently, COVID-19, a new version of the coronavirus disease has emerged unexpectedly, leading the World Health Organization (WHO) to declare it a Public Health Emergency of International Concern. To mitigate a pandemic, some practices can be adopted, such as social distance, which aims to reduce the transmission of the disease through the physical distance between individuals [2]. We can also include interruptions of activities in community and commercial establishments, educational institutions, cancellations of large public meetings and work on site. Such measures aim to reduce the agglomeration of individuals, hindering the spread of the disease and reducing greater damage to the population [2, 19]. As social distance cause workplaces to close, a lot of merchants have a tendency to pressure the Government to prematurely reduce the demands for social distance [18]. As a result, employers need to define work and support strategies for their employees, such as working from home. According to Blake et al. [6], it is important to ensure the health and productivity of remote workers until the necessary period of social isolation is over.

Recent research has assessed the impacts caused to individuals in different occupations in the job market. Béland et al. [4] examined the short-term impacts of COVID-19 on jobs and wages in the United States, and found out that people with the possibility to work remotely are the least affected by the pandemic. Spurk

and Straub [21] reported that workers who have occupations with greater flexibility, such as: architects, software engineers, etc. can adapt better to a pandemic than in other functions, such as urban transport drivers or taxi and Uber drivers. Eraso and Garcé [5] conducted an empirical survey in 27 companies and found an increasing number of companies that have been adopting remote work, although most of these companies do not have an emergency plan to face threats, such as those from COVID-19. Other works focused on understanding how the pandemic impacted the work of software developers. Paul Ralph et al [10] conducted a survey of software developers from 53 countries and obtained 2225 responses. The authors reported that employee's productivity is linked to well-being and that companies need to be concerned about working conditions in their employees' home offices to improve their well-being and productivity.

Bao et al. [3] assessed the productivity of developers at a company in China, where they collected 4,000 records from 139 software developers who work remotely. The authors used a quantitative approach with different metrics such as: builds, commits and code reviews. The authors found out that larger projects, maintained for a longer period of time, lead to lower productivity compared to recent projects. The developers also answered some questions about the positive and negative impact on productivity, during the pandemic, such as decreasing transportation costs and saving travel time. On the other hand, developers have taken on some personal tasks that they would not have to worry about if they were at work, such as looking after children, cooking and problems with self-discipline. We take a different approach. Contrary to the works mentioned above, rather than focusing on the productivity of the development team, we report the perception of the developers' team and stakeholders of a research project, assessing the risks to our project and making the practices we use to mitigate them explicit.

7 FINAL REMARKS

In this article, we presented the impacts caused in the development process of an R&D project during the period of social isolation. We had to make some changes in the configuration of the activities carried out and face some challenges that arose during this period, such as the unavailability of the stakeholders team. In the perception of the development team, this isolation period contributed so that they could focus their efforts on the project activities. Several team members stated that there was a gain in time dedication, since they do not need to commute to the workplace, and this time is being used to carry out other activities. In addition, the team's motivation and expectations continue to be kept high. During this period, it was also necessary to change the form of communication between the project' and the stakeholders' teams. Interactions with stakeholders became more difficult, which impacted the development of the planned features. If it weren't for the need for social isolation, we might not have had the challenges to work with limitations of information and interactions with stakeholders. Even without planning to work remotely, the development team was able to dedicate a lot and keep the planned schedule.

