Over the last decade, open source has proven to be the best way to collaborate on technology platforms and promote the adoption of innovation.

Open source is the enabler for innovation and collaboration

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Open source and open hardware have become more and more popular over the last two decades, in information technology (IT) circles, in the research and academia ecosystem, and even in industry. However, there are different types of open source project, from individual-driven projects to more corporate-driven and even collaborative projects, and every user or contributor should be conscious about what they get from the open source ecosystem, how they should contribute, and what they should put in place to benefit from the open source.

In this article, we cover how open source provides a global legal framework for collaboration (including between research and industry players), how open source foundations play a key role in helping organizations do open source properly, and how this can enable European leadership for upcoming technology trends.

Key insights

- Open source is a global framework for collaboration and innovation.
- Permissive licences and weak copyleft licences lower the barrier to usage and participation for industry players.
- Open source foundations like the Eclipse Foundation are there to support research and industry players to do open source the right way.
- European research and industry actors can thrive with open source by promoting global adoption of their innovations.

Key recommendations

- Use of open source to promote collaboration between academia and industry.
- Adopt permissive licences to lower barriers to collaboration with industry.
- Leverage the experience, governance, and processes of existing open source foundations established in Europe.

When I started working on open source in 2002, I was a technical architect at a French telecommunications operator, and our goal was to reduce the cost of our platforms by moving from proprietary Unix systems to Linux running on Intel hardware. At the time, open source was mostly a commoditization approach, and the main goal was to challenge monopolies and to reduce the cost of platforms by building and using open source alternatives to existing platforms: That's when the Apache HTTP Server, MySQL and to some extent PostgreSQL or the Eclipse development tools bloomed.

That's also when Linux won on the server side, while later the Linux kernel achieved more adoption in embedded systems.

However, as different stakeholders increasingly began to understand the open source model, it became clear that this was also a good way of getting adoption for innovative technologies. For the last 10 years, the platforms for big data, cloud and artificial intelligence (AI) technologies have been open source.

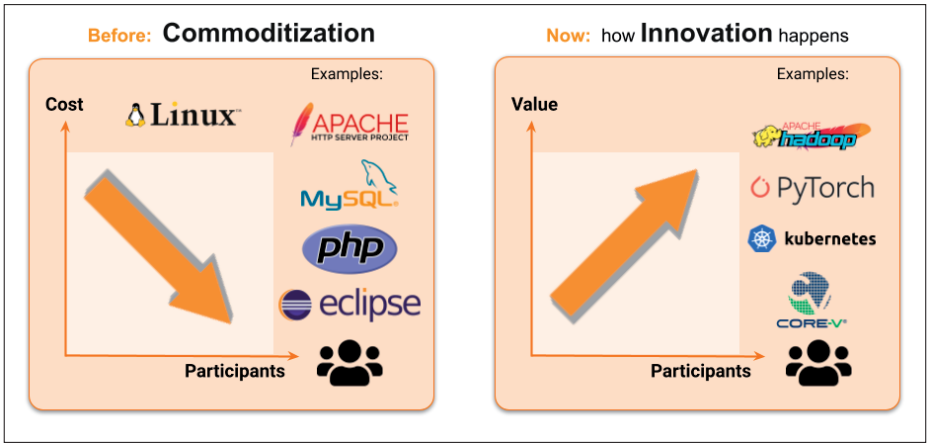

Figure 1: The shifting impact of open source

Open source superpowers have been used for more than 10 years to enable global collaboration in key technologies. This is because, as discussed below, 1) open source provides a proven global legal framework for collaboration and 2) open source provides a platform for most applications.

Open source as a global legal framework

The Free Software Foundation was founded in 1985 by Richard Stallman, from MIT, to support the free software movement. The foundation's "Free Software Definition" relies on the four essential freedoms [1] that allow anybody to run, study, modify and redistribute "free software".

