



First results

European Commission

Open Source Study

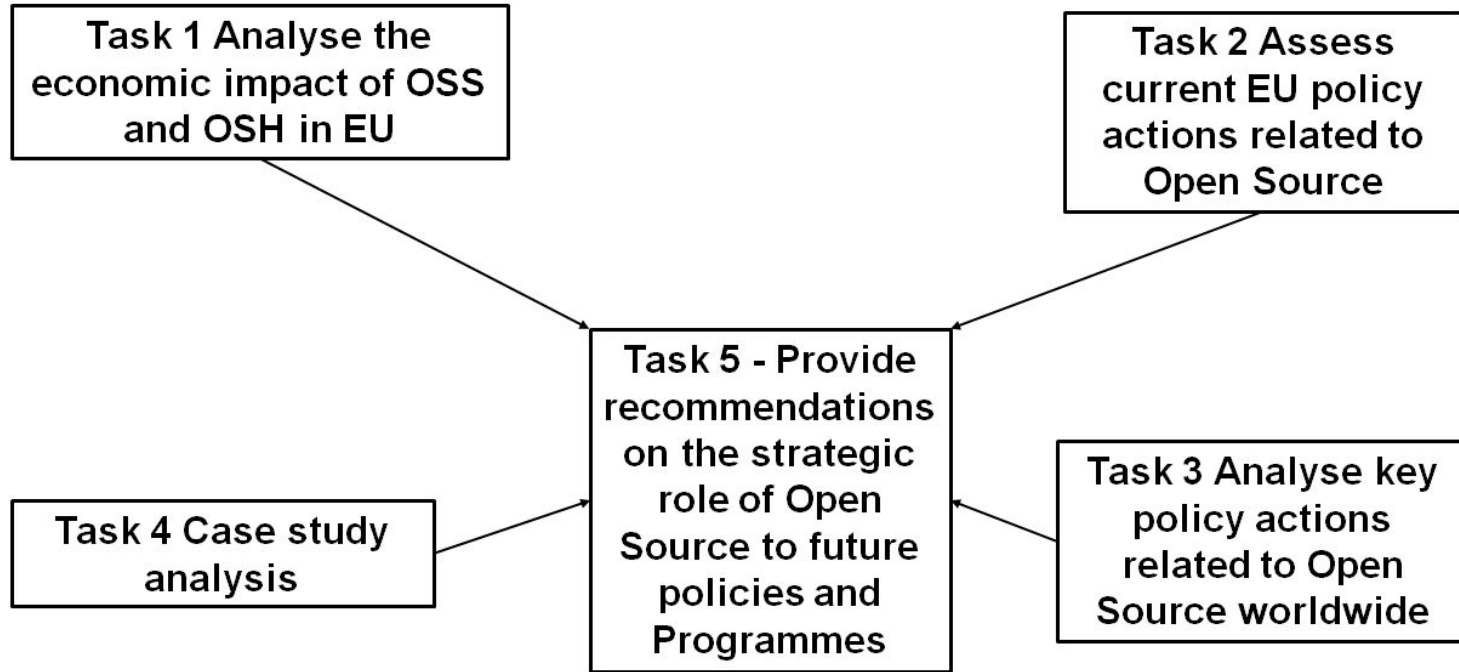
Agenda

- 14:30: Insights on quantitative impacts of Open Source
– *Knut Blind*
- 14:45: Core Infrastructure Initiative FOSS Contributor Survey
– *Frank Nagle, HBS*
- 15:00: Qualitative exploration of the impact of Open Source software and hardware on key domains
– *Mirko Böhm, Andrew Katz*
- 15:15: What can Governments do?
– *Sivan Pättsch*

