Pentalog TECH rocks

# TECHNOLOGY TRENDS 2021

# Trends Summary

As in previous years, the 2020 edition of Pentalog's Technology Trends review takes the specific angle of "reducing unnecessary complexity." Fortunately, today we have more tools to decrease this complexity. Now we have FaaS, CaaS, low-code, public cloud managed services and more specialized and better programming languages. Industry efforts to reduce unnecessary complexity are an important step for robust, secured, scalable and evolutionary architecture.

- Since the first version of Technology Trends in 2018, we saw WebAssembly as the next big thing, with huge impact over the web. However, its impact isn't there yet.
- Node.js is the new king!
- HTTP/3 has experimental browser support since this year.
- Speaking about something exceptional in the world of front-end frameworks, Vue gets finally its 3.0 release (React and Anglular have ordinary releases). It is hard to assess if the release comes too late or not to gain user traction.
- In the COVID-19 era, Teams outpaced Slack and automation got an unexpected boost with RPA, API, low-code/no-code, ML and intelligent business process management.
- Rust is the de-facto challenger and the unique viable alternative of C++ (which just saw its most important renewal: C++20). Go struggles with its future version, Swift moved to the backend, TypeScript it's all-times high and Dart increases its popularity since the existence of Flutter.
- React Native continues its growth, Flutter overpasses Xamarin.
- Python will become TIOBE's language of the year for the fourth time and gets even more attention from Microsoft.
- Java continues to decrease in popularity and interest and scores second in the TIOBE Programming Community index.
- PyTorch caught up Tensorflow in popularity and features.
- Serverless Functions, hybrid & multi-cloud is super boosted.
- Last but not least, AWS recorded its smallest revenue growth in the 4th quarter of 2020 yet remains the leader in public cloud.

# Major Releases

# 2020

## Q1

+ Java 14
+ Angular 10
+ **Swift 5**
+ **Symfony 5.0**

## Q2

+ ECMAScript 2020
+ **HTTP/3 RFC**
+ Node.js 16
+ **Blazor 3.2.0**
+ Svelte 3.21
+ Flask 1.1.2

## Q3

+ go1.15.1
+ **Java 15**
+ **Vue.js 3.0**
+ **C++20**
+ Android 11
+ Ruby 3 preview
+ PostgreSQL 13
+ Typescript 4.0
+ Kafka 2.6
+ Kotlin v1.4
+ Laravel 8
+ PyTorch 1.7.0

## Q4

+ **.NET 5**
+ **F# 5**
+ **C# 9**
+ Q# 0.14
+ Angular 11
+ **React 17**
+ Django 3.1.4
+ Tensorflow 2.4
+ Typescript 4.1
+ MongoDB 4.2
+ Rails 6.1 RC
+ Symfony 5.2.0
+ ASVS 4.0.2
+ MySQL 8.0.22
+ Terraform 0.14
+ Dart 2.10.4


CTO
facing CEO

One of our goals this year is to help CTOs have better conversations with non-technical stakeholders. Even if a CEO of a digital business might grasp the meaning of cybersecurity, cloud, big data or artificial intelligence, it would likely be difficult for them to link those concepts with containers, programming languages or frameworks. Nevertheless, we believe it is the responsibility of the CTO to translate technology for better decisions-making and for the greater good of the organization. Hopefully, the following discussion will help you have better conversations with your CEO.


At the macro-level, almost every technology trend study show increase in AI, Cybersecurity, Cloud, Big data, automation and edge computing.[1] Each of these points is large enough to be the subject of a dedicated trend review. But for the sake of the conversation with less-technical colleagues, we'll stay a general level.

## Cloud commodities

This breakthrough innovation of 3 years ago is commoditized today. Instead of developing from scratch and learning the required underlying technology, developers now think to check for out-of-the box services to do the job. Cognitive cloud computing, data analytics automation, augmented analytics, data as a service...these aren't things you need to reinvent.

## Ethics in software architecture

Gartner makes a point about privacy-enhancing computation.[2] Privacy might sound a bit political or not that interesting for business conversations, but the matter spans beyond IT teams. Building trusted environments, processing data in a decentralized manner and data anonymization before processing are new principles with important impact over the architecture. None of these items are easy to implement if systems aren't designed with these ideas in mind.

In the software development lifecycle, "policy as a code" noticed as an increasing trend for 2020. The opportunity is to have conversations with CEOs to explore a future where most organizational policies can be automated, and then to craft a vision about what that future might look like. Another axis of analysis is Ethics in Software Architecture in general, as a new thing many people talk about.[3] Listing questions and organizing debates will prepare the company to embrace a future where technology is safer for everyone.



1. https://www.gartner.com/smarterwithgartner/gartner-top-strategic-technology-trends-for-2021/
2. https://www.youtube.com/watch?v=s3rlYWcwdDY&t=324s&ab_channel=Gartner
3. https://qconlondon.com/london2020/track/when-things-go-wrong-gdpr-ethics-politics

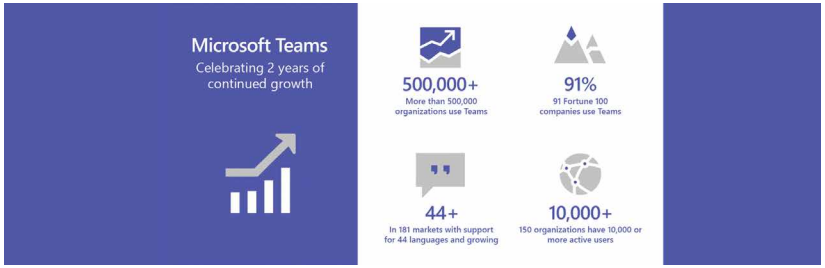
## New channels, new opportunities


B2B companies might want to look at new channels they haven't explored yet. According to Forrester, remote work will rise to 300% from pre-COVID levels. If you're a B2B business, you can make your services available through Slack or Teams as employees moved their focus.

You should also now that overall spending in security, network, cloud and mobility is estimated to increase by 30% for 2021[4].

## APIs and low-code connectors for business growth

In a post-COVID world, we expect integration between companies to intensify.




Therefore, CTOs and CEOs should seek to explore new business models based on APIs and connectors so that Partners may easily extend your capabilities while you remain in control. For example, Microsoft Teams is being used by more than 500,000 organizations. [5]Building wrapper applications or low-code connectors to be leveraged by users in Teams might be interesting business opportunities for CEOs and CTOs to explore.

## Opportunities in Dark Data

Everyone expects changes in the way people interact and do business in a post-COVID era. Depending on the source, between 75%-93% of the data collected today is dark data. Companies should look more into the data they have and better manage it. This ends with a very important activity we don't see solved by any other trends: data stewardship.
Some companies have started data governance initiatives. But you shouldn't do data governance before data stewardship. Data governance will show you how well you're doing data stewardship. If you start data governance without data stewardship, you will end-up with a difficult initiative that will just show how far you are from progressing beyond insufficient data management. This will discourage everyone. Leaders should evolve their decision-making to integrate data stewardship. Developers should do so as well. And new tooling should be added to the enterprise for data cataloging or discovery.

Here is where the CTO vision meets CEO vision. Data stewardship starts as an initiative from the technology department. When implemented properly, it should span globally. And as there is already a body of knowledge and experience in the organization, usually after a year of data stewardship, other initiatives find their place.



4. https://go.forrester.com/wp-content/uploads/2020/10/Forrester_Predictions_2021.pdf

5. https://www.microsoft.com/en-us/microsoft-365/blog/2019/03/19/microsoft-teams-experiences-intelligent-workplace/

A data governor can be added to steer data governance across the organization and lead improvements. Data science activities can be scaled as data discoverability and MLOps are handled properly.
Dark Data is acknowledged as a trend. Data Stewardship and Data Governance aren't, but they are required in order to properly harvest the dark data. It is hard for us to see the development of one without properly doing the others.

## Technology driven by data

We're living the moment where "data is being driven by technology" is shifting towards "technology driven by data." And while this just seems to be another fuzzy metaphor, this is a real long-term consequence when we want to make benefit of the data we collect from our users or sensors.
Why should CTOs talk about this with CEOs? Because it is impossible for humans handle so much complexity, to make sense of so much data. The first reason you should look into artificial intelligence is to decrease the complexity of rules that developers usually hard code when solving business problems. Failing to find complementarity between Machine Learning rules and rules coded by programmers might put an end to business growth.

## Legacy Deep Code puts companies at risk

CTOs managing IPs with Deep Code should double check their strategies in order to ensure they are the first ones to create AI-based innovations.

We've already met companies with significant amounts of Deep Code being easily overwhelmed by smaller competitors that base their technology on Machine Learning. Most of the exceptionality in Deep Coding comes from some special rules very few experts have elaborated and understand. If there is a new field, this is it.

## Low-code, RPA, SaaS extend

In a post-pandemic world, companies that embraced remote work brought along new sets of options to foster efficiency and automation. This is huge leverage in outpacing your competition. Backoffice applications will become available via app stores accessed within Collaboration Productivity Tools such as Teams or Slack. And hyper automation is now possible through low-code and RPA. Companies making consistent progress in their users' infrastructure will easily add these capabilities in their organizations.

To oversimplify a bit, these are companies which are already benefiting from document collaboration suites, centralized enterprise identity and access management, with DevOps and security teams in place.

Companies lagging behind in these areas already have the feeling that they are losing big. It will not be impossible to catch up, but some dramatic decisions need to be taken. We found it efficient for CTOs working in companies with "lagger's syndrome" to invest their efforts in reducing the complexity of projects and simplifying the technology stack. This is not just the foundation of the future of work, but the foundation of future automation.

# CTO facing CIOs

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infrastructure managers or DevOps practice leads

## Cloud wars

The main public cloud players such as Amazon Web Services (AWS), Azure and Google Cloud Platform have not only disrupted infrastructure technologies and practices, but they are also in the process of changing the game on digital technologies, including programming practices and architecture design. It is hard to nearly impossible to find more convenient platforms to better leverage DevOps, Security, Costs efficiency, Availability, Reliability, Innovation or Time to Market.

The number of services facilitating delivery are increasing from year to year. Cloud wars is not just about computing power, costs and materials, but more and more about software services and innovation. And this has been true for the last five years or more. Big data, artificial intelligence or data science were just the propellers. And this can be a lesson for everyone. There is a reason why these players compete more on the services stack instead of infrastructure options. These services are the real enablers of cloud adoption for the new businesses and great growth accelerators.

When building a business from scratch, there are many trade-offs to make. Cloud-managed services are a way to progress without compromising too much the solution architecture. And that should be the path for the most of us. Agile software development principles like “just enough” and “just in time” are favoured by public cloud. And we always have the opportunity to build something better later, when we have energy or after we have reached the limits of services out of the box.

Meanwhile, European Cloud players such as Orange or OVH, despite their strong support from political leaders, have little options to act and need to build alliances for the services stack. While Europe is exulted by this political success, we wonder if developers will ever remember that the infrastructure is owned by a European cloud player when they leverage American web services.

