

# Communication of Design Decisions and Usability Issues: A Protocol Based on Personas and Nielsen's Heuristics

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**Abstract.** Although both agile developers and UX designers have a common concern regarding to build software with quality, they usually have different viewpoint of the user experience and usability. We have proposed a protocol in which personas and Nielsen's heuristics were used as a common vocabulary between designers and developers (SCRUM team) for the communication of recommendations and/or design solutions. We have adopted action research to conduct our research, performing a workshop and interviews to study the feasibility of the proposal; and later two case studies to compare and evaluate the use and non-use the protocol. In the final, adding to the case study comparison, we interviewed the SCRUM team who revealed that the protocol improved the understanding of recommendations and the Nielsen's heuristics contributed to objectively communicate the main problems of interaction.

**Keywords:** Action research · User experience · Interaction design · SCRUM · ERP

## 1 Introduction

The integration of interaction design into the practice of software development may improve the process to support the development of products, which could be more adherent to user needs and expectations. The main concern of professionals who work in the field of User Experience (UX) is on drawing interactive products, which properly supply user-software communication and interaction [19]. Although the issues of UX and interaction design have been discussed by the software development area, few results have been achieved from the inclusion of interaction design practices within the phases of the main agile processes [20].

Boivie et al. [4] point out that the incorporation of interaction design in the software development process is not the simple addition of some UX activities. It requires new approaches and assets, such as guidelines of planning and practical methods. It also achieves cultural aspects in the organization triggering changes in the relationship among project managers, development team and UX designers. Wolkerstorfer et al. [23] spotlight that the difference between the mindset of software engineers and experts

in human-computer interaction area (HCI) - who use different practices and ways of expressing from their knowledge areas - may complicate the integration of design artifacts into the phases of agile processes. Moreover, developers are not familiar, as the usability experts, to give attention to the cognitive aspects of the end-user. Despite common concern of the agile developers and UX designers - they aim at building software with quality - each one addresses the development activities from a different perspective [11, 22], especially on the aspects of user experience and usability issues.

Considering the statements, this paper presents a protocol composed by decisions and recommendations of interaction design which aims to improve the communication of the agile development team and support the integration of user interaction design into the phases of SCRUM process [21]. The protocol for communication is based on concepts of personas and usability Nielsen's heuristics. The motivation for the adoption of personas and Nielsen's heuristics emerged from the hypothesis that these concepts can aid the developers and the UX designers to level out their interpretation on the usability fundamentals. Furthermore, the protocol can enhance the understanding of interaction design decisions for guiding the efforts of developers during the coding and testing activities. In the protocol the personas and the usability heuristics are used as a common vocabulary for the communication between both teams SCRUM and UX.

## 2 Research Approach

The protocol proposed is a partial result of a research project that has been developed in partnership with a producer company of ERP (Enterprise Resource Planning) systems. The objective of the research project is to propose methods and artifacts, suitable to the domain of ERP systems, for which can be incorporated into the SCRUM process, recently adopted by the company. To achieve the project goal, our strategy has been to work the mindset of the employees on the importance of the UX in the software development. Some workshops to introduce, promote user experience practices and evangelize the usability [18] have been developed during the last two years.

The research project is naturally incremental which partial findings applied directly to the company's processes, so the Action Research (AR) [1] has been the most appropriate methodology to conduct our research. According to Hayes [13], Action Research offers HCI researchers theoretical lenses, methodological approaches, and pragmatic guidance for conducting socially relevant, collaborative, and engaged research. Particularly, in the work reported in this paper, we used a qualitative approach of AR called Cooperative Method Development (CMD), which combines qualitative empirical research, with problem-oriented method, technique and process improvement [9]. In this approach the researchers, who are motivated to understand how the software developers face the daily challenges in software development, can combine both technical innovation, and method and process improvement within one CMD cycle. We adopted the interview and ethnography as supported techniques. The three stages of the CMD cycle are (1) Understanding Practice, (2) Deliberate Improvements, and (3) Implement and Observe Improvements.

In the following sections we describe the procedures used to mastermind, develop and validate one of the artifacts created to be used in the development process model proposed in the research project: a protocol based on personas and Nielsen's heuristics for communication of design decisions and usability issues.