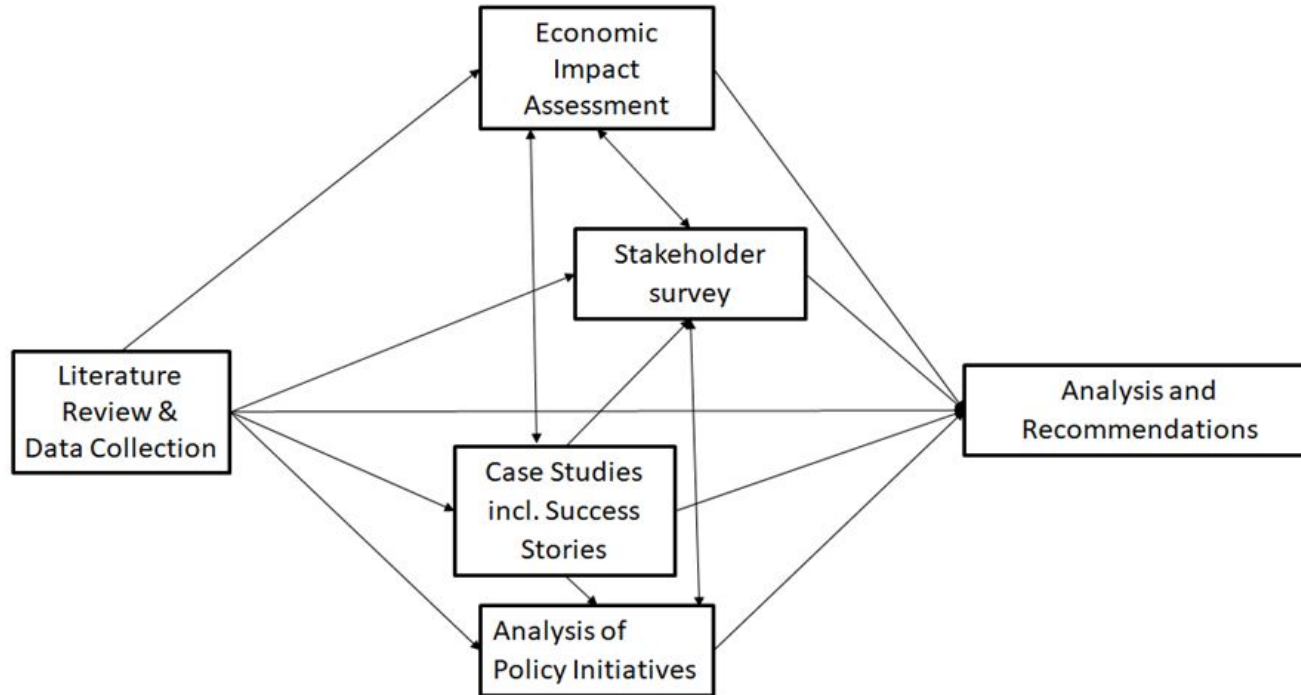
Insights on quantitative impacts of Open Source

