Open:UK

State of Open: The UK in 2022

Phase One: The Open Source Journey

7 July 2022

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1.1 Foreward - Thought Leadership
Sarah Murphy, MS, Welsh Parliament

Today's world of work, leisure, and communications is changing irrevocably through the rapid adoption of digital technology. These technologies present huge opportunities to reduce costs and duplication of effort for our society; to harness the power of the global community to support and benefit local projects and communities; to assemble huge numbers of people across the planet for causes that ignite positive change.

However, technologies have, and continue to threaten our society through exploitation and mismanagement of our data. As citizens, we put huge faith in public bodies or private companies to regulate and perform in the interests of the people and communities they serve. In many cases this faith is misplaced. Our data is indeed harvested and sold to third parties on a mass scale; we are profiled; decisions are made about us, opinions are formed, often without the knowledge and understanding that this is happening to us.

Open Source Software has all of the advantages of proprietary software but without the objective of increasing shareholder value. There are no oligarchs, no dark money, no licence fees. Just open code to explore, understand, and contribute to technological innovation.

Wales is a post-industrial country working hard to adapt to a new paradigm. As a nation, this presents great opportunities for us to lead in promoting and investing in Open Source Software. We cannot afford to ignore the huge potential of Open Source Software to support education, industry and community empowerment, and the benefits that it can bring to Wales and our people.

The OpenUK report is an opportunity for Wales to encapsulate this. I look forward to increasing the profile and the value of Open Source Software within every educational establishment, workplace, and home.

We must be aware that in an increasingly international and competitive digital economy, we can afford nothing less. It is not an exaggeration to say that many of us using proprietary software and social media platforms are unaware of what we sign up to, we must do what we can to shift to systems that are in our best interests as a society.

1.2 Introduction - Thought Leadership
Amanda Brock, CEO, OpenUK

"Wee, sleekit, cowrin, timerous beastie"[3] what are you doing on the front of the OpenUK State of Open 2022 Report? This wee mouse has been recorded for the **BBC's Springwatch TV programme using Open Source Software** (as have the starlings on the back) and you can read more about that usage in one of two case studies included in this report from the BBC. The second looks at an open standard combating fake news by authenticating the source of news.

The case studies draw out the Open Source Software journey and maturation across a wide range of UK businesses showing the practical impact that Open Source Software has on all of our day to day lives here in the UK. From TV and media consumption, to our finances, travel plans and fashion choices, even our energy suppliers, **in a digitalised world the use of Open Source Software underlies our daily activities**. This is not only true of enterprise but also in the public sector and we include case studies from this too.

Building on the "State of Open"2021, like the cameras in Springwatch, we **observe the passage of time** by following the journey to **Open Source Software maturity**, along the road from **consumption, to contribution and distribution of products and services based on Open Source Software**. We give consideration to the duration at each stage and how that impacts behaviours, note that **some consume and distribute but do not contribute**, and of course, the **maintainers**.

We have **not split the report by literature review, case studies and survey but instead by the phases of the journey, mixing these to tell the story of that lifecycle**. The **2022 survey results cross referenced against the stages** allow us to better understand and show the behaviours at these and to consider **benefits and challenges**.

When computer coding began decades ago, developers naturally shared code and collaborated. Only on the application of copyright law to code did proprietary software come into existence setting companies on the journey of licence revenue generation based on code carefully hidden, and secretly managed behind closed doors. A twist of fate.

I often wonder how our digital infrastructure would have evolved without that having happened. Would society, with the benefit of decades of collaborative innovation - without this artificial copyright barrier - have benefited from a faster pace of innovation? Perhaps we would have seen greater and earlier advancements in the state of technology and our digital infrastructure? I certainly imagine a world where there would be more digital equity and undoubtedly we would consider software forming this infrastructure as a digital public good.

As we see our public infrastructure shift today to digital public infrastructure, and these systems becoming equally if not more important than our physical infrastructure, our digital world is seen to be software defined and that infrastructure is critical. Whatever the imaginary might have been (hindsight is a great thing) today's reality is a **digital world shifted to Open Source Software forming a digital public good**.

Open Source Software is an inevitability in this picture. The UK's state requirements like that of an **Open Source Spine for the energy sector**, requested by the the **Energy Digitalisation Task Force Report** published in January 2022[4] are unsurprising and drive our digitalisation in the most appropriate direction. Today's challenge is this journey and maturation in the behaviours necessary to create and maintain secure and reliable Open Source Software.

3 To a Mouse by Robert Burns
4 https://es.catapult.org.uk/report/delivering-a-digitalised-energy-system/

The **balance of power in Open Source's disruption of the proprietary world shifted** as a consequence of the **change in the process of organisational acquisition of IT**. Traditional and cumbersome **legal and procurement** routes for the selection of and contracting for IT are **bypassed**. Open Source Software being freely usable and acquired via **repositories like GitHub and Gitlab** has driven this. Pre-licensed freely available Open Source code negates the requirement for a budget or the need for a contract to allow software. Only once code is successfully embedded in an organisation does the IT team need to engage with legal, finance or procurement and even then only if it wishes to **purchase services to ensure appropriate curation of the Open Source such as experts contributing to maintenance, security and the other good hygiene of Open Source.**

Software choice and governance is not **manageable through contract negotiations today. Instead risk may only be managed by appropriate policies and procedures** and these good practices and governance collectively facilitate **risk management and good hygiene in Open Source**. If necessary skills are not available in-house, or even where some are, deep expertise may be contracted for. Perhaps from the organisation behind the Open Source Software product but increasingly multiple parties offer support for a single product and organisations offer support services for their competitors' products not just their own.

Open Source is more than the legal definition. The public sector's Open Source journey, as with the organisational journey to maturity, often sees Open Source expressed as a requirement to place code on a public repository with an Open Source Initiative approved licence. But it takes **much more than the sharing of code and application of a licence** - it takes an understanding of **contribution, collaboration and community** to create well maintained code that is secure.

In the UK public sector and enterprise, if innovation is not accompanied by good technical hygiene and governance then open sourcing becomes a **tick box bureaucratic exercise, unlikely to meet financial goals such as avoiding vendor lock-in or seeing code reused and recycled across organisations**.

Vendors with the right skill sets and experience are critical to enterprise infrastructure and public sector adoption. Money spent with inexperienced Open Source organisations or those unwilling to fully embrace this full picture of what Open Source is, may well result in Open Source Software that might as well be proprietary software and loses the benefits Open Source ought to deliver. **A shortage of skills is clear**.

In this report we drill down on the detail of the UK's journey with the survey outputs, literature review, case studies and thought leadership on the State of Open: The UK in 2022. **We see the UK truly "Doubling Down on Open Source"**, so much so that more is needed. This was to be a single report to follow up to our three phases in 2021. However, **the immediacy of the need for more information on trust, curation and ensuring the UK infrastructure is secure means we will share a phase 2 on curation in September and a phase 3 on Sustainability and our new Societal Value Metrics in November**.

OpenUK's report is again leading the world with ground breaking questions, research and approaches to the economic calculations for Open Source Software focused on investment. We will continue to push boundaries and evolve thinking in all of our research.

I am personally grateful to all who have contributed to this report and thank you formally on a personal and OpenUK level. We continue to be a diverse organisation with a diverse set of participants and creators. Another hard year has led to exhaustion, family issues and ill health and **the level of hard work and dedication to make this report happen despite all of this is why we are a community. Thank you.**

1.3 Survey - Analysis of General Data from "State of Open Survey, 2022"

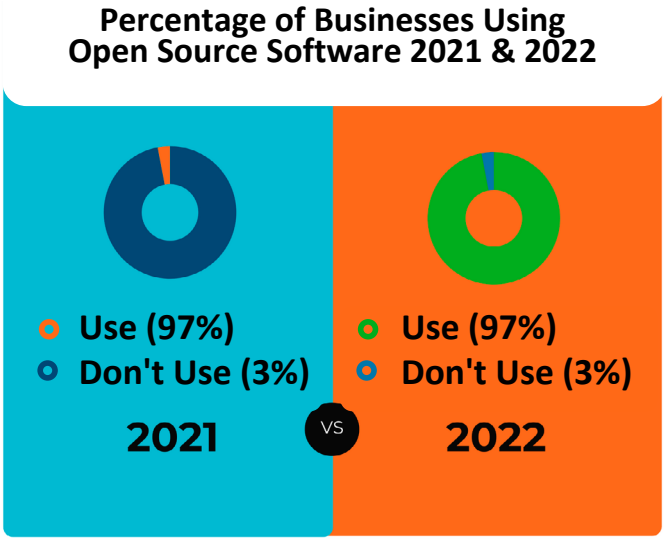
1.3.1 Response

This year's State of Open Survey received 243 responses of which 13% were not valid for the purposes of the survey. 9% of them are not UK-based while 4% of respondents do not use Open Source Software. Of the valid responses, a small minority (3%) did not answer the initial screening question specifying whether they consume, contribute, distribute products or services based on Open Source Software or maintenance. The remainder is the valid sample based on which we analysed the data and present the findings in this report.

This research shows that Open Source Software is widespread, but **interaction varies according to the capabilities of each organisation**. Different levels of **financial and human resources can affect how quickly and sustainably an organisation transitions and moves through the journey** from consumption of Open Source Software to contributing and distributing products and services based on it. Along the journey we see increasing awareness of responsible engagement including community engagement, good hygiene and governance and security and maintenance.

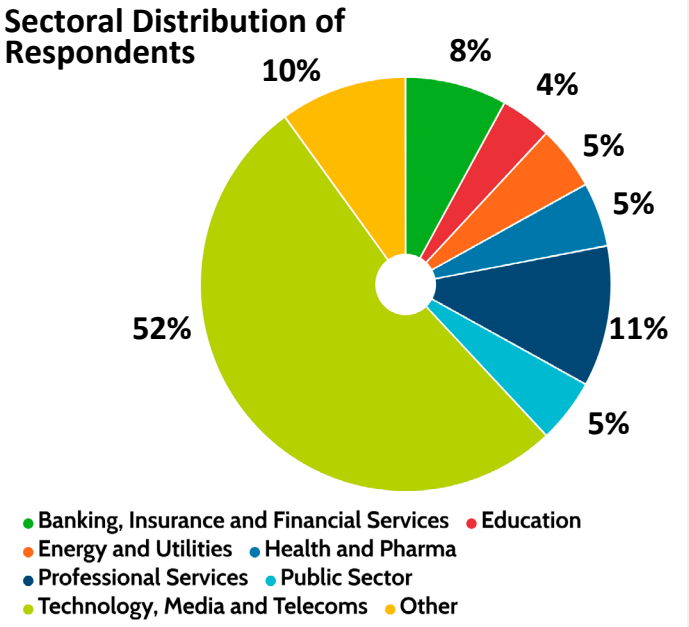
1.3.2 Survey Participants

Figure 01. Businesses Using Open Source Software



Source Q4 and State of Open Survey, 2021

Figure 02. The Sectoral Distribution



Source Q2

The percentage of businesses completing the survey and using ("consuming, contributing or distributing") **Open Source Software has remained consistent at 97%.** The sectoral composition of the sample largely resembles the sample collected in 2021, with dominance in the technology, media and telecommunications sectors (52%), unsurprising given the study's technical nature and objectives.

1.3.3 Software Consumption and Collaboration Repositories

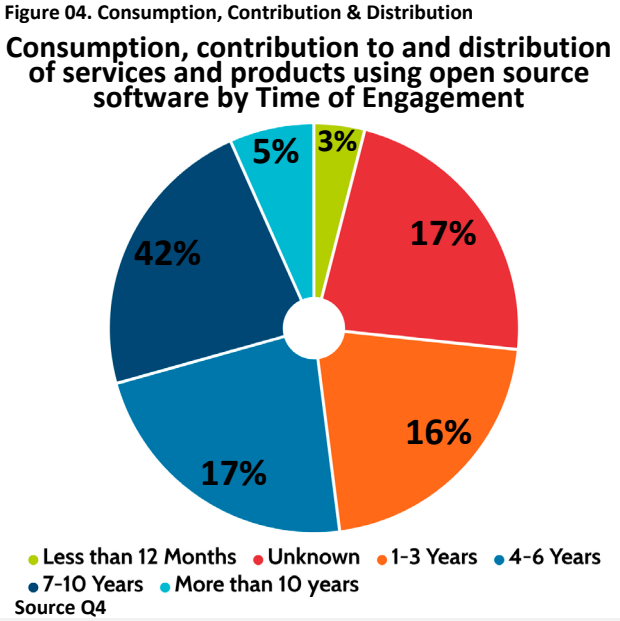
Looking to the types of software consumed we see **operating systems** are the most popular **followed by software tools**. This is followed closely by **Cloud Native technology**. The increase in the popularity of containers and Cloud Native technologies indicates a shift towards ever higher optimisation of resources, automation and speed of deployment. For many organisations, this enables the use of public cloud, allowing the running of workloads without the responsibilities and costs that come with operating servers.

1.3.4 Repositories

Sharing code, via repositories based on Git, while crucial for distributed collaboration, innovation and skill development, is also necessary for quality control. **77% of organisations involved in the distribution of their code as Open Source Software use Github.com**, followed by self-hosted Gitlab (12%) and Gitlab.com (11%). Azure DevOps and BitBucket are used by 3% while gitee.com is used by 2%.[3]

1.3.5 Duration of Consumption, Contribution and Distribution

Figure 04. Consumption, Contribution & Distribution



The survey is not time-agnostic. Acknowledging the cumulative effect of technological expertise, experience from collaborations, as well the dynamism of new entrants to the market, we have opted to include organisations that have been engaging with Open Source Software from a few months to more than a decade, to capture every aspect of their experience with Open Source Software.

19% of respondents have used open source software for three years or less; 34% have used open source software for 4 to 10 years and 42% for more than 10 years, **indicating a mature Open Source Software ecosystem in the UK.**

All organisations 3 years old or younger have been consuming Open Source Software during their entire existence; 74% of organisations operating for 4-6 years and 80% organisations operating for 7-10 years have been **consuming Open Source Software for as long as they have been in business**[4].

The pattern is different for more established organisations: 60% of organisations in business for 10 years or more have been consuming, contributing or distributing Open Source Software for more than 10 years, while 27% started in the last 3 years[5]. A possible explanation for this is that **established organisations are more likely to find themselves in long-term technological lock-in especially when they have legacy systems** that cannot be easily made redundant or replaced.

Some organisations have a very high level of technical sophistication due to long term engagement and investment, such as those that have been consuming Open Source Software for more than 10 years and consider their ability to not only develop but also to manage infrastructure as a competitive advantage.

"Open Source code was a core part of our strategy around how we built out the integrations into other products because it allowed our customers to connect their own systems where we didn't have an official plugin. As a start-up, we preferred to use Open Source Software, because it doesn't cost us anything in the beginning – we can prove our idea, contribute to it when we need to, and engage commercial services as we grow. Plus we have the ability to take control of the code."

David Mytton, Co-Founder, Console.dev

3 Q7
4 Calculated q3 BY Q4
5 Calculated q3 BY Q4

1.3.6 Challenges of Open Source Software

Figure 05. Benefits & Challenges

Source Q11 and Q12

Challenges

Challenges identified echo the persistence of issues outlined in OpenUK's earlier report, 'State of Open: The UK in 2021 Phase Three, The Values of Open'[6]. **Costs continue to be a stubborn problem**, especially as the UK economy emerges from the **shock of the COVID-19 pandemic, into a period of high inflation and tight market space.**

As such, it is no surprise that **cost saving in licence fees (62%)** is cited in our survey as one of the main benefits of Open Source Software, **along with collaboration (62%)** and **community contributions (62%)**. Other benefits include **access to innovation (58%), better quality of code (56%), agility (56%)** and the fact that some technologies they use are **only available as Open Source Software (56%).**

A recent report commissioned by **RedHat, 'The state of Enterprise Open Software 2022,'**[7] found that the top benefits of using Open Source Software are **better security, higher quality software, ability to safely leverage Open Source technologies, and the fact that they are designed to work in cloud or cloud-native technologies.**

Additionally, **Open Logic's report, 'The 2022 State of Open Source Report'**[8] **gives the following top benefits: access to innovations and latest technologies , no licence cost, overall cost reduction, the ability to modernise technology stack, the availability of many options for similar technologies, and constant releases and patches.**

Other reports on open source software highlight similar challenges.

6 State of Open: The UK in 2021 Phase Three The Values of Open (2021) openuk.uk/stateofopen
7 Redhat: The state of open enterprise software https://www.redhat.com/en/enterprise-open-source-report/2022
8 Open Logic, The 2022 State of Open Source Report https://www.openlogic.com/resources/2022-open-source-report

A global report commissioned by **Tidelift**, **'The 2022, Open Source Software Supply Chain Survey Report'**[9] shows that **security is the most common challenge** application development teams face when building with open source software, followed by **making good decisions about which components to use**, and then when to upgrade them. Tidelift's findings show that **every year** they have been conducting research, the top three **challenges named by respondents are related to maintenance, security, and licensing.**

In their earlier survey 'Tidelift's December 2021 Survey',[10] maintenance was the primary challenge, but this year—unsurprisingly—security took over the top spot.

The **'2022 Open Source Security and Risk Analysis Report'**[11] **published in the USA by Synopsys, Inc.** identifies the challenges reported by their respondents are concerns about the level of support, compatibility, about inherent security of code, **lack of internal skills to manage and support enterprise open source.**

Finally, the **OpenLogic 2022 State of the Open Source Report**[12] **by Perforce and the Open Source Initiative** reports that the top challenges for participants in their survey are **lack of internal skills to test, use and integrate, support and to scale efficiently.**[13]

A slightly **different picture** emerges in the 2022 OpenUK State of Open survey when looking at the challenges and benefits over **years of engagement with open source.** Those using open source software for **less than 3 years choose lack of licensing, governance and good practice knowledge as the biggest challenge.** Those using it for **more than 3 years choose issues relating to maintenance and security as the top challenge.**

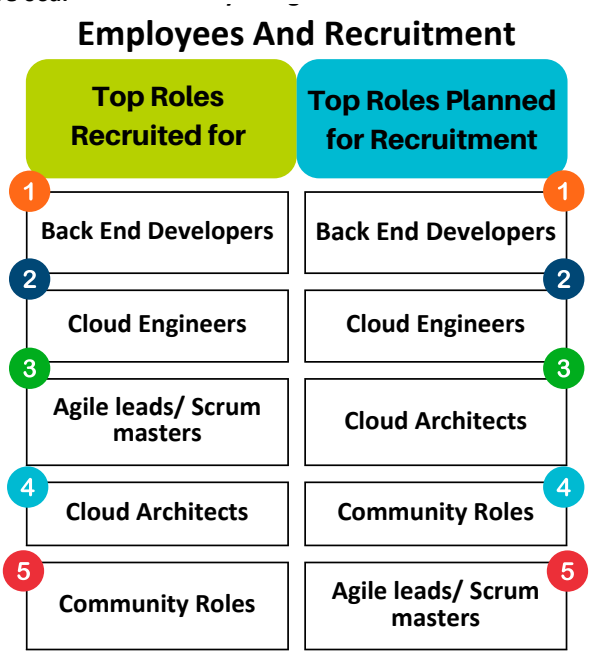
Benefits

In terms of **benefits, cost saving in licence fees is the main advantage for those with 3 years or less** of engagement and organisations with more than 10 years of engagement, whereas **community contributions matter for those with 4-6 years engagement**. Slightly older hands, with **7-10 years of experience in open source software put collaboration at the top of their list.**

1.3.7 Employees, Recruitment and Time Spent

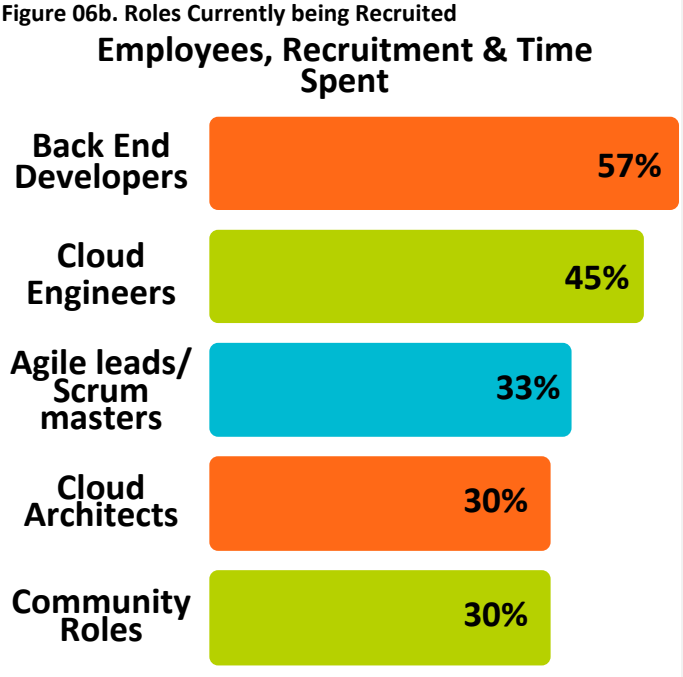
The Survey shows **organisations plan to recruit the following roles:**

Figure 06a. Roles most in demand



Source Q9

Figure 06b. Roles Currently being Recruited



Source Q9

9 TideLift: The 2022 Open Source Software Supply Chain Survey Report https://tidelift.com/2022-open-source-software-supply-chain-survey
10 TideLift: The 2021 Tidelift Open Source Maintainer Survey (2021) https://tidelift.com/subscription/the-tidelift-maintainer-survey
11 Synopsys: 2022 Open Source Security and Risk Analysis Report https://www.synopsys.com/content/dam/synopsys/sig-assets/reports/rep-ossra-2022.pdf
12 The Open Logic, The 2022 State of Open Source Report https://www.openlogic.com/resources/2022-open-source-report
13 The survey received a total of 2,660 responses (10.89% UK+Europe)

"For me the skills agenda is a horizontal conversation. We initially supported Gen Z and are now focused on Gen Alpha, between 8 and 29, because they are the future work force . There's a myriad of things we should be doing with them, but there should be a resonant conversation in our Open Source community every single day."