### 3 Understanding Practice

Both concepts of personas and Nielsen's heuristics are largely used in industry of software development. They are recognized by the experts as good practices to keep the focus on the end-user and on the software usability [3, 10].

Persona is a concept frequently used to create fictional characters, hypothetical archetypes of a group of real users, thus defining the typical users and their relevant features within a context of interaction. The personas are artifacts guiding the development of interaction scenarios and/or used to describe the typical tasks in usability testing [7]. The research presented by Billestrup et al. [3] reveals that the companies' developers recognize and understand the potential and advantages of using personas. The application of the persona technique has proved that designing for a small set of personas can meet a significant number of users by their similar goals and features. However, the construction of personas should be grounded in the research on target users, which requires a longer time spent on this work and that often the development companies cannot adopt [12]. Miller and Williams [15] present a simplified structure proposal for personas specification, thus allowing greater flexibility in the creation process and in the use of personas.

Nielsen's heuristics are usability guidelines commonly used to drive the design of interactive interfaces [17]. Heuristic is defined as a general principle or rule used to forward a decision in the process of designing an interactive system, support the critical analysis of a design decision already performed, or confirm problems identified in usability testing [12]. The ten Nielsen's heuristics are: Visibility of system status (H1); Match between system and the real world (H2); Control and freedom for user (H3); Consistency and standards (H4); Error prevention (H5); Recognition rather than recall (H6); Flexibility and efficiency of use (H7); Aesthetic and minimalist design (H8); Help users recognize, diagnose, and recover from errors (H9); Help and documentation (H10).

Nielsen's heuristics are known as general rules rather than specific usability guidelines, since they are not entirely suitable to address for particular use's characteristics of different interactive systems [16]. For this reason we have proposed Nielsen's heuristics to ERP systems by perspectives of presentation and task support. According to the impact of each orientation to usability inspection some heuristics were mapped to perspective of presentation; others to perspective of tasks support; and others to both perspectives. The perspectives may be used to guide the inspection in ERP software and lead properly the inspectors during the inspection of ERP systems. Results of empirical studies detailed in [6] have pointed that the perspective-based ERP heuristics can be efficient and effective to detect usability issues, especially in medium-fidelity prototypes.

On the assumption that the personas and Nielsen's heuristics concepts can be used as artifacts which cross the whole development process to support the different development phases, we decided to apply them to ensure that a minimum set of usability aspects would be implemented. We supposed that the artifacts that cross in the process should provide tools to the developer to work in final products, which supply the target audience with a good interaction experience. Aiming at putting in practice the assumption in the ERP software area, we try to address the following questions:

- RQ1 – Can the concepts of personas and Nielsen's heuristics level out the awareness and concerns on usability aspects of UX designers and developers (programmers and testers)?
- RQ2 – How could personas and Nielsen's heuristics concepts be used as a common vocabulary for the communication between the UX and SCRUM teams?

In order to answer the questions, we planned and carried out a workshop (to evangelizing the usability issues) and interviews with the UX and SCRUM teams (who participated of the workshop). In the next subsections, we report the activities and the analysis of the data collected.

### 3.1 Evangelizing Usability

First, we work with the workshop entitled "Usability Heuristics for ERP system" which had the goal of spreading the concepts and practices of application of personas and Nielsen's heuristics by perspectives (presentation and task support) in the ERP systems development.

A UX specialist (from the company) and two UX researchers organized and drove – in 2 days – the workshop. The 59 employees who participated in the event were professionals of the development area: developers (36), testers (12), analysts (5), technical leaders (4) and software architects (2). The workshop was divided into (i) explanation of the concepts of personas, heuristic inspection and Nielsen's heuristics to ERP systems by perspectives; and (ii) a heuristic inspection activity – in groups of up to 5 individuals – in two modules of ERP systems that were developed by the company – the Material Receiving module and the Sales Order module – both are modules of the Business Management System. The participants were clustered by the UX designer in order to prevent that one participant could perform the inspection in a module that s/he had interacted previously in the developing process. Before starting the inspection the groups should observe the description – goals, difficulties and knowledge – of 2 hypotheses of personas by module. The hypotheses of personas are supposition of personas that are built based on the previous knowledge of the end-users that the company can have.

