Communication Challenges and Strategies in Distributed DevOps

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Abstract—**Even though agile actively seeks collaboration from all its stakeholders, most agile projects do not extend themselves toward the operations people. To solve this problem, DevOps is introduced. DevOps is a conceptual framework for reintegrating development and operations of Information Systems, which is able to break the wall between developers and operations professionals. DevOps improves the work through a collection of principles and practices, centered around close collaboration between Development and Operations personnel. However, both sides have paid little attention to issues faced by each other. Communication gaps is a recurrent problem in agile teams that is also eminent in the relationship between developers and operations. Literature offers little research on this aspect of communication in DevOps. This position paper describes the communication practices from a distributed agile team composed of developers and operations based on communication challenges (geographical, socio-cultural, and temporal distance) and strategies (frequency, direction, modality, and content). From the results we outline possible research focus for future work, aiming to enrich the academia research on the matter as well as to help practitioners to improve their working practices.**

Keywords—**DevOps, communication challenges, communication strategy, distributed teams.**

I. INTRODUCTION

Industry has adopted the widely popular DevOps strategy, which combines aspects of development and operations to speed up the implementation and testing of new solutions [1]. The promise of DevOps is not that it will reduce costs or eliminate internal hurdles, but that one can leverage important skills and knowledge to provide a product or service to one's customers [2]. The DevOps paradigm addresses another major challenge, namely the split and barrier between developers and operations personnel [3]. To overcome such a split that is predominant in many organizations today, organizational changes, cultural changes, and technical frameworks are required [4].

Brown and Starkey [5] argue that culture conditions attitudes towards communication, communication processes, and systems. Moreover, they add that communication directly impacts decisions made by an organization. Through the literature it is possible to note that there are some communication gaps between developers and operations. There is also a pressing need for strengthening the harmonization of Development and Operations functions of an IT organization [6]. Therefore, the goal of this position paper is to describe the communication practices from a distributed agile team composed of developers and operations based on communication challenges (geographical, socio-cultural, and temporal distance) and strategies (frequency, direction, modality, and content) as proposed by Mohr and Nevin as part of their studies of communication in Marketing [7].

The research was conducted in a large multinational company, following an observational-based qualitative study of a team in which the development team is located in Australia and the operations team is in Brazil. In this paper, we focus on the communication that happens between developers and operations, to capture the complex nature of these team members working together in a distributed environment. The research question that guided our study is as follows: *How does the two-way communication happen in distributed DevOps?* We present our findings and discuss them next.

II. BACKGROUND

A. DevOps

There is a common sense among authors that DevOps is an emerging term that has yet to be further studied and defined. On the philosophical side, Hussaini [6] best defines DevOps as an acronym for Development (Dev) and Operations (Ops) of information technology systems and applications. He adds that the DevOps paradigm emerged as a response to the growing knowledge that there exists a gap of 4Cs (communication, cooperation, culture, and collaboration) between what is usually considered IT development function and IT operations function in an organization.

Debois [8] says that the term DevOps is only a stub for more global company collaboration, which he explains, works as follows: once priorities have been determined and work can start, developers pair together with operations people to get the job done. This pairing allows for better knowledge diffusion across the two traditionally separate teams. Issues such as stability, monitoring, and backup can be addressed immediately instead of being afterthoughts, and operations gets a better understanding of how the application works before it actually is deployed into production. Also, feedback is available to all people: those in operations learn what issues they might expect in production, while developers learn about the production environments. Feedback is not only of a technical nature–management and business can learn from production trial runs what customers want and how they react.

Hossono [9] brings a new focus into the definition of this concept by saying that the DevOps–an abbreviation term for development and operation–centers on two primary concepts: culture and technology. The culture seeks to change the dynamics, in which the development and operation teams interact with one another, emphasizing the tasks between design and operation, such as design for operation, test-driven development, and continuous integration. This culture is congruous to the technologies of tool chains, which are a collection of complimentary tools used to automate an end-to-end process. The tool chains enable lifecycle-based automation and rapid responses to changing business conditions, and become more dynamically changeable via programmatic interfaces [10].