In 1998, after the announcement of the release of the Netscape source code, the term "open source" was suggested by Christine Peterson to promote free software without the additional connotations of "free" (i.e. "free of cost") in the English language. The Open Source Initiative (OSI) was founded in February 1998 by Eric Raymond and Bruce Perens. The OSI published the "Open Source Definition" [2] that builds on top of the four freedoms and expresses with 10 clear points how a licence can comply with the definition. Since its creation, the OSI has been maintaining a list of approved licences [3].

Developers sometimes lose sight of the fact that both the free software and the open source definitions have enabled a global legal framework for software:

1. When an individual or an organization publishes software under an open source licence, they select the legal clauses of this specific licence to publish their intellectual property,
2. When an organization decides to use an open source component, they accept the use of it under the terms of the specific licence,
3. Open source licences are short (five pages long for the Apache Software Licenses V2 [4] or the Eclipse Public License V2 [5] or even shorter for the MIT License that is fewer than 200 words long [6]) and well understood globally).

Open source grows as it empowers application developers

Recent statistics show that 80-90% of applications use open source components [7]. This means that organizations can build applications by putting together existing open source components and focus on the 10-20% code that forms their unique value proposition.

This is possible thanks to the four fundamental freedoms. A good example of how open source enables modern applications is that, just as some proprietary licences explicitly restrict the usage of the software to non-life-critical functions, the Open Source Definition has the following "No Discrimination Against Fields of Endeavor" clause: "The license must not restrict anyone from making use of the program in a specific field of endeavor. For example, it may not restrict the program from being used in a business, or from being used for genetic research."

Any organization is empowered to use an open source kernel, platform, or component in their application without asking the authors of such components for permission.

All open source licences comply with the Open Source Definition, they all come with rights (at least the four freedoms, and often more), but they also come with duties and restrictions. The "JoinUp Licensing Assistant" describes the characteristics of different licences and enables comparison of different licences [8].

Over the years, users have identified that open source is not exempt from licence compatibility issues, and most companies have created an "open source compliance" process to ensure that they comply with the licences of components they redistribute in their products.

