

DevOps Job Roles: A Multivocal Literature Review

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Abstract. DevOps bridges the gap between software development and operations to provide rapid deliveries and integrated collaboration. However, DevOps entails lots of factors and challenges involved in its implementation including technical, organizational and personnel aspects. Focusing on the last set of aspects, this paper identifies current DevOps job roles, an aspect that is crucial to implement and to support DevOps practices in organizations. It also highlights collaboration between different actors under different automation levels in DevOps to deliver software at high speed.

Keywords: Multivocal literature review · DevOps · Job roles · Software development

1 Introduction

As the world is moving swiftly towards technological advancements, software development operations are carried out at excessive rates to keep up with the required change [1]. However, these changes do not come easy, software development companies are working hard to keep up with demands of frequent changes, but as the software and applications become extensive, it becomes nearly impossible to deliver rapid updates to end users. Development team can implement these changes relatively quick as compared to the time it takes for actual deployment to end system [2].

Agile development techniques were adopted to speed up the development process as the waterfall model failed to provide frequent updates. Agile development techniques successfully solved problems related to longer development time by splitting requirements in short sprints, however, it raises problems for IT operations responsible for deployment of code [3]. With the code now coming fast from agile methods it becomes hard for IT operations to test and validate these changes and deploy new changes. In other words, in agile settings, the information circulating between development and operations teams was not faster or more frequent [4].

Apart from that it is also a time consuming and labor-intensive work to manually test and move changes to deployment [5]. Frequent changes in development would normally create bottleneck at IT operations function which can lead to longer delay in software releases to customers. So in order to minimize the gap between development and deployment a strong relation between Development and Operations needs to be

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established which is termed as "DevOps" [3]. DevOps is about end-to-end automation in software development and delivery [6]. Inside DevOps arena, microservices architectures [7] are one of the main enablers in the adoption of DevOps [8], given that DevOps is grounded in the cloud [4].

The origin DevOps can be traced back to 2008 at Agile Conference in which Debois pointed out the need to improve collaboration between development and operations teams in order to deliver rapid response time to customer demands [9].

DevOps follows the **CI/CD** pipeline (Constant Integration/Constant Delivery) towards software automation. After the pioneering adoptions by big companies, many software companies are increasingly switching to DevOps to support short feedback loops and automated processes. In a recent study [10], authors indicate that one of the main reasons behind the adoption of DevOps is the acceleration of time-to-market while delivering high-quality products. While there are many benefits to adopting DevOps, companies and organizations also face many challenges during the transition. A company may have to undergo cultural changes to achieve DevOps [1].

DevOps provides greatest job satisfaction than agile [11]. DevOps follow agile principles for collaborative work and further extend them to broader perimeters. Grouping development and operations team improved team satisfaction. DevOps required strong collaboration between team members of different expertise to reach common ground, many challenges arise during the process so it required both strong hard and soft skills [11]. In a scenario in which technical issues regarding DevOps automation are more studied, however, there is no consensus on how to effectively empower collaboration among departments and persons [12]. Literature reported poor team performance as one of the aspects to improve in DevOps projects [13] being close communication, integration and collaboration measures to tackle this problem. DevOps fosters the formation of cross-functional squads in which there is a need among team members to contemplate and forestall the job to be completed by other members [3].

DevOps capable and experienced team members are hard to find as DevOps is still in emerging phase [14]. Different DevOps job roles require a comprehensive collaboration among team members, and each role is not just limited to a specific task but intertwined with one another. However major responsibility of these roles include planning, building and running within a team [15]. Release Manager, Architect, Product Owner, Department/Project Manager and Production Engineer are key roles to any DevOps environment. Developer is also crucial to DevOps as they share knowledge and collaborate, but we will not discuss them during this study because there is no significant challenges for them moving toward DevOps [3]. There exists several other software engineering job roles such as business specialist, test managers, QA engineer, which are not included in this study as they don't directly influence DevOps environment [1].

The rest of this paper is structured as follows: Sect. 2 describes the study method followed by results presented in Sect. 3. Finally, Sect. 4 presents conclusions and future research directions are depicted in Sect. 5.

2 Research Approach

2.1 Multivocal Literature Review

This study helps to identify and analyze various DevOps job roles that can make a successful and functioning DevOps environment. It also identifies key responsibilities for each role and how these roles contribute to **CI/CD** pipeline. Academic literature on selected topic is quite limited and gray literature must be included to provide further insights. So, in order to achieve goals presented earlier, authors adopted a multivocal literature review (MLR) as the selected method. In MLRs academic literature and gray literature are combined, academic literature represents scientific literature whereas gray literature involves all other sources of information like blog, post, websites, newspaper articles, white papers etc. Research is piloted observing known guidelines for counting grey literature and performing MLRs in software engineering [16] as well as guidelines in paper writing in ICT related disciplines [17].

