Transitioning towards DevOps - Common challenges and how to overcome them

May 8th, 2023

Adrian Karimi Valdani, Oskar Svanström
adriankv@kth.se, oskarsva@kth.se

DD2482
Automated Software Testing and DevOps

School of Electrical Engineering and Computer Science
KTH Royal Institute of Technology
Sweden

Contents

1 Introduction

By 2023 the DevOps methodology has become immensely popular and is widely adopted in the software development industry. DevOps emphasises collaboration and communication between development and operations teams to enable rapid development whilst meeting continuously changing user requirements. The well-established benefits are becoming necessary for organizations to stay competitive and adaptable in today's landscape of changing and scalable software development.

For this reason, the popularity of DevOps is not surprising. The growth has perhaps been most apparent in the startup industry where entrepreneurs can adopt the methodology from the start [9]. But what about established organizations that are used to other ways of working? They need to transition to DevOps from a previous work methodology.

1.1 What constitutes a transition to DevOps?

Transitioning to DevOps means adopting a variety of technical and cultural practices. A wide range of DevOps-supporting tools and technologies are to be considered, the architecture of the software product itself is often changed as well as development processes. Whichever tools an organization ends up using, code commits should trigger automated CI builds, including automated unit and integration testing. Additionally, according to Elberzhager et al. [3], another essential but often overlooked success factor is cultural change. This culture adoption is described as a long and delicate process: "silos" should be broken down, and collaboration and communication between teams need to be highly prioritized.

The transition process will not be the same in every organization. The specifics are formed by the needs and goals of the organization. For instance, one organization might primarily seek to achieve a faster time-to-market for product iterations, whilst another might want to improve the quality of their product. What all implementations do have in common, is the process of breaking down barriers between development and operations teams, enabling collaboration between the teams by automation of processes.

If a business practices Agile methods, the transition to DevOps will likely be more natural than with other methodologies such as the waterfall model which will require a significant shift in company culture. Agile methods already constitute important parts of DevOps, particularly regarding rapid development, continuous feedback, and customer satisfaction. Still, the entire software development pipeline needs to be revised, and the company has to invest heavily in infrastructure, tooling, and automation. By the year 2020 over 90% of companies were using Agile methods in some form for software development[4] so most transitions happening are from Agile to full-scale DevOps.

1.2 What is the problem?

DevOps is widely adopted, according to a 2021 report by Bain, 90% of leading software companies say moving to DevOps is a top priority. But only around 50% claim to have implemented DevOps at full-scale. Furthermore, only 12% would describe their practices as mature, having achieved a high degree of automation, a centrally managed tool chain, and full integration. [1]. A 2021 report by Puppet got similar results and described the state of most organizations as being "stuck in the middle". Meaning that as an organization reaches further into full-scale DevOps adoption, various barriers make the transition process stagnate (see figure 1) [10].

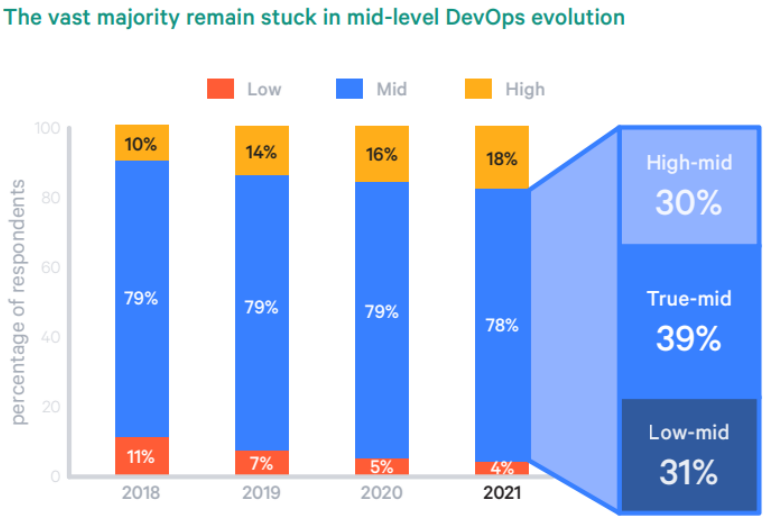

Figure 1: Proportion of software companies in adoption states

To avoid this and for organizations to fully utilize all benefits of DevOps it is of great interest to identify barriers in the transition process and implement strategies to mitigate them. This essay will therefore focus on the following problem questions:

- Which main challenges do software companies face when adopting a DevOps way of working?
- Which solutions/strategies have been shown to be effective to mitigate these challenges?