To put this in context, AWS R&D spending in Research in 2019 was $35.9 billion.[6] This is a 25% increase over ten years, every year. By comparison, France has an economic recovery plan of $100 billion.[7] That could be the R&D spending of AWS by 2024.

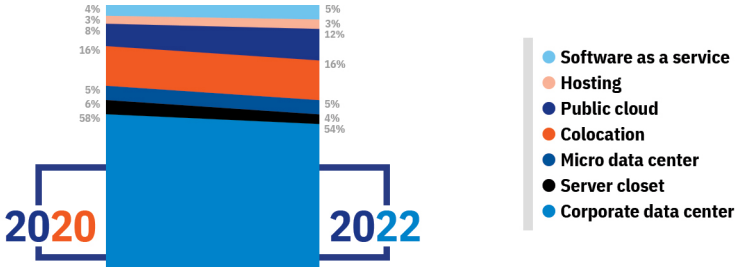
## Cloud adoption facts

Adopting Cloud is not easy. And we may speculate about the reasons behind hybrid cloud strategies or any of the facts listed below. Is this difficulty because adoption is hard and companies need intermediate steps and compromises, or is it because it is a real, long-term, value-added technology strategy? We don’t know. And it matters less for us as the issuer of this paper. The following facts are for the reader to find useful interpretations in their organizations.



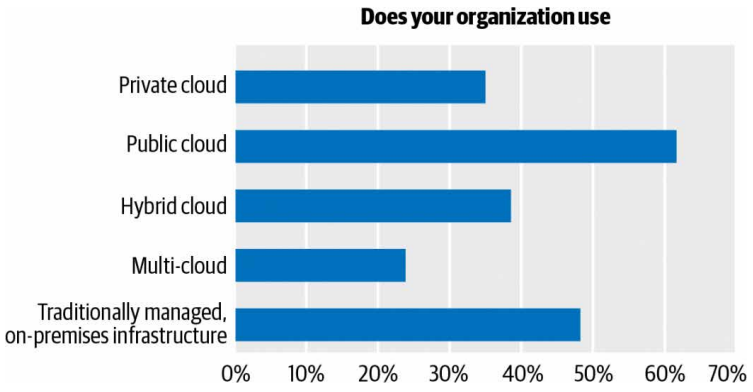
*6. https://twitter.com/JonErlichman/status/1285628647609638915*
*7. https://www.france24.com/en/20200903-live-france-unveils-%E2%82%AC100-billion-economy-rescue-plan*

- Public Cloud growth is not as strong as planned. More than half of workloads are expected to remain in on-premises data centers in 2022[8]

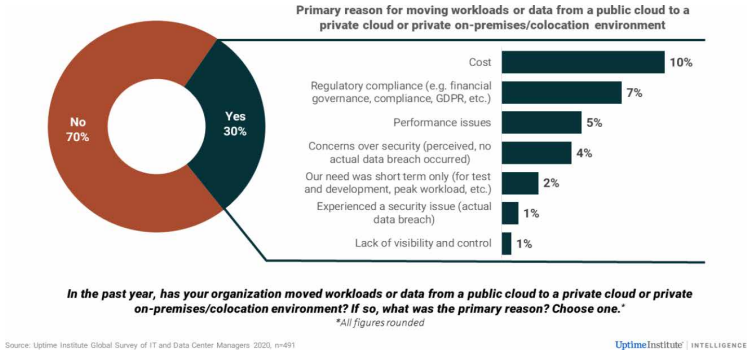



*source: Uptime Institute Global Survey of IT and Data Center Managers 2020*

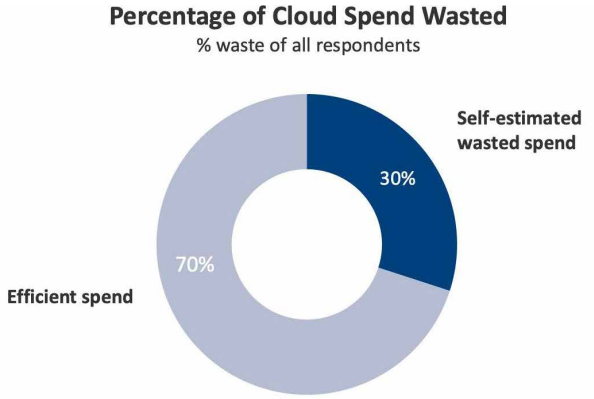
- The O'Reilly Cloud Adoption 2020 survey reports a dominance of Public Cloud; however, the usage of traditionally managed on-premises infrastructure is still close to 50%.




- 30% of the companies in the Uptime Institute Annual Survey 2020 are moving back from Public Cloud to on-premises. The main reasons being: Costs, Regulatory Compliance and Performance.




- This number strangely resonates with the 30% of companies reporting waste in the Flexera report.

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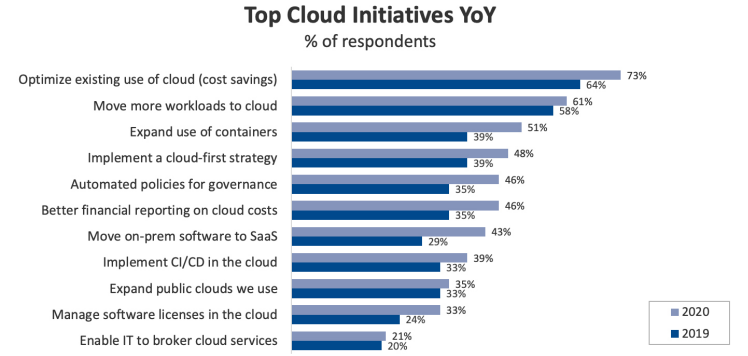
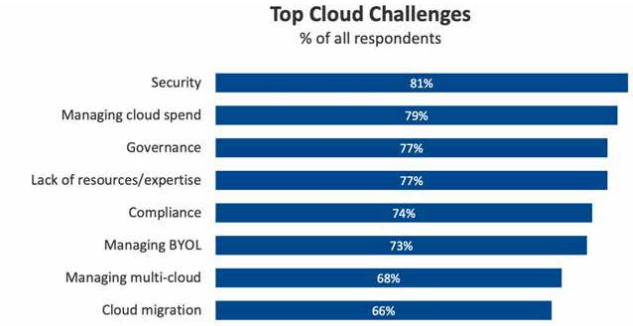
*Source: 2020 Flexera State of the Cloud Report*

- FinOps is also increasingly the highest concern for companies. There is no surprise here: many announcements from AWS re:Invent were budget-related: EBS GC, Charging Lambdas by milliseconds...



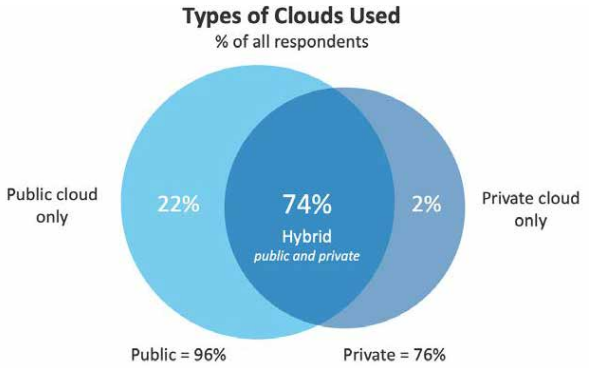

*N=750* *Source: Flexera 2020 State of the Cloud Report*

- Cloud is still hard to adopt for most companies as they are facing multiple challenges: Security, Costs, Governance and Lack of expertise.



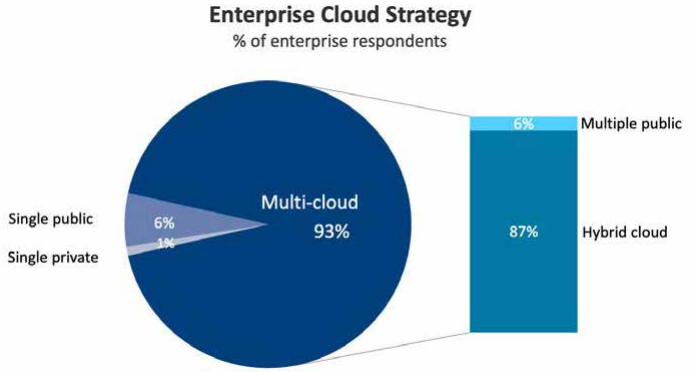

*N=750* *Source: Flexera 2020 State of the Cloud Report*

- Hybrid and Multicloud growth: 74% of companies are using Hybrid.




*N=750* *Source: Flexera 2020 State of the Cloud Report*

93% of companies are hosted on Hybrid Cloud.




*N=554* *Source: Flexera 2020 State of the Cloud Report*

This tendency is confirmed by Gartner, which predicts: «By 2021, over 75% of midsize and large organizations will have adopted a Multicloud and/or hybrid IT strategy.»[9]

9. *https://www.gartner.com/en/conferences/emea/infrastructure-operations-cloud-germany/featured-topics/cloud*

# Hybrid cloud

Major Cloud Platforms are already largely supporting hybrid. AWS has been continuously improving its Outpost offer with a general availability in 2019 and a partnership program announced in September 2020:

- In re:Invent 2020, AWS announced ECS and EKS anywhere to let its users run those AWS services on-premise.
- Azure is as reinforcing its hybrid offer with several announcements at Ignite 2020 which occurred at the end of September, such as general availability of: GPUs, AKS,Azure ARC for Data Services...
- As for Google Cloud, it supports both hybrid and multi-cloud with Anthos. The tool is one of the main drivers within Google's strategy to catch up with the competition. They have been signing deals with major companies worldwide.

Multicloud and hybrid trend should accelerate in Europe. The EU is struggling with its digital sovereignty as no competitor seem to be able to catch up with the main American and Asian players. Some initiatives such as Gaia X are attempts to create a solid counteroffer. Furthermore, the European Union invalidated the E.U.-U.S. Privacy Shield, a key method for transferring personal data into the U.S. Instead, European cloud players seem to promote alliances with major American operators rather than compete.

This trend is testified by numerous alliances:

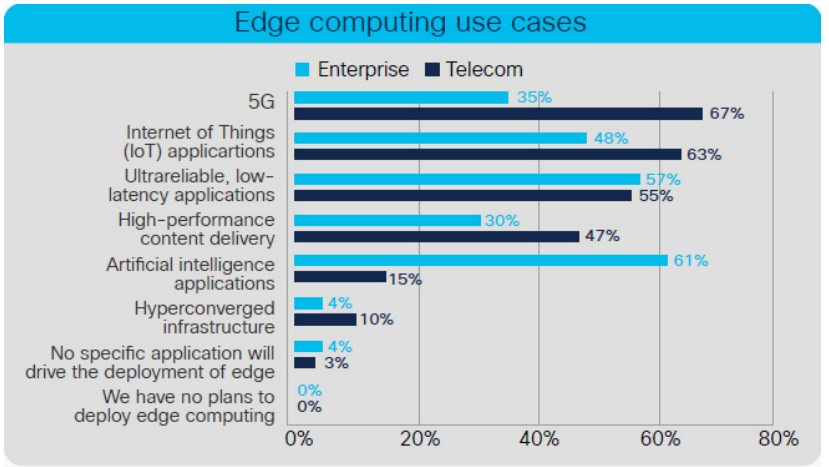
- Orange and Google Cloud (July 2020)
- Orange and Azure (September 2020)
- OVH and Google Cloud (November 2020)
- Orange and AWS (November 2020)

European companies should accelerate their hybrid and Multicloud adoption in the future. Solutions such as Google Anthos should be considered, as well as AWS Outpost or Azure Stack.