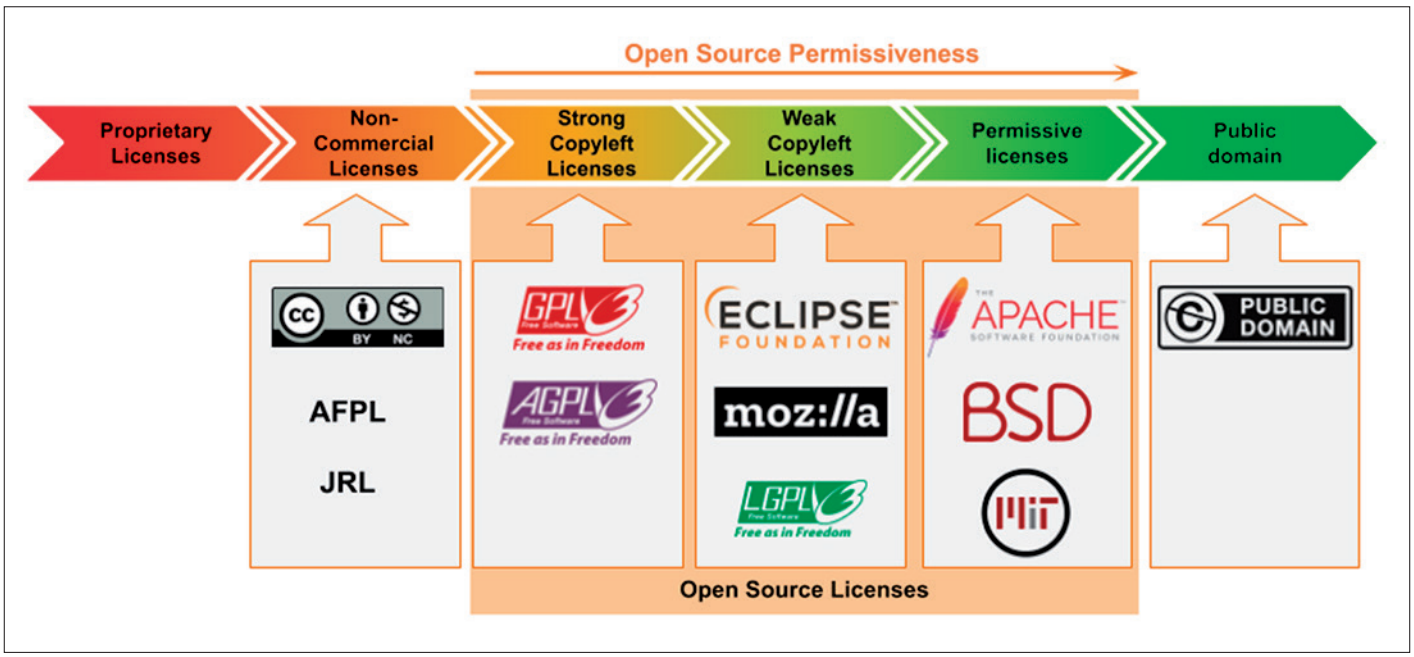

Figure 2: Open Source licences spectrum

To make things simple, developers and users of open source have widely adopted "weak copyleft" and "permissive licences" to facilitate collaboration and reuse of open source components in a product, without imposing constraints on the licence of the final product. That's the main reason why the Apache Software License became the most popular open source licence [9].

Beyond making open source compliance easier, the advantage of weak copyleft and permissive licences is that they enable collaboration between industry partners independently of how they will exploit the open source software: professional services, training, support, or even integrating the open source components in a proprietary software product. With these licences, as they limit the duties on users, the focus is on collaboration and, in most companies, components under licences like the Apache Software License, the BSD family of licences, the MIT License, or the Eclipse Public License can be used without any additional checks from the legal team.

Not all open source projects are "equal"

To simplify, one can consider that there are three main categories of open source projects: individual-driven open source, single-vendor open source, and open source hosted by foundations.

Some projects, started by individuals, are casually hosted on public platforms like GitHub or GitLab, and organically grow in popularity. It is more likely that an open source project driven by a single individual may struggle at some point to address different issues. One example is that the more the project becomes successful, the more it may get external contributions, and the more pressure the initial contributor may receive. Additionally, the individual may not have the skills or interest to address non-functional topics like security, performance or scalability. Finally, an individual, or a small group of individuals can be overwhelmed, shift interest to a new project, or even find a new job thanks to their new visibility acquired through open source that could get them away from the project. As we will see later, it is important to consider that when you use an open source component, some of its dependencies can be such a project, or even in some cases, an "orphan project" with barely any active maintainers.

Other projects that we call "single-vendor open source projects" [10], are mainly developed and supported by a single company. Most of the time, such a company requires contributors to sign a "Contributor License Agreement" to bring together all the intellectual property rights of the project. That enables different business models which likely make the project sustainable, but recent history has shown that single-vendor open source may sometimes stop being open source at some point [11]. This can be an issue for users who then need to find a plan B like becoming a customer of a product which is no longer open source, or fork the open source project...

The third main option is open source projects hosted by a well-established open source foundation.

Open source foundations as catalysers of best practices

Beyond code and documentation, an important aspect of open source projects is their governance. Open source governance is the set of rules that define who takes decisions in an open source project, how to engage with an open source project, how contributions are accepted, how a developer can gain write access to the project repository by becoming a committer, the rules that ensure the vendor neutrality of the ecosystem, …

Most successful projects have well-defined open source governance, as this provides a safe environment for users and contributors of a project. The goals of open source governance are to provide vendor-neutrality, to enable a multi-vendor ecosystem, to sustain a diverse community around the project, and to protect the investments of contributors and users of the project.

For more than 20 years, open source foundations have provided the governance framework for fruitful open source collaboration. Let's take the example of the governance framework of the Eclipse Foundation. As a non-profit organization established in Europe, the Eclipse Foundation has a mission to provide governance and sustainability for the projects that are hosted by the foundation.