Dr. Jacqui Taylor, CEO & Founder, FlyingBinary Ltd

"I believe it's important that we contribute to open source and give back to communities in general – many of our staff collaborate a lot within the CNCF. We've also built a free Academy for the Kubernetes community. We've developed 60 videos on our website, completely free for learning, to give back to grass roots. For us, it's been a lot more than just saying we're contributing to Open Source Software, it was a decision as a company about what sort of company we want to be and developing open and transparent values."

Mark Boost, CEO, Civo.com

The recruitment patterns are complementary to and associate with the most used types of open source software and changes and developments in this. These require specific skill sets.

Filling the in-demand roles is not always easy. **Lack of coding skills or technical expertise** is one of the **top challenges** organisations engaging with Open Source Software face in the UK. This illustrates the need to develop the right skills to support Open Source Software responsibly and for **support from the government for this open source skills development.**

Community Roles feature in both the top roles recruited for and which are planned to be recruited for. This indicates an increased focus on the need for community and developer engagement, collaboration and participation. **DevRel (Developer Relations) has rapidly become one of the most fashionable areas of software, particularly Open Source Software development.**

"Some people get jobs by doing Open Source Software contributions. I know that for maintainers, they're an example of people actually doing Open Source Software and because you are a great contributor, then you may actually join the company. It's a good example of how contributing is the best way to actually to display your skills."

Xavier Delamotte, Tech Lead, Red Badger

"I have no idea what a standardised career progression through Open Source would look like. But community participation is something we look for. We find it's been helpful for us in terms of transferable skills."

Joseph Salisbury, VP Engineering, Giant Swarm

1.3.8 Time spent each week

This is a first estimate of the average number of hours per person every week organisations utilise for their engagement with Open Source Software each week. These vary significantly by organisation size.

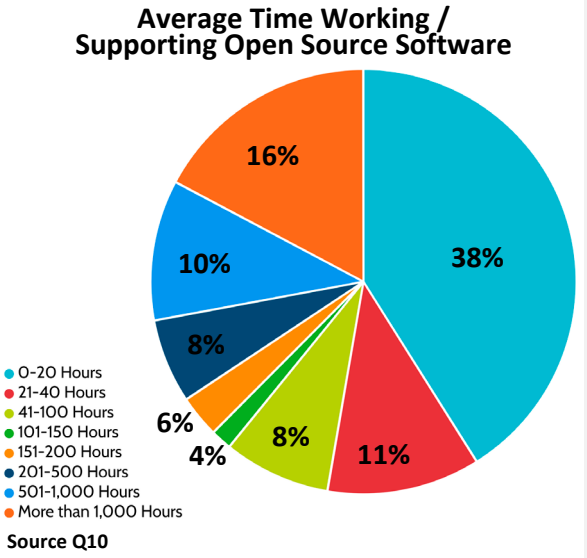
Figure 07a. Average weekly time working / supporting open source software

Average Time Working / Supporting Open Source Software by Organisation Size

Size	0-20 Hours	21-40 Hours	41-100 Hours	101-150 Hours	151-200 Hours	201-500 Hours	501-1,000 Hours	More than 1000 Hours
Up to 10 People	17%	3%	<3%	<3%	<3%	0%	0%	0%
11-49 People	5%	<3%	<3%	0%	0%	<3%	<3%	<3%
50-99 People	<3%	0%	0%	0%	0%	<3%	<3%	<3%
100-249 People	4%	0%	<3%	0%	<3%	0%	<3%	0%
250-499 People	<3%	0%	<3%	0%	0%	0%	0%	<3%
500-999 People	<3%	0%	0%	0%	0%	0%	<3%	<3%
1000 or More	4%	4%	<3%	<3%	<3%	<3%	4%	9%

Source Q10

Figure 07b. Average weekly time working / supporting open source software



Source Q10

1.3.9 Collaboration in open source software development

94% of organisations in our survey collaborate with other organisations, academia, non-profit organisations, or the broader community. In terms of the Open Source Software journey, there is a relationship between moving from consuming to consuming and contributing. As they **move from consumers to contributors and enter into collaborations, organisations tend to increase awareness of the open source community leading to enhanced networks, quality of code and skills.**

"You learn a lot when you contribute, because you have to interact with people from all around the world and you need to understand how things work in detail."

Xavier Delamotte, Tech Lead, Red Badger

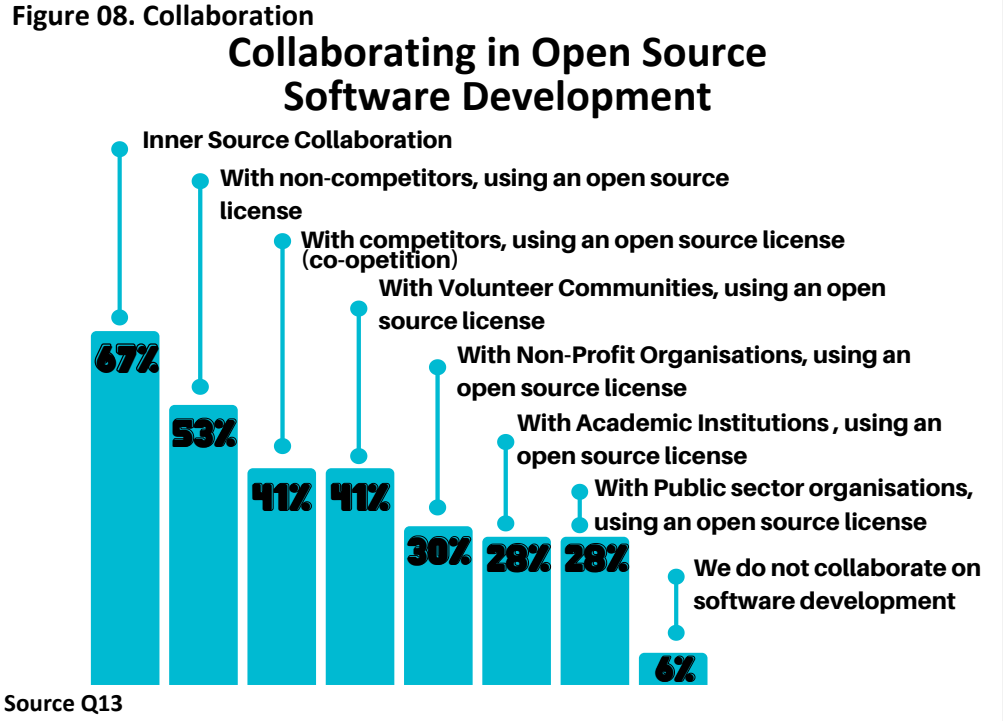
"People are realising that there are things that they work on that are non-strategic, non-differentiated things that they have, that it makes sense for them to work with other people on because if everyone will just be duplicating effort, if they do them independently."

Justin Cormack, CTO, Docker

There is a level of cooperation with competitor organisations (co-opetition) in UK Open Source Software that is **unusual in the marketplace,** with **41% participating in this co-opetition,** and competitor collaboration being the third most popular collaboration option.

74% of organisations that collaborate with others have policies and procedures for the consumption, contribution to and distribution of Open Source Software.

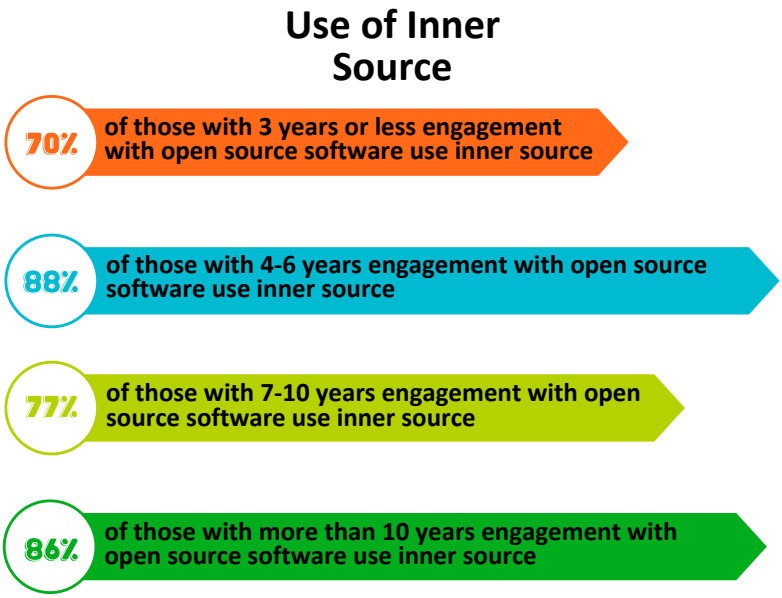
Figure 08. Collaboration



Source Q13

Some organisations on the journey to Open Source Software or which use it, utilise open source practices to collaborate within their organisation **"Inner Source"** in the following proportions:

Figure 09. Use of Inner Source



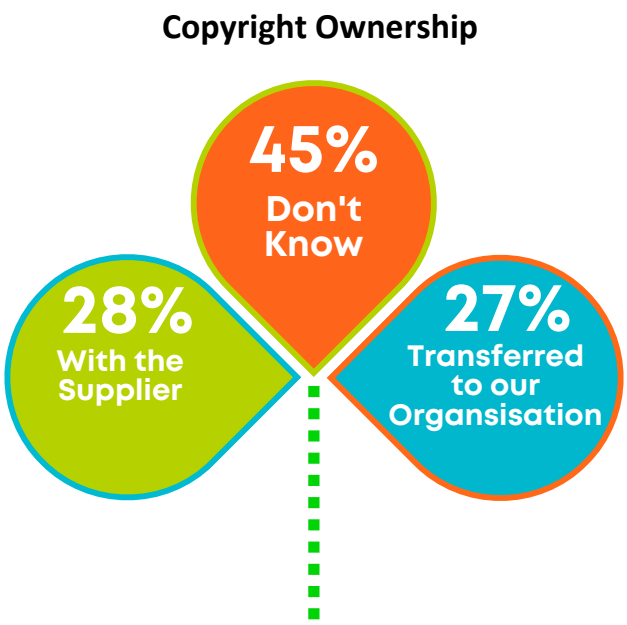
Source Q13

1.3.10 Intellectual Property

Copyright

Transferring ownership in copyright of open source software from the supplier or allowing them to keep it is almost equally split in the sample, with 28% of respondents saying it stays with the supplier, while 27% say it is transferred to their organisation.

Figure 10. Copyright Ownership

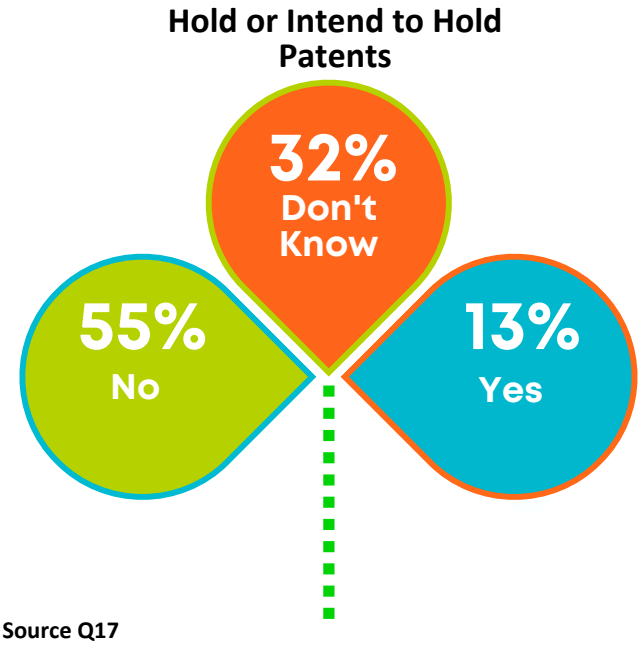


Source Q16

Patents

The majority of respondents (55%) do not currently hold or intend to hold patents in respect of Open Source Software.

Figure 11. Patents

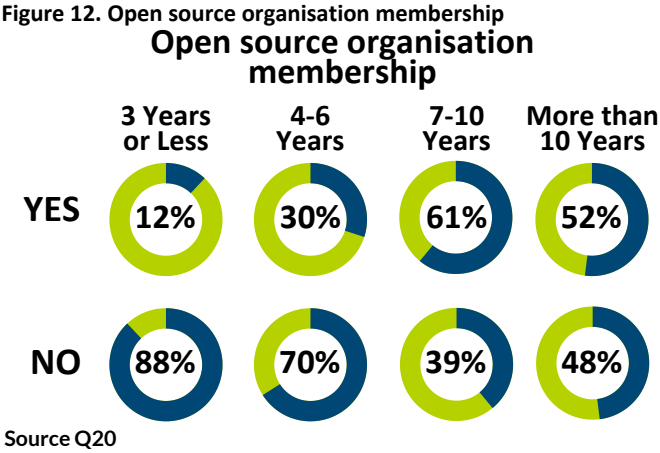


Source Q17

Participation in Open Source Software organisations

37% of respondents are members of an Open Source Software organisation for example Apache Foundation, Eclipse Foundation, Linux Foundation and the Open Source Initiative. This can be seen to increase with the duration of engagement with Open Source Software as part of the maturation model.

Figure 12. Open source organisation membership

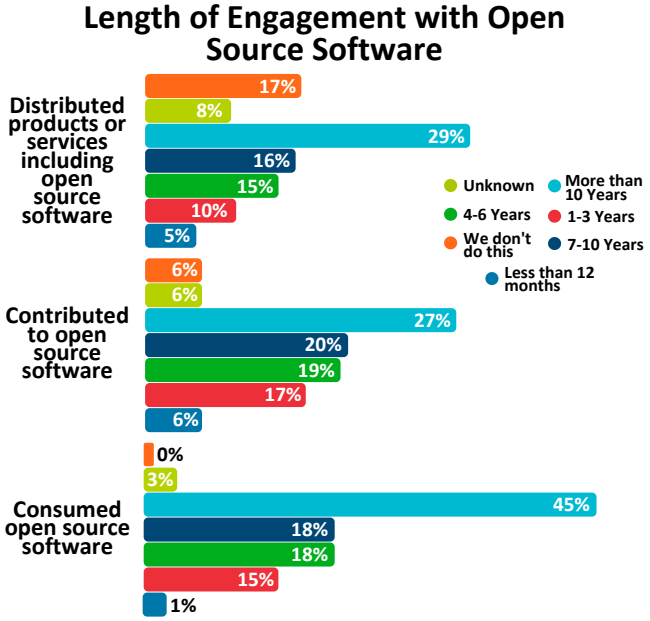


Source Q20

1.3.11 The Passage of Time and Maturity

The length of time that organisations have engaged with Open Source Software in each activity (consumption, contribution and distribution of products and services based on Open Source Software) shows an upward trend over time, as expected. Experience in Open Source Software can give businesses a competitive advantage, and the benefits they gain over time (in terms of collaboration and cost saving) can be significant. These can entice businesses to partake not just in consumption (which usually comes first) but contribution and distribution.

Figure 24. Activities and time



Source Q5

At 1.3.6 we saw benefits change with maturity of use from cost saving in licence fees at up to 3 years to community contributions at 4-6 years of engagement and to collaboration at over 7 years. As time of engagement passes so too the benefits change as do the challenges, but the persistence of maintenance costs and security - as is the case in all software not only Open Source - is prevalent over time.

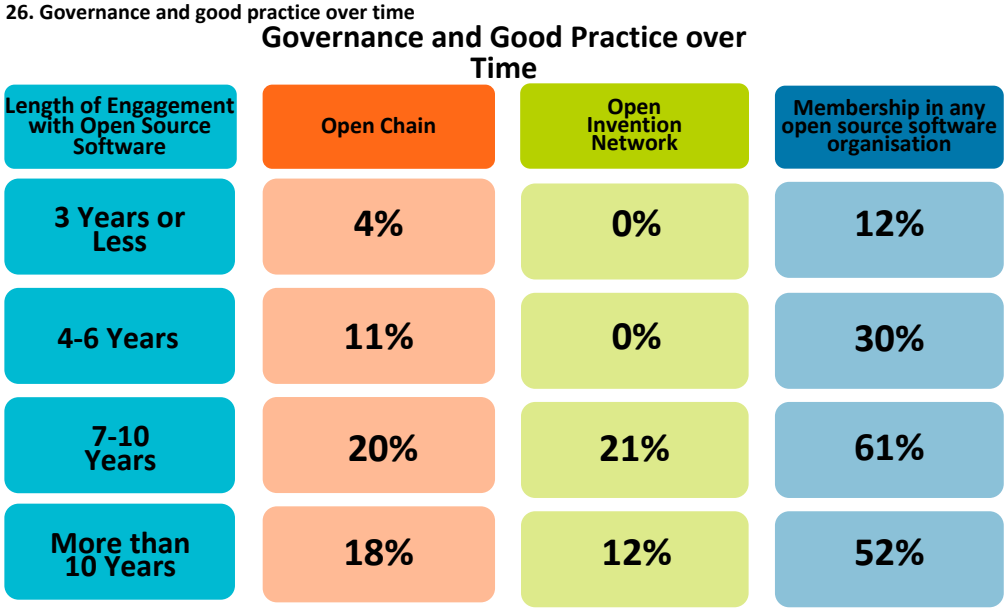
Figure 25. Top benefit and challenge by length of engagement

Length of Engagement with Open Source Software

Length of Engagement	Top Benefit	Top Challenge
Less than 12 Months	Cost saving in licence fees	Lack of licensing, governance and good practice knowledge
1-3 Years	Cost saving in licence fees & collaboration (same score)	Costs of maintenance and security
4-6 Years	Community collaboration	Maintenance concerns
7-10 Years	Collaboration	Costs of maintenance and security
More than 10 Years	Cost saving in licence fees	Costs of maintenance and security

Source Q11 & 12

Figure 26. Governance and good practice over time

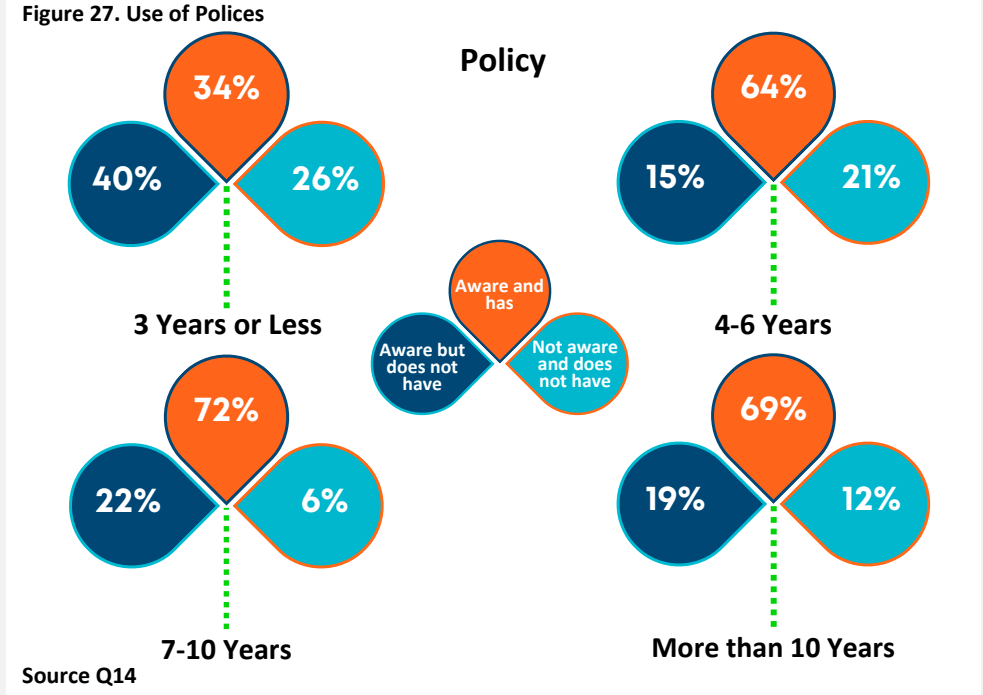


Source Q15,18 & 20

Disaggregating the duration of engagement with Open Source Software we see changes in the engagement with the good practices sometimes referred to as good hygiene and good governance in respect to Open Source Software. The Open Source Software communities have been working on these good practices for a decade plus and we see a sweet spot of those who have engaged in the last 7-10 years demonstrating the greatest maturity. Those earlier stage users are on the journey to this with steady increases.

