Exploring the Challenges of Cloud Migrations During a Global Pandemic

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***Abstract*—There are many benefits of migrating applications to the cloud, including highly available and elastic compute power, unlimited backup and storage, fully managed services, and overall cost savings. However, there are many challenges that software engineers face when migrating applications to the cloud. Even more challenges during the recent COVID-19 pandemic. The focus of this paper is to shed light on the challenges software engineers face performing cloud migrations during a global pandemic. A proposed set of research questions will be used to determine the challenges remote software engineers face, as well as the tools and methodologies used during the cloud migration process. Future work will consist of building a process model by examining the current state of cloud migration approaches as well as new approaches due to a global pandemic.**

***Index Terms*—service-oriented and cloud computing, cloud migration, global pandemic, remote software engineers**

I. Introduction

The advancement in service-oriented architectures and cloud computing has changed the way software engineers build roadmaps for applications. Cloud presence is seen in almost all Fortune 500 companies [2], [6], [8]. Companies are migrating to the cloud to gain flexible computing power and cost savings [10], [11]. However, there are still organizations building applications fully on-premise, in self-managed data centers, or hybrid cloud to reach their users. These organizations may have different regulatory requirements for the data they collect or reliance on proprietary technologies. They may also have shortages of software engineers with cloud migration experience, minute traffic footprints, region-specific users, or relaxed requirements on latency and downtime.

Due to the COVID-19 pandemic, the need to embrace cloud-based technologies into software systems has become ever apparent. According to an independent survey to 500 IT decision makers from around the globe 87% of IT decision-makers agree that acceleration to cloud migration will occur due to the COVID-19 pandemic [1]. This means that organizations will be migrating applications to the cloud, but not without challenges. In Fahmedeh's *et al.* piece [4] on migration techniques in cloud computing, the authors focus on building a process model, recommendations, and techniques for cloud migrations to overcome many of the challenges. However, this work was conducted without the barriers presented because of fully remote teams, enforced social distancing, and emotional stress brought on by a global pandemic. Determining key similarities and differences in established process models is one of our goals with this study.

In this paper, we present a number of research questions that can help us better understand the challenges remote software engineers face and the solutions to those challenges. We also aim to present the reasons behind a push for cloud migration during a pandemic, workstations and environments for remote software engineers, as well as learning techniques for successful cloud migrations. The evaluation will be determined by a single survey as well as interviews with remote software engineers to derive solutions. We hope to start a discussion with the community about this work and receive feedback.

II. Problem

We address the following gap in the current software engineering and cloud migration literature: there are no studies on how software engineers cope with cloud migrations demands because of and during a global pandemic. Literature shows that their are known barriers that applications face during the development process and with collaboration of software engineering teams [3], [5], [9].

During a global pandemic, all team members are remote workers. The applications these teams build could consist of on-premise infrastructure or infrastructure in self managed data centers. Other applications that are not running on-premise typically are hosted virtual machines in a cloud-based infrastructure which in turn alleviates the need to manage infrastructure in person and creates a need for migrating applications into the cloud.

Because of this, there is a surge of software engineers who are migrating applications to the cloud. This remediates issues with managing on-premise and self managed data center infrastructure and also creates scalable and elastic infrastructure to handle the massive spikes in workloads a global pandemic brings. A solution to this problem would be to present a process to prepare software engineers to work remotely along with ways to prepare the applications that are being built to run successfully in a cloud environment. Teams would be able to successfully collaborate remotely and software engineers would understand key factors needed for a cloud migration. This would increase collaboration and productivity while creating global pandemic resistant applications.

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III. Research Questions

Our research objective in this study is to better understand what tooling and challenges remote software engineer's face during a global pandemic. Therefore, we ask the following Research Questions (RQs):

- RQ_1 Are remote software engineers migrating applications to the cloud due to COVID-19?
- RQ_2 What are the challenges software engineers face migrating applications to the cloud during COVID-19?
- RQ_3 How are remote software engineers improving their skills and learning how to migrate applications to the cloud during COVID-19?
- RQ_4 How are software engineers preparing for the increase in user demands during COVID-19?

The rationale behind RQ_1 determines whether remote software engineering teams are migrating to the cloud specifically because of COVID-19. Since previous research has given us a solid understanding of cloud migration challenges and techniques [4], [7], [12], RQ_2 will help us determine the cloud migration challenges software engineers face during a global pandemic. To help determine what resources remote software engineers are using to upskill and learn how to successfully migrate applications to the cloud securely and safely, we ask RQ_3. Finally, in RQ_4 we ask software engineers about current and future preparations being established to determine what approaches are being done to prepare for increases in user demand and spikes in traffic due to the COVID-19 pandemic.

A. Methodology

We will conduct our evaluation in a single survey study that will be presented to remote software engineers as well as separate virtual interviews. The survey will be presented to remote software engineers working during the global pandemic. The survey and interviews includes questions regarding cloud migrations, challenges software engineers are facing, and lessons learned from successful and unsuccessful cloud migrations during COVID-19.

B. Evaluation and Solution

The goal of the evaluation is to determine the reasons for cloud migrations because of the global pandemic. These reasons could be from large spikes in traffic or no longer having the ability to manage infrastructure on-premises and in person that otherwise would not have been a factor. Once we determine the reasons why cloud migrations are occurring, we can then analyze the challenges software engineers are facing. Our results expect to find other challenges such as the inability to connect to the on-premise networks, a lack of engineers with cloud migration experience, new security risks with entire teams working remotely, and costly decisions to consider when moving parts or entire applications to the cloud. A one size fits all solution will not be suitable as software systems are diverse as well as the teams that develop them. Our solutions will involve ensuring remote software engineers have the necessary tools, skills, and process model to successfully migration applications to the cloud during a global pandemic. The solution will revolve around remote work, social distancing factors and other stress induced by the recent global pandemic. Our results will present:

1) Workstation and environments software engineers performing cloud migrations successfully are using
2) The challenges software engineers are facings and the successful and unsuccessful results from those challenges
3) The learning platforms software engineers are using to have a successful cloud migration
4) A process model that differs from current models to aid in migrating applications to the cloud

With these results, we hope to shed light on factors and solutions to enable successful application migrations to the cloud during a global pandemic.

IV. Future Work

The future work will consist of existing approaches that are proposed for cloud migration models and what is the current state of these approaches since the COVID-19 global pandemic. A new model can also be presented consisting of new methodologies to follow for software engineers who are required to work remotely as well as migrating on-premise and hybrid cloud applications. This will provide a deep understanding of the current state of migration approaches as well as new approaches that must be adopted because of the limitations a global pandemic presents. Software engineers can use this model to choose approaches depending on their organization, team, and cloud migration specifications.

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