In addition to that, the Eclipse Foundation provides a "community of practice" that enables companies to adopt open source best practices and fosters values of transparency, openness, meritocracy, and vendor neutrality.

Open source as a catalyser for European technology transfer

European research teams constantly make important advances in their areas of study, but they sometimes fail to provide a clear path to build on the results of their research in a way that creates value for industry and society. For almost ten years, the Eclipse Foundation has been working with European researchers and

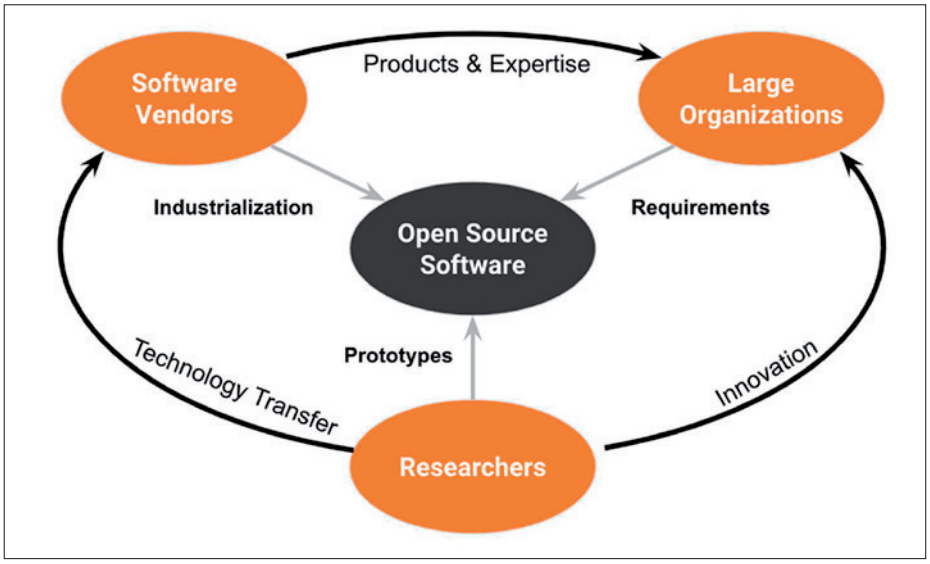

Figure 3: Open Source software as a catalyst for technology transfer and innovation

academics to help them create, evolve, and sustain open source projects that capture the results of their research so they can be disseminated and commercialized to solve real-world challenges

Researchers can leverage open source to build an open ecosystem that enables industry players and technology adopters to collaborate and build on their research. Everyone interested in using and contributing to further the research results can collaborate without the significant complexity and costs of setting up multiple contracts and licence agreements.

This is possible because the open source software acts as a catalyst for technology:

- industry players bring their requirements,
- academics and researchers innovate to develop solution prototypes that meet industry needs,
- software vendors industrialize these innovations to deliver products.

This kind of collaboration is greatly facilitated by open source best practices and business models.

As we argued in [12], thanks to its role in driving innovation, open source can allow researchers to challenge the status quo and become leaders in a specific field: look at the RISC-V initiative and OpenHW Group as examples. This is particularly important for Europe, which lacks the major vertical companies dominant in other parts of the world but which has a strong research infrastructure. Open source enables digital autonomy because it replaces dependency on proprietary intellectual property mainly owned by non-European companies with the need to invest in people and skills. European countries, with their well-established universities and robust education systems, are a great source of skilled researchers and engineers.

If European companies play alone against the major technology giants, at best they will be bought out, at worst put out of business. So if a European company wants a competitive edge, it needs to build a network of partners to pool resources. One example of this strategy is Robert Bosch: executives at Bosch realized that if each platform promoted their technology to the detriment of others, they would eventually collapse, resulting in a dependency on technologies by big tech companies. Instead, they decided to put their IoT technologies developed internally into the open arena, most of it being contributed to the Eclipse IoT Working Group [13], in order to benefit from a network effect leading to wider take up of their technologies on one hand, and the continued improvement of these technologies on the other.

