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BlueOptima Global Benchmark Report

October to December 2021

Key Trends in the Global Software development Industry

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Welcome

Welcome to the BlueOptima Global Benchmark (BGB) Report which provides insights into key trends from across the software development industry.

This quarters key insights are:

- Global productivity and quality has started to stabilise suggesting that enterprises are finding their feet in a post-pandemic world
- Industrials experienced a 3.1% drop from Q3 (October 2020 - September 2021) to Q4 (January 2021 to December 2021) in productivity and was the only economic sector to experience a decrease for the quarter
- After experiencing a severe decline last quarter, the economic sector of Healthcare has broken its downward trend and saw an increase in productivity for the quarter, while still managing to improve their code quality
- Eastern Europe continues to be the most maintainable and productive region
- India continues to fluctuate from quarter to quarter in terms of productivity and maintainability considerably more than other countries
- The cost of software development is on the rise and may have been accelerated by the pandemic and the associated 'Great Resignation[1]'

The Report consists of data extracted from hundreds of thousands of software developers located in more than 30 countries, providing a quantitative analysis of their performance. This Report is published quarterly with each Report containing data from the preceding 12 months. The data is analysed using BlueOptima's Developer Analytics platform to calculate Coding Effort (CE), which sets a global standard for measuring software developer productivity. Coding Effort is a metric derived from objectively measuring a software developer's work outputs, specifically changes in static source code metrics, and the context within which that output was delivered then benchmarking that against all other developers.

1 *The 'Great Resignation' Globally: New data: What developers look for in future job opportunities - Stack Overflow Blog. The 'Great Resignation' in the USA: HBR: Who Is Driving the Great Resignation. The 'Great Resignation' in India Despite bonuses and salary hikes, India's IT sector will see over a million resignations this year - Times of India.*

Coding Effort is used by large global enterprises to compare the productivity of software engineers across technologies and software development methodologies to deliver actionable insights to optimise the software development lifecycle.

Alongside productivity, the maintainability of source code changes delivered by software developers are measured using BlueOptima's Analysis of Relative Thresholds (ART). Analysis of Relative Thresholds is an objective measure of source code maintainability obtained by using static source code metrics to evaluate how easy it is for a developer unfamiliar with the source code to deliver change into that source code. ART is described as 'quality' in this report. It is the proportion of Billable Coding Effort (BCE) hours spent delivering maintainable source code change.

The analysis within this report deliberately excludes part-time and hobbyist software developers. For example, those contributing to open source projects, as the economic cost and impact of their participation in these projects are indirect and unclear. The data employed in this analysis represents an approximated 2% sampling of the global enterprise software developer population.