B. Communication Challenges and Strategies

In sharp contrast to the popular image of software developers as relatively introverted and isolated, they, in fact, spend a large proportion of their time communicating [11]. Communication process is the transfer of knowledge among two actors, and the tools used to assist such interaction. Communication is an important activity in whole software development life cycle [12].

Communication can occur synchronously (immediately) or asynchronously (wait longer for a response). Moreover, there are two different types of communication (formal and informal), each playing an important part in the teams' communication, e.g. face-to-face discussions in co-located or distributed teams, group meetings, steering group/milestone meetings, progress status meetings, etc [13].

Smite [14] argues that communication is an integral part of any relationship, and as in any relationship, it can be problematic. To illustrate, Herbsleb and Grinter [15] present a telling example of poor communication in a global software development project, when a tester interpreted a spacebar instruction as a b-l-a-n-k, instead of leaving the field empty, clearly not the intended message of the sender [16]. Etgar [17] suggests that conflict is caused by ineffective communication, which leads to "misunderstandings, incorrect strategies, and mutual feelings of frustration" [7]. Likewise, Khan et al. [18] highlighted some factors that can challenge communication, as follows:

- **Geographical Distance**: it is actually the effort required for one team member to visit another. Generally, low geographical distance offers high opportunity for team members to communicate [19].
- **Socio-Cultural Distance**: it is a measure of an actor's understanding of another actor's values and normative practices [20]. Cultural distance involves national culture, organizational background, policies, and moral principles [19].
- **Temporal Distance**: it is the measure of time difference experienced by two actors wishing to communicate [19]. Temporal distance results from different factors, including two actors located at two different time zones, for example.

To solve those problems, Tarone [21] brings the concept of Communication Strategies (CS) as a mutual attempt of two interlocutors to agree on a meaning in situations where linguistic and sociolinguistic structures do not seem to be shared. Therefore, it can be viewed as an attempt to bridge the gap between interlocutors in real communication situations. Four facets of communication strategies are explained by Mohr and Nevin [7]:

- **Frequency**: refers to the frequency and/or duration of contact between interlocutors. Though a minimal amount of contact is necessary to ensure adequate coordination, too much contact can overload interlocutors and have dysfunctional consequences [22];
- **Direction**: refers to the vertical and horizontal movement of communication within the organization hierarchy [23]. Literature discusses "downward" communication as flowing from the more powerful member to the weaker member and "upward" communication which would be the opposite from "downward".
- **Modality**: refers to the method used to transmit information. One straightforward way has been to categorize modality as face-to-face, written, telephone, or other modes. A second way has been to categorize according to the mode's ability to transmit "rich" information, or a variety of cues including feedback, facial cues, language variety, and personalization [24].
- **Content**: refers to the message that is transmitted - or what is said. Communication interaction can be analyzed for content by using pre-determined categories [25] or by asking the parties in an interaction what their perceptions of the nature of the content are [26]. Frazier and Summers [26] distinguished between direct (requests, recommendations, appeals to legal obligations, etc.) and indirect (exchange of information, discussions, etc.) the kinds of influence strategies within content.

III. RESEARCH METHODOLOGY

A. Data collection

To answer our research question, an exploratory observational study was conducted within a company using DevOps. To validate the observations made by the first author through her day-to-day interactions with the team members and reflection upon the current adopted processes and practices, face-to-face interviews with the operations team in Brazil were conducted. During the interviews a single question was asked: "*What are the challenges that you face today regarding the communication with the development team?*". Twelve professionals participated on those individual interviews and the obtained results are detailed in Section IV.

B. Data analysis

We used a concept mapping analysis approach [27] from the informal interview performed with the operations team members from Brazil. We first listed all the key points they mentioned, later grouped them by the meaning, having a total of seven general main issues encountered. We then classified

these issues according to the communication challenges and strategies and, finally, the researchers interpreted and discussed the findings altogether in order to reach consensus.