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REFERENCES

- [1] Titan M Alon, Matthias Doepke, Jane Olmstead-Rumsey, and Michele Tertilt. 2020. *The impact of COVID-19 on gender equality*. Technical Report. National Bureau of Economic Research.
- [2] Roy M Anderson, Hans Heesterbeek, Don Klinkenberg, and T Déirdre Hollingsworth. 2020. How will country-based mitigation measures influence the course of the COVID-19 epidemic? *The Lancet* 395, 10228 (2020), 931–934.
- [3] Lingfeng Bao, Tao Li, Xin Xia, Kaiyu Zhu, Hui Li, and Xiaohu Yang. 2020. How does Working from Home Affect Developer Productivity? - A Case Study of Baidu During COVID-19 Pandemic. *CoRR abs/2005.13167* (2020), 1–11.
- [4] Louis-Philippe Béland, Abel Brodeur, and Taylor Wright. 2020. The short-term economic consequences of Covid-19: exposure to disease, remote work and government response. *University of Ottawa - Department of Economics; IZA Institute of Labor Economics* 13159 (2020), 1–92.
- [5] Angel Belzunegui-Eraso and Amaya Erro-Garcés. 2020. Teleworking in the Context of the Covid-19 Crisis. *Sustainability* 12, 9 (2020), 3662.
- [6] Kelly D Blake, Robert J Blendon, and Kasisomayajula Viswanath. 2010. Employment and compliance with pandemic influenza mitigation recommendations. *Emerging infectious diseases* 16, 2 (2010), 212.
- [7] M Bruce and PA Pereira. 2019. *Microservices in Action*. Manning Publications Co., 978-1617294457.
- [8] Scott Chacon and Ben Straub. 2014. *Pro Git* (2nd ed.). Apress, USA.
- [9] Bonnie Eisenman. 2016. *Learning React Native: Building Native Mobile Apps with JavaScript* (1st ed.). O'Reilly Media, Inc., B076PWRYSS.
- [10] Paul Ralph et al. 2020. Pandemic Programming: How COVID-19 affects software developers and how their organizations can help. *CoRR abs/2005.01127* (2020), 1–32.
- [11] Robert Feldt and Thomas Zimmermann. 2020. ESE Special Issue on COVID-19 and Software Engineering.
- [12] Luciano A. Garcia, Edson Oliveira Jr, Gislaïne C. L. Leal, and Marcelo Morandini. 2020. On the Adaptations of the Scrum Framework Software Development Events: Literature and Practitioners Analysis using Feature Models. In *Proceedings of the 22nd International Conference on Enterprise Information Systems, ICEIS 2020, Prague, Czech Republic, May 5-7, 2020, Volume 2*. SCITEPRESS, 978-989-758-423-7, 416–423. <https://doi.org/10.5220/0009578904160423>
- [13] Jennifer Hehn, Daniel Méndez, Falk Uebernickel, Walter Brenner, and Manfred Broy. 2020. On Integrating Design Thinking for Human-Centered Requirements Engineering. *IEEE Softw.* 37, 2 (2020), 25–31.
- [14] Hadi Hemmati, Sarah Nadi, Olga Baysal, Oleksii Kononenko, Wei Wang, Reid Holmes, and Michael W. Godfrey. 2013. The MSR cookbook: mining a decade of research. In *Proceedings of the 10th Working Conference on Mining Software Repositories, MSR '13, San Francisco, CA, USA, May 18-19, 2013*, Thomas Zimmermann, Massimiliano Di Penta, and Sunghun Kim (Eds.). IEEE Computer Society, <https://doi.org/10.1109/MSR.2013.6624048>, 343–352. <https://doi.org/10.1109/MSR.2013.6624048>
- [15] Siw Elisabeth Hove and Bente Anda. 2005. Experiences from Conducting Semi-structured Interviews in Empirical Software Engineering Research. In *IEEE METRICS*. IEEE Computer Society, 10.1109/METRICS.2005.24, 23.
- [16] James Lewis and Martin Fowler. 2014. *Microservices*. <https://martinfowler.com/articles/microservices.html>
- [17] Ting-Peng Liang, Yu-Wen Wang, and Ping-Ju Wu. 2013. A System for Service Blueprint Design. In *ICSSI*. IEEE Computer Society, 10.1109/ICSSI.2013.52, 252–253.
- [18] Verne W Loose, Vanessa N Vargas, Drake E Warren, Shirley J Starks, Theresa J Brown, and Braeton J Smith. 2010. Economic and policy implications of pandemic influenza. *Report SAND2010-1910*, Sandia National Laboratories, Albuquerque, New Mexico March 1910 (2010), 1–22.
- [19] Terri Rebmman. 2009. Infectious disease disasters: bioterrorism, emerging infections, and pandemics. *APIC text of infection control and epidemiology*. 3rd ed. Washington, DC: Association for Professionals in Infection Control and Epidemiology, Inc 1 (2009), 1–22.
- [20] Ken Schwaber. 2004. *Agile Project Management with Scrum*. Microsoft Press, USA.
- [21] Daniel Spurr and Caroline Straub. 2020. Flexible employment relationships and careers in times of the COVID-19 pandemic.
- [22] Craig Walls. 2016. *Spring Boot in Action* (1st ed.). Manning Publications Co., USA.