As is pointed out in the introduction the change in the route to bringing Open Source Software into organisations caused by developers' direct access to **code without contract** necessitates a change in the approach to **organisational risk management moving this from contract to policy and procedures. The progression follows the same natural pattern as with other good governance practices, but again those using for 10 years plus are not as engaged in these.**

Figure 27. Use of Polices



Source Q14

1.4 Economic update

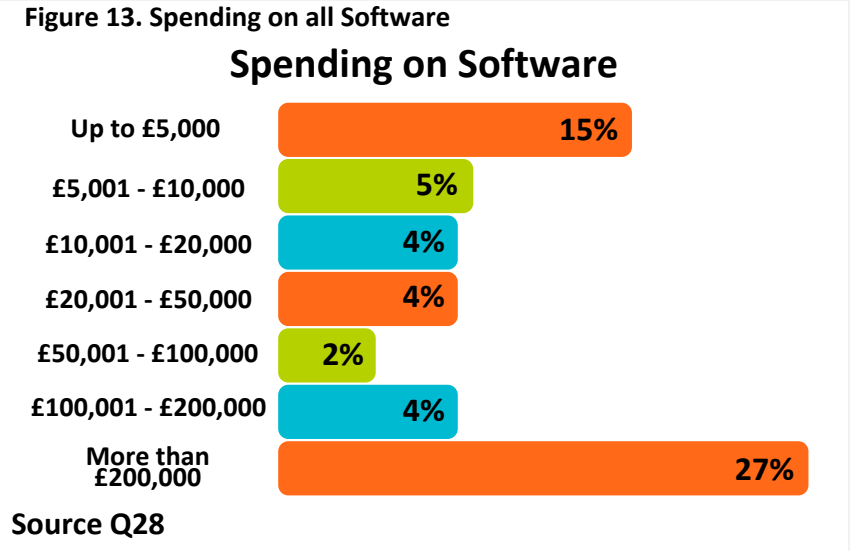
1.4.1 Comparison with 2021

Our findings show that in 2022, compared to 2021, 11% of organisations using Open Source Software increased their revenue during the pandemic, **revenue was not affected for 87% of organisations, while 2% had a revenue decrease**[14]**.**This indicates the **resilience of the sector despite the impact of COVID-19 on the economy** in 2021. Revenue is the lifeline of businesses, as it is the main way of increasing available resources. This should be considered with the biggest challenge organisations reported that they face, namely dealing with costs of maintenance and security, while also citing as the biggest benefit cost saving in licence fees.

Additionally, we find that the average **revenue growth for the organisations in the survey was 4% up from 2021, higher than the forecast 3% increase in revenues in the IT sector as a whole for 2021**[15]**.**

As in the 2021 OpenUK survey, this question had a low response rate, with 69% of respondents providing information, while the rest chose not to disclose information on their organisation's revenue for 2021 and 2022. About a **quarter (24%) of respondents spent less than £20,000 on software last year, as opposed to 27% that spent at least 10 times more**[16]**.** The behaviour of the former, when seen next to the cost concerns that respondents put on top of their challenges' list, is indicative of the difficulties faced by organisations when it comes to financing technological solutions.

Figure 13. Spending on all Software



From this expenditure, **33% of respondents reported that none goes towards Open Source Software activities, 24% of respondents spend 10% or less of these amounts on it**[17]**.**

Organisations that have been working with Open Source Software for longer tend to be more capital intensive in software development (higher spending for each hour of work excluding the cost of wages), which implies that in general they provide better resources towards this. We see an **increase over time: 24% of organisations that have been working with Open Source Software for at least 10 years invest more than £500 for each hour of work on Open Source Software, as opposed to those that have been doing so for 7-10 years (20%), 3-6 years (15%) and only 8% organisations that have been working with Open Source Software for 3 years of less.**[18]

This can have significant productivity effects, and implies access to newer technologies and equipment, which tend to be costly, as well as to different types of support services and subscriptions. Higher investment also allows for the quick replacement of technologies and equipment as it becomes obsolete, reducing security risks due to incompatible or legacy technology.

14 Source Q27 (a) and (b)
15 Source: own calculations based on Q27; data from Statista: https://www.statista.com/forecasts/961413/it-revenue-in-united-kingdom
16 Source Q28
17 Source Q29
18 Own calculations using Q28, Q10, Q4

1.4.2 New methodologies to value Open Source Software

11.9 million Open Source Software package downloads from the UK took place between 1 January 2022 and 15 June **(first 2 quarters of 2022 approximately)**, comprising pulls of Docker containers, npm packages, executables, and other raw file archives, based on first data from Scarf.[19]

This is the tip of the iceberg, as there is much more activity that is not yet fully captured. We are working with Scarf to make the iceberg visible as time goes by. The fact that much of this activity is not fully captured makes putting a monetary value to the work done in the Open Source Software space challenging to measure in a consistent way.

In 2021 OpenUK provided estimates about the possible value of Open Source Software in the UK for 2019, in the first of a series of landmark studies, using 2018 data from a study commissioned by the European Commission, estimates about the number of people working on/ with Open Source Software. Due to the lack of any comparable data, because the survey used in the European Commission has not been repeated and there is no reliable, updated information about the number of people working on Open Source Software in the UK, we are not able to provide an estimate following this method in the current report.

However, we have been able to make a new form of calculation using the amount of investment (in capital and labour) that goes in activities related to Open Source Software.

The total investment by enterprises in Open Source Software in the UK in 2021 was between £4.87 billion and £5.65 billion.

This level of investment is 29 to 34 times more than the UK government's spending (£164 million) on improvement of the UK's digital infrastructure as part of the levelling up agenda.[20]

The comparison shows the **enormous transformative potential Open Source Software has for the UK economy**, and if sustained, it **could lead to world-class innovation**. To increase the impact of this level of investment it is **crucial for enterprises to collaborate with the government and education providers to address the skills gap in the UK.**

In terms of the methodology, **using data collected in the survey** undertaken for the purposes of this report we are able to **estimate the time spent on Open Source Software (for the labour input) by organisation size and the amount of investment by organisations (for the capital input). This method is consistent with the way software investment flows are measured internationally,** and can be replicated without reliance on external, possibly commercially sensitive, or inaccessible data.

19 https://about.scarf.sh/, and https://www.gov.uk/government/news/levelling-up-push-sees-more-than-5000-public-buildings-plugged-into-high-speed-broadband
20 Own calculations using Q4, Q10, Q28, Q29, and https://www.gov.uk/government/news/levelling-up-push-sees-more-than-5000-public-buildings-plugged-into-high-speed-broadband

The caveat is that our survey drew responses **heavily from professionals in the technology sector, possibly underestimating investment in Open Source Software by other sectors** for which we have no data.

It is the first time an attempt has been made to estimate the total investment in Open Source Software in the UK, and over time as better quality data becomes available **we will be able to provide more accurate estimates to inform discussions on Open Source Software business strategy and showcase how much it is worth.**

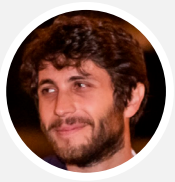
"In my view, what we are moving to is a profit for purpose model. We've been on a journey. If you look at that journey, it's been an evolution, fundamentally everybody needs to be paid for what they do, we're all worthy of payment for what we do, particularly when, in our open world, we contribute such value. People should be able to build careers on what they do in open, and that hasn't always been possible because it has been a volunteer approach. If you're going to consume, you have to contribute, but not with a for profit model, not with a for purpose model, with the combination, this is the business model our Open Source community needs to adopt. A rising tide raises all ships, we all benefit if we position it correctly. That's why it's so important to have a variety of ways in which we explain it. We should be moving on from either a for purpose, or a for profit business model, we need to combine the two."

Dr. Jacqui Taylor, CEO & Founder, FlyingBinary Ltd

"In the past it was an unusual situation to be paid a large amount of money to continue developing Open Source, but that's started to change in the last five years, as companies have been built on top of Open Source Software. Understanding what the business model behind those companies are important when you're adopting an Open Source product because that will determine the lifecycle and the roadmap. It's a good idea to be mindful of that, when picking products."

David Mytton, Co-Founder, Console.dev

1.5 How Much Value Does Open Source Provide, Exactly? - Thought Leadership Avi Press, Founder and CEO, Scarf



Quantifying the value of any public good is a classically difficult problem. Attempts to model and estimate the value of any given public good are prone to various difficulties, from woefully incomplete information to psychological biases of buying versus selling.[21] For more traditional goods, a better approach is typically to watch what the market does - if a good or service has an efficient market with well-aligned incentives, the good should be priced fairly, and your analysis is straightforward. Open-source software does not have one of those markets, but understanding the value supplied by digital public goods and in particular Open Source Software is of utmost importance for its continued success.

Without such a market in place, we must turn to models and estimation. Unfortunately, we collectively have inadequate information to even compute the majority of the value that Open Source Software delivers. If we had an omniscient catalogue of every piece of (Open Source and proprietary) software ever written, with every individual instance where that piece of software was used, the value created by that individual usage, and the percentage of that value that came from leveraging open-source software dependencies, then it would just be arithmetic!

A property of Open Source Software that can be helpful here is that its value is primarily realised and captured in other markets. From cars to healthcare to productivity software, goods and services in virtually every market are being built on top of Open Source Software. This implies that if we have data on the goods in other markets, and how the companies on the supply side of those markets use Open Source Software, we have another reasonable proxy to estimate the value we're after.

This data is actually attainable! Static code analysis on platforms like GitHub and package distribution analytics from platforms like Scarf have given Open Source Software projects a clearer understanding of which companies, organisations, and even governments are using their work. Distribution analytics can play a particularly important role here, as a large portion of open-source usage is for proprietary, internal, or operational purposes, which are missed by public code analysis.

Of course, even a perfect understanding of which organisations use which pieces of Open Source Software is not enough on its own. When tens of thousands of software components combine in complex ways to power an organisation's operations and products, assigning value to an individual piece or the entire set is a challenge on its own. However, it greatly reduces the scope of the problem and results in a more tractable system to model.

Estimating the value provided by Open Source Software remains an open and difficult task. However, we have a good reason to be optimistic in our efforts to reasonably do so – as we continue to improve our visibility into how Open Source is being used around the globe, we get closer to a clear answer.

21 Brookshire, David S., and Don L. Coursey. "Measuring the Value of a Public Good: An Empirical Comparison of Elicitation Procedures." The American Economic Review, vol. 77, no. 4, 1987, pp. 554–66. JSTOR, http://www.jstor.org/stable/1814530. Accessed 27 Jun. 2022

1.6 The Value of Open Source In 2022 - Thought Leadership
Bruce Perens, one of the founders, Open Source Software Movement

17 years ago, I explained the economics of Open Source Software.[22] The fundamental economic mechanisms of Open Source still work in 2022. In 2005, most software development and acquisition in business was not business-differentiating software, the software that would make your business look better than a competitor in the eyes of the customer.

"Perhaps 90% of the software in any business is non-differentiating. Much of it is referred to as infrastructure, the base upon which [business] differentiating technology is built. In the category of infrastructure are such things [as] operating systems, web servers, databases, Java application servers and other middle-ware, graphical user interface desktops, and the general tools used on GUI desktops such as web browsers, email clients, spreadsheets, word processing, and presentation applications. Any software that provides differentiating value to a non-software company is built on top of one or more of those infrastructure components."

… and I suggested that companies should take the 90% of software development and acquisition money that they spent on non-differentiators, and instead spend all of it on developing their business differentiators, and get the rest of the software that they need from the Open Source Software developer community.

That's happened.

Of course, Open Source Software has a cost in compliance, maintenance, and integration. But to a great extent, businesses have shifted their software development budget much more strongly toward developing business differentiators, and they either pick existing Open Source Software for everything else, or they share in the development of Open Source Software, and distribute the cost and risk of development and maintenance of non-differentiating software among many companies rather than doing it all themselves.

There have been several big economic changes within business software development:

> There has been tremendous increases in efficiency of business use of software development and acquisition funds. Since the advent of the Open Source movement, something like half of the total software budget in businesses has moved from things that the customer doesn't see or care about to things that directly influence that customer. Open Source Software provides the rest.
>
> Very many companies, institutions, and individuals now participate in a work exchange around Open Source Software, in which they contribute to software development when they need new features or to fix bugs and reap the benefit of the work of very many other people who are doing the same. Everybody gets great Open Source Software, nobody has to do too much of the work.
>
> Open Source Software truly has become a digital public good. Like the highways, or law enforcement, but rather than being supported by taxes and carried out by government it is carried out directly by the public (and a lot more efficiently).

But while there has been a tremendous improvement in the effectiveness of the businesses software budget, and Open Source Software is obviously providing tremendous value to business, almost none of those formerly-inefficiently-directed software funds have been captured by the Open Source developers themselves.

Thus we have classical tragedies of the commons: the communications security of every web and internet connection in the world, perhaps a Trillion dollars of business, depended on the work of a guy named Ben, who wasn't being paid by anyone. That got fixed, but similar problems exist across the Open Source Software world. And as business becomes more dependent on Open Source Software, its security becomes a matter of worldwide economic security.

22 The Emerging Economic Paradigm of Open Source https://firstmonday.org/ojs/index.php/fm/article/view/1470/1385

I try to evangelise companies to get to know what software they use, and to work directly with those projects, as a way to resolve the issue. I ask them to look askance at the companies and organisations that get between them and the Open Source Software developers and syphon off the revenue that should go to them. Get that money directly into the hands of the developers!

Others suggest that governments should be more involved, which frankly scares me. The Internet and Open Source Software owes much of the effectiveness of its development to the fact that no one entity was in control, and thus decisions were made for purely engineering reasons rather than one company holding its own interest over that of others. Heavy-handed governance could act to dissuade the Open Source Software community, rather than assist it.

Whatever happens, it means that people like myself, and OpenUK, should be spending a lot more time with corporate boards, business and innovation organisations; with legislators and others in government – if the Open Source Software developers are to be represented.

We are in for interesting times.

Part Two: Consumption

2.1 Survey - Consumption Data

99% of respondents replied that their organisation consumes Open Source Software. Consumers of Open Source Software vary in size and years of experience with Open Source Software.

Microstudy:
3% in our sample consumed only and did not also contribute to and/or distribute Open Source Software. This number is too small for rigorous data analysis and results should be interpreted with caution. However, what is prevalent is a very limited engagement with good practices:

Figure 14. Governance and Hygiene

Source Qs14-21& Q25

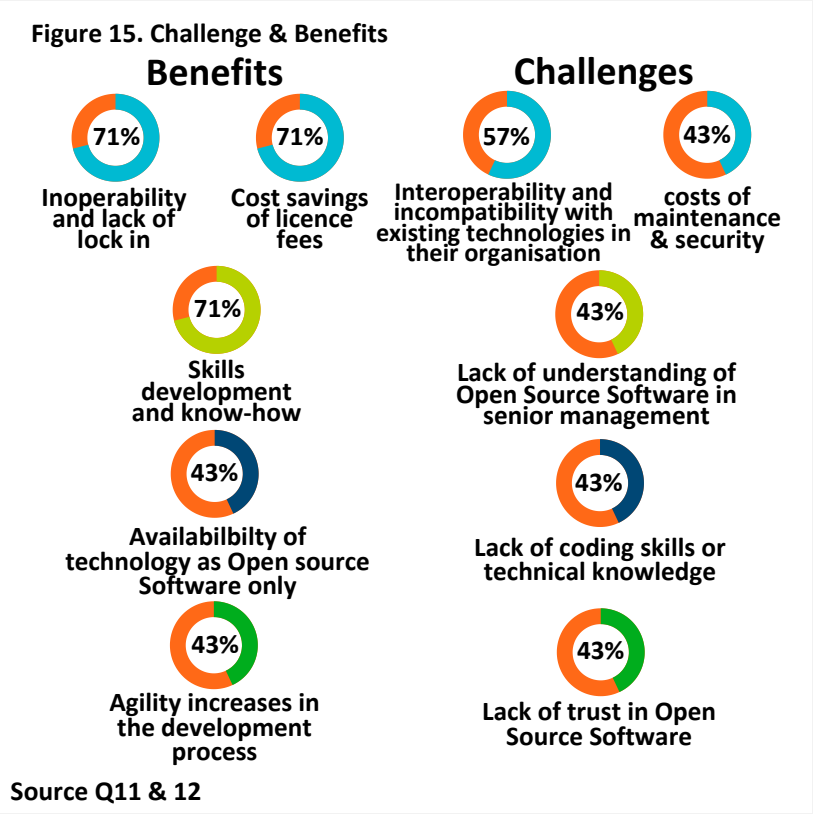
"If you're going to consume Open Source Software, you have to contribute, but not with a for profit model, not with a for purpose model, with a combination of these. That then is a community. Rising tides, raises all ships, we all benefit. It's important to have a variety of ways in which we explain it. It should be moving on from a for purpose, or for profit business model, we need to combine the two"

Dr. Jacqui Taylor, CEO & Founder, FlyingBinary Ltd

2.2 Challenge and Benefits

The microstudy sample shows less focus on the challenge of security and maintenance (costs and also just providing security) ranks the challenges and benefits as follows:

Figure15. Benefits and Challenges of Consumption



Notably whilst the priorities of the benefits are also observed in the total sample and are not dissimilar to the total sample, the **challenges are similar to those in the total sample, with the exception of lack of trust in Open Source Software, which does not feature prominently in the total sample.**

"We prefer to use Open Source as a small business, because it doesn't cost us anything. This is ideal at the beginning of a project because it allows for experimentation with no financial risk. We can contribute to it when we need to. And we have the ability to take control of the code, or at least keep a copy of it in the case that the project closes down or goes in a direction that we didn't want."

David Mytton, Co-Founder, Console.dev

"With LCN, the first company I founded, we were more of a consumer of Open Source Software. As a smaller company growing with no external funding, as much as we had the ambitions to give back to open source at the time, it was tough to do so as we were trying to make ends meet, as especially in the early days we weren't making any money. We didn't have the staff or resources to allow us to give our developers time back to Open Source. With that said, there were a few smaller things we did contribute when time allowed."

Mark Boost, CEO, Civo.com

2.3 Case Study - Dumfries and Galloway Council
James Parker, Community Planning & Engagement Service
Michael von Euw, Head of Applications, Scottish Tech Army (STA)

Dumfries and Galloway Council, a local authority in southwest Scotland with 6,000 employees, is responsible for the delivery of all local authority services and information for residents and businesses totalling 150,000 people. They consume the open source software tool Odoo and have used this to develop uniform website templates for Community Councils.

As James explains most community councils still share information the old fashioned way, "currently, we've got 85 Community Councils and 85 different ways of getting the information out, that kind of inhibits information sharing and the sharing of good practice and knowledge." Most community councils would greatly benefit from a uniform system and template that unifies their practices. Dumfries and Galloway Council have taken the initiative to use open source software as an efficient and effective way to create a standard, uniform website and data capture across all 85 community councils.

Within the public sector, James sees community councils as "the fundamental purpose of a community council, is it's the closest level of local democracy and representation for the people. The more people can get involved, the more democratic it is, the more effective it is." They are a statutory consultee, representing the interest of their communities. Essentially, they could form a single point of contact to represent community related concerns. The core objectives are more societal as opposed to financial. This has led them to consume and leverage the benefits of open source software for their digital goals as it allows them to move at pace, innovate, and produce quality work with a volunteer workforce.

Leveraging Open Source Software for the public good

They collaborated with STA to consume open source software and develop a universal and consistent website template. The primary reason for using open source software is to ease the community council's financial burden and more importantly to be able to scale-up. They use the community version of Odoo as the backbone software for the template. It is a unique open source software tool that allows community developers to provide usability that scales across sites. As Michael notes , "That's the beauty of open source, we can tweak things and make it work slightly better. This allows us now to have one database for every council area with centralised access for us and the council, as well as a central document distribution for everybody."