# Edge computing is coming

The demand for edge computing is growing slowly. Technologies such as 5G, IoT, photonic networks, container-based portable technologies such as WebAssembly should increase the number of possible edge computing business use-cases.

- 5G deployment has accelerated worldwide during 2020 and should support 10% of global mobile connections by 2023.[10]
- Evolving usage should accelerate Edge Computing needs.
- 14.6B IoT devices will eb enabled by 2022.
- 42% annual growth in business mobile traffic from 2017 to 2022.
- 12x increase in AR/VR traffic by 2022.




Source: Strategies for connecting the edge, heavy reading, September 2019



10. https://newsroom.cisco.com/press-release-content?type=webcontent&articleId=2055169

According to Gartner, acceleration won't happen before 2022, but it is something companies in the process of rearchitecting globally should anticipate, as many new tools are already on the market and should gain maturity by then:

- Anthos from Google is already providing edge computing capabilities for many clients. Google also created Global Mobile Edge Cloud (GMEC) to provide Telecom Companies specific capabilities to enhance their deployment and monetization of their 5G offers. AT&T is already part of this partnership strategy.
- AWS Local Zones or AWS Wavelength were announced in AWS re:Invent in 2019
- Azure proposes services such as Azure IOT Edge and Azure Private Edge Zones

## Networking as a core of the digital strategy

This evolution of Hybrid, Multicloud and Edge computing will have an impact on team skills and organization. According to Gartner, 20% of companies saw Networking as a core part of their digital strategy in 2018.[11] That number will raise to 60% by 2023.

To outline this trend, we can see an increase NetOps teams within IT services (as an extension of DevOps, to include networking better in their routines). These teams will be focused on addressing networks increasing complexity and need for modernization. For instance, again according to Gartner, 70% of Data Centers networking tasks are performed manually.[12] NetOps should promote automation to address this competitive challenge.

In addition, Cisco outlines new roles such as:[13]

- Network Guardian, focused on network security
- Network data architect, focused on leveraging networks analytics & AI
- Network Commander, focused on network lifecycle management
- Network Orchestrator, focused on policy translation & automation
- Network Detective, focused on network and service assurance

## AWS is still leading Public Cloud

Gartner Magic Quadrant captures it well enough. There are no real challengers. There are no real visionaries.

**Figure 1. Magic Quadrant for Cloud Infrastructure and Platform Services**



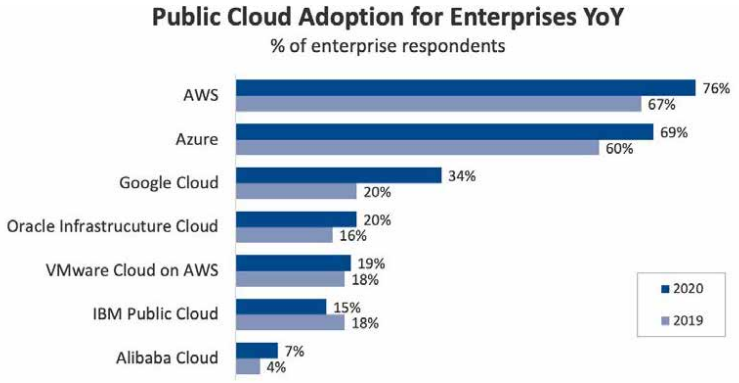

*11. Invest in Networks to Achieve Digital Business Success, Gartner, May 2019*
*12. 2019 Strategic Roadmap for Networking*
*13. 2020 Global Networking Trends Report, Cisco*

## Figures of Q4 2020 for leaders:

| | AWS | Azure | GCP |
|---|---|---|---|
| **Market share** | +32% | +19% | +7% |
| **Net Revenue Growth** | +13% | +47% | +45% |
| **Number of services** | +175 | +270 | +108 |
| **Regions** | +24/190 | +60+/140 | +24/73 |

## 2020 notable facts

- Alibaba increased its market share to 6% and is very close the enter the leading trio at 1 point only behind Google Cloud
- AWS generated about 57% of Amazon global Operating Revenues in Q3 2020
- 40 percent of enterprise AWS users spend at least $1.2 million annually versus 36 percent for Azure
- Google Cloud Had the highest rate of adoption from last year: 20%
- AWS recorded its biggest revenue growth slowdown in the 4th quarter of 2020
- AWS leadership and momentum is slowing down as nearly twice more enterprises are experimenting or planning to use Google Cloud and Azure than AWS.

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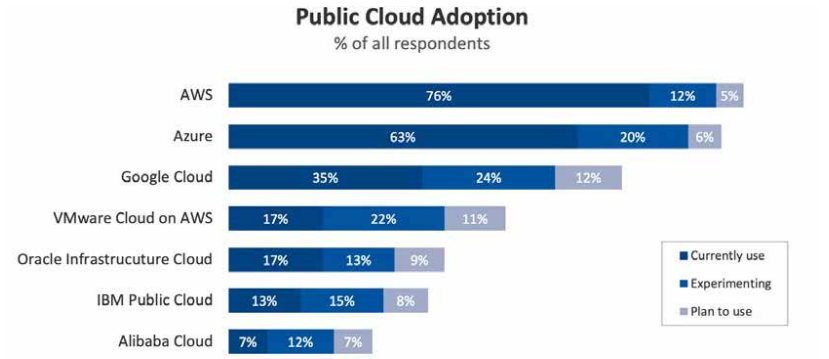
*Source: Flexera 2020 State of the Cloud Report*

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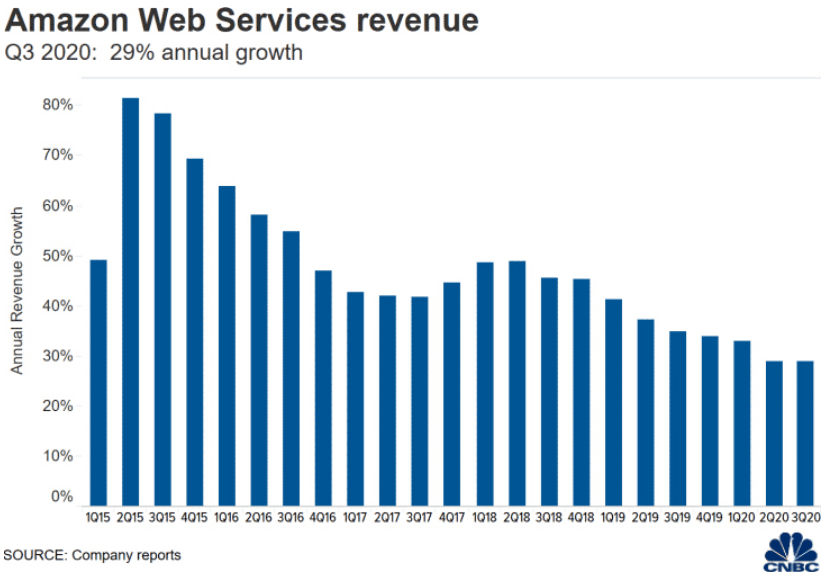
*Source: Flexera 2020 State of the Cloud Report*




CTO facing
developers
and DevOps

TIOBE December was released under the following headline:

> *Python on its way to become TIOBE's language of the year for the fourth time*

It's a great summary of mostly what we have to say about what's happening in the programming languages landscape.

**But not everything – other highlights include:**

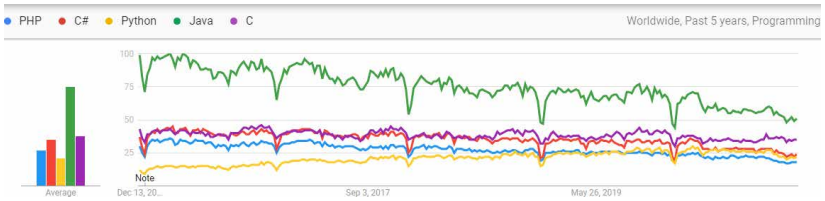
- Python is far ahead with a positive delta of +1.90% at the moment.
- Runner ups are C++ (+0.71%), R (+0.60%) and Groovy (+0.69%).
- Rust moved from position #25 to #21, Julia from #30 to #26, Dart from #27 to #31, Kotlin from #36 to #40 and TypeScript from #43 to #42

| Dec 2020 | Dec 2019 | Change | Programming Language | Ratings | Change |
|---|---|---|---|---|---|
| 1 | 2 | ↑ | C | 16.48% | +0.40% |
| 2 | 1 | ↓ | Java | 12.53% | -4.72% |
| **3** | **3** | | **Python** | **12.21%** | **+1.90%** |
| 4 | 4 | | C++ | 6.91% | +0.71% |
| 5 | 5 | | C# | 4.20% | -0.60% |
| 6 | 6 | | Visual Basic | 3.92% | -0.83% |
| 7 | 7 | | JavaScript | 2.35% | +0.26% |
| 8 | 8 | | PHP | 2.12% | +0.07% |
| 9 | 16 | ⇈ | R | 1.60% | +0.60% |
| 10 | 9 | ↓ | SQL | 1.53% | -0.31% |
| 11 | 22 | ⇈ | Groovy | 1.53% | +0.69% |
| 12 | 14 | ↑ | Assembly language | 1.35% | +0.28% |
| 13 | 10 | ↓ | Swift | 1.22% | -0.27% |
| 14 | 20 | ⇈ | Perl | 1.20% | +0.30% |
| 15 | 11 | ⇊ | Ruby | 1.16% | -0.15% |
| 16 | 15 | ↓ | Go | 1.14% | +0.15% |
| 17 | 17 | | MATLAB | 1.10% | +0.12% |

*source: https://www.tiobe.com/tiobe-index/*

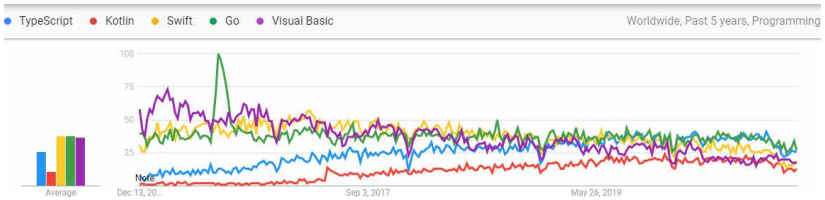
# Different languages leagues

Java, C, C#, PHP, Python and JavaScript are in the first league.