In the end of the workshop, we applied one based questionnaire on TAM model [8] to collect data of the perception of the participants on the usability evaluation technique using Nielsen's heuristics to ERP systems by perspectives and personas, focusing in three points: the perception of ease of use, the ease of understanding, and the usefulness of the heuristics. In this moment, the participants not answered question regarding the personas technique.

Although the main approach of this study is qualitative, we analyzed data collected from the questionnaire using the quantitative approach. Most participants had less than five years of experience in software development, and 56 % had less than five years of experience in developing ERP systems. Only 11 participants (18.64 %) had more than ten years of experience in software development and 9 participants (15.25 %) had experience in the development of ERP systems. The issues of perception of the ease of use and understanding in the application of usability evaluation technique with Nielsen's heuristics to ERP systems by perspectives and personas revealed that most participants broadly agree that the technique was easy to use and easy to understand, and 55 participants agree – completely (10) or largely (25) or partially (20) – that was easy to obtain skills for use the technique. Regarding the utility of technique, 28 participants (47.45 %) strongly agree that the technique is useful for usability inspections, 57 participants (96.61 %) agree (at some level) that the use of the technique has improved awareness on good interaction development practices, and 54 participants (91.52 %) believe that all heuristics are applicable to ERP systems.

### **3.2 Interviewing Participants of the Workshop**

In order to investigate the impact of the workshop in daily practice of the employees who attended it, we conducted an interview to observe: (i) the expertise and skills obtained from the workshop; and (ii) the contribution of the workshop in changing the participants' viewpoint on the usability aspects in the software development, especially in ERP systems. We led the interview thirty days after workshop for the purpose of pointing out the real changes that the event caused in the employees' work. The interviews were audio recorded with the prior permission of the interviewees, and later transcription to a report. During 1 day, we performed a semi-structured interview with ten individuals with different features (roles and experience), including questions that summarize three aspects: (i) their viewpoint of usability aspects, (ii) their perception for practical application of the Nielsen's heuristics and personas in ERP system, and (iii) their evaluation regarding the improvements on ERP systems brought by the application of usability issues. We analyzed qualitatively the participants' answers, categorizing them in the three points listed above. We include some participant's comments and our observations that are shown in Table 1.

### **3.3 Findings**

Based on the interviews outcomes, we found evidences to answer our first question (RQ1). We confirmed that the subjects and activities of the workshop had been enough to influence the participants' mindset. The participants considered that personas and Nielsen's heuristics can guide the product development and also can be used as a common vocabulary among the developers, testers and UX designers.

Taking into account the need of using a common vocabulary between designers and developers, we answered the second question (RQ2) masterminding a protocol to support the communication between the teams that consists of three items:

recommendations and/or design solutions, personas and Nielsen’s usability heuristics. The starting point is the research, ideation and prototyping activities performed by UX designers, generating indications about the end-user needs. After the UX designer has validated (using inspection or user tests techniques) the interaction design, s/he lists the usability issues and/or solutions, in accordance with the hypothesis of personas, mapping the issues/solutions to Nielsen’s heuristics. The Nielsen’s heuristics work as a classifier of the listed item (usability issues and/or solutions), allowing the teams to achieve the same interpretation of the items.

**Table 1.** Overview of participants comments in the three aspects

Aspect observed	Participants' comments	Findings
(i) viewpoint of usability aspects	<p><i>“(…) I pay more attention and recognize that simple points are important improvements which we should do (…)</i> the workshop opens my mind of user interaction.”</p> <p><i>“(…), now when we look at a new screen we try to simulate the persona’s interaction, we are able to identify usability problems.”</i></p> <p><i>“(…) we are working on changes of error messages of a project because we noted the messages had no significance to the user (…)”</i></p>	<p>The majority of the respondents say that they are more careful and pay attention the simple details, which can improve the system. They are concerned about the needs and perceptions of the users (the personas).</p>
(ii) perception for practical application of the Nielsen’s heuristics and personas in ERP system	<p><i>“(…) The heuristics and personas facilitated my work (…)</i> We developed a new user interface applying the concepts of colors in a caption. We had not decided to use them randomly; we had looked for color patterns.”</p> <p><i>“(…) In my opinion, the heuristics showed to me that my concerns should not be only about the functional aspects, I also have to consider the screen, the content arrangement, pattern, etc. (…)</i> After seeing the personas, I become more critical about the user interaction issues.”</p> <p><i>“(…) The heuristics could be used as a checklist during the software tests.”</i></p>	<p>All respondents agree with the usefulness of the heuristics and personas in the practice of ERP development. They believe that heuristics can guide the usability verification and aid the developer in finding alternatives to solve usability issues. The personas have a psychological influence, because they have a concrete person that represents the users.</p>
(iii) evaluation regarding the improvements on ERP systems brought by the application of usability issues	<p><i>“Some people and some professionals believe that in big and complex systems, like ERP systems, the usability is not necessary. They think the user is familiar with the idea of a difficult system. On the contrary, I do not agree. Even though ERP systems are complex and require complicated processes, I think our job, as developers, is to facilitate the user interaction, through the usability heuristics application, for example.”</i></p> <p><i>“The ERP system is really complex, I have no doubt about it, but it is always possible to improve the user interaction.”</i></p>	<p>Although the ERP system complexity, the respondents believe that it is possible to make the user experience more enjoyable.</p>

