

DevOps ADOPTION PRINCIPLES AND GUIDLINES

DevOps BENİMSEME İLKELERİ VE YÖNERGELERİ

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Abstract

Adopting DevOps methodology takes a certain perspective (i.e., theoretical framework, theoretical underpinnings) besides the practical experience. While a sheer number of studies have extensively addressed different aspects of theoretical frameworks, such as the underlying concepts and associated challenges, there is limited research on how to incorporate practitioners' ground truth (community of practices) into methodological and theoretical accounts related to DevOps. In particular, we explore what and how DevOps practices and methods are adopted in a real-world context. Hence, this paper is a contribution where the best of two worlds (community of practice and body of knowledge) is aligned. That is, theoretical understandings and practitioners' viewpoints are employed in order to come up with the best and most appropriate approach of adopting according to organizations' contexts and objectives. We identify a number of aspects that can provide a basis for the guideline supporting for DevOps adoption process. Practical and theoretical implications of the findings are discussed further.

Keywords: DevOps Adoption, DevOps General Principles, Adoption Guidelines, Software Development.

Öz

DevOps metodolojisini benimsemek, pratik deneyimin yanı sıra belirli bir bakış açısı (yani kuramsal çerçeve, teorik temeller) gerektirir. Çok sayıda çalışma, temel kavramlar ve ilgili zorluklar gibi bilgi çerçevelerinin farklı yönlerini kapsamlı bir şekilde ele almış olsa da, uygulayıcıların temel gerçeğinin (uygulamalar topluluğu) DevOps ile ilgili metodolojik ve teorik temelleri nasıl dahil edileceğine dair sınırlı araştırma vardır. Bu çalışma, vaka özelinde DevOps uygulamalarının ve yöntemlerinin ne ve nasıl benimsendiğini araştırıyoruz. Bu nedenle, bu makale iki dünyanın (Uygulayıcı Topluluğu ve Kuramsal Bilgi Kaynağı) en iyilerinin hizalanmasına bir katkı sunmaktadır. Diğer bir ifade ile, kuramsal ve uygulayıcıların bakış açıları, her bir organizasyonun bağlamına ve hedeflerine göre en iyi ve en uygun yaklaşımı benimsemesi dikkate alınmıştır. DevOps benimseme sürecini destekleyen kılavuz için bir temel sağlayabilecek temel hususlar belirlenmiştir. Bulguların pratik ve teorik çıkarımları ayrıca tartışılmaktadır.

Anahtar Kelimeler: DevOps Benimseme, DevOps Genel İlkeleri, Benimseme Yönergeleri, Yazılım Geliştirme.

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1. INTRODUCTION

While a sheer number of studies have extensively addressed different aspects of theoretical frameworks, such as the underlying concepts and associated challenges, the term DevOps appears to be yet another catchy term since its very nature, while at the same time still does not have a clear and a unified definition, and is surrounded by ambiguity (Kristian et al., 2016). On the other hand, it has been promoted as a panacea for the long standing problem in IS development and implementation. This seems to be a main motivating or resisting factor for the organizations to adopt this new emerging approach or practice. However, while there is a lack of a standard definition, there exist a way to define the nature of this organizational approach that has evolved as an improvement to the Agile methodology (Muhammad Zulfahmi et al., 2019), which in its essence, aims to continuously improve the features of a product (Singh, 2020). Hence, many aspects of DevOps are aligned with or rooted from the Agile methodology (Yarlagadda, 2018). The goal of DevOps has been defined to be reducing the time between development and operation of the software without affecting quality in a negative way (Erich et al., 2017). Each existing definition of DevOps necessarily reflects some aspect of the methodology. The term, however, stresses the incorporation of IT operations and software development teams forming a DevOps team where all activities previously performed by two separate silos are carried out by a single team consisting of software developers and IT and operation personnel within a collaborative environment. The integration of development and operations team is not necessarily done through forming a new dedicated team for DevOps activities, instead, there are more than one approach to achieve this goal (Leonardo Leite et al., 2019), which shall be discussed in a later section.

The fact that DevOps is lacking a standard definition can imply that each organization needs to find its way for adopting the methodology based on its related context (Erich et al., 2017). Thus, this research put emphasis on the gap between the theoretical accounts (Body of Knowledge) and practice. In fact this recalls for the motto that “one size does not fit all” is applicable to this subject matter and requires certain level of adaptation of the theoretical accounts (Body of Knowledge) to practice or vice versa. Since adopting this promising approach has gained interest in the past few years, the need for a guidance to support newcomers interested in adopting DevOps is increasingly necessary. The aim of this paper is to contribute into this gap of addressing the adoption process of DevOps by providing a fundamental understanding of the phenomenon by conducting a conceptual research which takes into consideration the perspectives and experiences of practitioners who have engaged in a DevOps-empowered work environment, moving towards developing a complete model or recommended path for the adoption process.