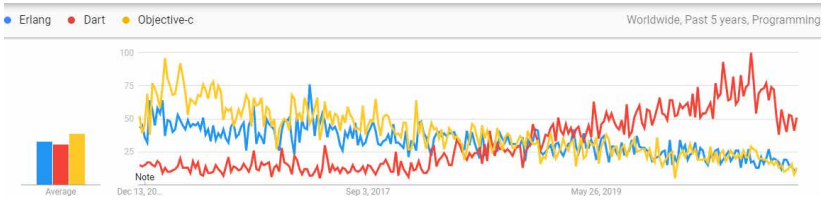

*source: google trends*

Kotlin, Swift, TypeScript, Go, Visual Basic, CSS, R, D or Ruby are in the second league.




*source: google trends*

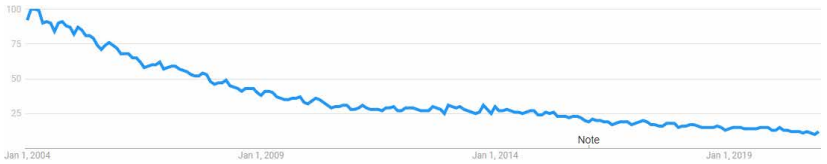
Erlang, Dart, Objective-C and most probably all the remaining languages are in the third league.



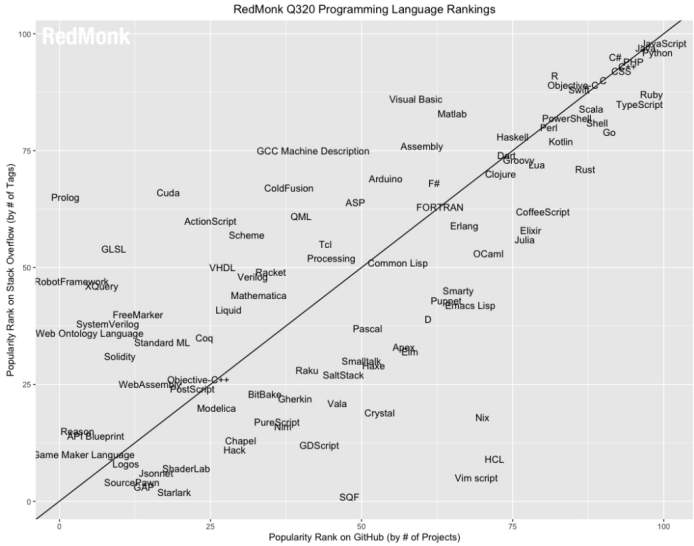

*source: google trends*

# The case of Java

We predicted last year that Java would lose first place in TIOBE. It happened. Java is no longer the first programming language, even if historically it maintains very high in popularity compared to any other language. C programming language just took its place in the index. Looking at Java interest in Google trends worldwide since 2004, its popularity will continue to be challenged.




Java continues this year to be the 5th on Stackoverflow 2020 survey[14] (it was on the same place last year) and stays on the 3rd place in RedMonk popular score on Q3 2020.




*14. https://insights.stackoverflow.com/survey/2020#technology-programming-scripting-and-markup-languages-professional-developers*

If we have to draw a conclusion for the decline, Java lost its "run everywhere" status since the mobile disruption. We thought it might be reborn with the big data revolution as the most popular bigdata technologies are Java-based (Hadoop, Spark, Kafka, etc.). But the pace of modernization, the arrival of more specialized and highly performant languages like GO or the development of ML/DL around C/C++ and Python prevented an increase in adoption.

Will the innovative releases bring enough innovation to regain traction? We don't know. Meanwhile Java job demand is still very high:

- Legacy projects
- New evolutive architectures (microservices)
- Or implementing around successful open-source projects (Hadoop, Spark, Kafka, Storm...)

## Favouring clarity over efficiency

In our view, and it's a topic we may revisit in a more methodological way later on, technical debt is rising to its highest levels. Without the proper capabilities (skills, tools, technology, methodology, governance and mindset) to continually increment, software entropy hits us hard. Joe Armstrong (one of the inventors of Erlang) once said: between Efficiency and Clarity (in programming) we've chosen systematically Efficiency. To make something clearer we add a layer of abstraction. To make something more efficient we need to remove a layer of abstraction.

We should choose more clarity!

## Low-code/no-code/Serverless workflows

Building systems with code is like building living organs. Complexity runs high in a matter of months. As consequence, the system becomes unstable. Once the organ is live, developers will need to perform many surgeries on that system. But not everything needs to become complex.

When we:

- Connect with OpenIdConnect,
- Download data from the CRM to the DataLake,
- From one storage to another (Data warehouse->data mart),
- Create analytics pipelines and self-service BI,
- Build APIs,
- Implement CRUD operations (with simple validations)
- RPA (not covered in this version of trends)
- ...

Grown-up integration and RAD solutions already exist. These activities tend to be much more like LEGO bricks, and they are enabled by cloud data integration tools, workflows and connectors, serverless and low code. Using these tools favours clarity. Until recently, it was hard for developers to admit there are many ways to increment systems (some of them require less code).

In the age of digital platforms and cloud computing, because it has been difficult to find the right balance between LEGO approach vs Organ(ic) approach, a new generation of solutions appear at our horizon. Among the major public cloud providers, we find Microsoft as having the most consistent offering in these regards (PowerApps, Flow, Data Factory, Logic Apps, etc.).

AWS (the leader in public cloud) announced this year HoneyCode, but they have so much catch up some wonder if they'll make it. Integration players such as Mulesoft, Dell Boomi, Snaplogic don't bring enough tooling for software engineers to merge low code with code approaches and data platforms (such as KNIME, TIBCO, RapidMiner or Dataiku) target completely different audiences than software developers.

## Static typing, type inference or new languages supersets

One of the most important causes of accidental complexity is the lack of strong typing. If there is one impediment to see dynamic languages as the champion of all languages is type safety. Despite the high degree of flexibility, developers lose tremendous time in debugging simple bugs. Compilers need to become more efficient.

That's why all the buzz about Dependency Type Systems in functional programming (tackled by Haskel and implemented in Agda). That's why we have the incredible adoption of TypeScript. And this is also what great Ruby advocates like Ryan Levick speak about Value Rigidity and the necessity to carefully choose a language before using it (Ruby being criticized by the lack of type inference)

Therefore, there is little chance today for a new language to emerge without some sort of explicit typing mechanism that the compiler can check in order to better assist the developers (win their time).

## TypeScript language

TypeScript stands-up when speaking about safer, faster and most stable code development.
Despite all the scepticism about the being just some "syntactic sugar" nobody should care about, there isn't a well-established front-end framework (Vue, React, Angular) without support for TypeScript and associated tooling.

TypeScript Ranking:

- The 4th on Octoverse GitHub, ahead of Ruby, C and many other languages. Last year it was the 7th position, so this is great news for TypeScript lovers.
- The 8th of most used (compared with 10th last year), the 2nd most loved in StackOverflow (last year it was on the 3rd place)
- 61% of companies from the npm Survey confirmed using TypeScript

Some launched rumours about TypeScript being replaced by either Dart or WebAssembly. It's #fakenews!

## Swift

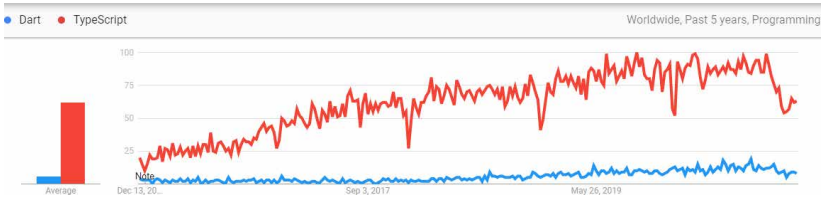
Clarity doesn't always win over efficiency. In the recent "Swift Concurrency Roadmap" it became obvious clarity is being sacrificed, at least temporarily across releases, until this language shift is completely done.[15] Still, this is an important evolution for a modern language. It worth mentioning that Swift is one of the most popular programming languages today that move from the 10th place in TIOBE index to 13th place in December 2020.



15. https://forums.swift.org/t/swift-concurrency-roadmap/41611

## Dart language vs TypeScript

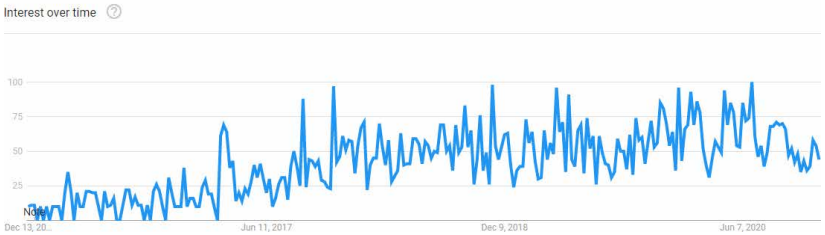
Some of the rumours come from TIOBE: TypeScript being ranked the 42rd (43rd last year) and Dart the 31st (compared with 24th one year ago) But don't mind about TIOBE as it is shamefully misleading in this case. Dart didn't enter in the Enterprise world as TypeScript has. And while it might get more popularity since Flutter has great potential, it still must surpass many other challenges. The following Google Trends chart says much more than we can write.




*source: google trends*

## WebAssembly

If there is one thing you can really take away from our review is that WebAssembly will revolutionize the Web and more...In regard to JavaScript and TypeScript, WebAssembly has also the potential to bring other great languages to the web (like python or ruby...). Or maybe it's just a matter of time until TypeScript compiles into WebAssembly and bypasses JavaScript?




## Ballerina language

A new language called Ballerina tries to address the distributed integration gap (in an increasingly disaggregated world). Historically, these challenges were tackled with integration architectures such as ESB, BPM, EAI (and associated products) which is agile-impossible or with General Purpose Programming Languages like Java, JavaScript, C#.

Ballerina is an open-source programming language and platform to write software for the cloud era. It has network in the language (HTTP/2, WebSockets, WebSub, AMQP, JSON, gRPC, OpenAPI...), it automatically generates the associated sequence diagram as meta information and is developer centric. Ballerina's promise is to bring the facilities of distributed computing as part of the application logic.

While it has tighter purpose than Go (generic purpose language for concurrency challenges), it seems easier to learn and was built with security, scalability, observability in mind. Go generates deployment artifacts for Docker and Kubernetes. It is already compatible with Kubless and OpenWhisk. Go is generic design. Go doesn't solve networking problems (just concurrency challenges). Type system is slightly more beautiful than Go's. It's easier to learn Ballerina.

If you haven't yet had time to play with Ballerina, don't worry! A major release is planned for January 2021.

## Dark language

Ellen Chisa, cofounder and CEO of Dark, makes a point about end-to-end programming with a simple expectation: building an app that sends automatic alerts. She found herself adding tremendous complexity just to set up her working environment (rails, Heroku, gems for auth, dependencies & versions, change across 12 files, connection to Twillio) without even delivering a feature or implementing some error logic.