Knut Blind

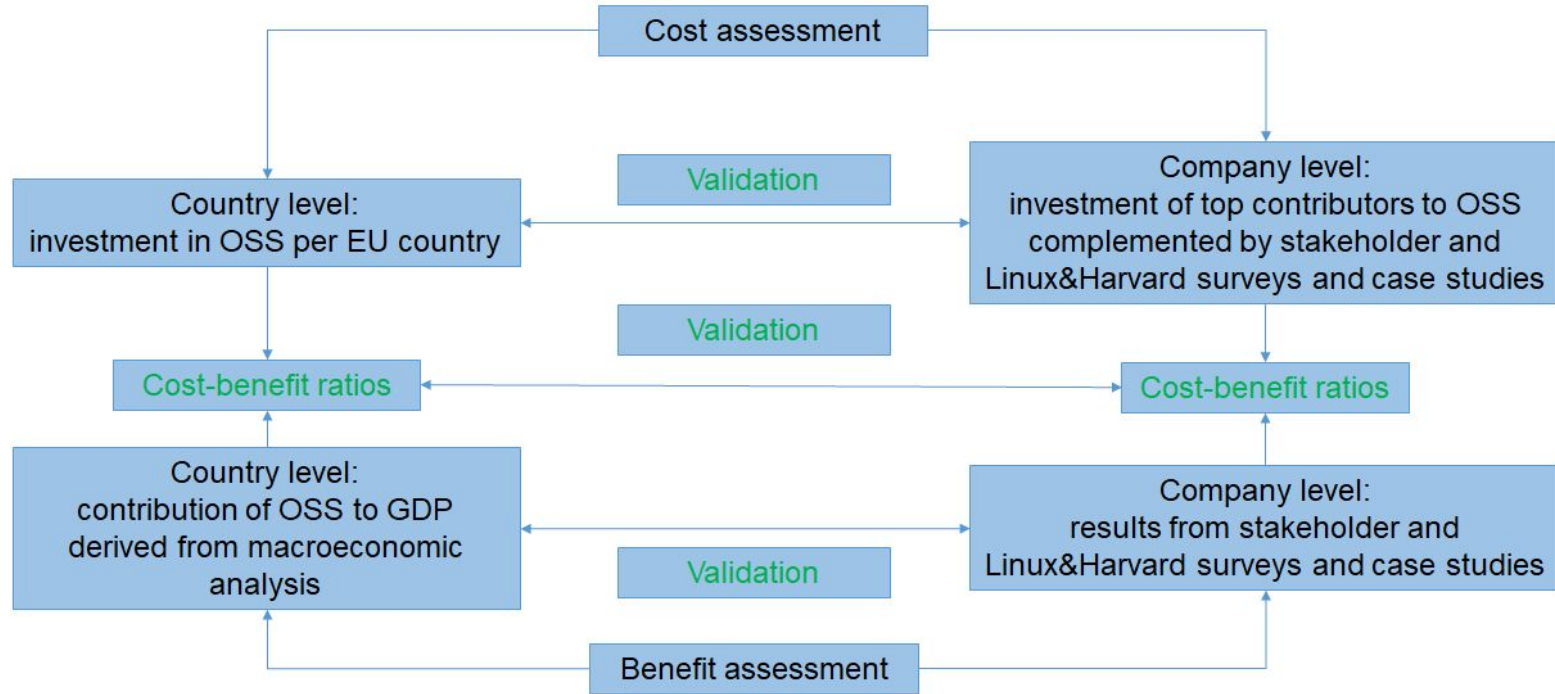
Tasks and their relations



Relation of methodological approaches



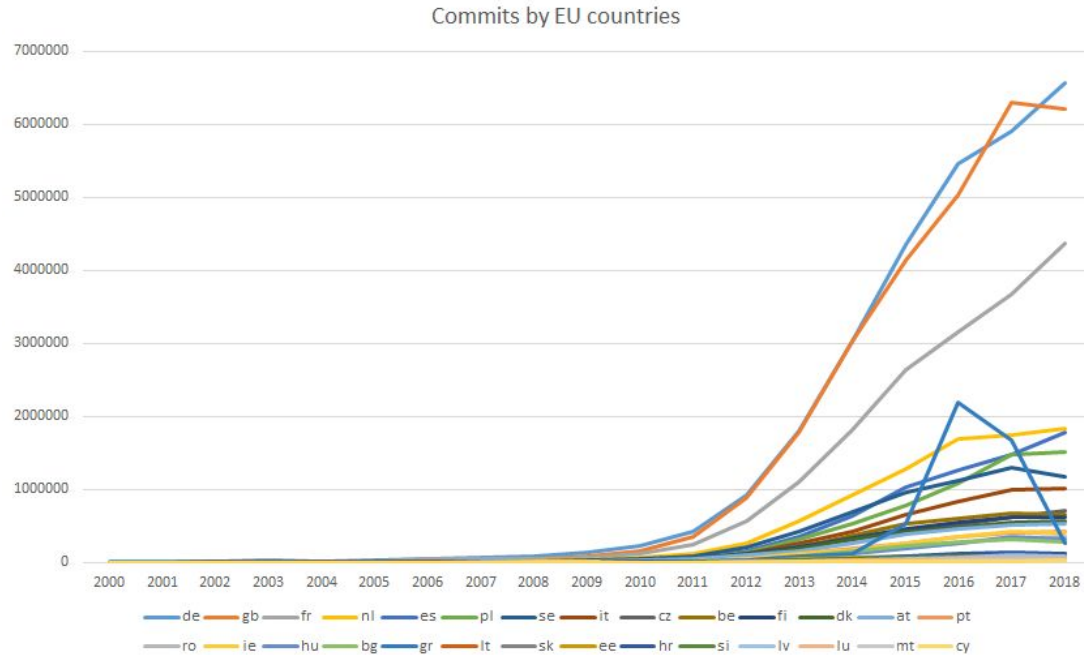
Overall approach



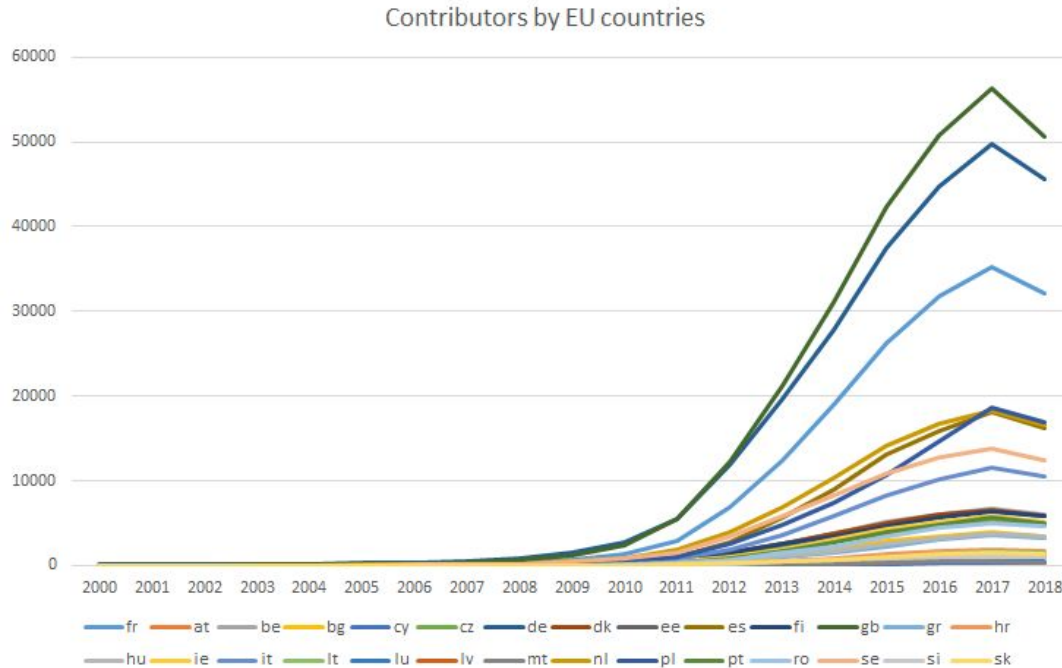
Data sources

- Open Source Software
 - 1.3 billion commits at GitHub
 - 32 million users at GitHub with 1.5 million organisational affiliations and 2.5 million country codes
 - almost 700,000 organizations
- Economic Data
 - OECD
 - Eurostat
 - European Patent office
 - Crunchbase, Amadeus, Worldbank, ILO, ...

GitHub Commits per EU country



GitHub Contributors per EU country



Cost-based impact assessment

- to generate a baseline for the economic impact of OSS, we have conducted cost-based impact assessments, which are based on two pillars.
 - efforts by the member countries of the EU
 - efforts by the most active companies located in the EU member states
- basic assumption beyond this approach is that benefits derived from these investments will at least outweigh invested costs
- consequently, findings will present only a lower bound of the economic impact

The cost of investing in OSS in the EU: the country level

- more than 3 millions employees in computer programming in the EU
- **in 2018 more than 260,000 contributors to GitHub**, i.e. on EU average **8.2% of employees in computer programming**
- **average personnel cost** of all contributors based on full time equivalents of more than **Euro 14 billion** in 2018