C. Context

The research was conducted on an IT multinational company whose main business is to develop software products (standalone and cloud applications) to support software development. Today, the company has around 1,400 employees and is located in eight different locations. The development team is mainly located in Australia, while the operations team is distributed in different timezones. The investigated teams consist of 13 members located in Brazil (including the first author) from operations and 3 different development teams having together around 18 team members (total of 31 people) all located in Australia. The operations personnel are the ones responsible for the products' deployment and infrastructure as well as collaborating on incidents raised by customers. The development teams, on the other hand, are responsible for conceiving the products and fixing possible bugs.

IV. RESULTS

During the data analysis, we identified 7 main challenges coming from the interviews with operations and through the observation from the developers daily activities. Once we identified these issues, we categorized them according to the factors that challenge communication [18] and the communication strategy' four facets [7]. Table I summarizes the results found, the categorization of each issue found along with which communication challenge or strategy it impacts. Detailed descriptions of such results are described next.

A. Geographical Distance

As team members are located in different countries, the communication is not as often as desired. Without such communication, teams become unaware of each others' working routines. This 'unknown feeling' about each others' routine causes teams to not look for other forms of communication with one another in order to find other ways to get the same information (e.g., to seek help from a closer colleague or to move on with a different approach) as exemplified below:

"You know, it's hard to complain about the things they [developers] do when you don't know how they do things around there." [Ops1]

B. Socio-Cultural Distance

Cultural and linguistic differences are evident in communication in electronic format, especially when it occurs in the form of a dialogue. We noticed that Brazilians usually seek more context to the information while the Australians are more straight to the point. For example, when there is a need to include a developer into a specific case for help, they usually do their research on the matter and point out a possible solution without any further details of what they did to get into the suggested solution. This often leads operations team to get frustrated because they end up not being aware of the root cause of the problem as indicated in the following excerpt:

"Not always after talking with a developer I understand where the information comes from, but the instructions sent and are always very clear." [Ops6]

The style of argumentation and the flow of conversation can vary according to whom is leading it. However, work practices to be used are shared between the teams, the company culture and values are strongly established within the two locations.

C. Temporal Distance

Due to the temporal distance, it is difficult to have both teams working along at the same time. The effort to maintain an efficient communication between teams is much higher. Since the time difference is 12 hours, electronic asynchronous communication is often the only way to contact the remote colleagues. Moreover, the distribution of knowledge usually happens into electronic form. This makes working harder since the dialogue between the teams only happens from one day to the next, which consumes more time for discussion of a particular subject. Ops12 reports on this matter:

"(...) that's the worst part! Sometimes you need to talk urgently with them [developers] and there's no one available online to help."

D. Frequency

The frequency of the communication is affected when teams are distributed in different timezones. The question and answer process happens only once a day for each team. Also, important communication of things that might affect each others' day are not sent in a timely manner. For instance, this kind of report is usually weekly shared between teams what causes an overload of work for team members. Once they receive the reports they have to run after complementary information that should have been made available before to everyone. The excerpt below from Ops7 suggests this issue:

"Developers do not always share information about what changes will be introduced in the next release. So we have to keep guessing if a certain thing is an expected behavior or a bug. Also, when a bug is created, it takes forever for them to give us feedback, looking like they do not prioritize things!"

E. Direction

The communication flow between both teams is not affected by which directions the information comes from. They all have free will to communicate to each other. One thing worth noting is that usually the communication that comes from the development team is more informative (e.g., reports about the functionality of the system) while when the communication comes from the operations team, generally it is intended to obtain information about a specific subject (usually a cry for help) or to inform the developer about a customer feedback on the product. However, the operations team also sends informative information to developers (e.g., reports of an update on the environment or implementation of a new technology), but it happens infrequently.

TABLE I

	A	B	C	D	E	F	G
	Geographical distance	Socio-Cultural distance	Temporal distance	Frequency	Direction	Modality	Content
Teams are not available at the same time	X		X		X		
It is not possible to talk to the dev on call immediately, QA sessions always take at least 24hrs	X		X	X		X	X
No previous notice of releases		X		X	X	X	X
Few/None training on the changes in the application	X	X	X	X		X	X
A team does not know the routine of another	X	X	X			X	X
Lack of prioritization of bugs open by ops	X	X		X	X	X	X
There is no formal communication channel between the teams for feedback	X	X	X	X	X	X	X