It's been a trial and error process. Originally, they adopted a traditional methodology to build solutions, but soon learnt that having one solution replicated and adapted across the board avoided the need to start from scratch. Michael feels that it's been a learning curve for everybody and has allowed them to develop adequate and useful processes for robust solutions.

Societal value: community driven culture

The platform is built, managed and maintained by capable and experienced volunteers. Michael highlights that in the beginning it was a challenge to find the right knowledge base within the volunteer community, but now have a diverse group consisting of a scrum master, two graduates of cyber security, a researcher and multiple coders from various sectors. As they continue to iterate, they are building an internal knowledge base, and developing skills that assist volunteers with the to complete and maintain the project.

Shaping the future

Moving forward they would like to make the shift from consuming to contributing back to the Odoo community, which has helped them immensely in their journey. As they work to deploy the template across the multiple councils, they hope to create a future, where community councils can pass on information to individuals in a secure, digital and efficient way.

2.4 Case Study - The Scottish Government

Gyda Carmichael, Head of Data Programmes, The Scottish Government
Thomas Williamson, Technical lead, The Scottish Government

The Scottish Government is the devolved government for Scotland with a range of responsibilities including the wellbeing of its citizens. Based in the Scottish Government's Digital Directorate, the Data Division is the centre of excellence for data which works towards unlocking the power of data in Scotland focusing on security, transparency, inclusion, innovation, and sustainability. The Data Platforms team is responsible for the delivery, management, and support of platforms for analysts. They have been developing an Open Source Software platform, the Analytical Workbench

Analytical Workbench and COVID-19

The Analytical Workbench has been developed in partnership with the University of Edinburgh and the Scottish Public Sector Analytical Collaborative (known as the SPACe Programme) Launched around four years ago the SPACe Programme is made up of representatives from Scottish Government, Public Health Scotland, Registers of Scotland and National Records of Scotland. It includes in its aims, "creating a shared infrastructure to support analysts across the public sector."

The Analytical Workbench creates a desktop that sits on a high-powered supercomputer that analysts can view and control through their web browser. It provides an easy way to collaborate across organisations and gives analysts access to a wide range of data science tools. It offers both Linux and Windows VMs. Its permission-controlled virtual machines create a secure environment and enhance collaboration across teams. As Gyda says, "this allows them to collaborate across organisational boundaries, provide safe, secure, permission-controlled environments, and offers an easy way to work with colleagues. It provides easy access to Open Source Software and common analytical tools."

The task of producing COVID-19 stats was a strong use case for the Analytical Workbench as it allowed analysts to carry out some collaborative tasks for COVID-19 faster.

Changing the software landscape

Using Open Source Software tools came up against some challenges within the Scottish Government,. Getting new tools approved can be slow. Thomas explains that with the Workbench "what really helped was if someone met us and said we need access to an Open Source Software equivalent to SPSS Statistical Software, for example, we could identify a product and present it to them to assess its suitability at speed, quite rapidly. That wouldn't be the same without the Workbench. The speed with which people can have products available is one of the advantages the Workbench is bringing."

Creating a culture of support

Scaling analytics is a challenge most enterprises face today, due to the explosion of data in the digital age, so they invested in creating a small support team - help desk - to encourage consumption of the platform by providing new users with adequate guidance to help people transition.

2.5 GDS and our public sector - Thought Leadership
James Stewart, Partner, Public Digital

When we set up the Government Digital Service back in 2011 we knew that we were only going to be able to meet the expectations citizens had of digital services if our team was free to build them the way the very best digital services are built.

The best services come when diverse, skilled teams are given a clear mission (outcomes to meet) and the freedom to bring their collective creativity to bear on meeting the needs of users. From a technology point of view that means equipping and incentivising technologists to focus on the distinctive problems that need solving here–and to do so as part of the multi-disciplinary team–rather than reinventing the wheel or fighting against top down technology constraints.

In 2011, as today, that meant understanding all the opportunities available in the Open Source Software world. Not as a top-down effort (they don't scale to handle the Open Source Software ecosystem) but by trusting our teams to identify, test, evaluate and select the right tools. The challenge for the teams was always to pick tools that would let us focus as much as possible on meeting users' needs and as little as possible on anything else, but to do so sustainably.

That was vital to deliver our initial services (things like GOV.UK, ePetitions, Register to Vote, and so on) at the pace, scale and quality that we did, but also to effect some of the deeper changes that were necessary.

Prior to 2011 almost all development of online services for government was wholesale outsourced, usually with complex functional specifications and architectures designed before anyone had gotten anywhere near a real user. It was rare to see a working relationship that allowed for an evolving understanding of what was needed, much less genuine openness about how any given system worked.

Structures that assumed governance meetings and contractual documents as the only mode of communication made it hard for government to see whether it was getting value for money, much less whether there were ways to reuse work or make their software supply chain more resilient. And they made it hard for vendors to have open conversations about better ways of achieving the intended outcomes.

By creating a different environment for our new teams we were able to seed a different culture of decision making and demonstrate a different mode of collaboration. By joining that up with colleagues working on procurement reform we were able to create new opportunities for different types of partnerships across government and its supply chain. And by doing all of that openly, the UK government became seen as a first mover in a wave of open-by-default digital service teams around the world.

Many others have sought to follow suit, and Open Source Software has captured the imagination of the Digital Public Goods and Digital Public Infrastructure movements in the international development community. That's incredibly exciting, but one of our lessons is that to be successful in embracing Open Source Software you need to work on many fronts. That's why last year my company, Public Digital, published **"Open Source Software in government: creating the conditions for success**[23]**"** covering four areas that all need focus: the policy environment, in-house skills and capabilities, Open Source Software vendor ecosystem, and sustainability.

More than a decade on, it's assumed that teams will use Open Source Software in UK government and there's plenty of precedent for them also releasing their work under Open Source Software licences. But there's more work to be done: there are worrying signs of slips back toward the old outsourcing models, of new functional silos springing up, and less commitment to building communities of practice and open communication than there was a few years ago.

23 https://public.digital/2021/06/21/open-source-in-government-creating-the-conditions-for-success

To realise the real opportunities and to make Open Source Software work sustainable, government needs to commit anew to working in the open, to do more to provide ways for teams to spot opportunities and do things like invest in supporting Open Source Software projects they have used or they have created, and to continue to lead the way in multi-disciplinary working.

The opportunity Open Source Software presented us with in 2011 was enormous. It still is. Embracing internet-era ways of working–seen in their most pure form in the Open Source Software world–let us take £4.1bn out of government IT spend over three years, stimulate a new ecosystem of businesses and build new, award winning services.

That was just the tip of the iceberg of what's possible in the UK and globally.

"The UK Government did a lot of good early stuff on open source in government, and they were kind of pioneering in that. There's a lot of value in those kinds of software, but there's still a lot more to do in those areas. In terms of regulation, often it is the global things that matter, not the legal things. Standardisation and not being different is actually kind of useful from that point of view."

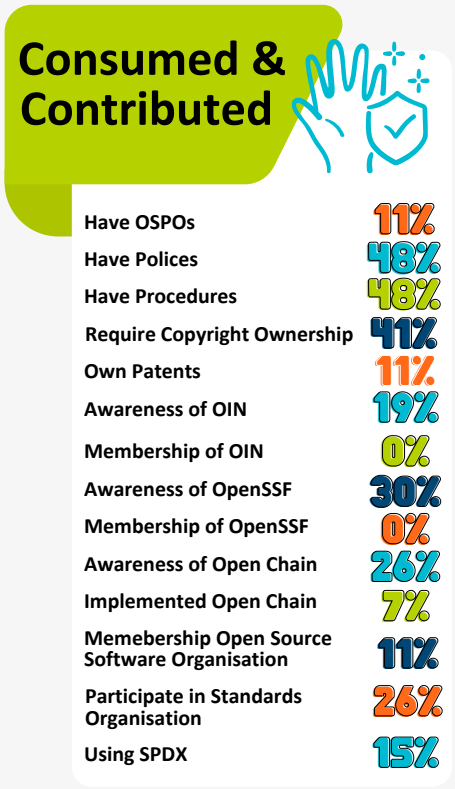
Justin Cormack, CTO, Docker

Part Three: Contribution

Contribution is essential to keep the agility of Open Source Software, and to meet the ever changing needs of a modern economy and society that is heavily digitally-dependent. Out of the valid answers in our survey, 13% consumed and contributed to, but did not distribute Open Source Software.

3.1 Contribution Data from Survey

Figure 16. Governance and Hygiene - Contribute



Source Qs14-21& Q25

"A lot of Open Source is actually about community and not just software, learning how other people do things, how to work collaboratively outside your organisation, which are very helpful byproducts. A lot of effective remote work culture came out of the Open Source Software community as well, because they started doing it long before anyone else. There's a lot of learning how to mature and to participate with other people and getting new ideas, new ways of doing things. faster adoption of new things, early innovation of new stuff happens through Open Source Software."

Justin Cormack, CTO, Docker

"In Civo today, we have a number of projects on GitHub that are Open Source and available to use. Some of those are quite specific to Civo, so you can only use them with CIVO. But we've decided to open source and in theory people can fork that code, and use for other projects.I think it's important that we contribute a lot - we contribute a lot within the CNCF, we built a Free Academy for the community, with 60 videos on our website, completely free for learning to give back to grass roots. It's been a lot more than just saying it's Open Source Software, it was a decision as a company about what's the sort of company we want to be.Compared to when I launched LCN, Civo has more funds so we have more freedom to choose where to spend our time and money, so we can give back more and become the company we want to be."

Mark Boost, CEO, Civo.com

3.2 Case Study - BBC Research and Development
Phil Tudor, Head of Applied Research for Infrastructure
Rob Cooper, Producer at BBC R&D

BBC Research and Development (BBC R&D) supports the digitalisation efforts of the BBC engineers who are at the forefront of broadcast technology. It has forged the way in the media sector, with innovative technology and collaborative ways of working. Based in Research Labs in the North and South of the UK, the department includes over 200 highly specialised research engineers, scientists, ethnographers, designers, producers and innovation professionals working across broadcast supporting work with audiences, production and distribution right through to making tv programmes.

Transformative Journey to a collaborative culture

BBC R&D has transformed traditional broadcasting infrastructure into cloud-based IT platform technologies, allowing it to share projects on an Open Source Software basis using distributed repositories, building communities and using open collaboration. Phil recognises that, "The shared nature of Open Source Software as a medium for collaboration is very powerful."

It's not a conscious effort for the BBC to use Open Source Software but an inevitability, as Open Source Software is deeply embedded in the existing software stacks it uses. Phil notes, "The technology we use is deeply driven by software - our industry has been on a journey from broadcast equipment and hardware systems to being software and computing driven." Moving forward, they expect a further shift to even more software.

Open Infrastructure

"In the BBC nature programme Spring Watch[24] There are lots of cameras filming animals out in the natural world. R&D has built machine vision pipelines that do a lot of the hard work of looking at hours of feed and finding the interesting bits - identifying when the animal walks in front of the camera and what kind of animal it is. The acquisition pipeline and storage are running on Open Infrastructure cloud."

BBC R&D made the shift to an Infrastructure as a Service (IaaS) model five years ago to support internal research and projects. They chose OpenStack, now called Open Infrastructure, a toolkit of many different technologies which creates a hybrid platform used for their research projects. As Phil explains, "We've built and currently have 3000 CPU cores, five petabytes of storage, 10 terabytes of RAM, 64 GPUs. The resources are available as a service to the teams on demand - and we can scale things up and down as needed."

BBC R&D is not just a consumer of Open Source Software it also contributes and is in the top 20 contributors over the last five releases of Open Infrastructure. They've made 1500 code commits and are in the top 10 for code reviews (meaning 6500 code reviews). The BBC team lead is actively engaged as a leader in the Open Infrastructure community, building a network of trust helping Open Infrastructure to deliver new releases every six months.

Contributing upstream is important, beyond giving back to the community, "The way we are using the software is unique to our use cases, for example in a particular network architecture which scales for the kinds of media we're using, we use the software in a certain configuration. And that's often where you find a bug or something that's not covered elsewhere, because other people aren't using the same code or tools in that way. That drives our contribution upstream. The important thing is that those contributions we've made remain in the source code that everyone else is testing and building on. It stops us effectively diverging with our code from the upstream code and allows many eyes to peer review our work."

24 See cover images of this report, from BBC Springwatch

Speech to text

BBC R&D also uses Speech to text software, created on Kaldi, a toolkit for speech recognition written in the C++ language and licensed under the Apache 2.0 Licence. "You've got things like music beds in the back of dramas, crowd noise in sports programmes, cross talk in discussion programmes, all sorts of things that speech to text really struggles with understanding," Rob explains. The BBC shared their data stacks with a group of academics who then used the Open Source Software Kaldi tool. The results that came back were impressive in the accuracy of speech to text systems automatically converting spoken audio to text, despite the distractions of background noise etc.

The BBC chose Kaldi for speech recognition as other commercial vendor tools were not seen to be fit for research purposes. Because it was trained on the broadcast data that BBC R&D supplied the researchers with, they were able to achieve higher than industry standard accuracy results in their subtitles.

Delivering outcomes at speed is critical in large research teams and Open Source Software allows for rapid prototyping, experimentation and tweaking as they go. As Rob says, "just the chance Open Source Software offers to get something up and running is crucial for innovation in general." The real improvements have come from endlessly optimising the model and adapting it.

According to Rob, adopting this Open Source Software has allowed the BBC to embark on a crucial learning journey. As it is a complex tool, its success requires that it has a sufficient amount of training and a specialised skill set to do this. They put one of the BBC's best developers on it for a period of almost twelve months before they really got to grips with the specifics of using and optimising the models. This collaboration allowed for an unprecedented opportunity to enhance the internal BBC skill set and expand team knowledge, particularly around the internal Open Source Software policies, licence understanding and management of Open Source Software projects.

Moving Forward

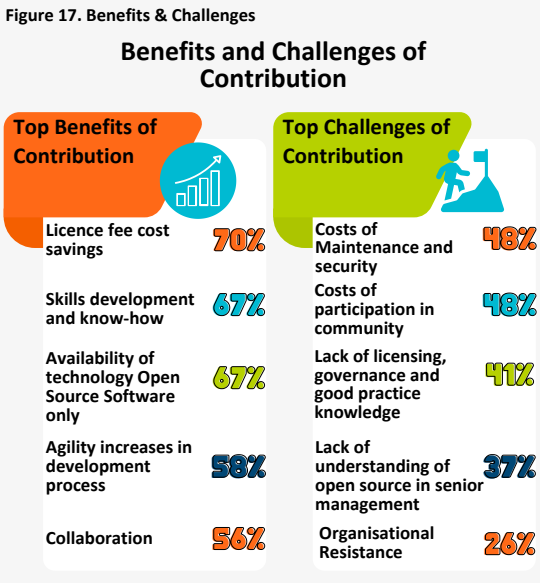
BBC R&D is creating a supportive ecosystem that allows it to contribute to the community, iterate, fix bugs, speed up delivery and enhance outcomes.

The BBC is intentionally making the shift from pure consumption to being active contributors within the relevant Open Source Software communities and building the necessary internal processes and governance to effectively do so with appropriate diligence.

Challenges and Benefits

The ranking of the benefits is also observed in the total sample and the ranking of the challenges follows the same pattern as the total sample, **with the exception that lack of coding skills or technical knowledge does not feature as a big challenge here, compared to the total sample.**

Figure 17. Benefits & Challenges



Source Q11 and Q12

"I would say the shift from consuming to contributing is so important - companies like us wouldn't exist without it. LCN wouldn't have existed when I first launched that without Open Source Software, there's no way we could have built products from scratch with a handful of the developers, we'd be locked away for years building Apache or equivalent. I think it's certainty from a startup point of view. It gives companies massive opportunities to kickstart projects and build software and speed up the development cycle."

Mark Boost, CEO, Civo.com

3.3 Open Source and Standards - Thought Leadership
Simon Phipps, Director of Standards Open Source Initiative

It may come as a surprise to find that some supposedly "open[25]" standards – including those ratified by standards development organisations (SDOs) like ISO, CEN and ETSI – can't be implemented without going cap-in-hand to the world's largest companies to buy a licence. It's the result of a legacy approach to innovation from the days when it was only really about hardware

As with any legal loophole, simply existing meant it was exploited and became the norm, even if it was initially temporary ("like income tax"). Once exploitation of a legal loophole becomes competitive, it becomes its own justification for the existence of the regulations ("look at the economic value of this segment") and they become near impossible to remove – even when the original justification has ceased to need preferential protection.

So today we see a swathe of rich consumer electronics and telecoms companies, unwilling to give up the revenue they get from licensing the patents (SEPs) they have embedded in "open" standards[1], lobbying hard to ensure their value to the economy is recognised. They have much to lose from the loss of their special status, so invest much to protect it.

On the other hand, software companies have less to gain by the reformation of this anachronism – to the extent they have flirted with SEPs, maybe even a little to lose. Meanwhile, the new world of **Open Source** powered innovation lacks rich lobbyists due to its diffusion. While the freedoms of **Open Source Software** mitigate to a degree, this means interoperability and interchangeability are being sacrificed on the altar of SEP protection.

It is not an ideological outlook that makes thoughtful Open Source advocates oppose patents in standards. It's pragmatic. Requiring a patent licence to implement a standard implies that those implementing it must engage in private negotiation to get a licence to proceed. That's toxic to Open Source, whose mainspring is code owners giving advance, un-negotiated, equal permission to enjoy the software in any way – use, improve, share, monetise - all protected by a rights licence reviewed and approved by OSI. So most projects avoid or work around SEP-encumbered standards and the ones that don't are industry-specific.

OSI takes the position that standards destined to be implemented as "Open Standards" must come with all the rights waived (and has done so for 15+ years) in respect of Open Source Software. The future of innovation is open innovation, implemented as Open Source. Using anachronistic patent-centric metrics and regulations will chill that future. How about we don't do that?

Survey Results - Participation in the work of a standards organisation

45% of respondents participate in the work of a standards organisation whose standards may impact Open Source Software, while 43% don't and 12% stated that they do not know if their organisation is participating[26].

Standard setting is essential to address concerns outlined above on good governance and transparency, while it can also help set the terms of collaboration between organisations and suppliers it must be undertaken in a way that works with Open Source Software licensing including with respect to Standard Essential Patents and Fair Reasonable and Non Discriminatory (FRAND) licensing which is problematic.[27]

> *"There's a friction between proprietary standards and open standards only because of business models, both proprietary standards and Open standards need to move their business models."*
>
> **Dr. Jacqui Taylor, CEO, Founder, FlyingBinary Ltd**

25 The word "open" is overloaded here. In the domain of standardisers, a process that permits any company to participate (even if doing so is punitively expensive) is considered "open" and the resulting deliverable is considered an "open standard" even if you have to pay to read it and get patent licences to implement it.
In the domain of software and APIs, it is the deliverable and not the process that has to be open – usable for any purpose without negotiation with its rights-holders. This overloading of the term is the origin of many of today's issues, since – properly understood – Open Source and open standards are conceptually orthogonal
26 Q21
27 Q21

3.4 Case Study - 4 BBC Standards
Judy Parnall, Head of Standards and Industry, BBC R&D

Many world events, including the recent COVID-19 pandemic have highlighted the dangers and impact of untruthful or fake facts within online news, leading to undue stress and misinformation. Interventions to reduce vulnerabilities are critical to reduce the harmful impact on individuals and society – and one such way forward is through the use of open standards to monitor and manage news reporting.

BBC Research and Development (BBC R&D) has taken a leadership role to pave the way forward in combating these concerns through the use of Open Source Software and standards. They have inputted into standards and industry bodies across production, broadcast and other media spheres to develop strategic visions for the future of credible news reporting.

Leading the way through open standards

BBC R&D aims to influence the broadcast sector by sharing their co-created Open Source Software and open standards. They believe that the way forward is critically dependent on partnerships and collaboration. Judy perfectly sums up their mission by saying, "we're always looking to use technology in a way that serves the BBC's public service ethos. We're aiming to change things to make a difference for the whole of the UK in a good way."

Approximately three years ago, the team at BBC R&D started the conversation to create a standard to authenticate published news stories. With a history of over 100 years of reporting, they felt that they needed to take the lead and put the wheels in motion for such an important conversation. They identified multiple challenges. "As you try and improve your detection, the deep fakes get better. You'll always be playing catch up. The question was what can we do? What can we do relatively easily that can be effective in helping people trust what they read?"

They came up with technology and an open standard which placed a symbol in the corner of websites, signalling that the piece of information had not been tampered with or edited since its origin, thereby confirming the source or originator of the content is as it appears.

