blueoptima

Quantifying the Impact of COVID-19 on Software Developer Productivity

Introduction

The pandemic has seen major disruptions to how we live and work. Many of us are now working from home, at least some of the time.

There have been varying reports on whether these changes have had a positive or negative impact on worker productivity and wellbeing.

According to a survey by Deloitte, 90% of workers say they were as productive or more productive during lockdown than before. On the other hand, some sectors of the economy have been hit hard by the pandemic. For example, according to the Office for National Statistics, retail sales fell by 1.9% in 2020 compared to 2019, which is the largest annual fall on record.

It is not clear whether this fall in retail sales is driven by changes in worker productivity or by changes in consumer behaviour. Surveys conducted by the Bank of England suggest that Top Factor Productivity of workers in the UK private sector as a whole fell by 4% during the pandemic. Retail channels may have suffered a greater loss in revenue due to their reliance on in-person

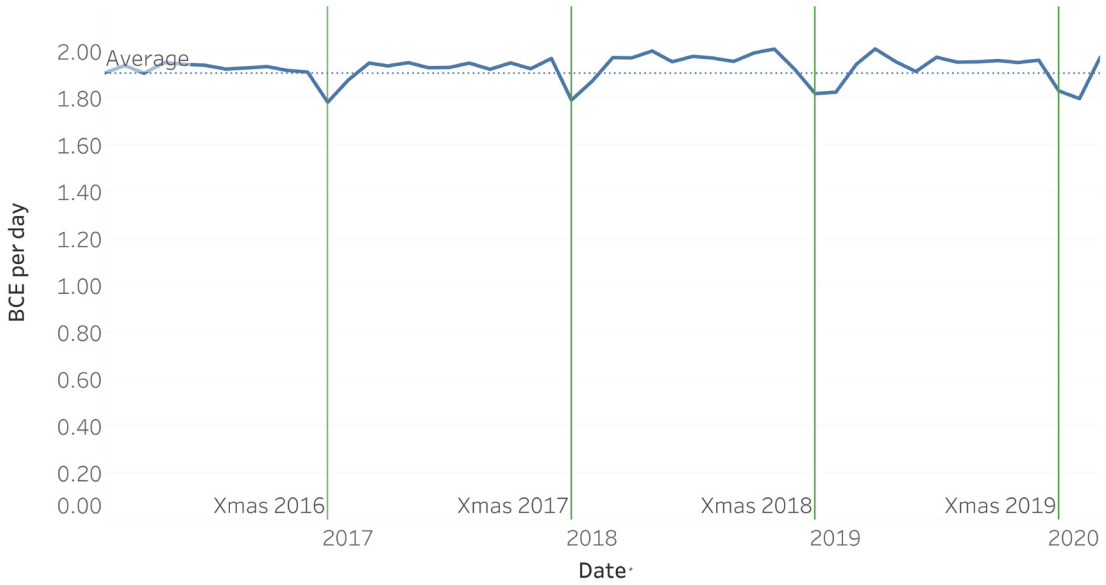


Figure 1: Overall trends from 2016 through to 2020

interactions, which were affected by the introduction of lockdowns. This is corroborated by the fact that e-commerce actually saw significant growth, as reported by Forbes, through the same period, despite this 1.9% fall in retail.

It is crucial that we understand the productivity impact of the very significant changes in working arrangements that were wrought by global COVID-19 lockdowns. It is especially important for the enterprise software development industry, which encompasses 11.7 million software developers and a global annual spend (salaries plus associated costs) of $1.02 trillion. This understanding is important because it enables organisations to plan and implement optimal "hybrid" work arrangements for the foreseeable future.

2. Methodology

At BlueOptima, we are in a unique position where we have direct observations of the output of hundreds of thousands of software developers, working in hundreds of enterprise environments across hundreds of locations. Meaning that we're able to detect changes in productivity from a vast sample of developers working in a broad array of enterprises.

We define developer productivity as the total number of hours of meaningful intellectual output delivered into a source code estate divided by the total number of active working days by all workers. Also known as Billable Coding Effort (BCE) per day. The higher a developer's meaningful output per day worked, the higher the productivity of that developer.

BlueOptima also measures the quality of code delivered by software developers, specifically the "maintainability" aspect of code quality. We define maintainability as the percentage of BCE which falls outside the thresholds of normal code within a given enterprise.

We also have historical data reaching back more than a decade. As a result, we are able to set a baseline for what 'normal' productivity looks like, and using statistical methods we're able to detect any changes or deviations from the 'normal' which happened during the pandemic.