That's how why she founded Dark: a language for building backends (so-called "deployless" backends).

Here are some highlights:

- Used to build workflows from endpoints to datastores
- Online IDEs
- Connectors (setup)
- Real-time debugging and data tracking

Of course, Dark is still experimental. The authors seem to be so confident, so that they have doubts about outsourcing it (this is new in the 21st century). Anyway, Dark is not Production Ready. But the emergence of such tools does point, no pun intended, to a brighter programming future.

We keep Dark in this release of technology trends with the hope that it serves as an argument in how the technology market shifts. Even so, Dark will probably not secure the traction needed to sustain a modern programming language.

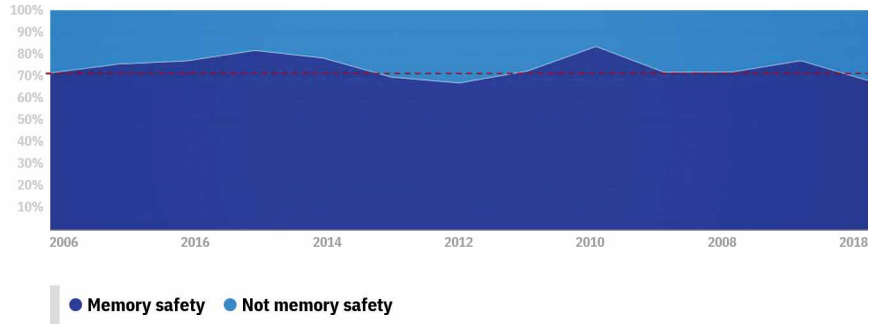
## GOLang

Rob Pike explains the origin of Go comes from frustration. In 2007, at Google, there were only 2 languages he could had used: Java and C++. At a conference in Sydney about the Draft Specifications of the 2nd version of Go, he clearly stated they were seeking for a language that would ease maintainability, debugging and scale. Go emerged from the frustration.

Again, against Efficiency, Clarity won! Many have spoken about the software entropy problem, but few as easy and straight forward as Joe Armstrong, the creator of Erlang. Safety wasn't a priority until now.[16]

## Rust

Ryan Levick, Principal Cloud Developer Advocate at Microsoft, wrote in a post that 70% of combined vulnerabilities (all-time and all-products) were about Memory safety.




*https://msrc-blog.microsoft.com/2019/07/18/we-need-a-safer-systems-programming-language*

16. *https://www.youtube.com/watch?v=lKXe3HUG2l4*

> *While many experienced programmers can write correct systems-level code, it's clear that no matter the amount of mitigations put in place, it is near impossible to write memory-safe code using traditional systems-level programming languages at scale.*

A few days later, he wrote another post, *"Why Rust for safe systems programming"*:

> *We believe Rust changes the game when it comes to writing safe systems software. Rust provides the performance and control needed to write low-level systems, while empowering software developers to write robust, secure programs.*

## Bosque programming language

Bosque was one of the most exotic moves announced by Microsoft in 2019. It shows at what point programming languages are an impediment in both coding clarity and efficiency in todays' world. Thought with automation in mind, Bosque was described as a functional language that should unlock the future of AI and Synthesis in the development pipeline. Bosque's fully determinized and loop free design can also help facilitate the development and application of automated program differentiation.

Bosque is still experimental, but its promise will bring huge innovation for developers.[17] Intermediate representations, regularized programming and cloud-first development are just a few of the underlying principles that drive Bosque development.

## Python

This November, Microsoft announced that they recruited the Python creator Guido van Rossum to improve and homogenize Python at Microsoft.[18] As if that wasn't enough good news for Python. TIOBE tips its hat by saying that "Python on its way to become TIOBE's language of the year for the fourth time."[19] Python also took 4th place in the Stackoverflow survey.

However, the overall (Google) interest in Python has remained constant over the last years.

# Faster and more secured Web applications

## WebAssembly

In a nutshell, WebAssembly is the technology with the most important implications over the way the web works:

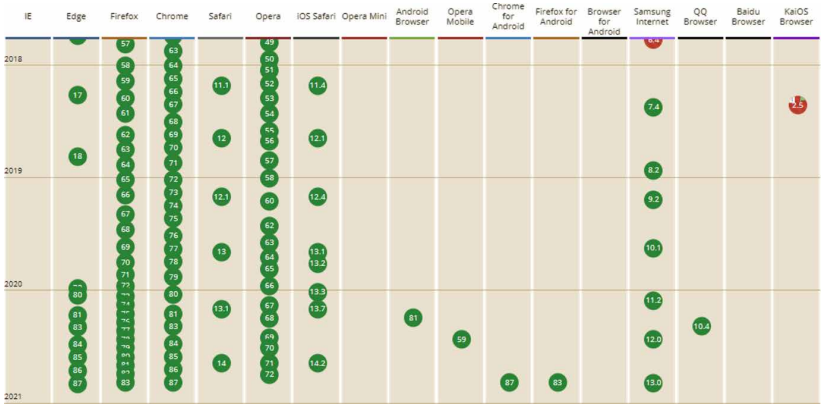
> *It provides a way to run code written in multiple languages on the web at near-native speed, with client apps running on the web that previously couldn't have done so.*

*https://developer.mozilla.org/en-US/docs/WebAssembly*

According to the website Caniuse, Chrome, Edge, Firefox, Safari, Opera, iOS Safari and Opera mobile have had WebAssembly support since 2017.



17. *https://github.com/Microsoft/BosqueLanguage*
18. *https://www.infoworld.com/article/3596436/python-creator-guido-van-rossum-heads-to-microsoft.html*
19. *https://www.tiobe.com/tiobe-index/*




Browser support has increased since last year 88.39% to 92.97% and we expect a 2020 with the first scientifically enhanced user apps powered by WebAssembly.

## React.js reign

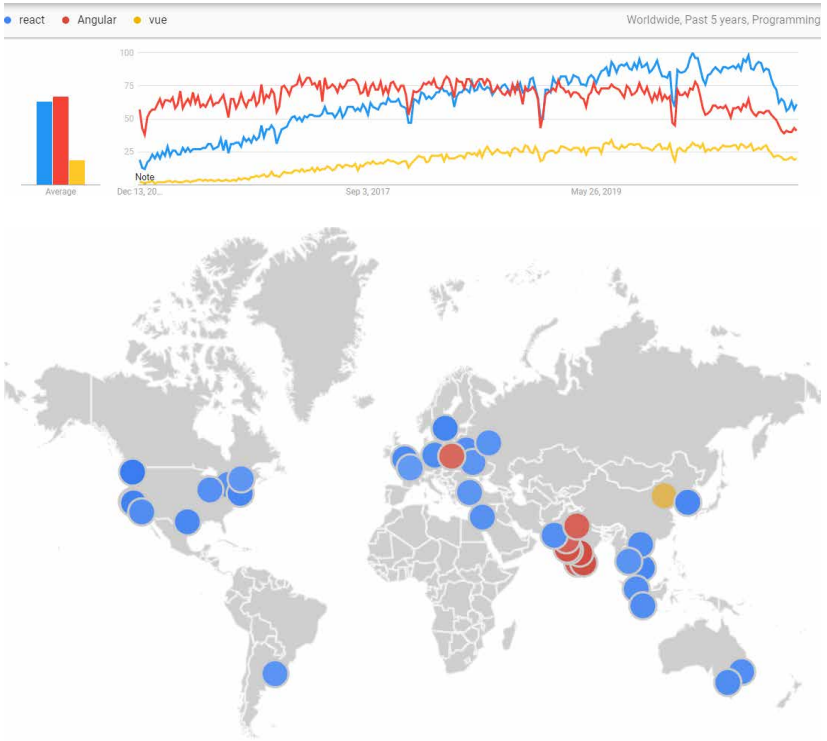
Frontend developers continue to be more passionate about React (remember 2019.stateofjs.com?). Let's look at the Stackoverflow survey:[20]

| | 2020 | 2019 | 2018 | 2017 |
|---|---|---|---|---|
| **React** | **+35.9%** | **+31.3%** | **+36.9%** | **+19.5%** |
| Angular | +25.1% | +30.7% | +27.8% | +44.3% |
| Vue | +17.3% | +15.2% | - | - |

These figures are confirmed by Google trends

| | USA | UK | FR | GE | RO | CHINA |
|---|---|---|---|---|---|---|
| **React** | **+48** | **+31** | **+29** | **+36** | **+34** | **+28** |
| Angular | +41 | +15 | +55 | +60 | +14 | +0 |
| Vue | +8 | +6 | +13 | +22 | +0 | +28 |

And if you were wondering about preact traction, it is almost missing.




*source: google trends*



20. h1ttps://insights.stackoverflow.com/survey/2020#overview

## PWA

We were expecting Progressive Web Apps adoption to continue to grow over 2020, and we still hope 2021 will be the year where we'll say PWA is the norm. Of course, progress was seen, but much remains to be accomplished for full support on iOS and Firefox.

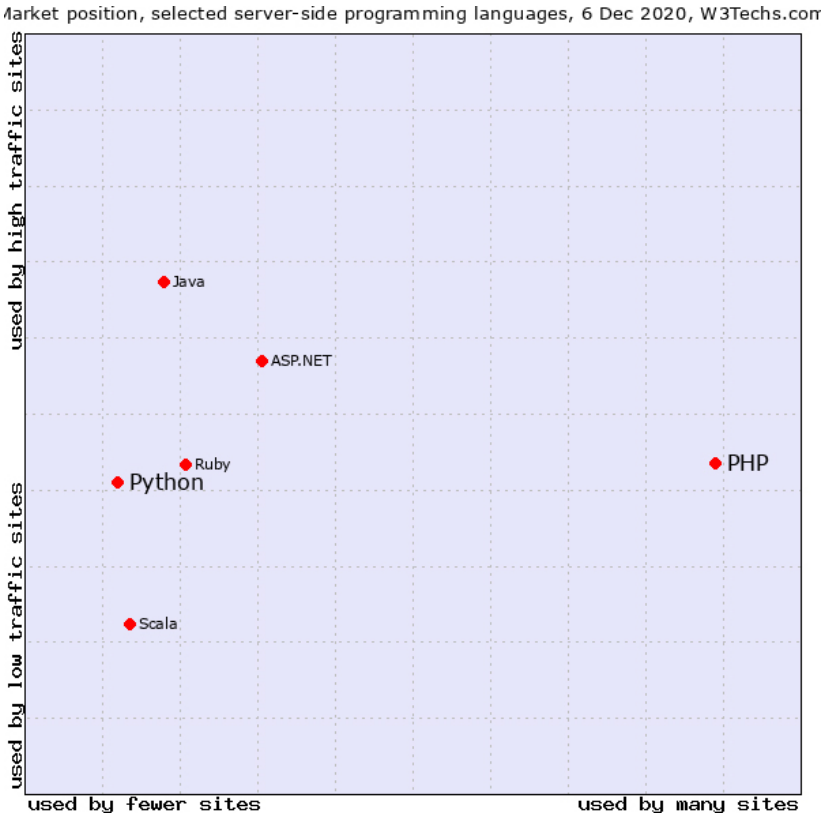
## Backend frameworks

Spring, Django, Flask, Laravel, Symfony, AspNetCore are the frameworks we should continue looking at. AspNetCore is still the most popular framework in the .NET world according to Jetbrains and in second place according to Stackoverflow.[21,22]

Symfony and Laravel fight for PHP supremacy, with Laravel having the lead in the United States and Symfony in Europe.[23] But if we compile all the sources, we can say that Laravel is slightly more popular overall and increased in popularity since 2019.
For JavaScript-related frameworks, Gatsby was the surprise of 2020, and we estimate it to gain even more traction in 2021.[24] We could also expect more traction from Nuxt and Next.js next year but not as much as we estimate from Gatsby.