Formalizing, the protocol can be represented in Eq. (1). In next section, we describe in details the protocol.

$$\text{Protocol} = \{\text{item} : \text{item} \equiv \text{description}, \text{NH}_{\text{subset}}, \text{HP}_{\text{subset}}\} \quad (1)$$

where:

- description  $\in$  {recommendation, solution} **(1a)**
- $\text{NH}_{\text{subset}} = \{\text{nh} : \text{nh} \in \text{NH}\}$  **(1b)**
- $\text{NH} = \{H_1, H_2, \dots, H_{10}\}$  **(1c)**
- $\text{HP}_{\text{subset}} = \{\text{hp} : \text{hp} \in \text{HP}\}$  **(1d)**
- $\text{HP} = \{\text{hypPersona}_1, \dots, \text{hypPersona}_j\}$  **(1e)**

NH = Nielsen's Heuristics HP = Hypotheses of Personas

## 4 Deliberate Improvements: The Protocol Elaboration

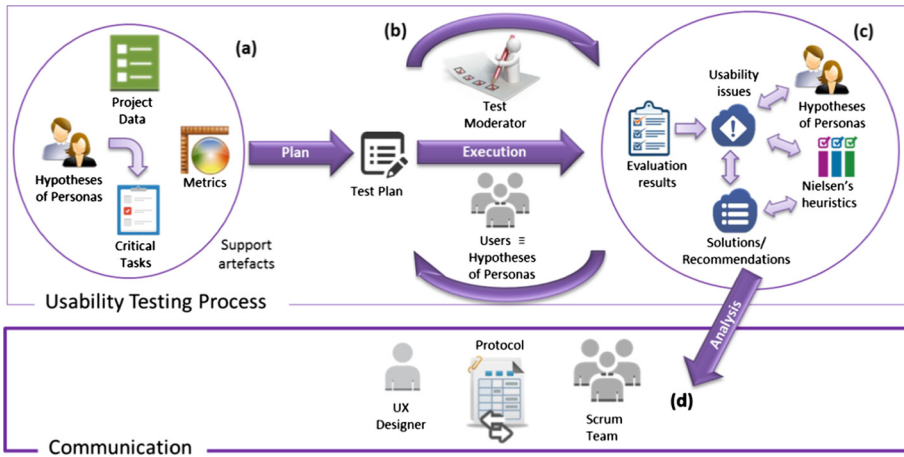
The activities and their outcomes were reported to the employees, UX designers and SCRUM (developers and testers), who keep the bridge between the company and the academic researchers. Up to the meetings, the company has never performed user tests formally, so we have suggested some improvements in the planning/execution/analysis of usability tests. The idea of using the protocol as an artifact to communicate and report results of evaluations and design solutions in usability testing was shared with the meetings' participants. In order to fulfill the agile principals we proposed to plan and perform the usability testing in a single day as proposed by Kjeldskov et al. [14]. Another important issue pointed out by the meetings' participants was the effort to identify and model the personas. Aiming to meet the company demand for producing artifacts quickly, we suggested them to follow the model proposed by Miller and Williams [15], named hypothesis of personas, whose the proposal is the description of personas in briefly way using a few fictitious data: name; skills and abilities; goals, motives and concerns; and usage patterns.