They aimed to create this accreditation of source in a way that was scalable and suitable for other organisations within their sector, such as CNN or the New York Times. And this in turn resulted in the collaborative creation of the Coalition for Content Provenance and Authenticity (C2PA).

A collaborative approach

C2PA addresses the provenance of information online through the development of technical standards for certifying the source of content and it is a Joint Development Foundation project, formed by an alliance between BBC R&D, Adobe, Arm, Intel, Microsoft and Truepic. It currently has 38 members.

The standard is open and free to use, which was of great importance to BBC R&D, as "the only way you're going to make this work is if you make the barrier for uptake as low as possible, whilst making sure it is a staple standard. So, we went for a standard under the Linux Foundation that is free at the point of use, and that anybody can join, putting their IPR into the standard, signing that they will not charge for the use of that IPR. It's an open standard! And yes, you can build tools around it, you can build services around it if you'd like to."

Because they've set up the framework through Linux Foundation, they have been able to use their experience of collaborative working amongst competitors to work at speed and avoid delays. As Judy points out they avoided reinventing the wheel - "if you spend ages with the lawyers, it just takes longer, and you lose the impetus to try and get this going. If it takes you a year as it can quite easily happen - to get your foundation or your standards body sorted. If the legals are the priority in set up, then de facto it has taken over and then the problems get worse. A bit of pragmatism is needed."

The Development Team

The team developed the standard relying on previous work completed by Adobe and in collaboration with other entities such as tech providers, leading journalist rights organisations and other news organisations. With an active team of eight, BBC R&D set up the requirements to allow it to work in practice, a user experience group, and conducted trials to understand what it means to be a user of the potential standard both as a content creator and a content user.

They worked on GitHub as key desired outcomes were collaborative development and results at speed, "we use a very collaborative approach to software, sharing on GitHub for the purpose of collaborative development. The only way you can get something like that turned around so quickly is through open source software and open standards. It was literally six months from launch of the group to the first draft of the standard being released for comment."

The standard aimed to use existing elements as much as possible and only inventi wheels that needed to be invented. Rather than trying to do everything at once, "…we constrained what we were trying to achieve to actually get the full impact. We aimed to understand how we could sign content, either having the signature carried along with the content, or accessed separately, so that, if the metadata gets stripped out, you can still find out where that content came from. We've got to appropriate implementation options and that enabled us to move very quickly."

Why Open Source Software?

To truly impact the sector, the BBC team identified that they needed to co-create and collaborate with other leaders, in effect their competitors, to all the project to have wider impact. "The benefit of working in the open source world is you're immediately lowering your barriers to entry. You've got a lot more people coming in and getting involved. These are people with skills who are doing this with a passion. These are the people who push things forward."

She goes on to explain that because it was built on collaborative platforms, they had people from all over the globe working on it from different time zones, and effectively they had someone working on it 24 hours a day, allowing for quick turnarounds and focused work.

The path forward

BBC R&D hope that the open standard will be widely adopted within not only their sector but other adjacent sectors that can use the technology in innovative ways for the good of the public.

When asked about the maintenance of the standard, Judy explains that maintenance will be taken on over time by those who utilise, need and benefit from it the most.

As she says, "you would normally find two to three organisations taking the lead in doing that and it will probably depend on who actually uses it to generate some revenue. I think generally, when you have an open standard or a piece of Open Source Software, the people who will maintain it in the long run, are the people who have got an interest in doing so."

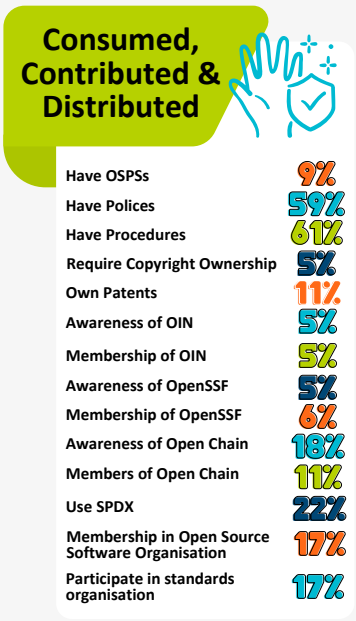
Part Four Distribution of products and services using Open Source Software

4.1 Survey - Analysis of Distribution of Products and Services

In our survey we saw that **81% consumed, contributed and distributed products and services based on Open Source Software**, while **2% consumed and distributed but did not contribute**.

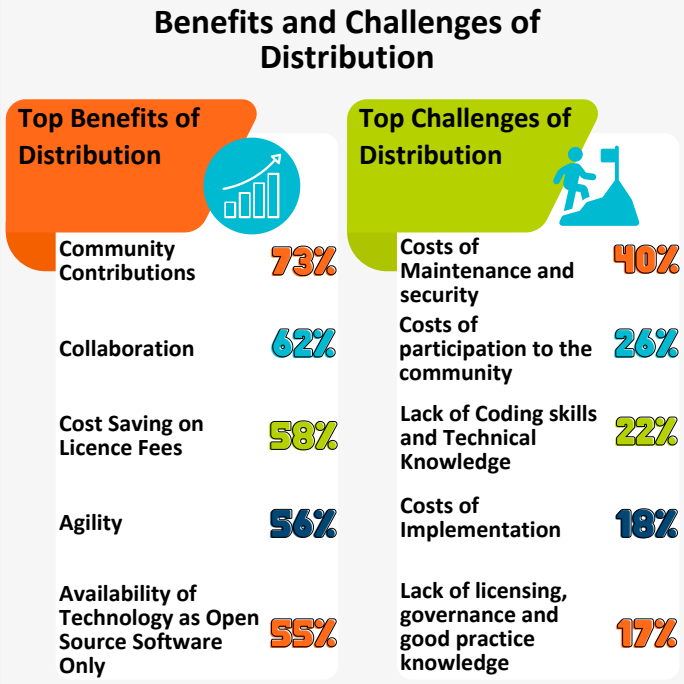
Looking at those who consumed, contributed and distributed products and services:

Figure 18. Governance and Hygiene - Contribute



Source Qs14-21& Q25

Figure 19. Benefits & Challenges



Source Q11 and Q12

These findings echo the general findings of our survey.

4.2 Case Study - Skyscanner
Christian Martorella, Chief Information Security Officer

Skyscanner is a travel search engine based in Edinburgh, Scotland, founded in 2001 and supporting customers researching travel options. It is available in 30 languages and used by 100 million people per month. The entire business infrastructure and online services are built, managed and maintained on Open Source Software and so their services are provided using Open Source Software. It is at the heart of Skyscanner's success.

The Origin: an Open Source first approach

Open Source Software is in Skyscanner's DNA From libraries, to frameworks, to tooling. Kubernetes, security and developer tools and libraries permeate its infrastructure. Christian explains that "We have an Open Source Software first approach. If there is something that is already built and fits the bill, we explore that option. Our business is to build value for travellers, that's why we want our engineers thinking and working on the innovative features that will bring value and are built on existing Open Source Software." This is how they deliver their core value proposition with optimised efficiency.

Backpack – the codification of design for the systems in Skyscanner forms a critical part of Skyscanner's infrastructure. It works on all platforms including mobile. It is reliant on a collection of design resources, reusable components, and guidelines for creating products with ease and consistency. It empowers their workforce to deliver high quality solutions at speed, and includes theming, RTL and dark mode support.

Skyscanner uses security tools such as Sysdig Falco and four projects have been developed by their security team and made publicly available as Open Source Software using this. Falco is a container native runtime security solution focused on intrusion and abnormality detection and which uses the Open Source SoftwareLinux Kernel tooling built by Sysdig to generate alerts based on a custom rules and a macros engine.

As Skyscanner were moving to Kubernetes it fitted their security tool roster perfectly. Some of the key features that were seen as beneficial and supported the decision to use Sysdig Falco:

- Complete container visibility through a single sensor that allows them to gain insight into application and container behaviour
- Easy installation as a Daemonset, ready for Kubernetes
- Adoption into the Cloud Native Computing Foundation (Incubated project)
- Active open-source community

The Ethos: from consumption to contribution

Skyscanner actively contributes back sharing elements of Open Source Software that they have built in-house for others to use. Christian strongly emphasised that as an organisation they value and understand the importance of giving back to the community and actively try to be 'a good global software citizen,' by making their code Open Source Software and sharing it.

Skyscanner has its own GitHub.io page to showcase the main projects they have released and some of the latest projects there include Turbolift, CFripper and Whispers. All of which have been covered in multiple industry articles and available here -https://github.com/Skyscanner?language=python.

He goes on to say, "The concept of contributing to Open Source Software is strong in the company," as the culture encourages conversation around open source projects and supports interested developers on their journey by providing them with the necessary tools to progress their personal contribution and skills development. Skyscanner gives back to the community with intention, allowing other companies and coders to benefit from their work.

This contribution is not entirely altruistic and Christian recognises the benefits "Using Open Source Software can also get people to contribute to our code, and gives us an opportunity to showcase what we do within Skyscanner to our peers."

Open Source Software is considered by them to have a lot of pros, such as the ability to access and make use of good quality code at no cost but one of the main benefits Skyscanner leverages is agility and speed.

Noting, "You can build your services/features much faster with Open Source Software, as you can get many of the things that you need ready-made. It's about integrating them and making them part of your service. And that's the thing you gain… you gain a lot of time, so you can go faster to the market on features." This in turn supports Skyscanner's core business needs, allowing them to spend time focusing on their core value proposition by removing the need to reinvent the wheel.

An open ecosystem: policies and guidelines

Skyscanner recognised that increased digitalisation brings increased complexities, especially in relation to cybersecurity threats, saying "there is more risk in the cyber world." This has pushed Skyscanner to actively implement policies and standards to manage the security of supply chain vulnerabilities and manage and monitor attacks. As he says of this supply chain focus, "our pipeline is designed and implemented in order to prevent any issues with Open Source Software. It's a big part of the security team's focus."

To improve their processes around Open Source Software, Skyscanner have refreshed and reviewed their internal organisational Open Source Software policy and guidelines and simplified the guidance to ensure it's clear and easy for engineers to follow. The Legal and Security teams have collaborated and created a new policy, centralising all of the processes for Open Source Software. They've also produced different open source policy and procedure documents, which are organised depending on if you are consuming/ adopting, contributing to, or releasing/ distributing Open Source Software. Mainly to give them a uniform and responsible way of adopting and using Open Source Software and projects.

Christian strongly believes that the way forward in managing software risk and open source practices is reliant on creating secure systems and guidelines, although he acknowledges that it is complex to implement security at every level and invest in resources and tooling. He feels that Skyscanner is quite mature in its security journey and has successfully embedded it as 'part of their processes.'

Combating the challenges of Open Source Software

Despite all of its benefits, Open Source Software like anything comes with some challenges. Maintaining and keeping up to date libraries could become taxing for the teams, security threats in the supply chain are on the rise, and abandoned projects are a common occurrence - to name a few.

Supply chain security is a key challenge identified by Christian. He elaborates that "When you import an open source project, it tends to have a number of dependencies - understanding the security of all that software in terms of who is maintaining it, how many people have left the project, if they have adequate security controls, is it being updated frequently or not and whenever there is a vulnerability in any of those libraries. All of this is critical." Finding the answers for these questions can be tricky without automated solutions.

When adopting a new open source dependency in the organisation, staff are encouraged to review Skyscanner's Open Source Software due diligence guidelines for a checklist and reminder of things to consider. Christian believes it is important to mindfully evaluate a new library, as they might become a burden if we don't choose the right one.

Caution should be exercised, because whilst it can be simple and frictionless to include a new library in your project, the consequences of not being diligent with the choice can be disproportionately significant. An important aspect of choosing the right project is which open source licence is used for the software

Skyscanner has a commercial solution that scans all the open source libraries that they consume and highlights vulnerabilities, informing them of the overall health of the project. It allows developers to choose between two different open source projects that are the same or similar and better understand the elements of licensing, governance and hygiene - "behind the scenes" - that determine the project's longevity and health.

Accessing skilled resources is another challenge. Christin notes a skills gap in Open Source Software, specifically in security. "Finding professionals with experience, for example a security engineer, is not easy. It's no longer a UK problem - it's a global problem, talent is global now. And as you're competing with all European companies, talent has more options, and the company has less autonomy. It's difficult to hire talent and you have to be open to hiring remote and to relocate and to find people in other pools, because it's very competitive."

Skyscanner's position on Open Source Software

Skyscanner champions Open Source Software both internally and externally, with a strong vision for its use in their future endeavours. They see it as being an enabler in improving their products and services, as Christian sums it up by saying, "Open Source Software is a great concept that has enabled us to build our services faster and better."

4.3 Case Study - Nationwide Building Society
Seiji Okamoto, Cloud Platform Engineer at Nationwide Building Society

Banking systems have historically run on-premises (on-prem) akin to expensive data centres within banks. Cut to 2022, banking systems have become modular layers in the cloud, enabling various components to be provided as a service, reliant on Open Source Software. Once such a bank is Nationwide Building Society.

Nationwide Building Society

Based in the UK with over 18,000 employees including 6,000 engineers, Nationwide is a pioneer in digital banking. Seiji Okamoto, Cloud Platform Engineer explained their journey. Digital transformation began in 2008, when Nationwide launched a project to transform its technology and upgrade its data centres. £4.1Bn investment in re-architecting systems around the streaming data technology Apache Kafka, has facilitated speeding up access to transactional data and increased resiliency.

Their overall digitalisation effort uses a mixed bag of technologies including Open Source Software. "It's very cost effective to use Open Source Software for our team. There's four of us, and we can't possibly write vast amounts of code. If there's tooling that exists, it makes more sense to utilise and reuse it"

A collaborative platform

Seiji and his team are creating a uniform engagement platform combining multiple tooling elements across the business into one shared platform. This allows developers to leverage the platform to . Open Source Software is in play across libraries, container cloud native technologies, databases, observability tools, security tools, software build tools and operating systems like Linux. Seiji notes that, "when Nationwide explores a new tool, one of the first things we'll look at is open source."

The Open Source Software journey in finance

As a consumer of Open Source Software not a contributor, Nationwide comes up against some challenges in its use, mainly related to maintenance concerns, such as if their tool needs a new feature, it's tricky to raise a feature request with the maintainer and achieve rapid results if you are not engaged. Seiji recognises that they need to evolve their relationship with Open Source Software and interact with the relevant communities at a deeper level.

He says, "we're trying to draft how we can contribute to the community, as in finance, as a regulated sector we need bespoke software to increase security." They also need internal approvals and appropriate policies and this desire to engage further creates a desire to mature and shift towards contributing back to the open source being used.

In terms of policies as a consumer of Open Source Software, Nationwide has a robust security process in place for adopting any new digital tools. Initially all suitable open source tools are evaluated with an analysis of the benefits, concerns and risks of each alternative. Senior and lead engineers review the analysis to make an informed decision. Seiji feels that it is critical to do more, especially at the very start of using an open software tool, when "There's a lot of security checks around things that are being run to make sure that any packages work sufficiently. It's much better to catch issues earlier on, for example in the build process, or the commit process."

Moving forward

Seiji feels there is awareness about Open Source Software in Nationwide but there is always room to do more and shape the journey ahead as more contributions occur. "I'm hoping to make Open Source Software much more obvious and visible within the engineering teams and the wider business - so that they're more aware of what it is that we're doing and how we're doing it. I'd really love to see what we can do to contribute back more as an organisation to the community."

4.4 Maintenance

Maintenance is at the heart of the current conversation around both security and curation of Open Source Software in the enterprise and public sector but also around the economic considerations. For many years there have been calls to **"pay the maintainers"** and we saw this discussed as the unseen labour behind our digital infrastructure in the now out of date but still relevant work **Roads and Bridges by Nadia Eghbal**. [28]

> *"A company looking at what software they use is critical to working out what their maintenance strategy is - how are we going to pay maintenance for this project? Are we going to just assume someone else maintains it? Are we going to do security audits for this project? Having a strategy about the critical software you use is important, not just assuming - you've got to have some strategy rather than hoping it's fine."*
>
> **Justin Cormack, CTO, Docker**

> *"It's not only about Open Source, but it's also about the ecosystem supporting it to give us visibility and monitoring. That goes back to the shared responsibility model with Open Source maintainers, but also with the companies using these projects. Organisations shouldn't expect the Open Source project to be 100% secure and should apply due diligence by using their own pipeline of tools they have implemented internally to detect if there are any security vulnerabilities within those projects."*
>
> **Sonya Moisset, Senior Security Advocate, Snyk**

4.5 Consume and Distribute but do not Contribute

The survey draws out that **some organisations consume and distribute Open Source Software almost surprisingly do not contribute.** We saw this last year with the more conservative finance companies and believe this may be the case in **regulated sectors as they follow the journey** and become more understanding of Open Source Software and real versus perceived risk.

2% of respondents distribute but do not contribute and of these we see in the results that these have very limited or no awareness of the good housekeeping and governance that build appropriate Open Source Software practices despite their distribution. This is a very small sample and it is difficult to draw conclusions but this area is **worthy of further exploration**, in particular **misconceptions around risk and motivation to distribute without contribution, so this should be used as a discussion point only.**

> *"Most of our hires now come from our Slack community, where people have reached out to us, and we've hired people. Because it's amazing when you see these people out there who from the goodness of their own heart develop code and contribute to your projects. It's a very powerful thing."*
>
> **Mark Boost, CEO, Civo.com**

28 https://www.fordfoundation.org/work/learning/research-reports/roads-and-bridges-the-unseen-labor-behind-our-digital-infrastructure/

Part Five The Future - Infrastructure, Curation, Security and Sustainability

5.1 Case Study 3 - New Look
Ed Alford, Chief Technology Officer, New Look

New Look, a leading UK fashion brand, has an online platform that serves 66 countries, with over 225 million visits in 2021. They are a keen innovator- integrating digital elements into its store proposition and personalising customer journeys.

Press Refresh

Ed Alford is leading a complete technology refresh creating an omni-channel retail offering giving customers the same experience online, in the app and in store. The revamp re-designs the store networks and embeds technology within transactional and store management processes. New Look is already a long term consumer of open source software.

The strategy for New Look's refresh focuses on curating the software to balance various tools, including open source software, maximising the opportunity for multiple benefits including shared libraries, bleeding edge innovation and creating a collaborative ecosystem. As Ed says, "It's about balance, choosing what's right for the situation you're facing."

Their holistic and strategic approach to the revamp means that by the end of year they will move to a more MACH based architecture and a focus on native app technology for iOS and Android . "We'll make it more Microservices and API based, which will allow us to move with speed, being responsive to our customer needs.

New Look's digitalisation journey is tailored for the long run. They are comfortable investing in the infrastructure now to engineer it well for the future and to avoid unnecessary future changes and take a forward looking, curated approach to open source software. As Ed says, "If we look at it through a three year lens, then we build in a way that optimises for quality and speed. We're re-engineering the platform from the ground up, so that you wouldn't need a point solution to solve a problem going forward. You'll be able to use the platform and build better solutions."

Security Concerns

The retail sector has been prone to security hacks and malware incidents leading many companies to take out and rely on insurance against these incidents. New Look's approach is different and instead to invest in stronger defences and software security and to use curated open source software.

Adopting any software including open source software comes with security challenges, New Look engages skilled third party vendors who invest in creating secure and reliable open source technologies as a response to the scale of their operations and mitigating risks. "It was a personal preference from a risk perspective. We use open source platforms and have paid for subscriptions or support for these from skilled providers simply because secure, reliable operations is our number one priority."

The New Lookers

As the current transformation needs to happen at scale, there are a variety of skills required including network infrastructure, software related skills, cloud infrastructure, operating system, development, and coding skills. New Look aims to build these skills in-house among the existing workforces. As Ed says, "I believe that you should have your own core team and engineering capability in cloud platforms, app and web development, data platforms and integration platforms. The key is to have a balance of internal resources and external experts and scale up through your partners." At the same time, they're bringing in fresh talent, such as graduates, to foster the right environment for the long term.

Conclusion

With e-commerce growth continuing at a rapid pace, brands like New Look are aware of the need to invest in digitalisation to manage customer demands. Consuming Open Source Software as part of this digitalisation can provide a compelling advantage to retail businesses, with an increasing number of brands waking up to its potential.

"It was kind of an unusual situation to be paid a large amount of money to continue developing Open Source but that's started to change. I suppose, in the last maybe five years, as companies have been built on top of Open Source Software. And so understanding what the business model behind those companies are, is important when you're adopting a product, or choosing a product, because that will lead into the lifecycle of whatever that product is, and the roadmap of being more understanding or mindful of that, when picking products. "

Mark Boost, CEO, Civo.com

5.2 Survey - Security

5.2.1 Security Impact

Respondents are **candidly open about having been impacted by security issues, with almost half (49%)**[29] **saying that they were impacted to varying degrees**, especially when it comes to software libraries. Most notably, respondents' organisations were **affected by Log4shell**, a critical vulnerability in the widely used logging tool Log4j, that affected businesses, governments, and individuals worldwide **in 2021. CVE-2014-0160** the heartbleed bug as it is known, has also caused headaches for respondents.