2 Challenges for DevOps transition

There is a diverse set of problems and challenges faced by companies when adopting DevOps from previous ways of working. These can broadly be divided into technical and cultural. Technical challenges are important and can include anything from finding the right automation tools and implementing an infrastructure that enables scalability to integration of older legacy systems with the DevOps process. But this essay will primarily focus on the cultural aspects and challenges of the DevOps transition. Krey et al. compiled various state-of-the-art research on DevOps adoption and concluded that the major-cultural shift often creates more difficult challenges than the various technical aspects [6]. The 2021 report by Puppet also finds that the barriers are more often than not, cultural [10].

A 2020 research paper on DevOps principle adoption [7] identified three main challenges that practitioners in companies that have contributed to DevOps often mentioned. These include *Poor communication and information flow*, *Deep-seated company culture*, and *Operations not participating in the requirements specifications.*

2.1 Poor communication and information flow

DevOps methodology emphasizes effective communication and collaboration between development teams, but without decent communication channels, there are increasing risks for misunderstandings and arbitrary or ill-defined objectives that lead to unnecessary delays. In DevOps, achieving a smooth information flow between all teams involved in the software lifecycle is an important goal. Companies with efficient communications generally perform significantly better. According to research by the Project Management Institute, companies with efficient communication met their goals around 80% of the time, compared to 51% for companies with poorer communication between teams and departments[11].

2.2 Deep-seated company culture

There are a variety of issues related to company culture that might hinder the transition to DevOps methodology. Employees might not embrace changes particularly if employees are used to working in silos and not used to sharing information. Other important problems include clashing incentives and competing priorities. Meaning that different teams will focus on some specific target, and in some cases, different roles might have different priorities that are not always compatible. Changing company cultures can be a challenging process and might require much time and resources.

2.3 Operations not participating in the requirements specifications

In the conventional structure of software companies with teams in silos, requirements for the product is often gathered by stakeholders external to operations teams. The DevOps approach emphasizes frequent collaboration and communication between development and operations, which partly means more responsibility

for the operations teams to be involved in gathering requirements and creating the product specification. If the operations teams are not sufficiently involved in these processes, it can cause issues in the deployment and maintenance of the software. For instance, if hardware requirements are not properly understood by operations issues can arise during deployment.

3 Solutions and strategies

After having outlined these main issues, Maroukian et al.[7] reason that the problems are best approached from a company culture perspective. After all, a large part of what makes up DevOps culture ultimately depends on the soft skills and collaboration patterns of the people that work in the organization. Kim et al.[5] emphasizes the importance of culture in DevOps: "a high-trust culture that enables all departments to work together effectively, where all work is transparently prioritized and there is sufficient slack in the system to allow high-priority work to be completed quickly."

3.1 Solutions for communication and information flow

One of the interviewees in the paper by Maroukian et al, said: "The 'email culture' on which business units heavily rely is detrimental to DevOps adoption aspirations." Perhaps an obvious bottleneck, having teams communicate mainly through email can cause information problems that hinder the kind of tight collaboration that is essential to DevOps culture. Appropriate tools and technologies should be leveraged to avoid these problems, for example using Slack, Teams, Discord, etc. for communication channels.

Hemon et al. [4] describe how soft skills are often overlooked in hiring processes, while the opposite is true for business skills and hard skills (technical skills). This possibly stems from the general problem of measuring soft skills during recruitment, as opposed to technical skills. Hiring the right people with both of these skill sets should not be overlooked. Common communication challenges between the teams can be attributed to lacking communication patterns. Often times, the issue at heart is *insufficient* communication [8]. A Finnish study on DevOps adoption identified that if communication between Dev and Ops teams only happens electronically, that might cause delays that limit communication. Essentially, the importance of in-person communication is important.

3.2 Solutions for company culture

The most efficient strategy for changing culture will be a multifaceted approach. The cultural shift should be driven top-down, meaning that the management and leadership of said company need to understand the benefits of DevOps to adequately promote it to coworkers down the chain. But it will only be effective when all members of the teams trust the changes. One way to achieve this is through smaller pilot projects before scaling up [2].

The company, particularly the leadership, should also try to establish goals/KPIs

which should ideally align with the company's existing goals to help ease integrating the practise into existing company culture. Finally, it is important to highlight successful cases of DevOps adoption within the company. If a team member contributed to the DevOps process in a meaningful way, this should be celebrated.

3.3 Solutions for lack of participation in the requirements specifications

A good strategy here is for development teams to involve operations very early in the software development process. Operations should take part in the requirements gathering and formation of the technical specification of the product. Agile methodologies/DevOps ceremonies can be used to aid in the communication aspects of these issues. Daily standups and sprint reviews for instance aid communication and ensure that every member of both Dev and Ops teams is on the same page, preventing misunderstandings that could cause resource waste and/or problems in deployment.