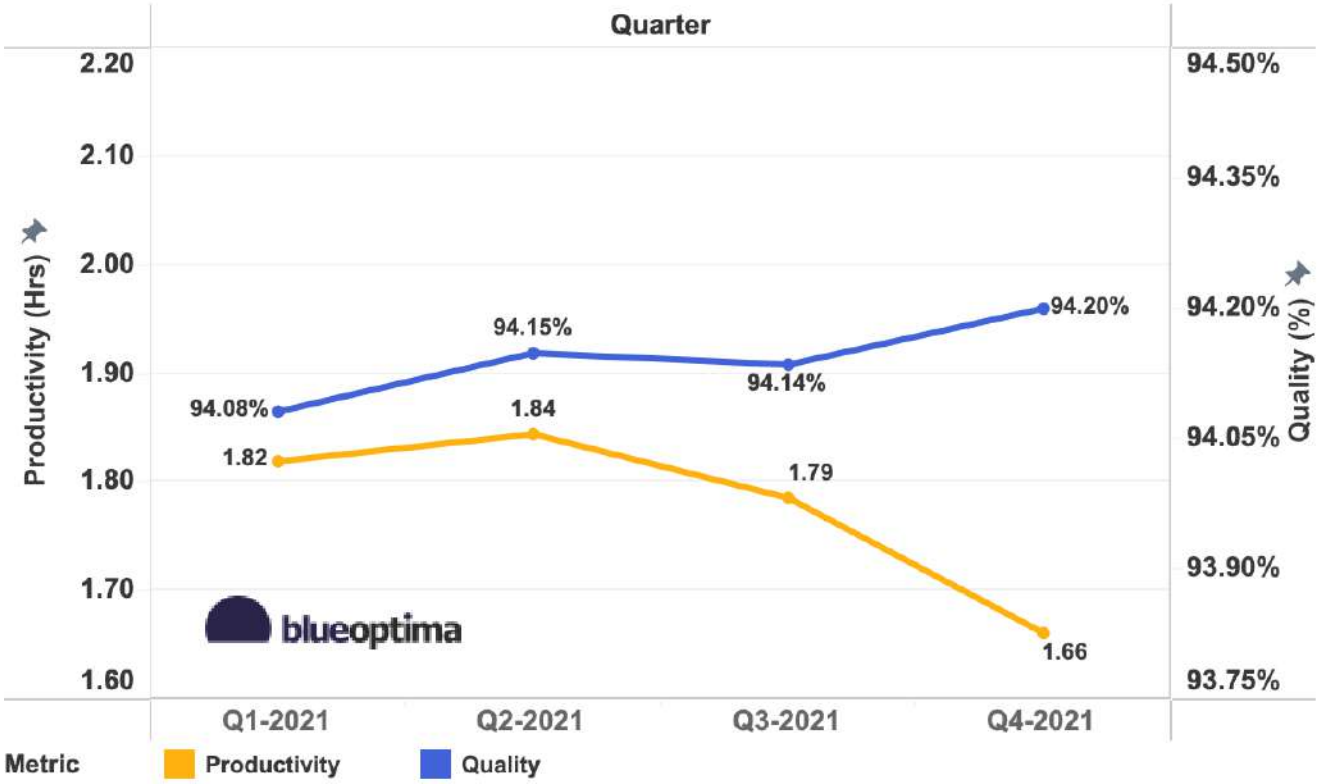
About BlueOptima

BlueOptima's analytics platform empowers software developers and their companies to create better software in the most time and cost-efficient way.

The first solution of its kind, BlueOptima provides insight based on the world's only objective software developer productivity metrics: Coding Effort. It's a breakthrough for software development.

BlueOptima's SaaS platform facilitates analysis of productivity, together with quality, in enterprise software development, in terms of individuals, teams, tasks, projects, divisions, and outsourced suppliers. Understanding variations in performance across an enterprise empowers managers to optimise efficiency. BlueOptima is proven to identify savings of up to 20% for software budgets.

BlueOptima's further offerings around benchmarking and recruiting allow organisations to cost-optimise as early as possible in software initiatives.

