


# Infrastructure as Code

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**INFRASTRUCTURE AS CODE  
UNLEASHED!**

**THE CURRENT IT** market is increasingly dominated by the “need for speed.” This need is reflected in the trending use of tactics which shorten the software development cycle and also intermix software development activities with IT operations—a trend commonly referred to as DevOps.

As part of the DevOps menu, many practices entail reusing standard tools from software development (e.g., code-versioning, code-revision management, and so on) to manage what is known as *infrastructure as code (IaC)*. Quoting from the first-ever infrastructure code paper in our

reference top venue, that is, the International Conference on Software Engineering (ICSE) in 2017,

*DevOps entails a series of software engineering tactics aimed at shortening the actionable operation of software design changes. One of these tactics is to harness infrastructure-as-code, that is, writing a blueprint that contains deployment specifications ready for orchestration in the cloud.*<sup>1</sup>

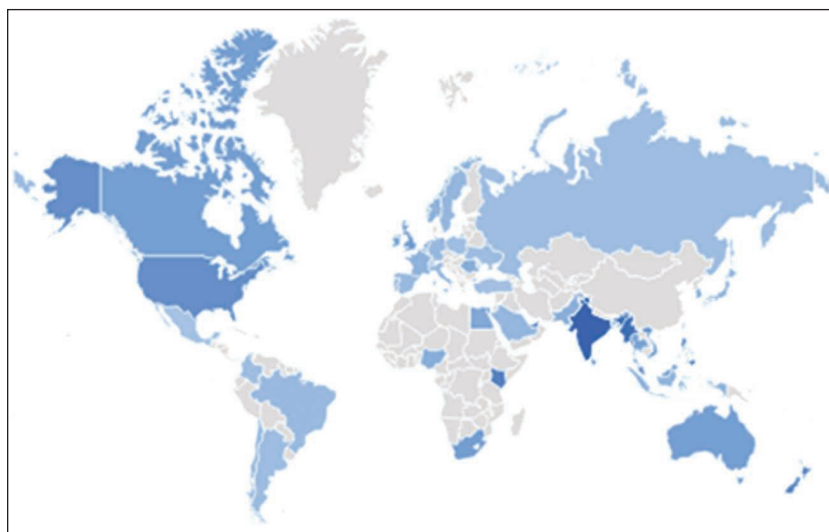
On the one hand, IaC reflects the key driver for automation of modern-day software systems and services which can refer to themselves as “cloud-native” and beyond,<sup>2</sup> even reaching those systems which were not designed in the cloud but eventually reached it through incremental, iterative (re-)design, presumably toward the well-known microservice architecture style.<sup>3</sup>

On the other hand, the IaC realm has greatly evolved in the last five years; this collection of top-quality research is both a salute to the field researchers and a synthesis of the state of the art and practice for the benefit of both practitioners and researchers and spreading around most areas of active cloud research around the world, as seen in Figure 1 which highlights the major research nodes around the world over the topic.

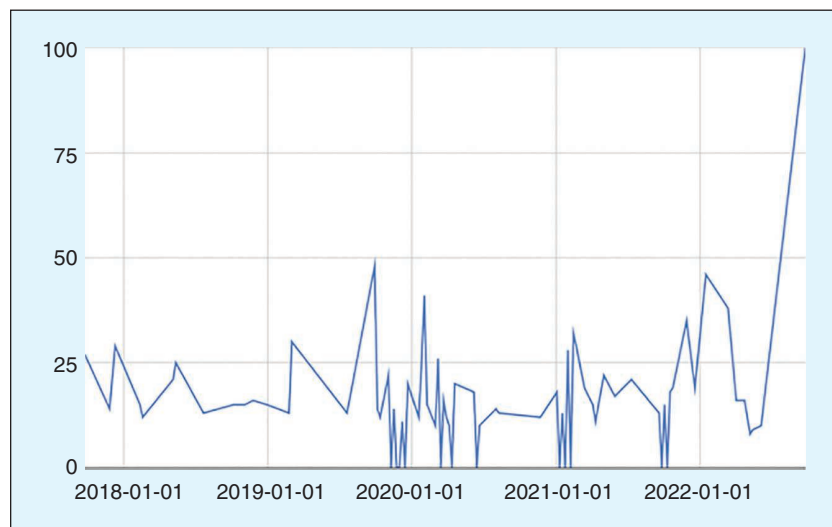
Indeed, such a goal has already manifested since the solicitation of articles we enacted at the beginning of this voyage.