2. METHOD

The goal of this research is two-fold. First, to establish the ground on which appropriate guidelines can be developed regarding DevOps adoption process in organizations. These guidelines are important because they consider perspectives and practical experiences of practitioners who

were involved in or contributed to the adoption process of DevOps in their organizations. Second, these guidelines and practices are compared to what the researchers have already reached on this matter. Therefore, the ultimate goal is to provide support for organizations moving towards DevOps, or even start-up companies planning on starting with DevOps methodology from the beginning. According to the above, the main research questions are:

1. What are crucial practices/steps required for adopting DevOps methodology in an organization?
2. What differences and similarities do these practices and steps hold in comparison with the existing literature? What the new findings have to add to support practitioners in their adoption process.

In order to achieve the specific objectives and address the research questions explained above, a mixed approach of qualitative and quantitative methods was employed.

Step 1. Data Collection

This research is based on data that are gathered from different sources. First was the individual in-depth interviews with DevOps personnel. Second, responses to a survey that has been used as another way to collect information from experts through an online channel. We shall provide more information about each source below.

1st Data Source: Interviews

1.a. Preparing questions of the interviews. The aim of these interviews was to collect data about practitioners' opinions, experiences, perspectives and advices regarding DevOps adoption process. Towards that end, interviews included general questions about DevOps, each practitioner's role and contribution to the organization's plan regarding DevOps, and exploration of the transformation process.

1.b. Conducting interviews. A limited number of practitioners in the field were targeted to participate in the interviews. Table 1. Contains a list of participant practitioners and their job titles in the organizations they work for. These were one-to-one interviews conducted through a video conferencing tool, each of which has lasted between 60 to 90 minutes. Participants were sent the questions before the interview starting time to insure they are able to reflect on the questions and to be able to provide informative details.

Table 2. interviewed practitioners job titles

Practitioner #1	Senior DevOps Engineer
Practitioner #2	DevOps Engineer

Step 2. Analyzing interviews data

After interviews were conducted, they were transcribed and analyzed.

2.a. Open-coding method. Open coding is an analytic process in the qualitative research through which concepts (codes) are assigned to each related set of excerpts that were extracted from each single interview transcription (Glaser, 2016). With open coding, interviews transcriptions were broken down into discrete parts, relevant portions were selected, labels or codes were assigned to them. This way of analyzing data allows comparing and contrasting similar concepts in the data which contributes toward the ultimate goal of the qualitative research. For the first interview transcription, inductive coding was implemented, where codes are derived from the qualitative data itself. For the following interview, deductive coding was applied, where the predefined codes attained from the 1st interview were assigned to new qualitative data. If other themes are observed in the data, new codes could be created.

2nd Data Source: Survey Responses

A second round of data collection was initiated taking into consideration the codes resulted from open-coding technique to the first source of data. A number of arguments regarding DevOps in general and the adoption process in particular, were formulated composing a survey of Likert-scale type of questions, in addition to one open-ended question where experts were asked about the most important step in the adoption process from their own perspective. The link to the online survey was then published and shared with experts who were willing to contribute their opinions giving responses to the questions.

3. FINDINGS

3.1. Interview Findings

We identify a number of aspects that can provide a basis for the guideline supporting for DevOps adoption process. In essence, identified aspects can be distinguished in terms of managerial and technical dimensions.

Managerial dimension. DevOps adoption needs to be enforced through a long time-frame and the involved team(s) should not to rush the expected results. The most critical element in the adoption process is the involved personnel themselves. It is of a particular importance for the teams to understand what DevOps mean for their organization, the motivation of the organization for taking the step, and what are their responsibilities as players in this transformational movement. Once team members understand what they should do and are aware of the specifications, the organization is transformed. As a manager or responsible for this journey, consider providing the necessary training workshops and required education to the staff, in addition to encouraging them to make the change. Ensuring compliance between teams is essential for the ultimate goal of encouraging a collaborative work environment. Well-defined processes that follows the organizational objectives are a priority for ensuring the adoption process would be on the right track for as long as it takes; without clear vision and processes, the transformation may fail.

Technical dimension. DevOps is not fully adopted unless the organization has a good enough technical ecosystem that enables the performing of required activities to follow DevOps methodology. Setting a reliable infrastructure can be considered as a preliminary step in the right direction. Utilizing multi-stage environment for developing and deploying software is also recommended by some organizations as a technical enabler for the process. Containers help developers and operations teams managing and automating software development and deployment.