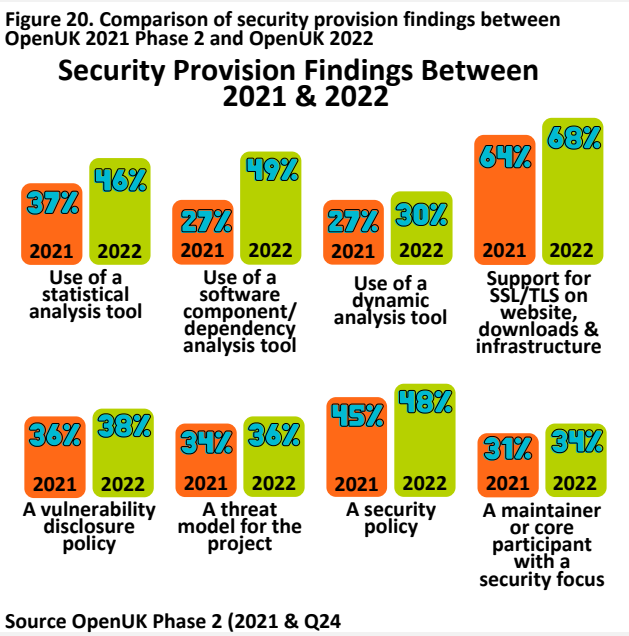
Log4shell occurred towards the end of 2022, following our final phase of State of Open 2021, and has seen a critical impact on security and Open Source Software discussed further at 5.3.

5.2.2 The risk in Open Source Software

There is broad consensus (78%)[30] that using Open Source Software does not pose a greater security risk than proprietary software. Similarly, Redhat's research 'The State of open enterprise software (2022)[31] found that 89% of global respondents believe that enterprise Open Source Software is as secure or more secure than proprietary software and that goes to 90% for EMEA, including the UK. As the report notes, "Anyone who has spent time in the IT industry will recognize that this is a significant shift from mainstream perceptions about Open Source Software from a decade or so ago when Open Source Software security often surfaced as a weakness"[29][32]

5.2.3 Update on 2021

Figure 20. Comparison of security provision findings between OpenUK 2021 Phase 2 and OpenUK 2022



Source OpenUK Phase 2 (2021 & Q24

29 Q22
30 Q23
31 Redhat: The State of Open Enterprise Software (2022)
32 Redhat: The State of Open Enterprise Software. (2022) Page 5

The UK is better prepared for security challenges in 2022 than in 2021. In last year's State of Open report[33], a series of questions mapped the level of security preparedness of businesses using, developing and looking after Open Source Software, which showed a relatively low level of adoption of security measures overall (albeit slightly higher than other comparable international studies).

Repeating this question this year, and considering the acceleration of digital technology adoption and increased awareness, **the findings for 2022 show a more promising picture, with increases in the measures organisations are taking for security.**

What stands out is the **significant increase** (up by 22% increase compared to 2021)[34] in the use of a **software component or a dependency analysis tool to identify dependencies with known vulnerabilities.** Almost half (49%)[35] of the respondents in this year's survey answered they are using such a tool. One possible explanation could be the **automatic inclusion of such tools when using cloud repository systems.** Another possible reason for the increase is a **higher awareness of threats**, which evolve constantly and have recently become more frequent because of geopolitical factors.

According to **Tidelift's report 'The 2022 Open Source Software Supply Chain Survey'(2022)**[36]**,** in the wake of the **White House Cybersecurity Executive Order** and other ensuing government actions, almost a quarter of global respondents, of which 41% are based in Europe including the UK (22%) indicate that **complying with government requirements is a challenge affecting larger organisations.**

"Awareness has grown over the last decade, of the challenges of open source, and in particular financial sustainability. I think developers now have more of an understanding of that. The awareness grows with the scale of the business and whether the Open Source Software components is critical to the business operations. That also ties into the security question - keeping the software up to date, and supply chain security. There have been quite a few hacking incidents in the last couple of years where it's become obvious that although you can pay attention to your direct vendor, you have less control over who they are connected to, and what tools they're using. The practices around good supply chain security are still pretty immature, which I think is probably the biggest risk today."

David Mytton, Co-Founder, Console.dev

5.2.4 Software Bill of Materials and SPDX

Software Package Data Exchange ("SPDX"), the Linux Foundation's de facto standard for Open Source Software Bill of Materials **(SBOMs)** has now achieved its **international ISO standard**[37] being actively used across supply chains to **improve supply chain transparency which will have a positive direct impact on security.**

In our survey 21% of respondents are aware of and use the software Bill of Materials (SBOMs) that requires suppliers to provide (or provide to their customers) an SBOM for Open Source Software.

An additional 22% are aware but do not use one[38]. Out of the organisations that only consume Open Source Software (microstudy), 14% are aware, but none is using. 15% of those who consume and contribute are using an SBOM. 22% of those who consume, contribute to and distribute Open Source Software are using SBOMs.[39]

33 OpenUK. (2021). State of Open: the UK in 2021. Phase 2: UK adoption.
34 Q24
35 Q24
36 TideLift: The 2022 Open Source Software Supply Chain Survey Report
37 ISO/IEC 5962:2021
38 Q15
39 Q15 by Q5

5.3 Security Response: The Open Source Security Foundation and the White House

Finding out about potential risks and coordinating action to respond quickly and outside the regular maintenance cycle is essential. This is why membership in **organisations such as the Open Source Software Security Foundation (OpenSSF)** is important. Despite this, **only 8% of respondents are members of OpenSSF**, with another 26% being aware of it but are not members.

For context, **'2022 State of the Open Resource Report' published by Open Logic and the Open Source Initiative (2022)** found that **security and patches were the most important point of consideration** when choosing infrastructure technologies like Linux distributions and containers.[40]

Snyk and Linux Foundation report (2022) "State of Open Source Security," includes amongst its key findings that the **"time it takes to fix vulnerabilities in open source projects has steadily increased**, more than doubling from 49 days in 2018 to 110 days in 2021," recognising the increased complexity in development.The report found that **fixing vulnerabilities in open source projects takes almost 20% longer (18.75%) than in proprietary projects.**

"Software developers today have their own supply chains – instead of assembling car parts, they are **assembling code by patching together existing Open Source components** with their unique code. While this leads to **increased productivity and innovation, it has also created significant security concerns," said Matt Jarvis, Director, Developer Relations, Snyk and Director OpenUK.** "This first-of-its-kind report found widespread evidence suggesting industry naivete about the state of Open Source security today."

Atlantic Council whose security focused work began with their **Breaking Trust project**[41] inevitably led them to Open Source Software as they focused on the **practical impossibility as they saw it, of trusting any software one did not build** and focused on how to build levels of trust for both private sector and sensitive organisations. Of course their focus is on supply chain.

They point out in 2022 that "Owing to the structure of open source software, version control, ownership, repository management, dependency tracking, and even naming conventions impact the ecosystem's security deeply."

"That is not to say that open source software is inherently less secure than proprietary—proprietary code's significant reliance on open source makes that conclusion circular at best. Some even argue that open source is more secure because of the greater number of eyes that can review and repair it, all else being equal. Regardless, the same transparency and mutability that make Open Source Software so useful to the entire ecosystem also present security challenges."[42]

Their recommendations:"Invest in open source software as infrastructure: Institutionalize collaboration on OSS security and governance: Maintain regular dialogue on open source:Recommend and require best practices in open source incorporation during software development:Establish voluntary repository best practices: and Leverage buying power to speed improvement and adoption." all point to the responsibility of the user of Open Source Software.

> *"In the Open Source ecosystem, security is often regarded as adequate, this does not reflect the views of the Cyber Security industry. The gap is as a result of a shift in the technology industry towards zero trust models, and a move from a threat to a risk landscape. The reality is this will require a shift on both sides, and soon."*
>
> **Dr Jacqui Taylor CEO, co-Founder FlyingBinary Ltd**

40 The 2022 State of Open Source Report
41 https://www.atlanticcouncil.org/programs/scowcroft-center-for-strategy-and-security/cyber-statecraft-initiative/breaking-trust/
42 https://www.atlanticcouncil.org/content-series/buying-down-risk/open-source-software/

5.4 Case Study - OVO
Simon Goldsmith Director of Information Security, OVO

Launched in 2009 in Bristol, OVO is the third largest independent UK energy retailer with over 4.5 million retail customers. The company has spent the last decade investing in the market leading technology, customer service operations and digital products to help members cut their carbon emissions. OVO is on a mission through its sustainability strategy Plan Zero to tackle the most important issue of our time; the climate crisis, by bringing our customers with us on the journey towards zero carbon living. OVO has committed to being a net zero carbon business and achieve bold science-based carbon reduction targets by 2030, while helping members reduce their household emissions at the same time. The OVO information security team actively consumes, contributes and distributes Open Source Software. They recently open sourced a security tool to prevent subdomain takeovers, named Domain Protect.

Securing the landscape with Domain Protect

OVO has a hybrid cloud environment, with multiple autonomous development teams each managing their own cloud accounts, leading to occasional disparate systems and missed vulnerabilities. OVO began its own private bug bounty program, rewarding researchers who found various security issues, over half of which were subdomain takeovers.

To get ahead of the researchers and find vulnerabilities themselves, OVO chose to develop Domain Protect using serverless functions in the cloud to detect subdomain takeover vulnerabilities and alert security and engineering teams to them. There are many different types of subdomain takeover, such as removing a cloud resource, and forgetting to delete the corresponding DNS records and as Simon explains, all of them can be damaging to an organisation and its customers. Domain Protect "solves a specific problem that quite a few security teams and organisations face in the digital world."

Domain Protect supports Amazon Web Services (AWS) and Cloudflare. OVO recently extended the application to cover Google Cloud Platform (GCP). Typically Domain Protect is installed to a security audit account within an AWS Organisation. A number of Lambda functions are installed, each running at regular intervals triggered by a CloudWatch scheduled event. The Lambda functions look for different types of domain takeover vulnerabilities, and then write their findings to a Simple Notification Service topic. Another Lambda function is triggered by new events arising on the SNS topic and sends an alert to Slack. Optionally, we introduced automated 'friendly' takeover within the security account and an administrator can then resolve the problem later.

An Open Source Software journey

The journey started over a year ago as an internal Open Source (inner source) project creating the tool. Today it is shared for third party use on OVO's Open Source repository. Simon believes it's "a genuinely useful tool that would benefit security teams globally." The security team manages its maintenance and contributions, and through public events and opportunities, hopes to raise awareness and distribute it further.

There are several advantages of an Open Source Software build for OVO. In particular, the rich community of contributors, "the more people we can get contributing to it, the richer that tool and that problem solving space becomes. The more inputs from the community, the more useful it becomes both to us and to everybody else." This is not only from a quality perspective but also a skills perspective. Simon believes that it isn't just about developing the team's skillset but developing the skills of others and developing the defensive security capabilities of a broader community and society.

There are also valuable reputational benefits gained by contributing to Open Source Software. Simon emphasises this intangible benefit as critical in positioning OVO as a leader in technology and increasing its attractiveness to the UK's skilled workforce. Not just consuming but contributing to Open Source Software is an easily verified way to demonstrate that they are at the forefront of innovation, highlights their commitment to the cybersecurity profession and displays their technical competence.

Shaping the relationship between security and Open Source Software

Simon sees a link between Open Source Software and the broader energy sector. In particular OVO'S commitment to sustainability and digitisation, saying "Sustainable and secure energy is reliant on technology - there's obviously financial concerns and geopolitics to consider - but there is a key role that technology plays in shifting people to zero carbon energy, including digitisation of our platforms, making the whole data and technology landscape a lot more cost effective, and a lot easier to access."

Security is linked closely to the software development lifecycle. OVO believes in establishing a level of trust and verification of repositories when consuming code via them. A large organisation, such as OVO needs to prepare for and handle supply chain security.

They recognise that, "attackers are using the supply chain, including Open Source Software as a means to execute their attacks." He views " The solution is to include security in engineering development and operations cycles. There can be a tendency to think that security is only a compliance, or a governance activity, when actually, it really should be part of the systems engineering, lifecycle and the quality of a product."

Conclusion

Across OVO, they have extended the functionality of Domain Protect to DNS records held in Google Cloud Platform (GCP). And as they become aware of new types of subdomain takeover which may be present across OVO teams, and are feasible to detect, they'll add further misconfiguration checks as well. Simon believes that in the future, OVO will increasingly include malicious use cases in their engineering designs and inject those into their overall thinking but he understands that it's tricky and hopes Open Source Software will be part of the solution, as he says, "It feels like the security community is developing a maturity around how we get the benefits of Open Source and minimise the risks of it. There's been a noticeable acceleration this year."

"Yes, Open Source Software has security issues, because all software security issues, if you have more eyes using it, and more people trying it out, it'll just get more security."

Dr. Jacqui Taylor, CEO & Founder, FlyingBinary Ltd

"The number of reported vulnerabilities in Open Source Software has gone up substantially, because more people are filing CVS rather than just fixing issues. It looks worse, but if software doesn't have issues filed, almost certainly, it's worse than if it does. People don't realise that if their software's got no issue and never had a CVS filed that means no one's looked at it and no one's bothered to file an issue. You should be more worried about that than the things that have issues filed."

Justin Cormack, CTO, Docker

"There's a lack of understanding and awareness of the open source ecosystem. This is why I'm referring to the education piece. If we take the example of the Linux Foundation projects, we can expect security guardrails and best practices to have been put in place for those systems, whereas expectations from smaller projects and applications would be different."

Sonya Moisset, Senior Security Advocate, Snyk

5.5 Security - Thought Leadership
Andrew Martin, Founder and CEO Control Plane and CISO OpenUK

Since our last report in October 2021, the online security landscape has changed significantly. November saw the internet catch fire with the infamous Log4shell vulnerability reminding us of the value of security assessing and patching critical projects, while December saw the OpenSSF's "Great MultiFactor Authentication Distribution Project" hand out hardware security keys to open source developers. January then saw the commencement of hostilities between Russia and Ukraine, widening the threat landscape internationally and bringing nation state capabilities into sharp relief for producers and consumers of software everywhere.

In this more hostile landscape Open Source Software usage has remained a constant. Its use continues to rise in the private sector and governments despite the growing concerns about its provenance and veracity. January saw the OpenSSF brief the White House on software supply chain integrity, addressing the challenge of defending long and meandering developer and infrastructure supply chains, and advocating for Software Bills of Materials (SBOMs).

The snowballing adoption of SBOMs and the accompanying SPDX standard has not come as a surprise to the Open Source community, who have been managing software composition risk in distributions and the kernel for decades. Along with other emerging standards like Open Chain (simplifying open source trust and compliance), these projects represent years of steady effort and industry education.

Shipping an SBOM with a vendor or open source project is a signal that developers may understand the complex nature of software composition, and potentially a positive indicator of the safety of their software's build and distribution processes. SBOMs are not a panacea, but one piece of the complex puzzle of modern software security that was brought so strongly into focus by the SolarWinds and Colonial Pipeline incidents at the start of 2021.

Alongside composition, the nature of human identity and beneficial ownership in Open Source has also come under scrutiny, as we attempt to decloak and unmask potentially hostile parties masquerading as benevolent contributors. Identifying developers under potential hostile regimes may put them at risk, so the challenges of preventing collusion are balanced with the need to maintain a free and open contributor network.

As for hostile contributions, a research team from the University of Minnesota attempted to ship malicious patches into the Linux Kernel, which tested the boundaries of ethical academia. They were detected and rejected (with the exception of an accidentally non-malicious patch, which was merged), but the kernel maintainers' person-hours expended to identify and correct the contributions were non-trivial.

This highlights another great dichotomy in Open Source: the good faith and positive intent shown by maintainers, in the light of the cost of their time.

In an effort to balance this equation, the Alpha Omega project was launched in February to distribute funds and support to maintainers of critical Open Source Software, with an ambition to secure 10,000 open source projects with automation and scanning, and an initial core focus on Node.js's vulnerability and dependency management, release process, and security patching and releasing.

Funding is imperative for these Open Source maintainers, who are often asymmetrically imbalanced against the large organisations that consume their projects, and unable to cope with security disclosure and management requirements those consumers may require. The OpenSSF is also looking to address this by offering a Security Incident Response Team (SIRT) of last resort, providing management for open source projects that have neither the funding, time, nor inclination to handle vulnerabilities disclosed to them. The void between widely-adopted but unfunded open source projects and their consumers is being closed by these efforts, as maintainers are being proactively assisted with patches, scanning, and management of vulnerability.

And funding is coming not just directly from consumers but also from the OpenSSF and its sponsors. The Open Source Summit, North America, brought together supply chain practitioners across the community at the OpenSSF Day to discuss SBOMs, securing critical software projects, and curated open source. The summit also included SupplyChainSecurityCon, focused on the implementation of supply chain fixes and emerging tools in the space.

Looking forward, September's European-based Open Source Summit in Dublin also hosts another OpenSSF day, as well as a Supply Chain Security Con. It will be followed on September 20 by an OpenUK event in London, to bring the relevant practitioners together to address government and industry.

Following these solution-focused events, the OpenUK Summer of Open Source Software Security brings our own friends and colleagues across OpenUK, OpenSSF, and US Government to support UK Government on their response to the open source and supply chain security issues of the past year. With a series of presentations and open discussion, we look to build on our existing collaborations and assist the government and policymakers with the complex issues of open source legislation: if we can convince the UK to sponsor security fixes and maintainers of open source projects we will have achieved a significant milestone for the industry in the UK.

Finally, we look forward to February 2023, when the OpenUK conference in London hosts Security and Government work streams. We have a busy year ahead, and with the existing kind collaboration fostered between businesses and governments across Europe and the Atlantic the future for the challenges of Open Source Security has never looked brighter.

5.6 Curation: The Path to Trustworthy Open Source - Thought Leadership
Eric Brewer, Google Fellow, Google

Although Open Source Software has been around for decades, the last decade in particular has seen explosive growth across all sectors and nearly all nations. Open source enables developers to build "on the shoulders of giants" and thus achieve rapid innovation. There are now millions of easy-to-reuse packages in many different languages that enable this innovation. As a consequence Open Source is now used widely by governments and in much of the critical infrastructure of many nations. GOV.UK, the UK government's platform for hosting government websites, was built using Open Source and its code has been publicly available since 2012. Overall this is a great outcome: citizens and taxpayers benefit from more innovative, more efficient public services.

At the same time, Open Source delivers software "as is" — it literally comes with a licence that says the creators are not responsible for any defects, nor are the liable for any damages.. Many consumers of Open Source do not really understand "as is" and often expect a higher level of service and accountability. But this misunderstanding falls entirely on the consumer.

Conversely, most government projects have "top down" requirements and expectations that are important to creating trustworthy solutions. These requirements are in some sense in conflict with the "as is" nature of open source.

The solution to this fundamental incompatibility is "curation" — the use of an intermediary provider or contractor that provides Open Source solutions that are NOT "as is" and in fact meet the top-down expectations, whatever they may be (and those expectations vary by sector and nation). The curator is building on top of raw "as is" Open Source Software: finding and fixing vulnerabilities, managing technical debt, and building new capabilities. The Open Source software remains the engine of innovation, and the curator's key role is to bridge the expectation gap.

Curation costs money and it should.

It is hard work to bridge the gap, and it takes both engineers to do the work, plus non-trivial operation expenses to regularly build and test software. In addition, when a vulnerability is uncovered, such as the recent og4j incident, there is a huge amount of work to do to bring the curated solutions back into compliance.

A good curator should be making explicit promises about their solutions, and should be legally accountable for those promises. Similarly, a good curator should not only fix problems in the solution, but track the many dependencies used by their solution; 90% of vulnerabilities in a solution are actually in its dependencies (again log4j is an example).

Curation comes in many forms. Existing examples include Red Hat's supported libraries for Linux, the new Google Assured OSS product, and corporate versions of Open Source Software projects that come with strong support, such as DataStax version of Cassandra, or Databricks or Cloudera's version of Spark. Curation will also be layered, with upper layers using curated packages from lower layers (and paying for it). The goal, in progress, is a healthy collection of curators that sometimes work together and sometimes compete.

Overall, both governments and Open Source Software communities need forms of curation.

If we are to unlock the power of Open Source to drive public sector innovation, curation is the key to bridging the expectations gap between governments and Open Source communities and to establishing a level of trust commensurate with the degree of trust we already place in it as a global society.