While they don't serve the same purpose, Flask continues to increase in adoption and Django stays the constant leader of web Python development.

According to w3techs Ruby continues to grow slowly in adoption but has lost pace in preferences and usage as Stackoverflow shows (comparing 2019 with 2020).[25]






21. https://blog.jetbrains.com/dotnet/2020/06/16/developer-ecosystem-2020-key-trends-c/
22. https://insights.stackoverflow.com/survey/2020#overview
23. https://trends.google.com/trends/explore?cat=31&date=today%205-y&q=Symfony,Laravel
24. https://www.gatsbyjs.com/
25. https://w3techs.com/technologies/comparison/pl-php,pl-python

## Node.js

Very similar with TypeScript, many people in tech communities had the same reaction: why another technology? But node.js had addressed real pain-points industry was having. There was much to be improved in the I/O resource access management without the complexity associated with multi-threading. There was an urgency for single-thread I/O efficiency. Node.js was doing just that. This brough the foundation for RTAs (Real Time Applications) and had important impact on SPAs (Single Page Applications).

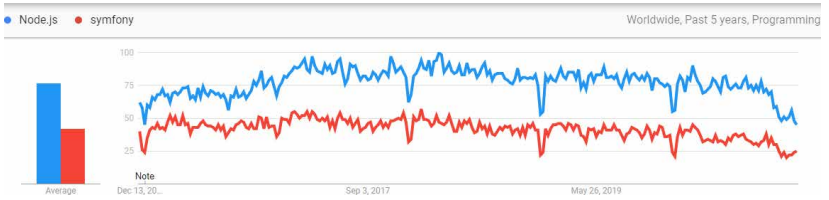
Node.js had other positive side-effects as well. It is multi-platform; therefore, it can run on your PC or Linux which brought a new range of JavaScript based desktop applications. Electron.js is just one of the many examples in these regards. It uses JavaScript as language, fact that removes the burden of developers to shift their mindset when changing from front-end implementation to the back-end. And now Node.js is being used to fully provision infrastructures. With the risk of oversimplifying a very complex and diverse reality, we can say that Node.js is a real propeller of JavaScript everywhere.

Today, Node.js is the new King. At least in our eyes. Not in the sense of replacing other backend technologies, but as a narrow technical solution addressing real technology pain-points. Of course, we should avoid using it in scenarios where it is completely outmatched. We remember a very sad context of a customer having full ETL implementation in Node.js.

Node.js's simplicity and efficacy in I/O and its universality and portability that come with JavaScript, made it the default development technology:

- in Cloud providers like AWS and GCP
- in IoT, Serverless and Microservices
- in almost any JavaScript modern framework

Confirmed by google trends:




*source: google trends*

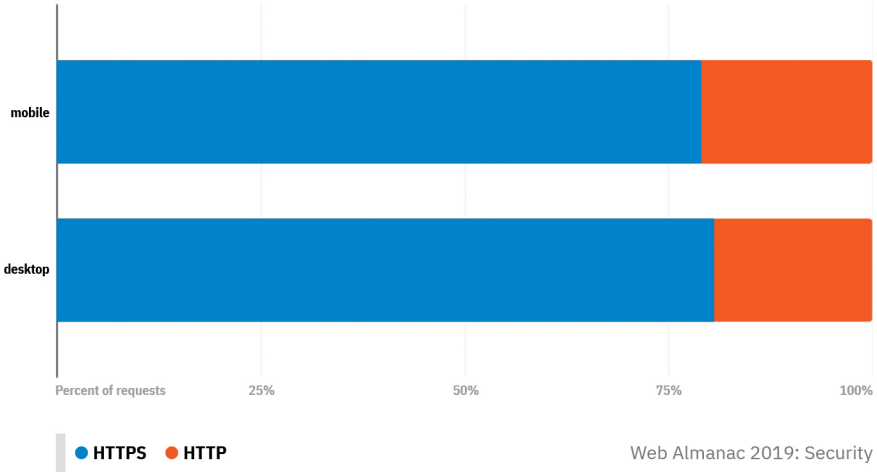
Another interesting perspective is seen in the number of courses indexed by e-learning providers and see node.js is by far the most popular (1857 courses) compared to Django (309), Symfony(72) or ASP.NET core (53).[26]



26. https://www.wanttolearn.xyz/compare/nodejs-vs-django-vs-symfony-vs-aspnet-core/

## Web Security

According with https://almanac.httparchive.org/ , 95% of global users now support HTTP/2 and 8.38% support QUIC.



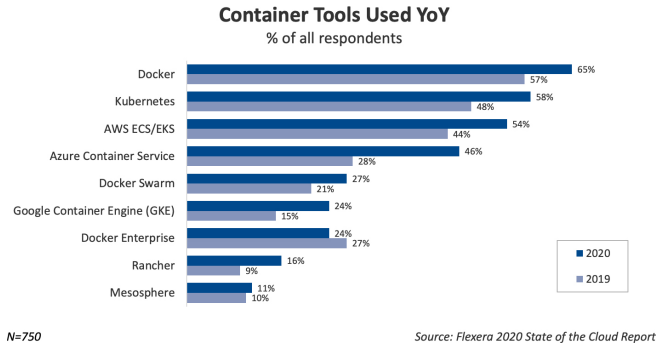

Web Almanac 2019: Security

*Use of legacy TLS versions like TLSv1.0 and TLSv1.1 is minimal, and almost all support is for the newer TLSv1.2 and TLSv1.3 versions of the protocol. Even though TLSv1.3 is still very young as a standard (TLSv1.3 was only formally approved in August 2018), over 40% of requests using TLS are using the latest version!*

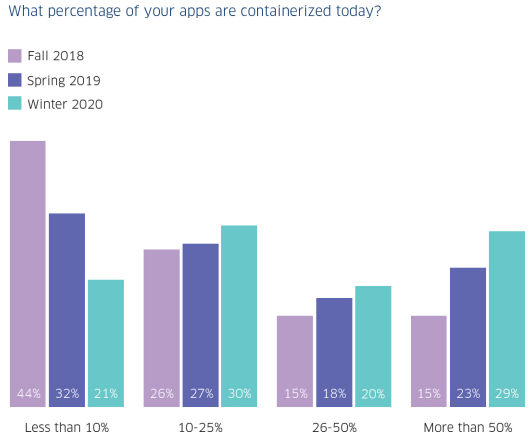
Security headers are still lacking even if they are easy to be configured, RSA keys are preferred over ECDA and Google Internet Authority G3 is the leader (19.26%) among certificates authorities.

## Containers is nearly a standard

Their usage is continuously growing, plus 8 points in a year for the Flexera 2020 survey with 65% of adoption on Docker. Docker being with Kubernetes the mainstream technology for containers and their orchestration.

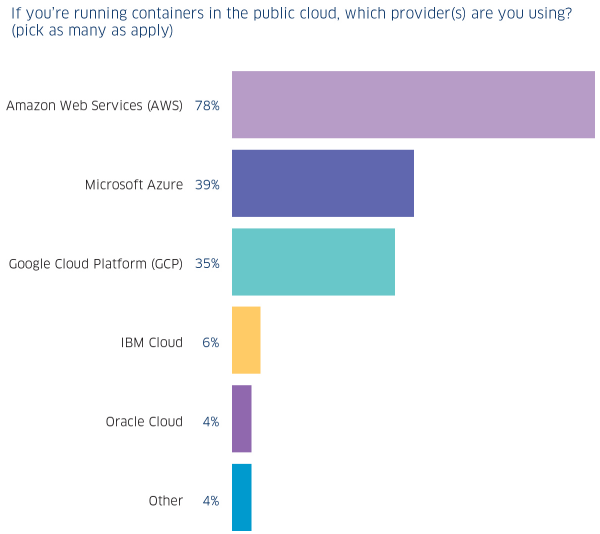



The survey about containers adoption from StackRox shows that 29% of companies have more than half of their application containerized, which is a growth of 22% in less than a year.[27]

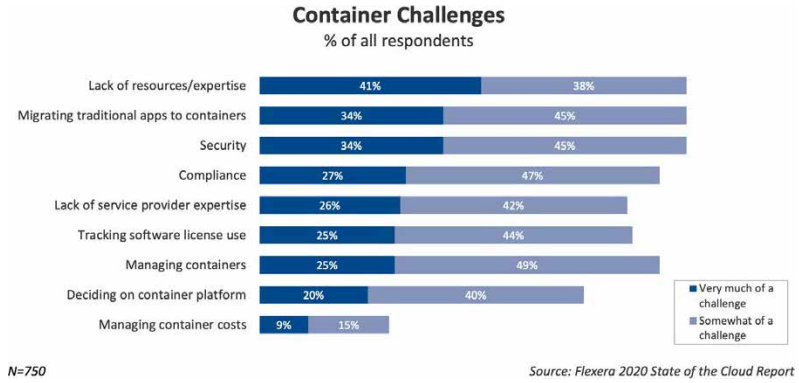



27. https://www.stackrox.com/post/2020/03/6-container-adoption-trends-of-2020/

The main hosting solutions for containers on public cloud is AWS with 78% of users according to StackRox, which is twice more than Azure or Google Cloud.[28]




Even if growing fast, container adoption is still a huge challenge for the great majority of companies, lack of resources and expertise being at the top challenges.




Containers are clearly part of Cloud strategy for the coming years:

- Once again, Anthos can be cited as the Google Cloud strategy flagship. One of its main purposes is to ease migration, deployment, security and hosting of containers.
- Azure announced in September 2020 its increasing support for Docker. For example, they will add support in Visual Studio.
- AWS announced several new tools at re:Invent 2020, such as AWS Proton to ease the deployment of containers or a new Public Container Registry service.[29]

Another trend seems to be enforcing Containers and Serverless integration. The Azure Docker integration, for instance, enables the deployment of Serverless Containers to Azure Containers Instances (ACI). AWS, on the other hand, has announced more integration between Serverless and Containers, with services such as AWS Proton or AWS Lambda support for container images.[30]

## Serverless adoption is accelerating

Serverless made more progress in the last 12 months than ever before. A full review would be needed to cover these evolutions. We'd have loved to speak more about no-code, low-code or even the NoOps movement. They are all new, important, and trendy, but not widely adopted. Therefore, it is more difficult to compare with the important mind share Containers and Serverless have gained. And if we've just been through containers already, let's look at some interesting facts about Serverless.