Definition and Goals. DevOps is perceived by some practitioners as a software development culture that combine multiple sectors in one, and that the ultimate goal of DevOps is improving the speed, quality and reliability of products delivery. The transformation to DevOps is a mindset shift that enables an approach to collaboration, communication, sharing, openness for software development. Among the observed benefits of adopting DevOps are cost cutting, quick deployments, improved staff and customer satisfaction, and for an organization to remain updated regarding new technology and techniques.

Organizational Structure. The followed way into adoption changes according to both the type and size of the organization. For start-up companies, it is not necessarily a transformation requirement to have a dedicated DevOps team; other approaches can be followed. However, at that stage, having more business analysts is more recommended given their crucial role in defining the processes, such as business requirements and application development requirements. Once well established, companies are to dispense with the business analysts and have more DevOps Engineers. Having a team member from the operations team working in the development team makes communication easier and execution faster as development personnel will not have to submit operations or production related requests to the management, instead, they can check with their operations teammate directly. Tasks among the DevOps team, if such a team existed, are assigned according to the organizational level (junior, senior, etc.). This third approach of a dedicated team is more recommended in large organizations, where DevOps experts are responsible for the guidance and consulting for the whole development-to-deployment task chain coordinating with all units of the organization. For that end, virtual teams, consisting of members from each unit, can be formed to communicate with DevOps experts about the progress of their projects.

DevOps Skills. People considered for DevOps-related roles are those who are competent in skills required for both the development, security, quality management, operations and production. Having said that, some practitioners observed that an educational background of computer engineering, computer science or other IT-related disciplines are not necessarily a must to fulfill such roles as experience is more relevant. Some other skills that are required for DevOps personnel are system engineering, service management and understanding of virtualization layers.

DevOps Tasks. It is among DevOps personnel responsibilities to answer questions of the development and operations staff, to provide support for them, and to establish practices to improve communication between the two teams. For example, when a new technology or tool is introduced in the organization, DevOps team members take the lead to learn those tools. Afterwards, they conduct training sessions educating involved members and provide hands-on assistance.

Before DevOps. Practitioners reported that the main difference that distinguish methodologies prior to DevOps, such as the waterfall model, is that they used to focus on one project at a time, whereas after adopting DevOps, the usual practice is to work on multiple projects at the same time. Some organizations choose to adopt Agile before DevOps, as an interim step, while other organizations make a transformation from the traditional SDLC to DevOps directly. Software Engineers, in traditional model settings, did not consider different aspects of the production process other than the code and programming, neglecting several other, such as the scalability, security and production environment aspects. Also, it was reported that prior to DevOps, communication between developers and operations personnel was minimized, costs were higher, and products took a long time to enter the market.

Transitioning Team. For organizations that adopt DevOps with a dedicated team, there would be what can be called a central DevOps team that is responsible for building, managing and monitoring the DevOps ecosystem, assisting the development and operations teams to build CI/CD pipelines, and designing and implementing SDLC process. In these types of organization, DevOps team could consist of 10 people focusing on a part of the projects of each unit in the organization. For other projects, this team can provide staff with project templates to work on.

3.2. Survey Findings

Respondents with different job titles responded to the survey providing their own opinion on the arguments. Table 2. summarizes job titles for the respondents. The diversity in career paths for respondents is a good element for capturing a better image of the related concepts and principles.

Table 3. Survey Respondents Job Titles

Job Title	Number of Respondents
Agile Coach	1
Continual Improvement Manager	2
Director	1
IT Director	1
Managing Partner	1
Principle Consultant	1
Sales Manager	1
Manager	1
Unit Manager	1
DevOps Engineer	1

Each argument in the survey corresponds to one of the predefined codes derived from the interviews. The purpose of the survey was to measure to what extent each practitioner agrees or disagree with some aspect of DevOps adoption and related principles.

The results confirm some commonly agreed-upon aspects of DevOps adoption process and general concepts related to the definition of the term.

Definition and Goals. Responses lacked a general agreement on the purpose of adopting DevOps; interestingly, responses were evenly split as to whether DevOps is considered a tool/means or a purpose by itself. On the other hand, there was a general agreement that communication between teams is enhanced as a result of DevOps adoption. It was not a given that quality of products is necessarily enhanced (36.4% neutral and 9% disagreed). Nearly 90% agreed to define DevOps by its cultural dimension.

Transitioning Team. Most of respondent practitioners (72.7%) agreed that the job of DevOps Engineers is to orchestrate tasks between development and operations teams and that they act as a guide for them, where others disagreed with this argument and some took a neutral position.