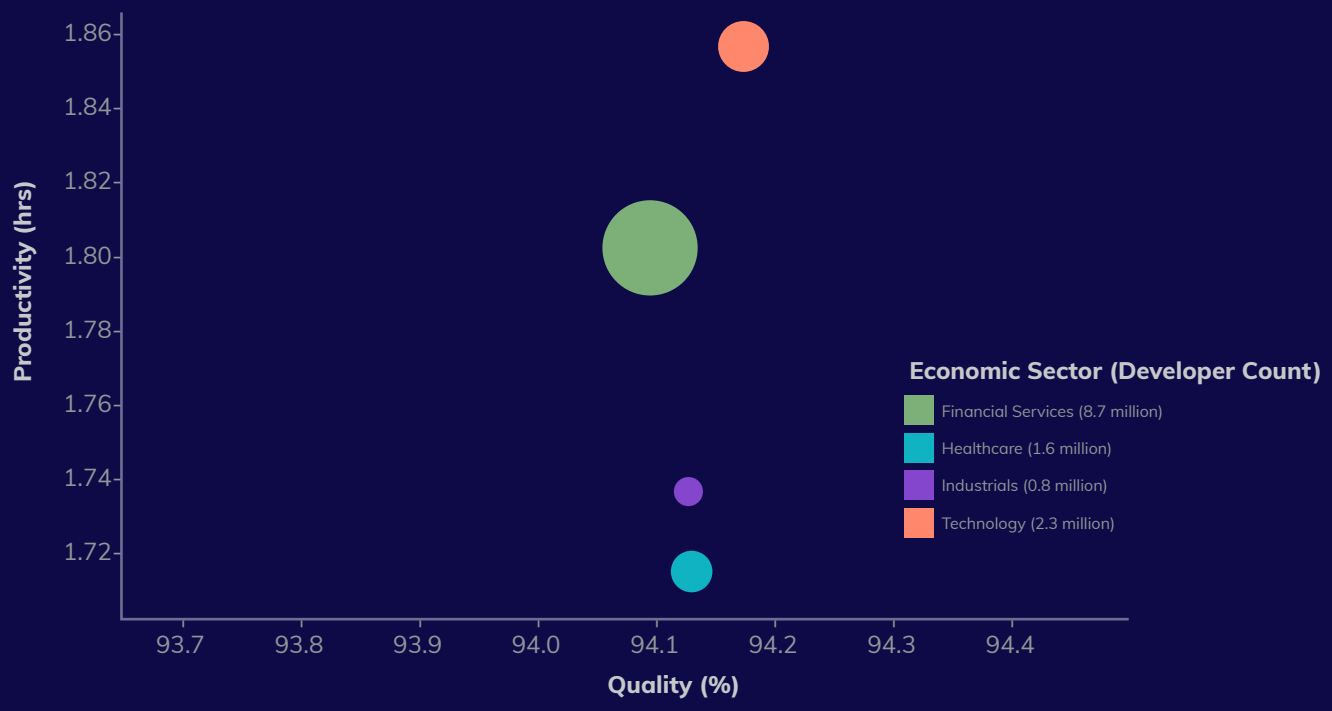


Global Trends

Where did the productivity and quality of your software development teams sit this quarter? Global metrics for Q4 2021 show that software development organisations are starting to stabilise as we normalise business in a post-covid world. Quality remained stable for the quarter with only a small change from 94.14% in Q3 to 94.20% in Q4.

Global Productivity has declined for another quarter compared to the pre-pandemic levels this is 14% lower than the average for 2020 (1.93 BCE/day). Historically Q4 often results in a drop of productivity; this continuing downward trend is worrying. Some comfort can be taken that quality has improved. Even though software enterprises have started implementing their 'Back to Office' programmes, the productivity of developers hasn't yet started to respond positively.

As is consistent with prior years, the BGB normally exhibits a brief drop in productivity between November and January each year. Historically (using 2016-17 to 2020-21 data) December is 7.3% below the average for the year and 5.4% lower in January. The results this quarter reflect a similar trend with the total number of coding hours having dropped. Developers remained more or less as productive as we might expect in Q4, we have seen the overall volume of Coding Effort hours drop by 7.3% globally compared to Q3 2021 and expect to see that return in February 2022.



Economic Sector Performance

This quarter we saw Technology take the lead in productivity with 1.85 BCE/day. This was followed by Financial Services which came in at 1.80 BCE/day and Industrials (1.73 BCE/day). The economic sector with the lowest productivity was Healthcare at 1.72 BCE/day.

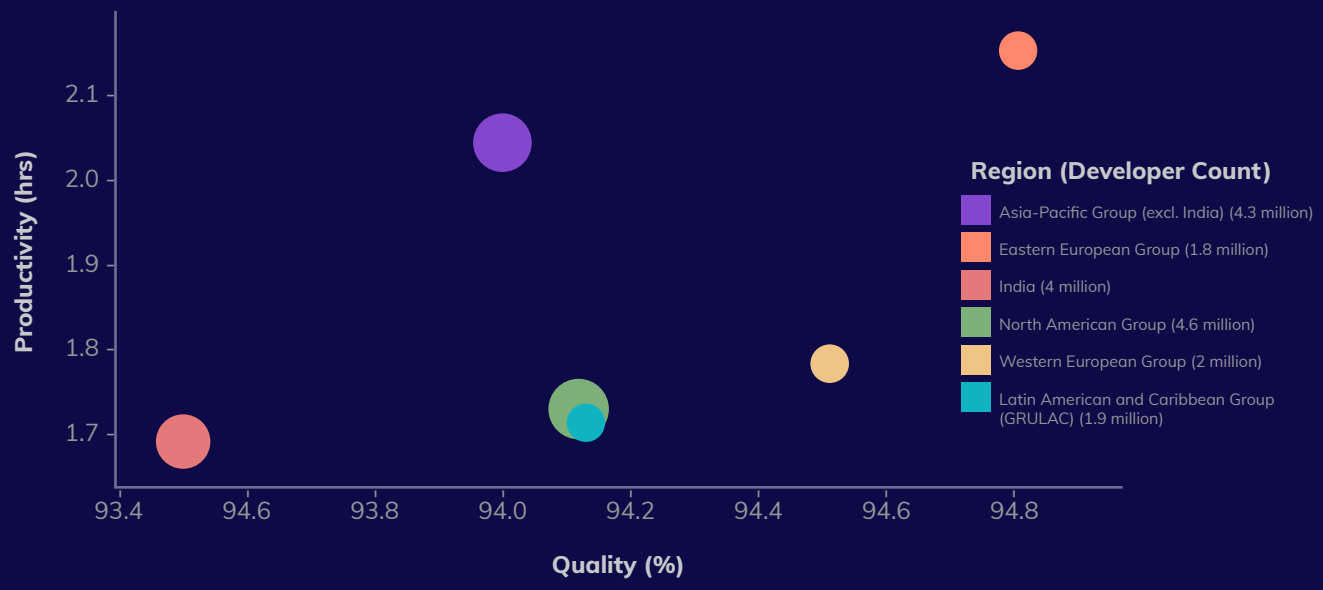
Each area showed a very similar level of quality to each other but the rankings of quality varied slightly in comparison to productivity. Technology remained in the top spot at 94.18%. However, second place was qually held by Healthcare and Industrials which were both 94.13%. Whereas, Financials Services had the lowest quality for the quarter but it was not far off the other sectors coming in at 94.10%.