2.2 Research Questions

The goal of this study to understand different job roles in DevOps and their importance at different stages of development and deployment, so, in order to accomplish the aim of this paper, three research questions (RQs) are formulated. There are two researchers involved in this study, first author is responsible for the selection procedure and provide initial results while second author assessed the process, checked the results and supervised answers to research questions, the research questions are as follows:

- **RQ 1:** What are major DevOps Job Roles?
- **RQ 2:** What are different automation levels in DevOps?
- **RQ 3**: How different job roles collaborate at each automation level

2.3 Selection of Studies

This section illustrates all the phases required for collecting literature for reviews, including the selection of which online databases will be used for searching literature. This section also explains search strategy, inclusive and exclusive criteria to find relevant literature for review.

Databases
The listed databases were recommended by the library of Østfold University College for selecting academic literature on the topic under review in this study.

- ACM
- IEEE
- Springer
- Science Direct
- Google Scholar

Apart from the internal recommendations mentioned earlier, these sources were chosen given that they are among the most relevant sources of information in the broad computing field. Also, in order to find relevant grey literature, the following search engines are used.

- Google Search
- Bing

Search Terms
The first step towards building a search strategy is to identify potential keywords that can pin-point research to literature that is relevant to topic and helps to achieve the goals of this study.

After the initial screening the potential keywords for this study are identified. These keywords include “DevOps” and “Job Roles”. These keywords are not case sensitive, so now only thing required is to rearrange keywords in a manner that it brings out relevant literature either gray or academic. After testing following search string is used to conduct this review:

("DevOps") AND ("Job Roles")

Inclusion and Exclusion Criteria
Once search results are obtained by applying the search query mentioned in previous step, a list of inclusive and exclusive criteria needs to be determined to limit content to fewer and relevant literature that aligns well with objective of this study.

Inclusion Criteria

- Papers that precisely deals with DevOps Job Roles.
- Literature that discusses major DevOps Job Roles.
- Literature that discusses advantages/benefits DevOps Job Roles.
- Literature that discusses challenges/limitations DevOps Job Roles.
- Literature only retrieved from the first 15 pages of Google Search & Bing.

Exclusion Criteria

- Papers that are not accessible.
- Studies that contain required keywords but are not relevant to this study.
- Duplicates found in Google Scholar.
- Literature not available in English.

2.4 Literature Retrieval

Literature retrieval involved finding the relevant literature in an efficient and organized way. Four stages were designed to achieve the goal, first stages documents all the papers that are returned by applying initial search string. Second stages filters papers based on the inclusive and exclusive criteria. Third stages involve reading of title, keywords and abstract to identify papers that are relevant to study. Fourth stage is an in-depth study of entire paper by a full text read to see how it can help to achieve the objectives of this study.

2.5 Data Storage

Retrieved literature is stored systematically in a reference manager, namely Zotero, Furthermore, important papers were color coded for references during this study in order to facilitate their classification in this study.

3 Results

In what follows, obtained results previous sections will be discussed to answer formulated RQs.

3.1 Studies Retrieved

In Table 1 authors show the quantity of papers and articles retrieved from different stages of literature retrieval, first stage shows the total number of papers returned after applying search query, second stage shows papers after applying inclusive and exclusive criteria, third stage shows relevance of papers based on title and abstract, and fourth stage shows paper with full depth analysis. Table 2 contains the final set of 11 papers selected indicating the reference and the title of each of these papers.

Table 1. Number of papers analyzed per stage

Source	1	2	3	4
ACM	7	2	1	1
IEEE	10	6	3	1
Springer	18	8	6	1
Science Direct	2	0	0	0
Google Scholar	149	45	24	3
Google	463,000	150	12	5
Bing	65,600	150	5	0
Total	***528,786***	***361***	***51***	***11***

Table 2. List of primary studies

#	Title	Reference
1	*A Large Agile Organization on Its Journey Towards DevOps*	[1]
2	*The Impacts of Digital Transformation, Agile, and DevOps on Future IT curricula*	[2]
3	*From Agile to DevOps: Smart Skills and Collaborations*	[3]
4	*DevOps for Developers*	[5]
5	*Orchestrating automation and sharing in DevOps teams: a revelatory case of job satisfaction factors, risk and work conditions*	[11]
6	*A Survey of DevOps in the South African Software Context*	[14]
7	*Are you ready for DevOps? Required skill set for DevOps teams*	[15]
8	*DevOps and the Product Owner - what changes?*	[18]
9	*DevOps Release Manager - Roles, responsibilities, and salary insights,*	[19]
10	*Cloud and DevOps: CI/CD and Market Analysis*	[20]
11	*DevOps Career Path: 6 Demanding & Diverse Roles*	[21]