Creating a new open source foundation is a long and expensive process. Some groups think that they should create a new association to develop an ecosystem around the results they publish in open source. Creating such an organization is certainly a very exciting process, but it is very likely more efficient to leverage the proven collaboration models provided by existing foundations:

- In many cases, one or several open source projects can provide enough of a meeting point to build a successful community.
- Several open source foundations support a "foundation in a box" approach. For example, the Linux Foundation provides a toolbox to organizations that want to create their own "foundation" managed by the Linux Foundation, and the Eclipse Foundation provides processes to create Interest Groups (lightweight) or Working Groups (full featured) that enable collaborations, and for example the development of open specifications.

As a reference, the OpenHW Group [14] created an Eclipse Working Group, OpenHW Group Europe, to specifically support its European ecosystem around Core-V applications.

We estimate that creating an association from scratch that could provide the right level of open source governance would take more than 18 months before it would be fully operational and would require a legal budget of hundreds of thousands, if not millions, of euros. Teaming up with an established foundation makes the process much faster and an order of magnitude less expensive.

Non-functional aspects of open source are important too

Having looked at code, community, and the ecosystem, let's approach two challenges that open source has to face in the coming years: supply-chain security and certification.

For a long time, it was clear that even if the OSS movement was not designed with security in mind, the Linus' law in open source states that: "given enough eyeballs, all bugs are shallow." [15].

It is obviously the case that major security vulnerabilities impact proprietary software as much as open source software. The SolarWinds Hack [16] is an example of a security breach that has impacted a proprietary product without any relations to open source.

But in the last few years, the conjunction of a few vulnerabilities in critical open source software like OpenSSL [17] – and the fact that open source has become pervasive and is used in almost every piece of software [18] – makes open source security and more specifically supply-chain security a major topic. Recently, the Log4Shell [19] vulnerability has been a wakeup call for governments, communities and companies to put supply-chain security on top of their priority list.

As a result, several open source foundations are addressing the challenge of open source supply chain. The Open Source Security Foundation [20] was created by the Linux Foundation and is hosting the Alpha-Omega project, funded by Google and Microsoft, whose mission is to "Protect society by improving the security of open source software through direct maintainer engagement and expert analysis". The Eclipse Foundation is also creating its own security team, partly supported by funds from the Alpha-Omega project, to help the Eclipse community at large address the supply-chain security of the more than 400 projects hosted by the Eclipse Foundation. This includes developing new processes and deploying new tools to support projects so we can guarantee the traceability of software that users consume from the Eclipse Foundation,

while also ensuring that vulnerabilities are found early and are fixed in a predictable way.

Finally, as we see new open source initiatives being created like the Eclipse Software Defined Vehicle (SDV) Working Group [21] where automotive companies collaborate not only on development tools but also on software that will be embedded in future generations of cars, it is important to mention the topic of certification. For a long time, lots of people considered that open source components could not be certified, but, as in the case of security, the open source collaboration model and the approach to certification are orthogonal topics and there are several cases where open source components have been reused in certified environments. The point is that either an organization contributing to open source projects executes the certification, or the users of the open source component will have to execute it in their context. As an example, Eclipse iceoryx is striving for being able to safety-certify the code base up to ISO 26262 ASIL D that is essential to the automotive industry [22].

Conclusion

As it enables scalability, collaboration and adoption, forthcoming technology trends like edge computing will largely leverage open source. This is a unique opportunity for the European ecosystem if European organizations move quickly from using and contributing to open source to a more strategic approach of open source.

Open Source has been used successfully to grow the adoption of some of the platforms we all use today, like Kubernetes. As we develop exciting technologies in research and industry, let's make sure that we use the superpowers of open source to foster global adoption of these technologies.

There is good news: the European Commission is pushing for open source, the industry is increasingly embracing open source, and open source foundations are ready to help.

So, everything is aligned to show strong leadership for the global ecosystem to collaborate on open source technologies with strong roots in Europe.

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