Top three most Productive Economic Sectors

1.85
BCE / day
TECHNOLOGY

1.80
BCE / day
FINANCIAL SERVICES

1.73
BCE / day
INDUSTRIALS



Regional Performance

When looking at the average across the past 12 months, we saw less movement when it came to geographical regions in regard to their productivity and quality.

The Eastern European region, consisting of 1.8M developers or 8% of the global total, continues to be the most maintainable and productive region. A trend that has been observed for over two years and an area of the world which has only seen minor variations despite the tumult of the pandemic.

India (with 3.9M developers) on the other hand has continued to show a gradual decline in both productivity and quality for the past four quarters. India is a region that doesn't seem to be stabilising and has apparently been more profoundly affected by the impact of the pandemic on working practises.

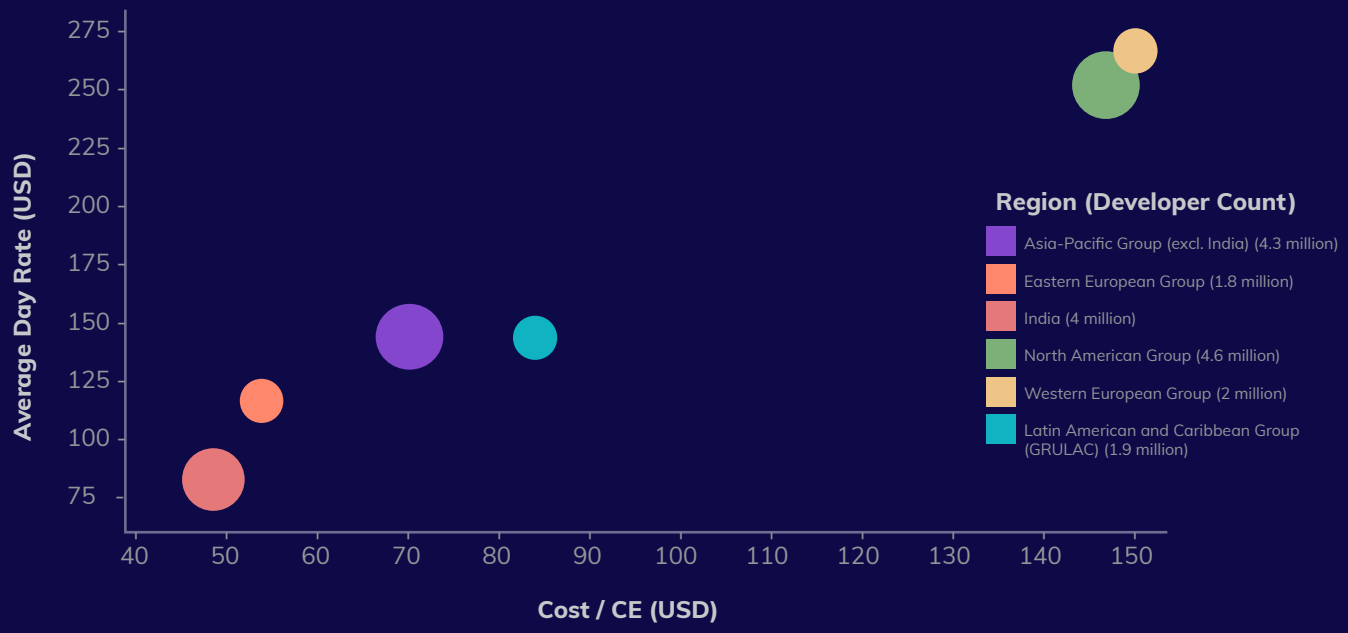
Western Europe is also experiencing a trend of gradual decline in productivity and quality which has been occurring for at least the past four quarters.