Pre-pandemic we saw that:

- Productivity sits around an average of 1.95 BCE per day with some seasonal fluctuations.
- Once a year, over the Gregorian calendar holiday periods, productivity drops by 8% on average (December and January, green lines).
- Maintainability (% Aberrant BCE) of code for BlueOptima's clients has seen a gradual improvement from 2017 through to 2019. In those 3 years it improved by 6%.

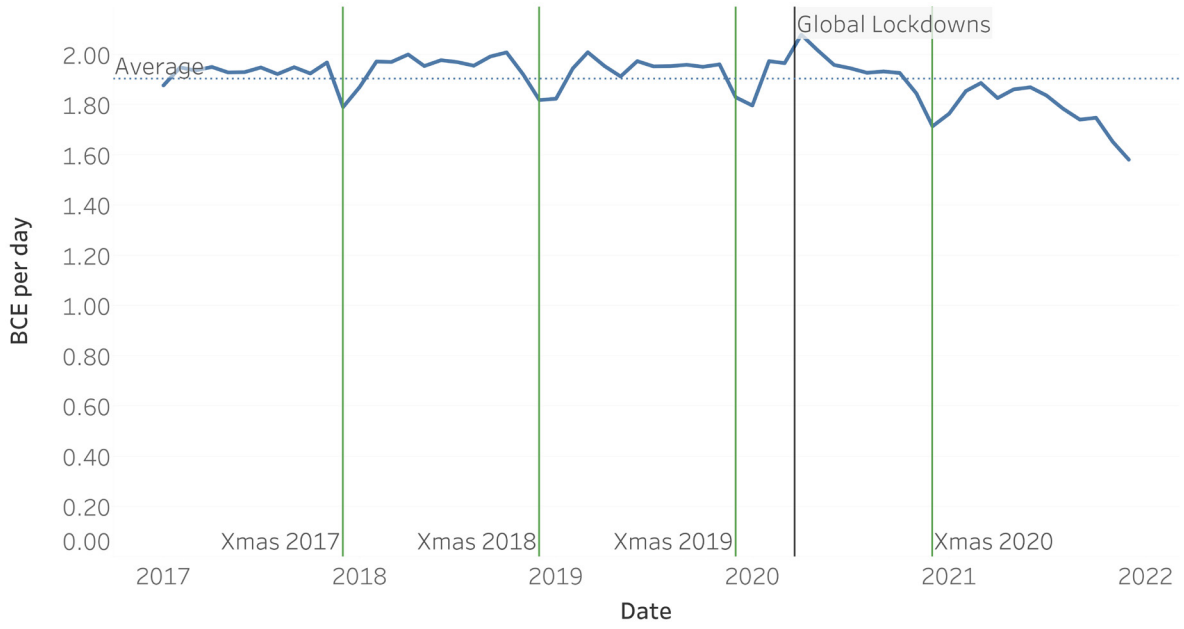


Figure 2: Overall results from 2017 to 2022

3. Analysis of COVID-19 impact on software developer productivity

Now that we have a figure for the baseline level of productivity (1.95 BCE per day), and a reference point for seasonal variations (8% drop over the holiday period), we are in a position to quantify deviations from normal productivity since the start of the pandemic.

The general finding across BlueOptima's universe:

- Productivity increased temporarily in the first two months following global lockdowns (+7% in April and +4% in May 2020).
- Aside from that, 2020 productivity was in-line with the previous years.
- In 2021, particularly the second half of the year, we saw a major and unprecedented decline in productivity (-4% in the first half of 2021 and -10% in the second half).
- The improvements in code maintainability from 2017 to 2019 were effectively cancelled out by reductions in maintainability which occurred 5 months after lockdowns. This brought maintainability levels back to 2017 levels.

3.1 Local differences in COVID-19 productivity impact

Country-level

There was a 10% productivity drop in the second half of 2021. This was seen across BlueOptima's universe of software developers consisting of over 100 countries. In order to determine whether this decline was localised to one particular country or seen across the globe, we ran the same analysis separately for the three countries with the largest developer populations (India, United Kingdom,and United States).

India

In India we saw roughly the same pattern as the global dataset showed:

- There was an initial increase in productivity for the first two months following on from the original lockdowns. (+10% in April 2020 and +7% in May 2020).
- However, there was a major and unprecedented decline in productivity for 2021. (-3% in the first half of the year and -8% in the second half).