4 Discussion

4.1 Which strategies are the most effective?

It is difficult to assess when certain strategies will be most effective since this depends very much on the company culture, and also how far into the transition process the organization is. There are also some problems that do not have a clear answer. Krey, et al found that there are no real recommendations among state-of-the-art research regarding how to deal with different views and opinions in the development and operation teams. However, they still argue that reaching some consensus on the importance of DevOps in the organization is important for mitigating communication issues [6]. There are many well-used methods in Lean and Agile development that address the range of issues that might arise. For example, daily standups benefit communication and prevent misunderstandings. For an organization to put some resources into exploring which specific methods would benefit them, might be the best starting strategy. DevOps is all about continuous improvement, and each organization that adopts its principles should accept that this process will be one of trial and error.

4.2 Focus on the organization

Since DevOps is a comprehensive and interdisciplinary methodology, it can be hard to define. Several of the studies referenced in this essay mainly aim at formulating the problems identified by people working in real organizations. As previously mentioned, there is not just one single DevOps culture. The principles are adopted and applied in relation to the specific needs and challenges of an organization. Ultimately, the strategies that will work the best are the ones that address those needs and challenges.

5 Conclusion

For an organization not to get "stuck in the middle," it is important to have a multifaceted approach for all potential barriers. What we have found is that whilst technical barriers are important, cultural barriers can be more difficult and often overlooked.

An organization that adopts DevOps principles will probably encounter at least one of the three main challenges discussed in this essay. Although these general challenges are identified as common, the day-to-day problem-solving involved in adopting DevOps will differ significantly between organizations. Even though the benefits of DevOps are established, implementation can be quite difficult and there is no one approach that will work for all organizations.

Key takeaway : Whilst it is important to focus on technical challenges in DevOps adoption. The cultural aspect of a company is equally, if not more, important when adopting DevOps practices. Therefore, identify cultural barriers and work towards removing them!

Note from the authors: We certify that generative AI, incl. ChatGPT, has not been used to write this essay. Using generative AI without permission is considered academic misconduct.

References

[1] Christian Buecker, Greg Fiore, and Johnny Lee. *Taming the wild west of devops*. Oct. 2022. URL: https://www.bain.com/insights/devops-tech-report-2021/.

[2] Lalatendu Das, Ling Lau, and Chris Smith. *Five cultural changes you need for devops to work*. Feb. 2017. URL: https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/digital-blog/five-cultural-changes-you-need-for-devops-to-work.

[3] Frank Elberzhager et al. "From Agile Development to DevOps: Going Towards Faster Releases at High Quality – Experiences from an Industrial Context". In: *Software Quality. Complexity and Challenges of Software Engineering in Emerging Technologies*. Ed. by Dietmar Winkler, Stefan Biffl, and Johannes Bergsmann. Cham: Springer International Publishing, 2017, pp. 33–44. ISBN: 978-3-319-49421-0.

[4] Aymeric Hemon et al. "From agile to devops: Smart skills and collaborations". In: *Information Systems Frontiers* 22.4 (2019), pp. 927–945. DOI: 10.1007/s10796-019-09905-1.

[5] Gene Kim et al. *The DevOps handbook: How to create world-class agility, reliability, & security in technology organizations*. IT Revolution, 2021.

[6] Mike Krey. "DevOps adoption: Challenges amp; Barriers". In: *Proceedings of the Annual Hawaii International Conference on System Sciences* (2022). DOI: 10.24251/hicss.2022.877.

[7] Krikor Maroukian and Stephen R. Gulliver. "Leading DevOps Practice and Principle Adoption". In: *9th International Conference on Information Technology Convergence and Services (ITCSE 2020)*. AIRCC Publishing Corporation, May 2020. DOI: 10.5121/csit.2020.100504. URL: https://doi.org/10.5121%2Fcsit.2020.100504.

[8] Leah Riungu-Kalliosaari et al. "DevOps adoption benefits and challenges in practice: A case study". In: *Product-Focused Software Process Improvement* (2016), pp. 590–597. DOI: 10.1007/978-3-319-49094-6_44.

[9] *Staying ahead of your competitors with DevOps*. URL: https://www.zdnet.com/paid-content/article/staying-ahead-of-your-competitors-with-devops/.

[10] *The 2021 state of devops report is here!* URL: https://www.puppet.com/resources/state-of-devops-report.

[11] *The high cost of low performance: The Essential Role of Communications*. Project Management Institute, 2013.