Top three most Productive Regions (BCE/Day)

2.15
Eastern European Group
1.8M

2.04
Asia-Pacific Group (excl. India)
4.3M

1.78
Western European Group
2.0M



Regional Cost Efficiency

Regional cost efficiency saw little variation this quarter. Overall, Eastern Europe and India still remain the regions with the lowest cost to deliver an hour of Coding Effort.

Interestingly Western Europe saw another minor drop in quality and productivity which is consistent with past trends. However the region still continued to have the highest average day rate compared to other geographical regions. The drop in productivity and then increased day rate has compounded to increase the cost per hour of coding effort from $144.77 (USD) to $149.46 (USD) which was a 3.2% increase.

The region which followed closely behind Western Europe was the North American region which was $3 (USD) cheaper in delivering a unit of Coding Effort.

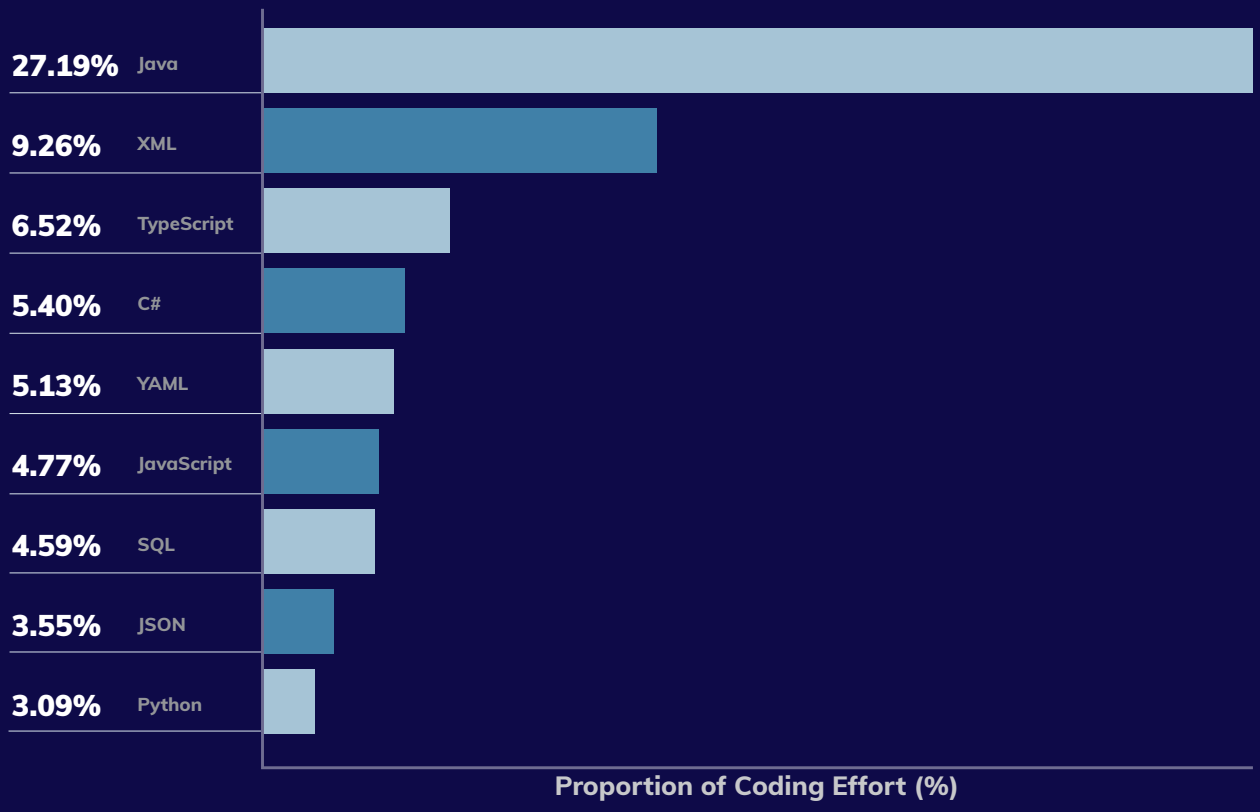
The BlueOptima Global Benchmark makes evident that, over the past two years, the cost per unit Coding Effort has been rising since the pandemic began. This is observed in most geographical regions. It appears that the cost of software development is increasing and the pandemic may have served to accelerate this trend.