United Kingdom

In the UK there was a consistent downward trend for productivity right from the start of the pandemic with the following percentage declines being felt:

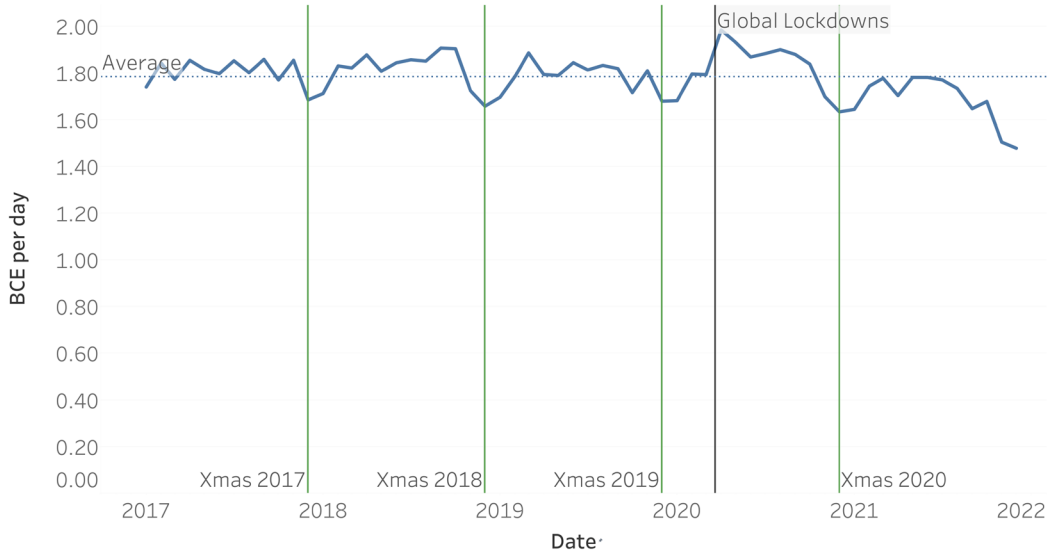


Figure 3: The impacts on India

- -7% in 2020
- -11% in the first six months of 2021
- -18% in the second six months of 2021

United States

Overall the United States followed roughly the same pattern as India and the BlueOptima universe.

- There was an initial increase in productivity in the first two months following on from the original lockdowns. (+5% in April 2020 and +7% in May 2020).
- However, there was a major and unprecedented decline in productivity for 2021. (-3% in the first half of 2021 and -12% in the second half of the year).

Enterprise-level

Overall, the productivity drop in 2021 has affected significant developer populations in India, the United States, and the United Kingdom. However, what proportion of companies experienced the drop?