In fact, the trend identified in Figure 2, shows a clear correlation between our initiative in early 2021 and the spike in interest over the infrastructure code topic and endeavors.

From such trends and growing interest, one conclusion is blatant:



**FIGURE 1.** The major research and practice hotspots around the world for IaC.



**FIGURE 2.** The trends in “infrastructure code” search query in the last 80 months; a linear trend is evident until our solicitation of papers in early 2021 across multiple social and technical challenges while a spike is also evident toward the end.

infrastructure code, its operations management, optimization, maintenance, and evolution are here to stay.

This special issue represents both an opportunity for the exploratory depiction of the current state-of-practice along the lines of IaC development and quality assessment as well as a call to action for further work and transfer of theoretical-practical research around IaC from academia toward IaC practitioners in industry. From a theoretical and practical implications perspective, the special issue offers plenty of opportunities:

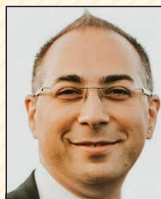
- First, for practitioners and researchers alike, the special issue reveals key differences in the infrastructure programming models which are not known currently and would reflect the state-of-the-art work in the field.
- Practitioners are provided with key technology “outtakes” and research results or emerging technologies which would be valuable in their infrastructure coding exercises.
- Researchers are provided with valuable lessons over where and how successfully has IaC design and management been supported with scientific results and contributions.

Overall, the special issue is bound to contain essential elements for anyone approaching the IaC subject matter—both from practical and theoretical perspective—with all essentials to tackle such research challenges. Indeed, most if not all of the articles we received and evaluated highlight such conclusions from several perspectives, e.g., security, privacy, decentralization, automation levels, maturity, and more.

## ABOUT THE AUTHORS



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## Structure and Contents of This Special Issue

This special issue shows how the realm of infrastructure code has evolved to a status which—analyzed from a scientific perspective—can be considered mature, and rich in practices which can be seen as off-the-shelf approaches to continuous software engineering. Stemming from the works we accepted, four key conclusions can be drawn.

First, *decentralization is the door and infrastructure code is its key*. Two articles in this special issue address the need for more fine-grained management of decentralization, federation, and other more complex than regular architectural structures. This calls to action in terms of understanding and finding best-fit architectural configurations for infrastructures as much as—and in continuity with—the software architectures being run on such infrastructures, which are typically microservice-oriented designs.

Second, *lifecycle automation requires smart optimization*. With the


current and near-future scale achieved by industrial-strength cloud applications, lifecycle automation needs to become proactive rather than reactive; proactivity needs to be nourished with smart automations able to context-adapt as well as make decisions rapidly, explainably, and with a rapid turnover.

Third, *maturity models for DevOps are essential*. From an organizational perspective, most if not all of the articles predicate on the need for structured and smarter governance around the adoption of DevOps through infrastructure code; such adoption and governance schemas need to adhere to a yet nonexistent DevOps maturity model in order to offer guarantees to external stakeholders of their veracity and resilience.

Fourth, *security is the paramount dimension in operations*. Perhaps even more importantly, the security foundations of infrastructure code quality management, lifecycle operations as well as maintenance and evolution are paramount. More

automated practices are needed to handle this aspect which has remained implicit so far.

**W**e conclude that the infrastructure code discipline—young though it might be—is bound to pick up even more disruptive interest in the near and not so near future, given its many ramifications and often

very granular nonfunctionals. We are confident that the present special issue serves as a first compass for those that are willing either to initiate IaC studies or practitioners willing to perfect their IaC practices with state-of-the-art approaches. 

**References**

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