Top three most Cost Efficent Regions (USD)

49.22
India
4.0M

54.41
Eastern European Group
1.8M

70.43
Asia-Pacific Group (excl. India)
4.3M



Top Enterprise Technologies

Java continues to be the most commonly used language in enterprise software development. This accounts for over a quarter of Coding Effort (CE) delivered globally.

Overall we have not seen any drastic changes in the top ten enterprise technologies for the quarter, suggesting some stability in the dominant languages used in practice.

Top three languages

27.19% development done using **JAVA**

9.26% development done using **TYPESCRIPT**

6.52% development done using **XML**

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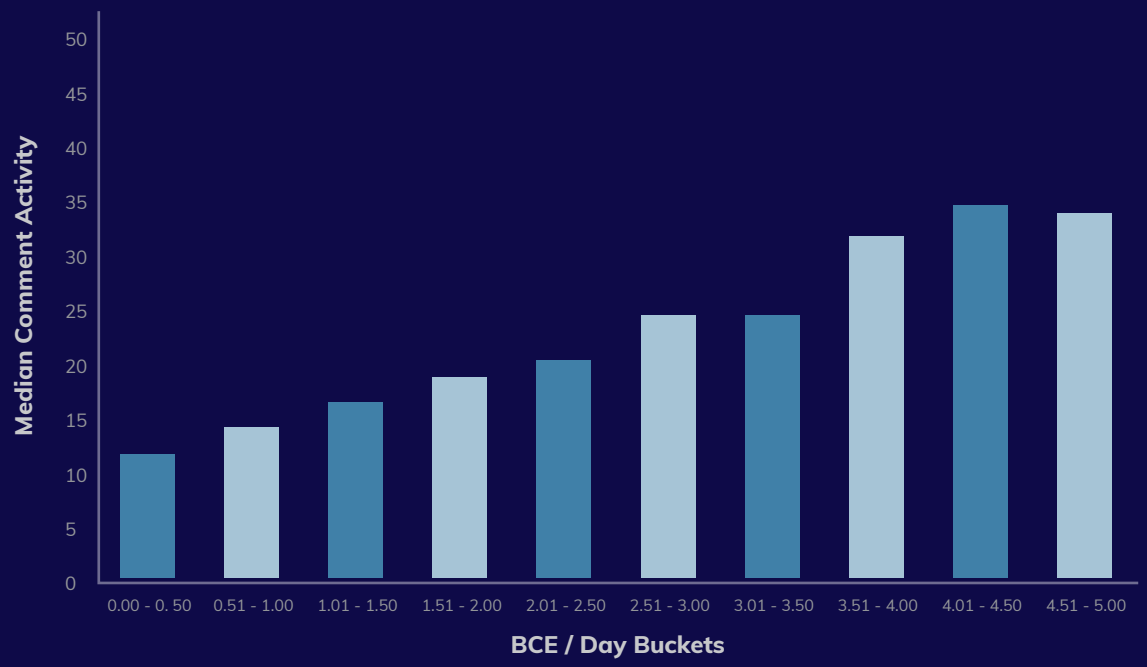
SPECIAL REPORT

Analysing code reviews to enhance a developer's productivity



Let's set the scene...