5.7 Societal Value Metrics for Open Technology - Thought Leadership
Cristian Parrino, Chief Sustainability Officer, OpenUK

OpenUK launched its first **sustainability strategy in 2021** and as a result embarked on a journey to elevate the role of Open Technology in society as an enabler across the 17 Sustainable Development Goals (SDGs) and hosted its **Open Technology for Sustainability Day at COP26 in November 2021**[43]**.**

Adopting open principles and Open Technology across government, business and academia is fundamental to facilitate the **change required to achieve the prosperity of all people and of the planet.** Open Technology is effectively collective equity, a public good, which can be used by changemakers to support them in **solving the societal problems** they are being affected by, across the full sustainability spectrum - equality, education, climate, health, poverty, fair work, environment, justice and community.

When framing the role of Open Technology in this way, the natural next step is to understand **how that societal value can be measured.**

Most societal value measurement frameworks available in the UK (Cost-Benefit Analysis, Wellbeing Valuation, Social Return of Investment, TOMS Framework) place a monetary value on societal value. We believe it's time we **shift the measure of success away from perpetual economic growth, to a variety of societally focused metrics** capable of representing the health and wellbeing of all people and the planet.

We're not alone - many existing movements across sustainability have been shifting their attention to community level solutions. This communities over economics movement already has some major early adopters. **New Zealand** announced that it is **ditching GDP for a new happiness and wellbeing metric** under prime minister Jacinda Arden, **Amsterdam has followed suit with its adoption of its own doughnut economic model**[44] and Shanghai and several other cities in China have been working on similar metrics for some time.

We kicked off the Societal Value Metrics for Open Technology project in March 2022, in collaboration and with the support of the newly created **OpenUK Sustainability Advisory Board**[45] sponsored by Intel, composed of people working on a broad spectrum of sustainability issues across government, business, academia, technology and NGOs. The **scope of the project is as simple as it is challenging: how do we measure the contribution of Open Technology to society, in non-economic terms?**

The first (and current) phase of the project is an **extensive literature review** in order to understand the landscape of measuring the societal value of something (technology, public services, infrastructure, buildings, etc), and how each of these initiatives defined their value themes, how those value themes align with the Sustainable Development Goals **(SDGs)**[46]**, what is being measured against them**, and what **examples of non-monetary measurement units have been used.**

Three cases from this literature review can be used to summarise the societal value measurement landscape:

Digital Public Goods Registry

For the technology sector, the Digital Public Goods Alliance has created a registry of open technology solutions that directly benefit at least one SDG and can therefore be considered a "digital public good".[47] This includes full solutions using Open Source Software, open data, open AI models, open standards or open content. It does not include components, code in the stack, or open hardware solutions. The qualifying criteria for belonging on the registry takes into account the solution's relevance to the SDGs, the use of approved open licenses, clear ownership, platform independence, documentation, data privacy mechanism, and a do not harm by design approach. It does not attempt to measure the value of the solutions in the registry.

43 Video footage available at https://openuk.uk/sustainability/
44 https://www.kateraworth.com/doughnut/
45 https://openuk.uk/sustainability-advisory-board/
46 https://sdgs.un.org/goals
47 https://digitalpublicgoods.net/registry/

Scotland National Performance Framework

The Scottish Government published this framework to give a measure of national well being across social, environmental and economic indicators in order to inform public services reform, procurement, and equality policy development. The value themes being measured, or outcomes, include Children & Young People, Communities, Culture, Economy, Education, Environment, Fair Work & Business, Health, Human Rights, International, and Poverty. Each of these outcomes, which are essentially a localisation of the SDGs, are broken down into several indicators (81 in total) which determine the performance across each outcome as follows: Improving, Maintaining, Worsening, TBC, In Development.

UKGBC Delivering Social Value Measurement

For the built environment, the UK Green Buildings Council (UKGBC) has published their framework to measure the social value (environmental, economic and social) of buildings and places. It focuses on the development life cycle of buildings and places, which includes Investment, Planning, Design, Construction and Operation and their contribution to the following value themes: Jobs & Economic Growth; Health, Wellbeing & Environment; Strength of Community (with specific indicators for each theme). The measurement output is always a monetary value.

During the next phases of the Societal Value Metrics for Open Technology project, the **working group will be considering the following questions:**

- What Open Technology (hardware, software, data) is being measured? This includes understanding where it resides, and how code in the stack, components and partial solutions are considered.
- How should the value themes be defined for Open Technology and how do these align with the SDGs?
- What is the non-economic measurement output for each value theme?

"In terms of sustainability, it's something that doesn't come up enough in Open Source Software. A lot of the impetus seems to be on hyper scalars for this kind of stuff - if we start to try and build much more efficient software, and consider how we actually architect things, there's currently not a way to say, OK, this workload will probably consume this much energy, run it at night in these locations, stuff like that. We don't have that sort of as part of it yet but we need it."

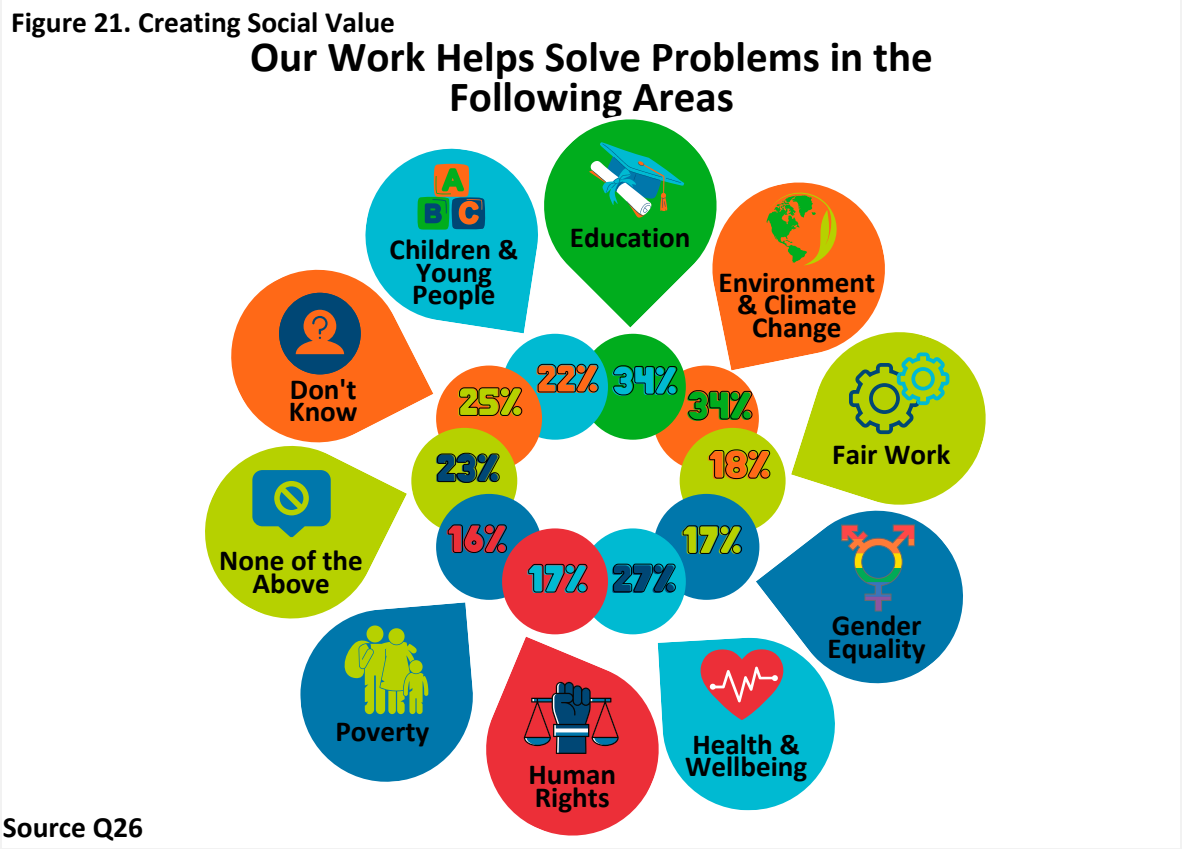
Joseph Salisbury, VP Engineering, Giant Swarm

"Fitting to the philosophies and beliefs of CIVO, both on the software which we wanted to be open, but on the hardware, we chose to be open as well. We contribute back as an Open Compute member. We only buy Open Compute hardware currently and there's real efficiency savings. It's great for sustainability as well."

Mark Boost, CEO, Civo.com

The Societal Value Metrics for Open Technology project will be showcased at the second annual OpenUK Open Technology for Sustainability Day in Edinburgh on 16 November, 2022. A third phase of this report will be shared focusing on sustainability and Open Technology.

Figure 21. Creating Social Value



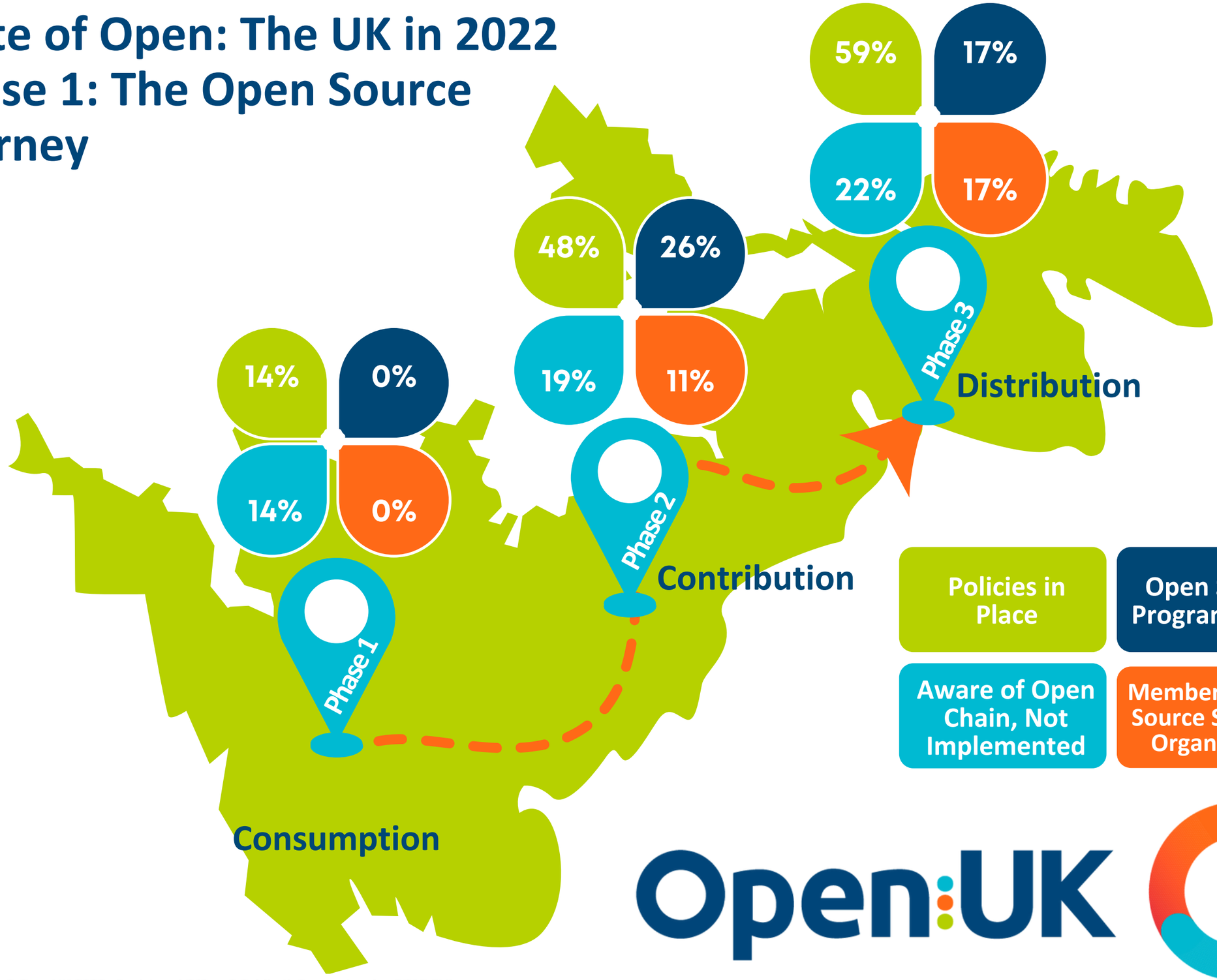
Source Q26

"Fitting to the philosophies and beliefs of CIVO, both on the software which we wanted to be open, but on the hardware, we chose to be open as well. We contribute back as an Open Compute member. We only buy Open Compute hardware currently and there's real efficiency savings. It's great for sustainability as well."

Mark Boost, CEO, Civo.com

6. Conclusion
The Open Source Software Journey - 2 page infographic

State of Open: The UK in 2022
Phase 1: The Open Source Journey



Open:UK

6.2 Conclusion - Thought Leadership
Dr Jennifer Barth, Smoothmedia

For the second consecutive year we surveyed organisations in the UK about the role of Open Source Software in their practices and processes, their challenges, the skill set they need, and their organisational goals. We were delighted when almost 250 people took the time to fill it in, and pleased by the results. In 2021 we looked at adoption to showcase the vast amount of Open Source Software innovation and innovators in the UK. In 2022 we charted the journey to Open Source Software maturity - those consuming; consuming and distributing; and those organisations consuming, contributing and distributing, Open Source Software - and found that organisations in the UK are mature in relation to Open Source. We draw attention to the importance of innovation in that journey to maturity.

Roger's Law of Diffusion helps us to understand how innovation moves through different audiences and levels of engagement. Diffusion, he notes, is the process by which a new innovation or product is communicated over time amongst the participants in a social system or market. New ideas move through from disruptive innovators to early adopters fairly seamlessly before reaching a critical point, a chasm, that organisations must move through to come out the other side of majority. We know how this works in practise but in order to demonstrate that journey for any individual set of technologies or domains - like the proliferation of Open Source Software - through various levels of maturity, you first need to understand what are the catalysts or enablers that support organisations with shifting from one stage of maturity to another.

Organisations have long been challenged to cross the chasm in innovation theory but are often bewildered by what steps would be necessary to get their product into the mainstream or to enable whole organisation adoption and willingness to engage with new things. This year's State of Open: The UK in 2022 report focuses on the Open Source journey and reveals some of the crucial enabling factors that support organisations to cross that chasm. We chart the landscape from consuming Open Source Software to a deeper level of maturity including contributing and then distributing, bringing to light what it takes to go wider and deeper with Open Source Software - to integrate, collaborate and extend its reach.

Case studies including Dumfries and Galloway Council in Scotland, the Scottish are treading into new territory, consuming Open Source Software for social good with all of its scalability potential. The Scottish Government is encouraging cooperation and interoperability with its Analytical Workbench. The BBC Research and Development team knows the quality of code and OpenStack is made better by the BBC contributing upstream - they are leading lights in broadcasting technology. The BBC's Standards project knows the value of collaboration and creating a tool that has a global importance and reach.

To cross a chasm you have to build bridges and these need to be stable, able to bear weight, and be a foundation for further development. We take the research through precisely this bridge building by showing the aspects of good hygiene that organisations are adopting to support and sustain Open Source Software development.

These good hygiene indicators include having policies and procedures in place internally to guide security, legal and other aspects of development - using SBOM's, implementing Open Chain, being members of Open Invention Network or OpenSSF or other Open Source organisations all indicate a connection to the broader community and being involved in setting standards the ecosystem can follow.

The small number of respondents in the survey that are only consuming Open Source Software, regardless of the length of time they have been doing so, have not yet taken

the leap across the chasm and show very low numbers in respect of good hygiene. The governance and hygiene numbers grow as we look at organisations that both consume and contribute. Certainly in the interviews with individuals and case studies it was clear that moving from consuming only to contributing to code increases engagement with the network of Open Source Software people and resources and makes visible the need for policies and procedures to guide interaction.

The numbers start to look healthy when looking at the majority of the respondents, 81%, that consume, contribute to and distribute Open Source Software. As such, we found in the UK these bridges are being built and there is migration across them in many areas and industries. These foundational elements are catalysts for believing in the stability of the bridge that allows Open Source Software to drive business growth and opportunity. Skyscanner has built its business on these foundational elements, Nationwide pushes the financial world with its use of Open Source Software in a traditionally less open industry and New Look will use Open Source Software in and through its digital transformation re-boot.

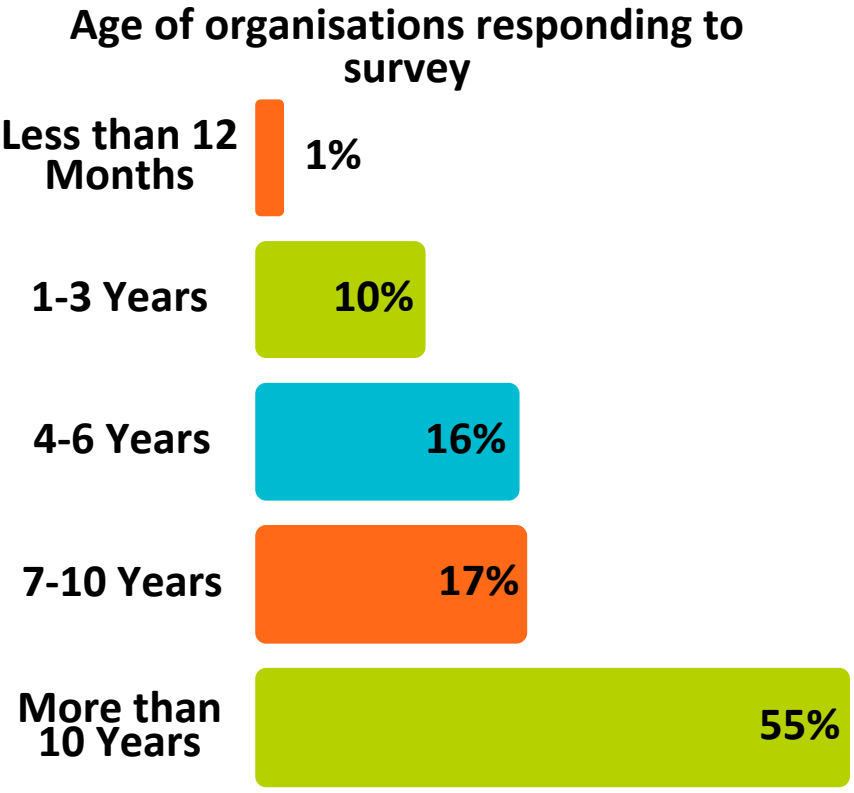
On the other side of the chasm lies a whole new land to explore: new markets, new brown and green field spaces to take on new competitors, new audiences and increased access to them, and customer engagement. Here you need to be able to explain your presence and to make clear your purpose, the impacts you will have and the speed at which you can deliver the results.

This is nothing less than a cultural transformation that can occur alongside the technical transformation. A willingness to engage more deeply, to create richer and more meaningful experiences and to collaborate. The research shows that collaboration is strong amongst organsiations in the UK at 94%. OVO's Domain Protect is a showcase for a high level of maturity in realising both the internal potential and need of the project and also the creative potential of contributors, the skill development it enables and how it allows OVO to place itself as a technological innovator.

This cultural shift brings to bear the literacies that need to be in place to harness the potential of this frontier. The situation looks good and with awareness and action towards responsible citizenship in the Open Source community is growing. We now need to further integrate the next step - critical thinking, a sense of purpose, and a willingness to engage more deeply to create richer and more meaningful experiences.

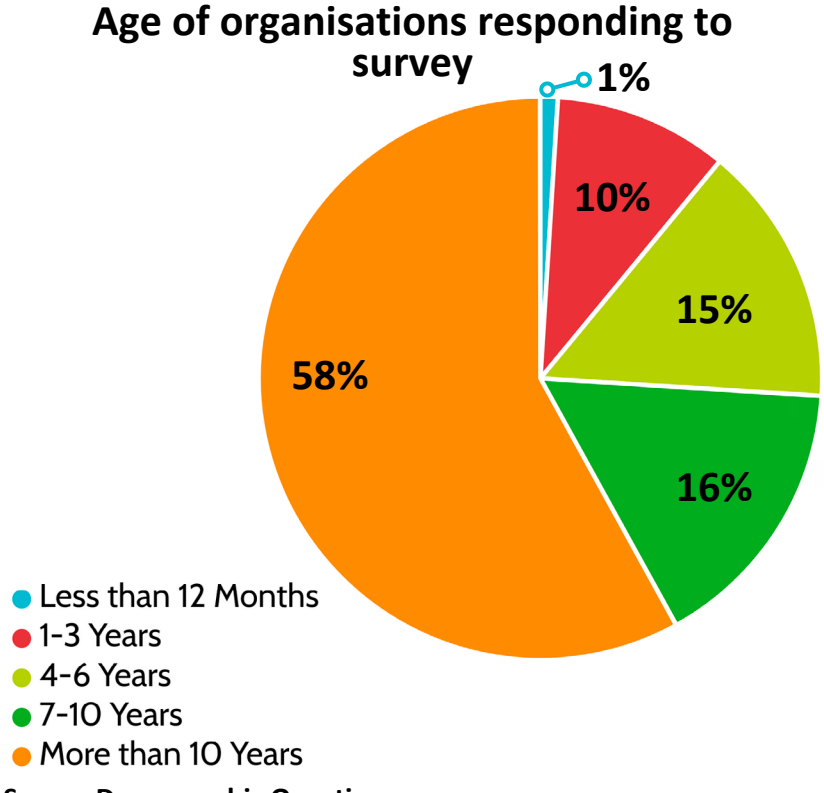
The majority of responses (55%) came from established organisations (operating more than 10 years).