Adding the usability test proposal to the protocol we draw the process that the teams should follow. Figure 1 shows the approach to conduct user tests, implementing the improvements proposed in the meetings, and the generation of the usability solutions/recommendations from evaluation outcomes based on the communication protocol.

In the planning phase (Fig. 1a); the UX team selects the artifacts (low/media/high prototypes) and hypotheses of personas - relevant to the tests. The steps are performed to produce the test plan (phase output): (i) to list the critical tasks usually played by the users and match them to the hypothesis of personas; (ii) determine the quantitative and/or qualitative metrics that matched to the test goal (the task, time spent on task, difficulties to find resources, use of appropriate messages, etc.); and (iii) recruit at least 5 users that correspond to the hypothesis of personas, balancing the distribution of user into the personas. The number of users of a test followed the suggestion of the Borsci et al. [5] study.

In the execution phase (Fig. 1b) the UX designer carries out the test in a prepared computer, or even in the user's computer for convenience. Software suites - to capture

images or for online observation - may be used to improve the data caught during the tests and the further analysis.



**Fig. 1.** Approach to conduct the user tests and report the usability solutions/recommendations

In the analysis phase (Fig. 1c), the test moderator and/or UX designers review and analyze the notes and eventually the images recorded during the test, performing the four steps: (i) list the issues caught, removing the duplicate issues (same issues pointed out by more than one persona) and false positives (issues that were not considered real); (ii) analyze each pointed issues, and propose their respective solutions/recommendations; (iii) pinpoint the personas that can be affected by the issues; and finally (iv) map each issue to Nielsen's heuristics.

Following the protocol, the UX designer reports the outcomes of analysis phase to communicate to the SCRUM teams the solutions and recommendation that should be followed in the Sprint (Fig. 1d). The outcomes can be discussed between designer and developers during a Planning Meeting or in Daily Meetings according to the needs. The team evaluates the reported items, seeing the effects of them, and the personas and the Nielsen's heuristics that would be achieved. After the report evaluation, the SCRUM team writes the user stories (basic SCRUM artifact), considering the protocol items.

## 5 Implement and Observe Improvements: Usability Testing and Protocol

Based on a principle of CMD, in a collaboratively agreement between the academic researchers and the company employees – UX designers and project managers – we carried out the validation of the protocol through two case studies performed in a real redesign project. In addition, we checked the guidelines to plan and conduct the usability tests as we proposed (Fig. 1). The UX designer and SCRUM team, who



attended of the validation, had participated of the workshop and interviews, so they had previously knowledge of the Nielsen's heuristics, and personas. The same redesign project was used in both case studies: a new design for a high fidelity prototype to Registration of Employees that is a sub module of a Web-based Human Resources module. In order to compare the viability of the use of protocol and the guidelines to the usability test, we chose to implement the protocol only in the second case study.

## 5.1 First Case Study

In the first case study, we did not interfere in the planning and conduction (for 5 days) of the usability test. We observed the UX designer actions who outlined as relevant to user test on the high fidelity prototype the following issues: (i) navigability and overall usability; (ii) the adherence of the terminologies and languages to the domain and users; (iii) number of steps performed by the user in the execution of the tasks; and (iv) new design recommendations from the identified usability issues.

Considering the features of the sub module and without using the personas conception, the UX designers recruited for the test five participants who were company's employees from different departments; the participants had different educational backgrounds, and no one has never used the sub module which would be tested. The tests were run on a computer prepared for this purpose and the UX designer played the role of test moderator; the sessions of each participant were recorded by a simple camera with the consent of the participants. Afterwards, the recordings would aid the UX designer on the analysis phase to calculate task execution time, and to pick the user difficulties up.

An important outcome observation was that none of the users was able to complete the proposed tasks in the number of steps previously estimated by the UX designers. The most efforts of users were on performing more steps caused by their mistakes, as required fields that were not filled, and four users had tried to login on the sub module before their registration. After the test analysis, the UX designer listed ten identified issues (without duplications) and reported them in natural language without any kind of pattern, in writing and orally, to the SCRUM team during an informal meeting. In sequence, the SCRUM team implemented some adjustments in accordance with their understood of the usability issues reported.

## 5.2 Second Case Study

Differently from the first case study, in the second, we participated in the usability test and in the protocol implementation, working in collaboration with the UX designer. The usability testing was planned following the guidelines proposed in Fig. 1a during 1 day, keeping up the same test goals of the first case study. For this test, we considered a new version of the same high fidelity prototype delivered after the SCRUM team had implemented the changes based on the user test report of the first case study.