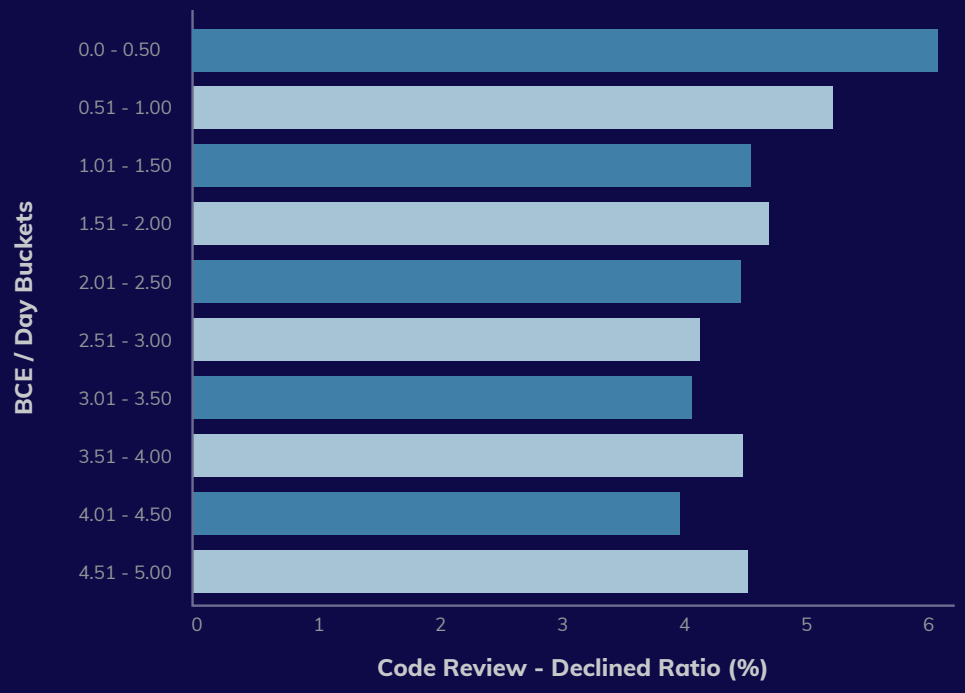
Code reviews are an increasingly mainstream software development practice. Code reviews are a process by which developers formally review the code from other developers before it is published. A process which is completed through workflow capabilities provided in modern version control systems. This improves the adherence to coding best practises and shared conventions within a team and also increases the chance of catching code defects before they reach Production. The reviewer will comment code and provide proposed fixes/edits. The author of the code will typically then review the reviewer's comments before submitting a final version of the code for subsequent progression into Production environments.

With an increased adoption of such tools, BlueOptima gathers and objectively analyses related data for generating actionable insights for Team Leads and Senior Managers. In this report we investigate the combined power of our Developer Analytics software with code reviews to identify workflows and practises that enhance a developer's productivity. For the purpose of this report, we have limited the scope of data analysed to Pull Request Rejection Ratio as a measure of review diligence and submission quality and Comment Activity as a measure of collaboration.

The Analysis

High-performing teams are those that build and deliver high quality software to the end-user as quickly as possible. However, in order to deliver high quality software faster, it is absolutely necessary for developers to have clarity on the delivery requirements and functionality needs of the project. As such, it is important for team leads to analyse and understand the patterns that improve a developers experience and what enables them to incrementally deliver software faster. It is about understanding the behaviours and best practises surrounding code reviews from the data. This can lead to a better developer experience and essentially improve collaboration as well as knowledge sharing which can result in higher productivity and better code quality.

Clearly, the ongoing engagement of a developer with a codebase is key to them leveraging their past experience with that codebase to enhance the productivity of the team working on that codebase. A study carried out in 2018 has shown that the



continuous contribution from developers on only Open Source projects directly correlated to code reviews being approved, whereas rejected reviews lead to fewer future contributions. This suggests that rejections may demotivate developers as it may be perceived as harming their reputation that they may consequently stop contributing to the project. This demotivation thus may lead to reduced productivity and impact the performance of a team as a whole.

Data Scope

We have taken a subset of the data (having both code reviews and productivity data for given months) and analysed approximately pull requests created by 9000+ developers working in an enterprise setting across 10,000+ repositories. For analysis specific to your enterprise or industry, please reach out to the BlueOptima Data Science team at consulting@blueoptima.com

Analysis

Our analysis on the decline ratio of pull requests for varying productivity ranges found that less productive developers (<= 1.0 BCE/ Day) have a 26.5% higher decline rate than productive developers (>= 3.5 BCE/ Day). This gap increased to 28% when compared with developers having BCE/ Day greater than 4.0.