Figure 22. Age of organisations responding to survey



Source Demographic Questions

Figure 23. Age of organisations responding to survey



Source Demographic Questions

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8. Acknowledgments, Methodology and Resources

8.1 Acknowledgements

The research was led by Dr Jennifer Barth, Research Director at Smoothmedia Consulting Ltd in partnership with Amanda Brock, CEO OpenUK in 2022. The independent team of economists, psychologists, data scientists and social scientists included Dr. Eurydice Fotopoulou and Areej Ahsan. Thanks for their contributions to our Creative Director and graphic designer, Georgia Cooke, Web developer Elefteria Kokkinia at Civic and Media Manager George Bareham.

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We are grateful to the large group of contributors to our workshops from many companies and foundations, all of whom are working on research, reporting and the economics of open source software and who will continue to meet quarterly to evolve this research. They are too many to list but know who they are. Anyone interested in taking part should contact admin@openuk.uk

8.2 Methodology

The research used a mixed method approach to explore and demonstrate the evolving journey of Open Source Software consumption, contribution and distribution in the UK. The survey collected responses from 10 May until 16 June, 2022, as an anonymous online questionnaire, circulated online via OpenUK. Due to the method of administration of the survey, there might be proximity bias, but as we were surveying a specific population (current consumers and custodians of Open Source Software) which forms a tight-knit community, this would be unavoidable.

We received 243 responses, which, after removing non-UK responses and non-users of Open Source Software, yielded a sample of 211 valid answers by organisations both from the private and the public sector, predominantly active in technology, media and telecommunications.

The microstudy in section 2.1 represents a very small proportion of the population we are interested in and it is presented here for reference only. Results from the microstudy should thus be considered with caution.

We used data collected in the survey for the purposes of this report to estimate the time spent by organisation size on Open Source Software (for the labour input: hours spent on open source) and the amount of investment by organisations (for the capital input: proportion of their total investment in software). This method is consistent with the way software investment flows are measured internationally, and can be replicated without reliance on external, possibly commercially sensitive, or inaccessible data. The caveat is that our survey drew responses heavily from professionals in the technology sector, possibly underestimating investment in open source by other sectors for which we have no data.

All numbers are reported as rounded percentages to avoid disclosure.

The regional distribution reflects the concentration of economic activity in the UK, with most (78%) responses coming from England. This however does not mean that there is little engagement with Open Source Software in other regions, it simply indicates that there were fewer respondents from these regions.

Interviews were conducted with industry leaders and organisational heads of large, medium and small organisations in the UK included as case studies on the value of Open Source Software.

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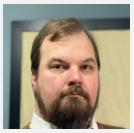
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Smoothmedia
Smoothmedia looks beyond the surface and behind the curtain of the fundamental innovations and trends shaping our society, markets, culture, and values. We are academics and researchers looking at the intersections of emerging technology and socioeconomic impact, producing independent research for thought leadership and PR.

Smoothmedia's mission is to share and grow knowledge about everyday lives. We want to understand the past, present, and future of human interaction with emerging technologies and socioeconomic changes—from behaviour to context, nature to nurture, origin to experiences—so we can help our clients engage their clients and public imagination.

Amanda Brock
Amanda Brock is CEO of OpenUK, the UK organisation for the business of Open Technology in the UK – being open source software, open hardware and open data -with a purpose of UK Leadership and International Collaboration in Open Technology. She is a Board Member of the Open Source Initiative; UK Cabinet Office Open Standards Board Member; British Computer Society Inaugural Influence Board Member; Advisory Board Member: KDE, Planet Crust, Everseen, and Mimoto; Charity Trustee, Creative Crieff and GeekZone; and European Representative of the Open Invention Network.

Amanda was awarded the 2022 UK Lifetime Achievement Award in the Women, Influence & Power Awards, and included in Computer Weekly's Most influential Women in Tech Long list in 2021 and in their UK Tech50 longlist for 2022.

She is the editor of Open Source, Law, Policy and Practise, second edition being published by Oxford University Press in October 2022 and with open access thanks to the Vietsch Foundation.

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OpenUK
OpenUK is the organisation for the business of Open Technology in the UK, being Open Source Software, open source hardware and open data. As an industry organisation, OpenUK gives its participants greater influence than they could ever achieve alone. Open UK's purpose is to promote UK leadership and global collaboration in Open Technology.

OpenUK is committed to promoting UK leadership in Open Technology and supporting collaboration between businesses, public sector organisations, government and communities to expand the opportunities available to all around Open Technology on a global basis. OpenUK creates a visible Open Technology community in the UK, and uses that community's impact to ensure that the UK's laws and policies work for Open Technology whilst encouraging the future community in the business of Open Technology through learning.

OpenUK is a not-for-profit company limited by guarantee, company number 11209475 with its registered office at 8 Coldbath Square, London EC1R 5HS

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Appendix 1 State of Open Survey 2022

Questions

Where are you based? (Tick one only)

England
Wales
Scotland
Northern Ireland
No in the UK (Skip to section 11)

The Basics

1. What is the role within you business? (Tick one only)

Architect
C Suite or Executive (CXO)
Community
Director or VP
Engineer or Developer
Legal or Governance
Manager
Senior Manager
Non Executive
Open Source Program Officer
Other:

2. What sector is most applicable to your business? (Tick one only)

Banking, Insurance and Financial Services
Defence
Education
Energy and Utilities
Entertainment
Hotels and Hospitality
Health and Pharma
Professional Services
Public Sector
Retail
Technology, Media and Telecoms
Transport and Logistics
None of the above
I don't know

The Journey to Open Source Software

3. How long ago was your organisation founded

Less than 12 months
1-3 years
4-6 years
7-10 years
More than 10 years
I don't know

4. How long has your organisation consumed, contributed or distributed open source software?

Less than 12 months
1-3 years
4-6 years
7-10 years
More than 10 years
We do not do this (Skip to section 11)
I don't know

5. How long has your organisation:

	Less than 12 months	1-3 years	4-6 years	7-10 years	More than 10 years	I don't know
Consumed Open Source Software						
Contributed to Open Source Software						
Maintained Open Source Software						
Distributed products or services including Open Source Software						

6. Does your organisation consumer, contributed to or distributed any of the following open source software: (Tick all that apply)

Big data tools e.g. Kafka, Hadoop
Blockchain e.g. Hyperledger, Ethereum
Compilers e.g. gcc, LLVM
Container/ cloud native technology e.g. Docker, Kubernetes, Cilium
Databases e.g. MySQL, PostgreSQL, Cassandra
Front end technology e.g. React, Angular
Observability tools e.g. OpenTelemetry, Prometheus, Grafana
Operating systems e.g. Linux, Android
Security tools e.g. Snort, Notary and Trivy
Software build tools e.g. Ant, Grandle, npm
Software tools e.g. Jenkins, Git
Web software e.g. WordPress, Drupal, Magento
None of the above
I don't know
Other

7. If your organisation distributes any of its code as open source software which of the following does it use to make that code publicly available? (Tick all that apply)

Azure DevOps
BitBucket
Gitee.com
GitHub.com
GitLab.com
Gitlab (self-hosted)
SourceForge
Other self-hosted Git service
Other service
We don't share code as open source
I don't know

8. How many employees does your organisation currently have? (Tick one only)

Up to 10 people
11-49 people
50-99 people
100-249 people
250-499 people
500-999 people
1,000 or more
I don't know

9. With respect to staff helping your organisation consumer, contribute to or distribute open source software? (Tick all that apply and scroll to see more roles)

1. Has your organisation recruited any of the following roles?
2. Does your organisation plan to recruit any of the following roles?

Options

Agile Lead/Scrum Master
Back End Developer
Cloud Engineer
Cloud Architect
Community roles
CTO
C Suite/CXO
Development Lead
DevOps Engineer
DevOps Architect
Developer Relations roles
Director/VP
Enterprise Architect
Front End Developer
Full Stack Developer
Non-Engineering technical team e.g. design, documentation
Open Source Program Office staff
Product Manager
Project or Program Manager
Solution Architect
SRE
System Administrator
Security
Support Roles e.g. legal and governance, sales, marketing
UX or UI Designer
I don't know
Other

10. Can you estimate how much time is spent on average each week working on or supporting open source software by your organisation? (Tick one only)

0-20 hours
21-40 hours
41-100 hours
101-150 hours
151-200 hours
201-500 hours
501-1,000 hours
More than 1,000 hours

Values, Innovation and Collaboration

11. Does your organisation receive any of the following benefits by consuming, contributing to or distributing open source software: (Tick all that apply)

Agility increases in development process
Availability of technology as open source only
Brand association and recognition
Collaboration
Community contributions
Connections in the industry
Cost savings of licence fees
Cost savings through collaborative development
Costs savings – other
Delivery times accelerated
Diversity, Equity and Inclusion
Documentation for software
Governance understanding
Improved quality of code
Improved innovation
Improved security
Influence feature development in projects
Influence projects otherwise
Interoperability and lack of lock-in
Licensing understanding
Skills development and know how
None of the above
I don't know

12. Does your organisation face any of the following challenges by consuming, contributing to or distributing open source software: (Tick all that apply)

Costs of foundation membership
Costs of implementation
Costs of maintenance and security
Costs of participation in community
Costs of governance
Costs – other
Lack of coding skills or technical knowledge
Lack of licensing, governance and good practice knowledge
Interoperability and incompatibility with existing technology
Lack of trust in open source software
Lack of understanding in senior open source management
Lock-in to existing suppliers
Maintenance concerns
Organisational or managerial resistance
Security concerns
None of the above
I don't know

13. Does your organisation collaborate on software development: (Tick all that apply)

In private with other teams in the same organisation ("inner source")
In private with other corporate enterprises
In public with other organisations that are competitors to your organisation using an open source licence
In private with academic institutions
In public with academic institutions using an open source licence
In private with public sector organisations
In public with public sector organisations using an open source licence
In private with non-profit organisations
In public with non-profit organisations using an open source licence
In private with volunteer communities
In public with volunteer communities using an open source licence
We do not collaborate on software development
I don't know

Governance and Good Hygiene

14. Is your organisation aware of and using:

	Yes, my organisation is aware of but does not have	Yes, my organisation is aware of and has	No, my organisation is not aware of the need for this and does not have	I don't know
A policy for the consumption, contribution to, and distribution of open source software? (Tick one only)				
Procedures for the consumption, contribution to, and distribution of open source software? (Tick one only)				

15. Is your organisation aware of and using:

	Yes, my organisation is aware of but does not use	Yes, my organisation is aware of and uses	No, my organisation is not aware of the need for this and does not use	I don't know
Open Chain, the supply chain standard for open source software? (Tick one only)				
Software "Bill of Materials" (SBOMs), such as the SPDX standard, requiring suppliers to provide, or providing to your customers, an SBOM for open source software? (Tick one only)				

16. Who owns the copyright in open source software created for your organisation by suppliers? (Tick one only)

- Copyright remains with the supplier
- Copyright is transferred to our organisation
- I don't know

17. Does your organisation register, hold or intend to register and hold patents in relation to open source software? (Tick one only)

- Yes
- No
- I don't know

18. Is your organisation aware of and a member of the Open Invention Network (OIN)? (Tick one only)

- Yes, we are aware of OIN but not a member
- Yes, we are aware of OIN and are a member
- No, we are not aware of OIN
- I don't know

19. Is your organisation aware of the concept of an Open Source Program Office (OSPO) and does it have one? (Tick one only)

- Yes, we are aware of OSPOs but do not have
- Yes, we are aware of OSPOs and have part-time
- Yes, we are aware of OSPOs and have full-time
- No, we are not aware of OSPOs
- I don't know

20. Is your organisation a member of any open source software organisation eg Apache Foundation, Eclipse Foundation, Linux Foundation, Open Source Initiative? (Tick one only)

- Yes
- No
- I don't know

21.Does your organisation participate in the work of any standards organisation whose standards may impact open source software? (Tick one only)

- Yes
- No
- I don't know

22a. If Yes to Question 22 - which incidents?

23. Does your organisation consider open source software as a greater security risk than proprietary software? (Tick one only)

- Yes
- No
- I don't know

24. Does your organisation have the following with respect to open source software? (Tick all that apply)

- Staff working as a maintainer or core participant with a security focus
- Security Policy (a definition of what it means to be secure for a given system)
- Software composition/dependency analysis (a tool to identify dependencies with known vulnerabilities, e.g. Dependabot, Synk, Black Duck)
- Static analysis (a tool that analyses source code for security vulnerabilities without executing it, e.g., Checkmarx, Coverity Scan)
- Dynamic web application testing tools (e.g. OWASP ZAP, Burp Suite)
- Support for TLS encryption on website, downloads, and infrastructure
- Project threat models (a practice of identifying and prioritising potential threats & security mitigations)
- Code or binary artifact signing
- Vulnerability disclosure policy (guidelines for users to report vulnerabilities, and how to process those reports)
- Bug bounty programs for software the organisation delivers
- None of the above
- I don't know

25.Is your organisation aware of, or a member of, the Open Source Software Security Foundation (OpenSSF)? (Tick one only)

- Yes, we are aware of OpenSSF but not a member
- Yes, we are aware of OpenSSF and are a member
- No, we are not aware of OpenSSF
- I don't know

Sustainability and the Sustainable Development Goals

26. Does the open source you consume, contribute to or distribute create value for, or help solve problems across any of the following areas: (Tick all that apply)

- Children & Young People
- Education
- Environment & Climate Change
- Fair Work
- Gender Equality
- Health & Wellbeing
- Human Rights
- Poverty
- None of the Above
- I don't know

Finance and Investment

27. What was your organisation's revenue in £GBP in:

	No revenue	Under 249ks	250k-499k	500k-999k	1m-1.999m	2m-4.999m	5m-9.999m	50 million	Prefer not to say
2021									
2022									

28. How much does your organisation spend on all software and related services including software subscription, software services, database and cloud services but excluding any employee salaries in the last tax year? (Tick one only)

£0
Up to £5,000
£5,001 - £10,000
£10,001 - £20,000
£20,001 - £50,000
£50,001 - £100,000
£100,001 - £200,000
More than £200,000
I don't know

29. What proportion of the spend in Question 28 is allocated to open source software? (Tick one only)

0%
1-10%
11-20%
21-30%
31-40%
41-50%
51-60%
61-70%
71-80%
81-90%
91-100%

30. Is it appropriate that organisations benefiting from open source software contribute financially to development communities and maintenance of open source software? (Tick one only)

Yes
No
I don't know

Demographic Questions
Diversity in all forms is celebrated at OpenUK and we ask these questions in the spirit of this.

Where is your organisation's head office located?

In the UK
Outside the UK

What is your age? (Tick one only)

25 or younger
26-34
35 – 44
45 – 54
55 – 64
Over 65
Prefer not to say

What is your gender? (Tick one only)

Female
Male
Non-binary
Other
Prefer not to say

What is your ethnicity? (Tick one only)

English / Welsh / Scottish / Northern Irish / British
Irish
Roma or Irish Traveller
Any other White background
White and Black Caribbean
White and Black African
White and Asian
Any other Mixed / Multiple ethnic background
Indian
Pakistani
Bangladeshi
Chinese
Any other Asian background
African
Caribbean
Any other Black / African / Caribbean background
Arab
Any other ethnic group
Prefer not to say

Do you identify as neurodiverse? (Tick one only)

Yes
No
Prefer not to say

Was your country of birth outside of the UK? (Tick one only)

Yes
No
Prefer not to say

Would you say that your day-to-day activities are limited because of a health problem or disability which has lasted, or is expected to last, at least 12 months? (Tick one only)

Yes
No
Prefer not to say

What is your current employment status? (Tick one only)

Employed Full-Time
Employed Part-Time
Freelance / contracting
Seeking Opportunities
Retired
Prefer not to say

Do you volunteer/ provide pro bono skills to any open source project? (Tick one only)

Yes
No
Prefer not to say

Would you like to add any comments?

Before you submit your response...
Thank you for taking the time to do our survey. OpenUK and its agents Smoothmedia will use your information provided in this survey solely in accordance with its privacy policy (https://openuk.uk/privacy-policy/) and all privacy requirements applicable under the laws of England and Wales, Northern Ireland, and Scotland as appropriate.

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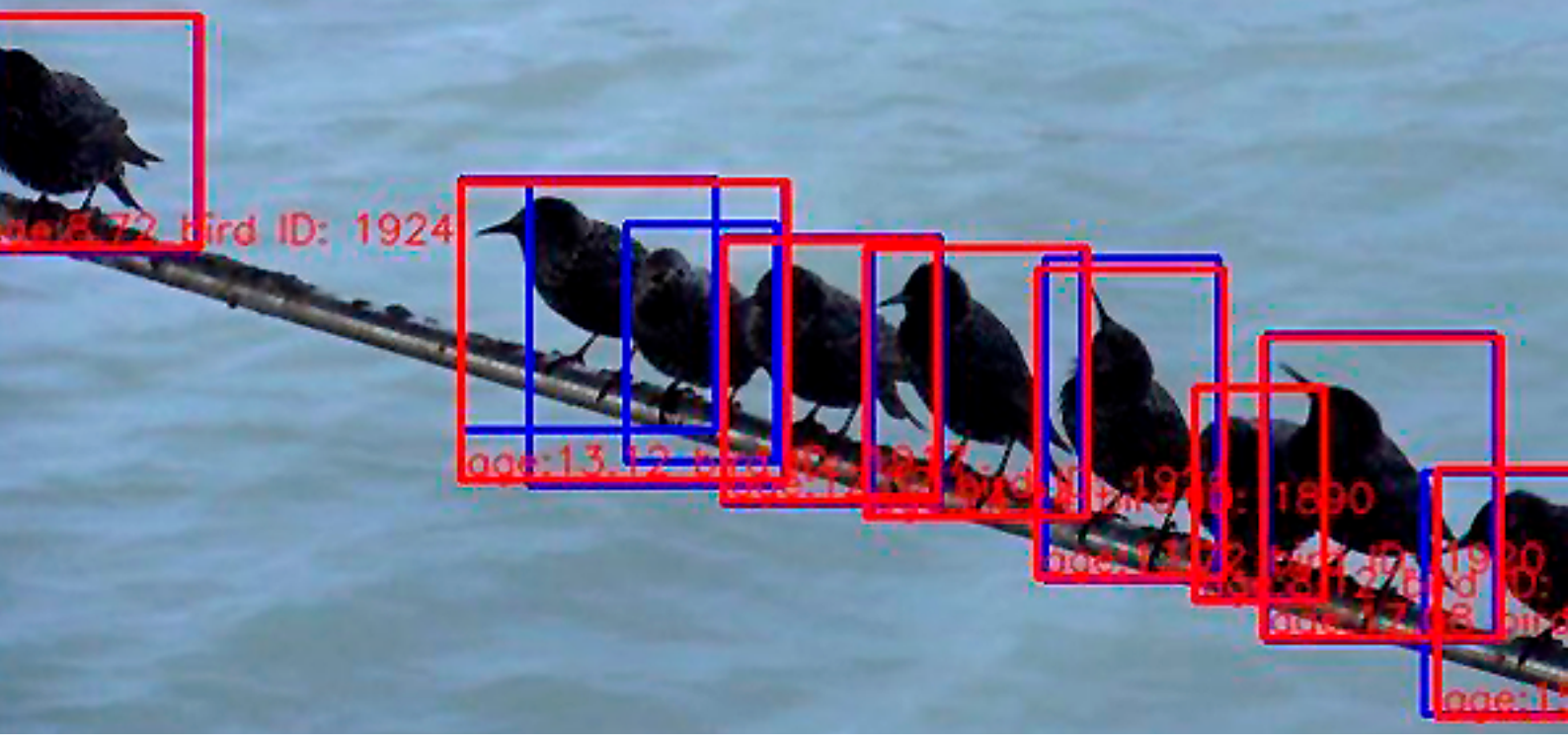

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