Nonetheless, on this occasion, before the recruitment of the users, the UX designer built the three personas – using the format that we proposed in Sect. 4 – by mining

information from the company's database about the target audience. Considering the features of the sub module, the personas were created to represent three different levels of expertise regarding the use of technology: basic, intermediate and advanced.

After the steps of planning, six participants for the test – none of them had participated in the first case study – were recruited, distributed two of them by persona. We played the role of observer and the UX designer of test moderator, and the tests were performed (Fig. 1b) in the same conditions of the previous study: in a computer for the test, and recording the user interaction with their consent.

We followed step by step – (i) to (iv) of analysis phase (Fig. 1c) to compose the information of the protocol to communicate recommendations and solutions, taking into account the protocol structure (Eq. 1), and the notes and video snippets collected in the test. Aiming to create an easier format for reporting the protocol items to the SCRUM team, we decided to build a table in which a row is equivalent to an item of the protocol. Figure 2 shows an example of the components of an item based on the Eq. (1).

<b>(1a)</b>	description = All users needed help to relate the acronyms of their identity card to the interface labels. We do not recommend using the acronyms adopted by identity card, adding to them a hint with brief non-technical information.
<b>(1b)</b>	$NH_{\text{subset}} = \{H_6\}$
<b>(1c)</b>	$NH = \{H_1, H_2, \dots, H_{10}\}$
<b>(1d)</b>	$HP_{\text{subset}} = \{\text{Basic, Intermediate, and Advanced}\}$
<b>(1e)</b>	$HP = \{\text{Basic, Intermediate, and Advanced}\}$

**Fig. 2.** Item to communicate recommendation and usability issues

### 5.3 Lessons Learned

In the first case study, the report was composed by the tasks performed by the user, and the correlated issues found in the test described in natural language. The UX designer stated to us that the SCRUM team asked his/her, a couple of times, the clarification of some description, arguing in a contrary view of the recommendation. We noticed that from the ten issues pointed out by the UX designer in the report only six issues had been fixed and four had triggered doubts of their need of fixing. In the second case study, the test revealed three new issues, and the four issues, which had not been fixed, were confirmed once again. The SCRUM team - who had no doubts regarding the results and recommendations - fixed all the items reported through the protocol.

Days later of the second case study, we have interviewed the SCRUM team in order to collect their opinion of the use of the protocol aiming to reassert or not the research questions (RQ1 and RQ2) described in Sect. 3. Two developers who implemented the improvements commented “(...) it was clear to understand the need of the adjustments, because I could see the equivalent heuristic and the consequence of the fix in the software”. Regarding the personas one of them said: “we could understand that the problem was really serious and was affecting more than one kind of user”.

According to Bak et al. [2], although the software companies have stated to apply usability testing, many have mentioned that software developers (analyst, programmer, testers) have difficulties to understand the test results, and in some cases they do not accept the results. Based on this assertion, and adding our findings during the two case study, we can answer in the affirmative the research questions and confirm that the proposed protocol, in its formally structure, is an good alternative to promote the communication between the UX and developer teams. Moreover, the UX designers perform the test observing the usability issues by the standpoint of Nielsen's heuristics that is the same viewpoint of the developers.

## 6 Conclusion and Further Work

The contribution of this work was to propose a protocol based on the concepts of personas and Nielsen's heuristics that improves the communication of usability aspects between the UX team and SCRUM team. The outcomes of this work are part of a set of actions - technological and cultural - which have aimed to promote the inclusion of HCI techniques into the software development process of ERP system company.

Our proposal has been conducted by action research approach allowing us to deal with particularities on practices of software development; and also to facilitate the deliberation of improvements and the validation of proposals collaboratively with the industry. The protocol has enhanced the common understanding between UX team and SCRUM team from a unique code language and observing the features of personas. Moreover the SCRUM team felt more comfortable to fix the modifications outlined where the Nielsen's heuristics communicate, in their opinion, objectively the main problems of the interaction. In further work we will refine the protocol, and test it again on other projects. Currently we have discussed with the representatives of both teams SCRUM and UX to find out what is the best site to deliver the protocol and thus facilitate the team's access.

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