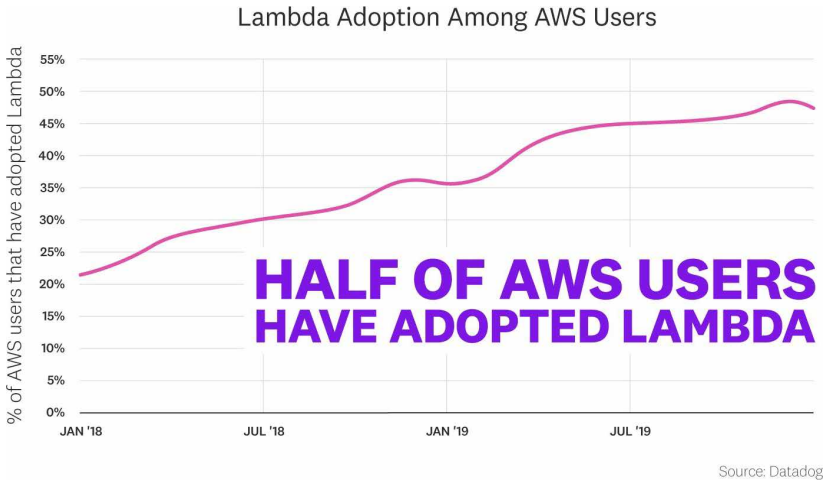


28. https://www.stackrox.com/post/2020/03/6-container-adoption-trends-of-2020/

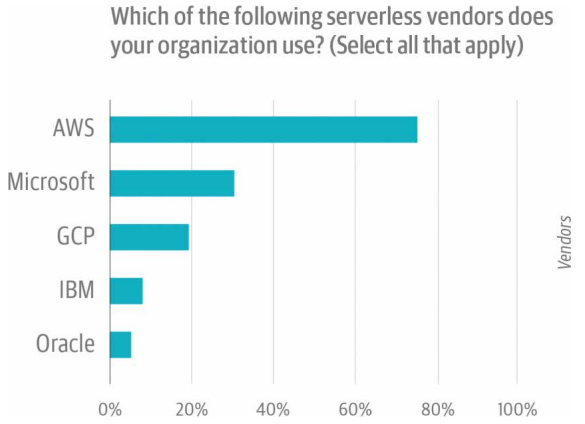
29. https://aws.amazon.com/fr/blogs/aws/amazon-ecr-public-a-new-public-container-registry/
30. https://aws.amazon.com/fr/about-aws/whats-new/2020/12/aws-lambda-now-supports-container-images-as-a-packaging-format/

It worth mentioning that Serverless is a wide concept and the word is already misleading. Most of the industry refers to Serverless Functions as Serverless. We will pursue the same logic.

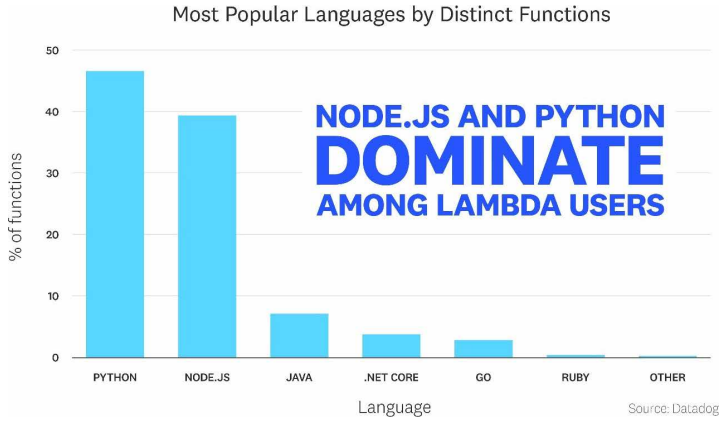
- The New Relic Serverless Benchmark Report for AWS Lambda 2020 states that there is a rise of 206% in the average weekly invocation of Serverless within 12 months.
- This O'Reilly Serverless Survey 2019 reported that 40% of companies are already using Serverless
- During its Keynote at re:Invent 2020, Andy Jassy (CEO of AWS) reported that nearly half of new apps at Amazon were deployed to AWS Lambda in 2020
- According to the State of Serverless survey 2020 from Datadog, half of AWS users have adopted Lambda



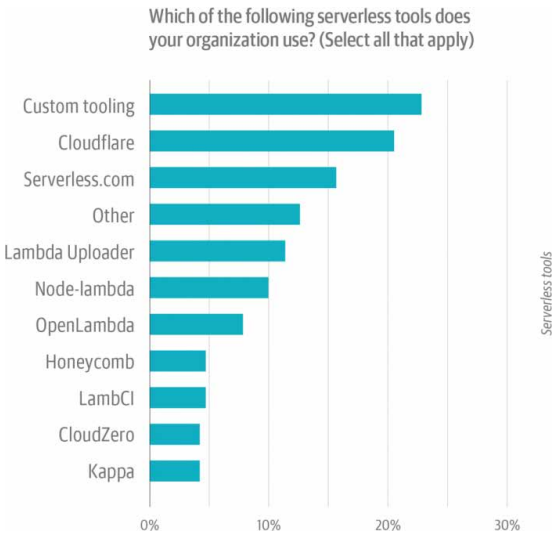

Among the Function as a Service providers, AWS clearly has the lead with nearly 80% of the O'Reilly Serverless survey as adopters:




If many languages are currently supported, Python and Node.JS have the lead:

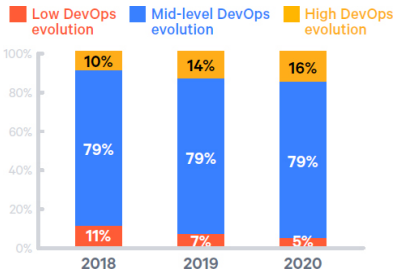


Despite its popularity, Serverless still lacks a convenient framework, with most users depending on a custom based implementation:




## More DevOps for the better

According to the Puppet State of DevOps 2020 report, DevOps adoption is growing but at a slower pace. If the Mid-Level DevOps remains at the same level of 79% for 2 years, the amount of High DevOps evolution has raised by 60% for the same period of time.

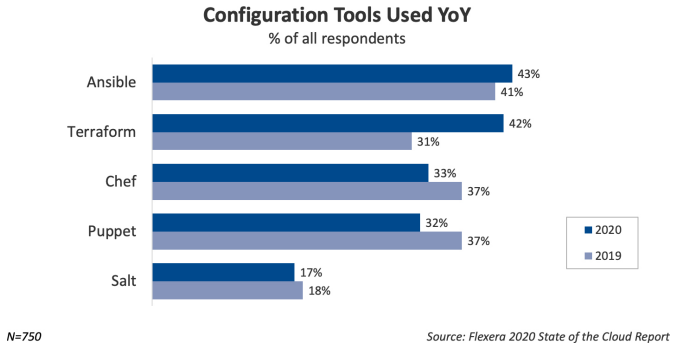



The report also shows DevOps excellence benefits such as:

- 3 times as likely to have highly effective change management
- About twice more likely to remediate critical vulnerability issues within a day
- Twice as likely to be highly product oriented as firms in the middle of the DevOps adoption

## IaC: More provisioning, less configuration management

Regarding Infrastructure as Code, the Flexera State of the Cloud 2020 indicates that Configuration Management tools usage is decreasing, except for Ansible which grew by 2 points. This is probably due to new technologies based on Containers and Serverless. On the contrary, Provisioning tools such as Terraform have had a huge growth in terms of adoption, being used by 42% of companies.



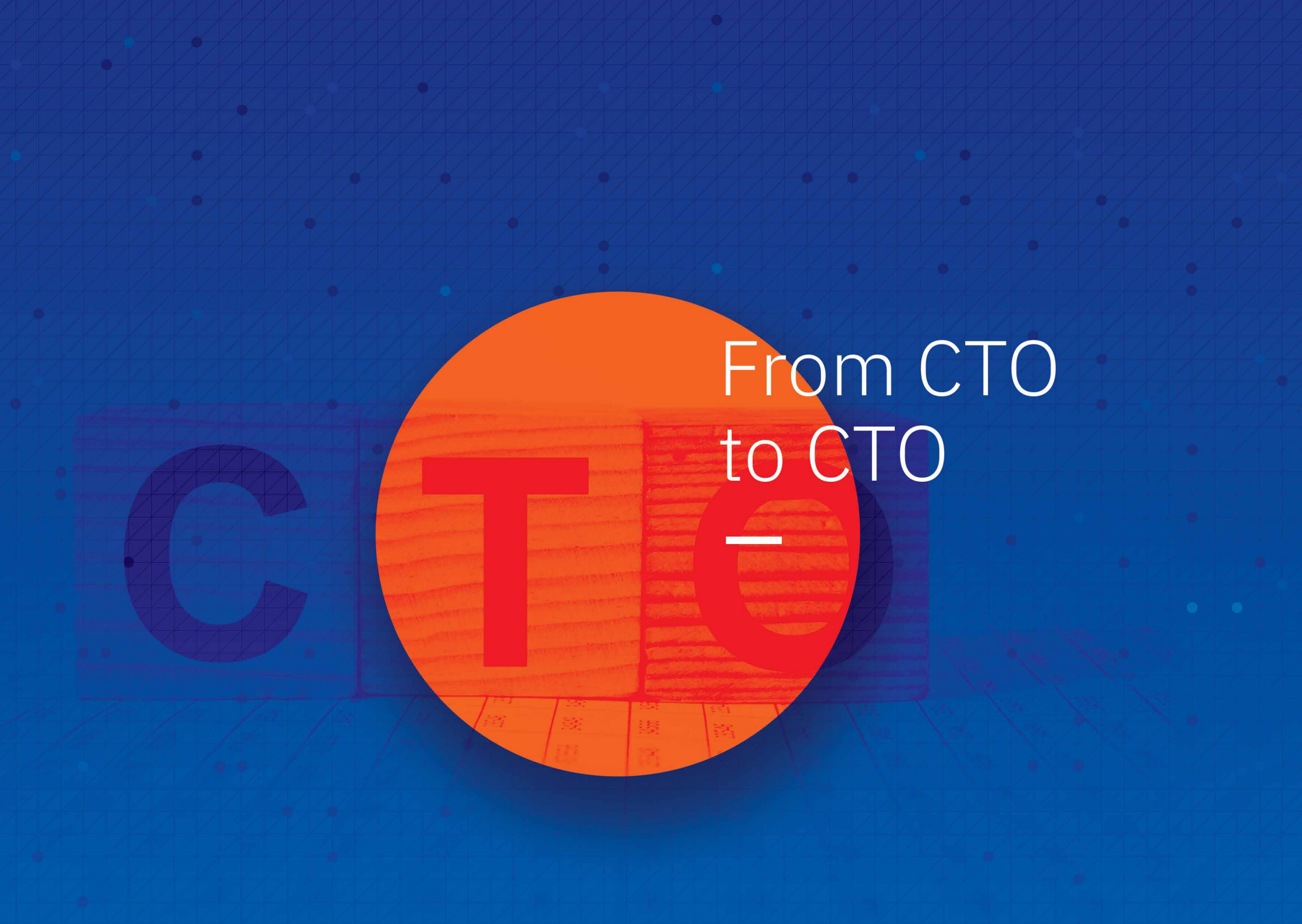

Regarding Cloud Native provisioning tools, unfortunately we could not find metrics at this time regarding Azure ARM, AWS CDK or Cloudformation.