DevOps Skills. A percentage of 81.9% of the respondents agreed that a background in software engineering or in similar discipline is required for DevOps-related roles.

Organizational Structure. Near half of the respondents maintained a position of neutrality regarding complete restructuring for teams and whether it is a necessary step towards the adoption. Only 36.4% agreed that it is not recommended to have a separate DevOps team for DevOps except for companies with medium to high IT performance.

Transformation Requirements. As a first definitive result, all respondents agreed that organizations planning to adopt DevOps should first have their business processes well defined to ensure the success of the initiative. Although nearly half of the respondents (45.5%) agreed that Agile implementation prior to DevOps is a better approach than moving directly from the waterfall model, 36.4% disagreed with the statement. Additionally, a great majority of 81.9% agreed that making some adaptation to the traditional SDLC process is possible as a step towards the transformation.

It is not surprising that more practitioners agreed that automation of all processes is required to fully adopt DevOps. However, it is less definitive that frequent deployments are essential in following DevOps methodology. Statistics also showed a lack of agreement on considering setting a reliable infrastructure as a first step towards the adoption process.

4. DISCUSSION AND CONCLUSIONS

As discussed in a previous section, the literature on DevOps research has extensively addressed concepts, principles, benefits and associated challenges. However, less efforts have been directed to the details of the adoption process. However, in order to validate our results, we compare the findings of this research with the guidelines presented in the literature regarding DevOps adoption.

This research, grounded in data collected from practitioners of the field of software development and experienced in DevOps methodology, is a contribution that attempts to fill the gap between the theoretical and practical point of views regarding DevOps adoption process and related concepts. Although may not be directly related to the adoption specification, derived factors and recommendations are considered contextual factors necessary for the success of the process.

Multiple sources of information were used in order to avoid bias in the findings. Different informants with various roles from different organizations and adoption contexts contributed their opinions and experiences which allows forming solid theories. Two rounds of open-coding, as a part of data analysis, were applied, each of which was done by a different researcher to insure validity of the results. The results from individual interviews can be used to derive a set of recommendations for adopting DevOps in different contexts; big organizations and start-ups. They included advices and experiences considering the technical, managerial and organizational dimensions. On the other hand, responses to the survey can be used to support results from the interviewes or even contradict them opening the need for further investigation regarding specific aspects. Hence, we try in the discussion to triangulate

Similar to referring to DevOps as a mindset change by some of the research from the literature, data from this research shows that the greatest majority of practitioners perceives it as a mindset transformation as opposed to being a technological change, and that the mindset is the biggest blocker in transforming a team with traditional project experience into continuous delivery, short release cycle and DevOps. Therein lies the significance of understanding how practitioners perceive DevOps as it affects the actual steps taken by an organization at the planning stage. The undisputed fact shared between practitioners is that for an organization to transform, real efforts need to be done in order to motivate the personnel, both from development and operations side, to introduce the concept of product-thinking, and to support them in understanding the value brought by the new methodology at all levels.

When organizations are established and have expert professionals, workshops and trainings are essential for introducing the new integrated way of working, the new protocols needed to facilitate the new model or workflow, where development professionals, unlike how used to work, need to take over new deployment related tasks, the reverse is equally true.

In cases where the organizations are rather small or are completely start-ups, the formation of a dedicated DevOps team can be through stages. First, as the focus of the organization is placed on understanding business requirements, it is recommended by some practitioners to hire more developers and business analysts, simply limiting personnel with DevOps experience to one or two at most. As the organization grows, a fewer number of business analysts will be needed, less developers, and more DevOps engineers will be a valuable part of the team.

Progressivity and scalability for a successful adoption were reported as critical factors. In most cases, an organization transforming towards DevOps, starts by adopting Agile methodology, as they are connected and concepts are shared. Organizations are not recommended to leap to a completely new approach which could lead to an unsuccessful experience. It is recommended that a part of the projects are used as a take-off set of projects dedicated for the initial period, where the assigned team will start working on them according to the new protocol and, upon execution, outcomes are distributed as guidelines and plans for the remaining projects throughout the organization. Experiences presented in the literature emphasizes the importance of choosing the correct project

to start with. Team DevOps will not supervise each and every project executed in the organization, virtual teams are formed consisting of involved team members representing a business unit. The virtual teams will be the contact point with the DevOps personnel who will provide templates to be adopted by all units. This way, consistency in the work is ensured.

Our results show that some practitioners are not sure about the time that could takes an organization to adopt DevOps, while others agree that it is a long process that could take a year or two. In the literature it is recommended that organizations set a realistic timeline for the process.

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