Figure 4: The impacts on the UK

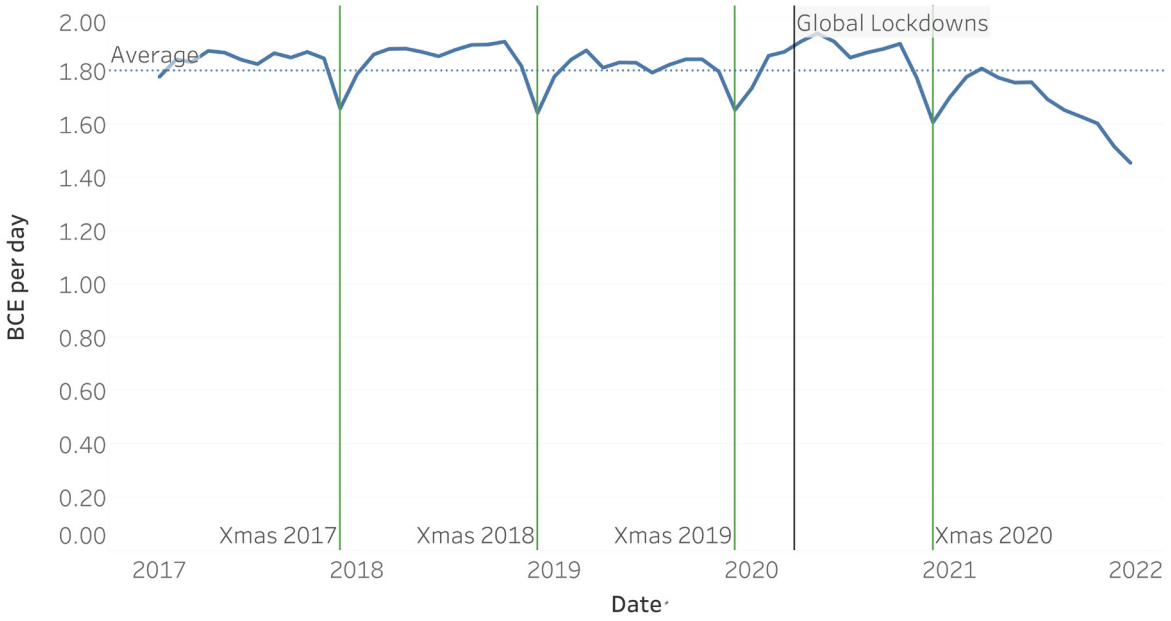


Figure 5: The impacts on the USA

The answer, according to our measurements of over 300,000 developers from over 50 enterprises, was that 80% have experienced a decrease in productivity in the second half of 2021. Whereas, 20% managed to increase productivity in the same period.

If we calculate the same proportion of enterprises who increased their productivity but for 2020 and 2019, we see that it is normally 52%. This means that in a typical year, about 50% of enterprises will have improved their productivity compared to the previous year.

Overall, the average change in productivity for an enterprise during the second half of 2021 compared to the baseline was -7%.

Team-level

We found that 65% of teams decreased in productivity, whereas 35% saw an increase in productivity for the second half of 2021 compared to the baseline. In previous years, we have seen around 50% of teams improving year-on-year.

It is worth noting that for this study the average team size was 20 active developers per year.

Individual-level

On an individual level, 60% of developers decreased in their productivity for the second half of 2021 compared to their own personal baseline levels from previous years. In previous years, we have seen around 50% of developers improving year-on-year.

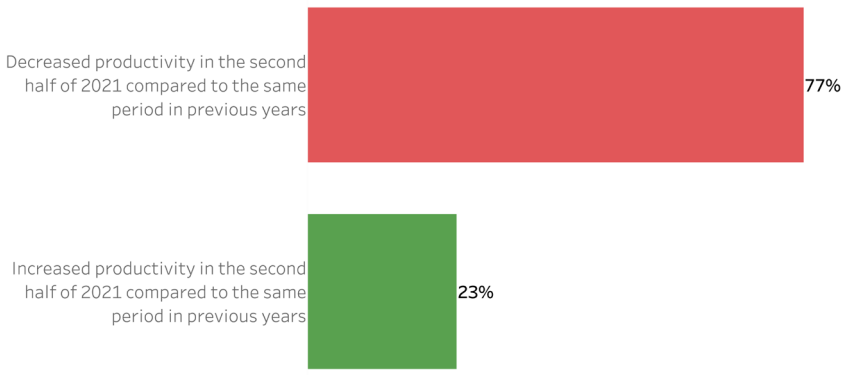


Figure 6: Percentage of enterprises in the BlueOptima universe

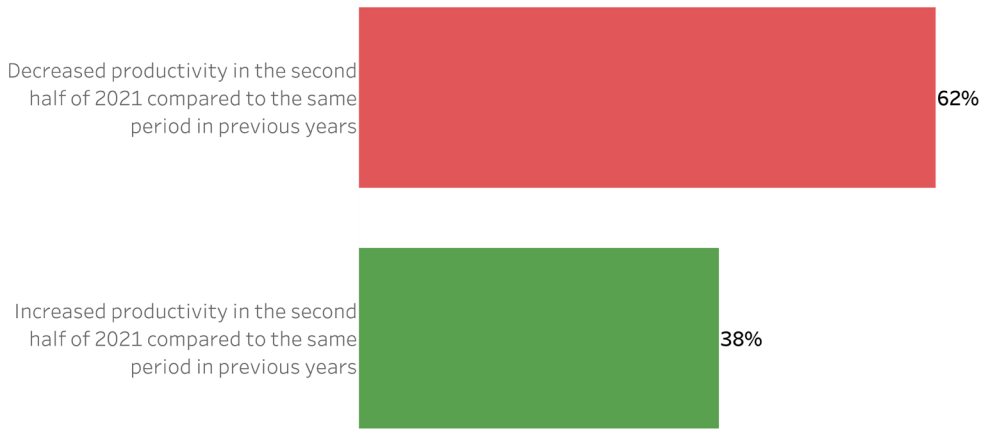


Figure 7: Percentage of software developers in the BlueOptima universe

3.2 Explanatory factors for decreasing productivity in the second half of 2021

Country-level

The changes in productivity could be explained by factors at the country level, such as nationwide lockdowns or workplace closures.