3.2 RQ1: What are Major DevOps Job Roles?

Although everyone involved in Software Development and IT Operations is part of the DevOps functional chain, few roles play a crucial role in determining success and failure of DevOps. These roles are as follows:

- Product Owner
- Architect
- Production Engineer
- Department/Project Manager
- Release Manager

Developer is not part of major DevOps job roles because developer does not have any significant challenge in moving towards DevOps. These roles are identified as important by performing a 2 stage experiment process in a large European IT services firm [3]. However, other research articles discuss DevOps job roles and responsibilities but does not assign importance to any job role. The description of the roles in DevOps are as follows:

Product Owner
A product owner is responsible for representing client during the entire lifecycle from development to deployment. It is real operation role that links business to project management. And product owner is responsible for managing the product backlog. Product

owners understand the vision of project and responsible for deliveries, with fewer deliveries before DevOps, but now with DevOps they must move faster to keep up with instant updates. Product owners also needs to think in terms of system [18].

Architect
A crucial member of the team as they are responsible for setting up system and functional architecture. They must strongly communicate with project manager to exchange information. Architect is responsible for setting up smooth transition between development and operation functions [3]. Architect focus is towards setting up smooth CI part in the DevOps pipeline.

Production Engineers
Production Engineers are production integrators, they are also tester and responsible for productions. operations, incident monitoring, user support.

Department/Project Manager
Project managers are responsible for collaborating between all other actor, to debate budget, tracking and prioritization of items. Sometimes also work with functional architecture.

Release Manager
Release manager is a crucial member towards safeguarding success of project. They are responsible for handling Constant Delivery (CD) part of a DevOps pipeline [19].

3.3 RQ2: What are Different Automation Levels in DevOps?

There are three major automation levels in DevOps [3], they are listed as follows.

Automation Level 1 (Agile)
Automation level 1 represents traditional agile development life cycle in which development and operations are working in silos without any proper sharing, no automation in release so it's fine to say the DevOps is not realized during automation level 1.

Automation Level 2 Continuous Integration
The operation requests to be in line with development, during this automation process more focus is provided toward the integration part between development and operation, the reason behind is company policy toward rapid movement of code form development to production, performs unit testing, study shows that 53% of companies using DevOps prefer continuous integration [20].

Automation Level 3 Continuous Deployment
Fully automated DevOps pipeline performs integration testing, user testing, performance testing. Here the development needs to be aligned with operations. Greater the level of automation requires more sharing and mutual discussion.

3.4 RQ3: How Different Job Roles Collaborate at Each Automation Level?

In order to solve this RQ, we focus on a paper presenting a study conducted in a large European IT Services company with over 15000 employees. 12 teams were selected from the company which were following agile and DevOps techniques [3]. The study showed the collaboration between operation and development can be divided in three different automation levels.

Collaboration During Automation Level 1
During automation level 1 the development and operations has little collaboration between each other compared to communication within Development and also within Operations teams.

Collaboration During Automation Level 2
At this level, development and operations have almost equal communication with one another and among themselves, however internal communications can be a bit higher.

Collaboration During Automation Level 2
At this level, development and operations present a perfect balance in the communication both internally and externally.

4 Conclusion

In this paper, authors present a MLR devoted to analyze DevOps Job Roles. With the goal of identifying major DevOps job roles, how DevOps affects each role, different automation level in DevOps process and how different automation level increase or decrease collaboration between different job roles. Different literature databases and search engines were used for gathering literature used in this study.

DevOps is rapidly increasing field of software development [21], it's less about code and more about collaboration between individual to improve integration and delivery pipeline. DevOps expert requires diversity in skills as it requires knowledge of development and operations functions. It also addresses barriers in DevOps, various factors that impose problems for a new company to adopt DevOps [1].

5 Future Work

The research in this study is limited to few DevOps job roles and automation levels associated with them. However, DevOps is still evolving rapidly, so it is important that each software engineering role and process needs to be redefined to align with DevOps concepts. Also, there are several challenges involved for an organization to move towards DevOps from traditional development techniques because of insufficient technical skills existing within an organization. Research can be done towards mitigating these aspects. In order to help organizations in the adoption and implementation of DevOps, a recent paper provides guidance to adopt DevOps, including a generic process and a mapping of roles [22].Following this path, authors would like to map this approach

with more stablished approaches. Finally, given the increasing importance of DevSecOps or SecDevOps [23], authors would like to perform research on job roles in this evolution of DevOps to check for specific job roles in the approach. Also, specific studies in line with [24] are planned to study competences and skills beyond roles.

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