## Databases

From Stackoverflow annual survey, we know MySQL is still the preferred option for a database. PostgreSQL is the second most popular along with SQL Server, followed shortly by SQLite.

Nothing essential changed compared with 2019.

| | 2020 | 2019 | 2018 | 2017 |
|---|---|---|---|---|
| **MySQL** | **+55.6%** | **+54.0%** | **+58.7%** | +49.6% |
| **SQL Server** | +33.0% | +32.8% | +41.2% | +54.2% |
| **Cassandra** | +3.3% | +3.5% | +3.7% | +49.9% |
| **SQLite** | +31.2% | +31.6% | +19.7% | +47.2% |
| **Oracle** | +16.5% | +16.5% | +11.1% | +36.9% |
| **MongoDB** | +26.4% | +25.0% | +25.9% | +55.0% |
| **Redis** | +18.3% | +18.6% | +18.0% | **+64.8%** |
| **PostgreSQL** | +36.1% | +32.4% | +32.9% | +60.8% |
| **ElasticSearch** | +13.8% | +14.3% | +14.1% | - |
| **MariaDB** | +16.8% | +16.5% | +13.4% | - |
| **Apache Hive** | - | - | +2.2% | - |
| **Apache HBase** | - | - | +1.7% | - |
| **Google BigQuery** | - | - | +2.1% | - |
| **Neo4j** | - | - | +2.4% | - |
| **AWS DynamoDB** | +7.1% | +6.2% | +5.2% | - |
| **AWS Aurora** | - | - | +5.1% | - |
| **Azure** | - | - | +7.9% | - |
| **Firebase** | +14.4% | +12.8% | - | - |
| **IBM DB2** | +2.9% | - | - | - |
| **Couchbase** | +1.9% | - | - | - |


From CTO
to CTO

## More technology than CTOs can bears

How often have you thought that you might optimize your site performance with WebAssembly? Or any algorithm with Machine Learning? Or to better balance workloads between edge and your infrastructure? Or put in order data flowing around without real access control? If you are a typical CTO, our opinion is that you don't have time for these questions.

And you will never have that time with a saturated team.

How many opportunities are companies missing because of that? Hard to tell. Sometimes you might even find it very delicate to speak loudly about the pain-point. But if it is the CTO's responsibility to seek for technology opportunities with high potential for new revenue or better TCO (total cost of ownership), it is up to the CTO to act in such a way to make room for studying. And of course, as a CTO you can't study and test every new thing.

Whatever time you allocate to study new ideas:

- Spend one third of it at the office and ensure everyone sees it (make an example),
- Find key people in your team and ask them to spend learning at least the same time as you do during office hours (it will be hard for them to only study at work),
- List a framework of interest to guide their learning efforts,
- Assign someone to facilitate learning,
- Iterate learning!

There you have it! Your first organizational-learning plan. It is still far from being enough, but you shouldn't plan for more before you've done that.

No matter what kind of team a CTO has to work with, it is impossible to just test every option out there, every new technology. Therefore, continuous study is important for the sake of the organization. Choosing carefully what to test is equally as important, and we can only do that once we've learned to filter properly during study time.

Experimenting with new technologies is more familiar for us and should be straightforward.
Acting so will not make miracles in new technology adoption. But will align everyone on much more reasonable expectations about what can be done. And this is your opportunity to take a strategic decision about where your organization should ideally be in terms of technology adoption: innovators, early adaptors, early majority or late majority.

## Hot CTO topics

If we can speak of trends when we discuss technologies, it is harder to do so with respect to architecture. At first sight, Google trends aren't relevant. And having some statistics in the number of papers supporting various topics wasn't an easy task to conduct for this year.

However, there are some additional hot architectural topics worth mentioning:

- Policies as code
- Ethics in architecture
- DataOps, DevSecOps in combination with UXSecOps
- Mob programming and testing
- Data mesh, Security mesh and Services mesh
- Micro frontends and Serverless SPAs
- Low-code connectors
- Modular monoliths

The topics enumerated above aren't real trends. But they move the communities today. We'll just have to wait for the next year to see if they are adopted.

# Interview

*Why technology trends for Tech.Rocks?*

This document has a favorite audience. It is an audience that consistently suffers from pressure, decision-making dynamics, market changes and budget constraints: the CTO role. And there are many good reasons supporting our decision. Traditionally, the success of our services was strongly coupled with the success of the CTOs in their company. The better we stand for CTOs, the more we increase our chances to succeed. And Technology Trends is not the first tool we've developed in their support.

The way we structure our catalog of services should easily talk with CTOs. The holistic visibility CTOs gain when working with us through the Maturity Models is another indispensable tool that augment the decision-making processes, just to name one of the many options CTOs may get benefit from our toolkit. Technology Tends is the ideal tool for CTOs seeking for insights about technologies and best practices: development, infrastructure, security, architecture and processes.

*If we'd have to choose one major difference since last year, something that needs to be highlighted, what would that be?*

Adding chapters per CTO interlocutor is the main differentiator of this release. And in terms of content, there is much more about cloud and DevOps compared to the last year version.

## About Tech.Rocks

Tech.Rocks is a community driven by the dedication of a team of forward-thinkers – the Tech Leaders (CTOs, VPs of Engineering, Heads of Engineering, Tech Leads, Architects and more). They are shaping the digital world of tomorrow by turning their passion for technology into daring actions that they bravely embrace in the companies they lead, whether startups or large corporations.

Founded in 2016 by Francis Nappez (CTO and co-founder of BlaBlaCar), Dimitri Baeli (former CTO of lesFurets.com) Nicolas Silberman (former CTO of 20 Minutes and Mediapart) and Cyril Pierre de Geyer (CEO of Rocket School and creator of the Executive MBA Epitech), Tech.Rocks aims to **bring together, connect, and grow inspiring Tech Leaders in a caring community of peers.**

TECH rocks

## Tech.Rocks is:

- A Slack hub of 500+ Tech Leaders who chat every day (membership is subject to verification of a professional profile).
- A monthly meetup with 100+ Tech Leaders who get together to discuss hot topics (open event).
- A «Core» Think Tank, with 40+ members who share their ideas daily and meet at special events. Entry into the Core group is subject to specific criteria (co-option, c-level status, etc.).
- A full community of 1500+ Tech Leaders who have followed us, attend our events and engage in debates with us since Tech.Rocks began.

## An annual event AND a community

Each year, meetings with our community of tech experts and partners culminate into a day-long event with the only watchword: the «No Bullshit.» The program, which focuses on issues facing CTOs and tech leaders, addresses team organization, technological choices, product ownership, management, role of the CTO and its career path.

The goal? Be a genuine link between Tech Leaders looking for a platform to share their experiences and debate the latest tech trends, and open a dialogue throughout the year in a community that shares similar challenges and questions every day.

*Contact us : hello@tech.rocks*
*https://tech.rocks*

## Partnering with companies to create products and scale their business

As a trusted digital services partner of digital nomads, emerging digital innovators, and large traditional industry players, we support businesses worldwide to achieve end-to-end digital transformation through agility at every stage of their solution lifecycle.
We boost our clients' capacity to grow and scale their business across a broad spectrum of high-demand needs, including Software Engineering, Product Development, Talent Recruitment, Digital Marketing, Agility Consulting, and Innovation Financing.

Our essential mission is to assist our clients in creating products and growing their business, responding to unmet user needs, and evolving over time to engage and retain users. That's why we embrace **Lean thinking, Agile/Scrum** methodologies, and **DevOps** best practices so that we can quickly create, deploy, test and iterate.

## Digital skills to power growth

With a global team of 1,100 in-house tech and digital specialists and a private community of 400,000 IT professionals, we offer flexible engagement models to support our clients' short and long-term objectives, including outsourcing, recruitment, and freelancing.

By combining freelancing, outsourcing, and IT recruitment, we can remain highly reactive to their demands, empowering them to locate top-notch IT talent worldwide, drive sustainable business growth, and boost their innovation capacity.

# Pentalog

**Pentalog is a global digital skills and services platform dedicated to helping companies access high-quality, cost-effective digital talent.**

We enable our clients to generate and sustain growth with flexible engagement models to staff hard-to-fill software engineering, product development, and business innovation projects.

**25 years of experience**
in IT outsourcing & software engineering

**7 delivery centers & 7 consulting offices**
in Europe, Asia, and America

**300+ digital products yearly**
delivered by our Agile teams

**27 startup investments**
through our tech acceleration program

## CORNEL FATULESCU

Pentalog
Chief Platform Officer

### About Cornel

Cornel joined Pentalog in 2005 as an architecture developer before moving into the Head of CTOs position, then Chief Platform Officer.

With extensive knowledge of IS transformation, technical and functional consulting, organization & human resources management, Cornel approaches digitization from a global perspective. He manages a team of 60 engineers and designs data strategies, technical and functional architecture for companies of all sizes.

Thanks to his expertise in agile project management, Cornel is a supporter of continuous process improvement and is heavily involved in setting up software factories.

### About Vasile

Company transition towards agility. Trainer on the Agile, Scrum, Kanban methods. QualityVasile designs training programs for IT development teams in the subjects of: knowledge sharing, process alignment, quality, collective improvement, and more. Adapting very quickly in a competitive environment is essential for the survival of any organisation. Production cycles are getting shorter, application deliveries are more frequent, and the collaboration with the development teams is tighter. Vasile assists clients and their technical teams with the implementation of new methods to help them become more agile.

## VASILE PUTINA

Pentalog
CTO Pentalog Software Factory

## GUILLAUME POUSSEO

Pentalog
Chief Customer DevOps Services Officer

### About Guillaume

Guillaume is the Director of our Customer DevOps services. After more than 15 years of experience, mainly as a CTO, he is now helping our clients achieve the best quality, reliability and time to market for their infrastructures
Guillaume's team is composed of certified experts in Cloud technologies (AWS, Azure, GCP) and DevOps practices. They can onboard at any stage of a project to provide a wide range of services such as audits, consulting, mentoring and engineering. As soon as a collaboration starts, Guillaume and his team ensure Continuous Improvement through well-defined objectives that are constantly tracked and refined.
Guillaume works on enforcing the focus on Agile and Lean at Pentalog. This is done by leveraging DevOps practices and technologies focused on promoting strong collaboration within multi-disciplinary teams who work together to align your infrastructure with your business objectives.

Pentalog
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