The University of Oxford has developed a Stringency Index, which records the strictness of closure and containment policies which reduce contacts between people.

One interesting finding within the data was that productivity was strongly (and negatively) correlated with the stringency index in India, United States, and United Kingdom. Meaning that generally, the more strict lockdown measures were, the higher the developer productivity.

Although we cannot necessarily draw a causal inference in regard to lower productivity in the second half of 2021, and say that it was caused by lockdown measures being lifted, there is a correlation between the productivity and the strictness of lockdowns. Reach out to us if you would like to hear about work with BlueOptima's data soon to be published by researchers at Harvard and NYU that explore this in more detail.

Enterprise-level

Enterprise-level factors could also have affected the change in productivity for the second half of 2021. BlueOptima estimates that 77% of all major enterprises saw a decrease in productivity for the second half of 2021 compared to baseline levels. However, this means that in actual fact 23% saw an increase. The difference between these two groups could be key to understanding the declining trend in productivity.

Some enterprises were affected by "The Great Resignation", which saw heightened levels of developer churn for the second half of 2021. (Stay tuned for the next report to understand the full extent of the 'Great Resignation' in the software development community.).

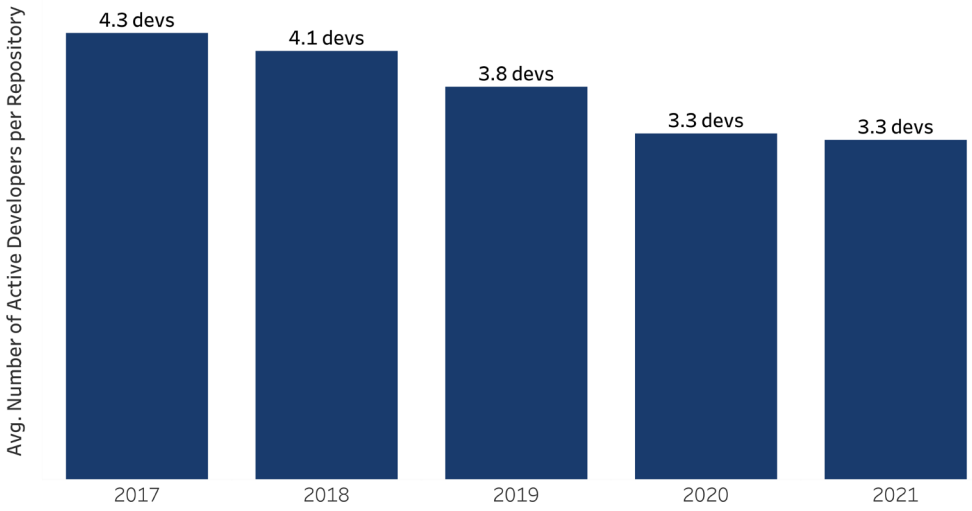
Team-level

Team level dynamics could also be impacting developer productivity. Collaboration between team members could be affected by working conditions in the pandemic, and according to our measurements, it has likely been affected negatively.

The average number of software developers who are actively committing code on the same code repository has fallen by 19% in 2020 and 2021 as compared to previous years. Since the pandemic started, the average repository has 3 developers working on it concurrently each year, whereas the average number of active developers per repository was around 4 in pre-pandemic years.

Individual level

Individuals could be struggling to adapt to a return-to-office in 2021, which re-introduces challenges such as having the time to commute to the office taken out of your day. This could also explain the declining levels of productivity in 2021.



4. Summary

Overall from our study, we found that:

- The productivity of the developer population increased temporarily in the first two months following global lockdowns (+7% in April and +4% in May 2020).
- Otherwise the remainder of productivity in 2020 was in-line with the previous years.
- Whereas in 2021, in particular the second half of the year, we saw a major and unprecedented decline in productivity (-4% in the first half of 2021 and -10% in the second half).
- What can we expect in the future? Take a look at some of our other reports on the BlueOptima.com website to find out more.

5. Who is BlueOptima?

We provide a SaaS technology that objectively measures software development efficiency. Our core metrics for productivity and code maintainability allow executives to make data driven decisions related to talent optimization, vendor management, location strategy and more.

6. Contact the Data Science Team

Interested in finding out if your team is suffering from the global decrease in productivity of 2021, or if you've managed to buck the trend? To discover powerful insights and determine areas of improvement specific to your organisation, reach out to our Data Science team and explore our custom analytics solutions.

Contact us

p +44 207 100 8740
e enquiries@blueoptima.com
w www.blueoptima.com