A study carried out in 2018 found that "continued contribution to a project is correlated with higher pull request acceptance rates and that pull request rejections lead to fewer future contributions".

Our analysis has shown that code review requests of high-performing developers had higher levels of collaboration than low-performing developers. There was an increase of 140% in the median comment activity of higher-performing developers compared to that of low-performing developers.

The Takeaway

These findings suggest that it is important that pull requests are properly engaged with, hence providing a skills development opportunity for the developers requesting code reviews. Those providing code reviews should invest time and effort in providing detailed comments and proposed edits rather than simply rejecting them.

over
100,000
professional software engineers

30
different countries

12
months of data

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More about the Report's Data

Proration Methodology Changes

BlueOptima has made significant improvements to our proration logic, particularly when handling infrequent committers or those with an extended break from the code base, this change considerably reduces the instance of underreported productivity due to extended absences from working with a codebase. In order to ensure the comparison between the two quarters is statistically justifiable the previous quarters data has been recalculated in this report so both quarters are using the same proration methodology and hence a comparison on productivity can be made.

Coding Effort

Coding Effort is calculated by statistically evaluating every source code change made by developers in terms of 36 static source code metrics measuring various aspects of Volume, Complexity, and Inter-relatedness while considering the context worked in e.g. a complex legacy software component or a brand new project.

Analysis of Relative Thresholds (ART)

ART is a measure of the quality (specifically: maintainability) of source code. It is calculated by evaluating the proportion of code which is aberrant, relative to the codebase in which it sits. Code is flagged as aberrant when it violates certain internally benchmarked statistical thresholds, across a number of static source code metrics.

BlueOptima Population Sample

This report leverages models and analysis built on the BlueOptima dataset which contains activities of over 400,000 developers and more than 126 Billion static metrics changes. Detailed location, employment, and organisational data is available for more than 38,000 based in India, 12,000 based in North America, 10,000 based in Western Europe, 4000 based in Eastern Europe, 4,000 based in the APAC region (excl. India & China), 3,000 based in China, and 3,000 based in Latin America and the Caribbean. The regions of Africa and the Middle East, which represent an estimated 6.8% of the global developer population, have been omitted from this analysis due to insufficient sample size. All data used is anonymised and aggregated.

Global Software Developer Population

BlueOptima uses a sampling technique in calculating the performance of software engineers across various geographical regions and industries globally. BlueOptima has estimated the global software developer population using a combination of accredited sources and predictive modelling.

The global population of software engineers across various geographical regions according to the BlueOptima Global Benchmark are 3,966,219 in India, 4,642,058 in North America, 1,834,578 in Eastern Europe, 1,962,108 in Western Europe, 4,317,893 in the APAC region (excl. India), and 1,898,734 in Latin America and the Caribbean. Africa and the Middle East, which represent an estimated 6.8% of the global developer population, have been omitted from this analysis due to insufficient sample size. All data used is anonymised and aggregated.

Estimates of the total number of developers per region are derived from the following sources using a process of harmonising the data sources and arriving at a best-estimate across all sources: IDC Worldwide Developer Census, Evans Data Global Developer Population and Demographic Study, Stack Overflow State of European Tech, Statista, and World Bank Open Data.

Business Classification

The classification of organisations into Economic Sectors, Industry Groups, and Industries is done using The Refinitiv Business Classification. Estimates of the numbers of enterprise software developers in Economic Sectors, Industry Groups, and Industries is done by measuring various proxies of software developers in a firm (e.g. annual revenue, profit, assets, and headcount of each organisation) on a per industry basis and optimising estimation of this against the known developer population in a subset of the those organisations that are known to BlueOptima. Once this industry level estimate is arrived at, constituents of the Global 2000 are evaluated and their developer populations estimated. The relative proportions of developers in Economic Sectors are then applied on a pro rata basis to the global software developer population.

This analysis is provided as a source of information in good faith based on sound underlying data. However, BlueOptima accepts no liability for any actions taken in reliance on this analysis.

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