F. Modality

Due to the temporal distance, the most used form of communication is through e-mail. The second most used is through an asynchronous chat, via internal online documentation, and a tracking system. Although the e-mail is the most popular means of communication, the richest in information detailing is the internal documentation. What has been observed is that teams often prefer to write internal documentation and then share it via e-mail with others. This process allows each person to define if the information being shared is useful or not. It can also reach more people and the information will be there available to anyone 24 hours, 7 days a week as illustrated next:

"*We do get a lot of information via e-mail. Sometimes it's overwhelming, but the good thing is that I can read only what interests me.*" [Ops3]

One thing that bothers both teams is the lack of a formal communication channel in which they could share feedback about daily activities and procedures as expressed by Ops4:

"*The downside is that we don't have a way to share feedback between both teams, you know?! So that we can talk to each other when needed or warn about important things.*" [Ops4]

G. Content

Communication comes in both forms: direct and indirect. The direct form occurs when there is a need for a training on a new technology that is going to be implemented. When this kind of communication arrives on the team, all members must take actions and perform what they are been told, e.g., training sessions about a new feature on the system or on the new technology to be used on the production environment. On the other hand, the indirect form happens when teams share thoughts or start a discussion on how a procedure should better be handled. Usually indirect communication is always the source of misunderstandings and confusion between teams

because they are not always complete and/or clear as pointed out by Ops7:

"*When we talk about release notes, things get serious! They [developers] do publish a release note when a new release is going into production, though the information in there is not always complete or correct. Sometimes the information do not reflect the real changes on the system. And when we talk about it, they don't seem to care and upgrade the process.*" [Ops7]

V. Limitations

We have used a small sample of DevOps employees from the company in our study. Therefore, the results reported here could differ from what other operations teams within the company might have to say when considering their different contexts and culture backgrounds. Another limitation of this work is that it relies only on observations confirmed by interviews, which can raise concerns about the reliability of the results. On an attempt to mitigate this, three researchers discussed about the notes from the observations and interviews and later coded the findings as presented in Section IV. Due to limitations imposed by the company, it was not possible to mitigate the problem of the triangulation of the results with multiple methods of data collection.

VI. Discussion and Final Considerations

In this paper we presented the results from a study on how two-way communication happens distributed DevOps on a sample of a large multinational company. Since DevOps is all about collaboration to better serve the customer, it is important that both teams are very well aligned on their communication practices. Our findings reveal improvement opportunities within the company, specially considering the modality and the content facets since both teams are geographically dispersed.

For instance, teams could detail further the information to be sent to others, perhaps to go through a group of auditors to confirm that the information is complete and clear, or even to establish a formal communication channel/routine for feedback between both teams. Regarding the tasks, they could add a note on each communication where the message sender would have to leave an explanation note on how all the troubleshooting was performed. Another way would be to document all the steps taken into each action on an internal documentation (e.g. a task report), this way all the steps would be available at anytime to everybody.

With regard to communication challenges, a possible solution for the geographical distance could be the company creating exchange programs between both teams to strengthen the relations between them [28], allowing people to get familiar with each other and their working processes. On a management level, an option to mitigate cultural-related issues would be to get both teams more involved with each others' cultures. In relation to temporal distance, managers could promote a "quarter" meeting where teams would met each other face-to-face, taking advantage of these meetings to promote feedback rounds, or even, spread flyers in offices with details/fun facts about the cultures of other sites.

Literature in Global Software Engineering extensively discusses communication issues and solutions for them. Our next step is to investigate this vast literature and identify whether what is being offered is applicable to DevOps, reusing knowledge already empirically reported by the software engineering community. We also aim to further investigate the communication between developers and operations, involving rounds of feedback within both teams. This will certainly enrich the body of knowledge on the matter and can help closing the gap pointed out by Erich, Amrit and Daneva [29], as well as it can help practitioners to improve their day-to-day working practices. Also, by tackling this matter it can bring value to a company's business as companies not only seek to deliver new applications and features to the market as quickly as possible but also to operationalize their processes in such a way to be able to properly attend to modern demands on this new Internet-based and globalized market [30].

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