- **in 2018 more than 30 million commits** to GitHub representing an **effort of more than 16,000 years** based on Constructive Cost Model
- **almost Euro 1 billion invested personnel cost in the EU** in 2018

The cost of investing in OSS in the EU: the company perspective

- sample of most active companies in GitHub in 2018 responsible for more than 12% of the contributors and for ca. one third of commits
- **high share of small companies among most active companies participating in OSS, i.e. more than 75% have less than 100 employees**
- **the smaller the companies active in OSS, the more contributors are listed, the more commits they provide, i.e. almost 50% by companies up to 50 employees, and the more efforts they invest, e.g. those between 11 and 100 employees invest more than 5% of their full-time equivalents**
- **validity of approach confirmed**

Quantification of economic benefit based on European growth model

- elasticity of 0.04, i.e. the **10% increase of commits** as from 2017 to 2018 contributed to GitHub is **contributing 0.4% of GDP** in the EU
- in 2018, 0.4% of the total GDP of Euro 15,900 billion in the EU is a contribution of more than **Euro 63 billion** per year
- a **10% increase in the number of contributors** would increase EU GDP by 0.6%, i.e. **Euro 95 billion** per year
- in summary, the GDP of EU is significantly benefiting from the global pool of OSS code based on number of commits or users as indicators
- if the EU can increase both of them only marginally, EU GDP increase significantly above Euro 100 billion per year

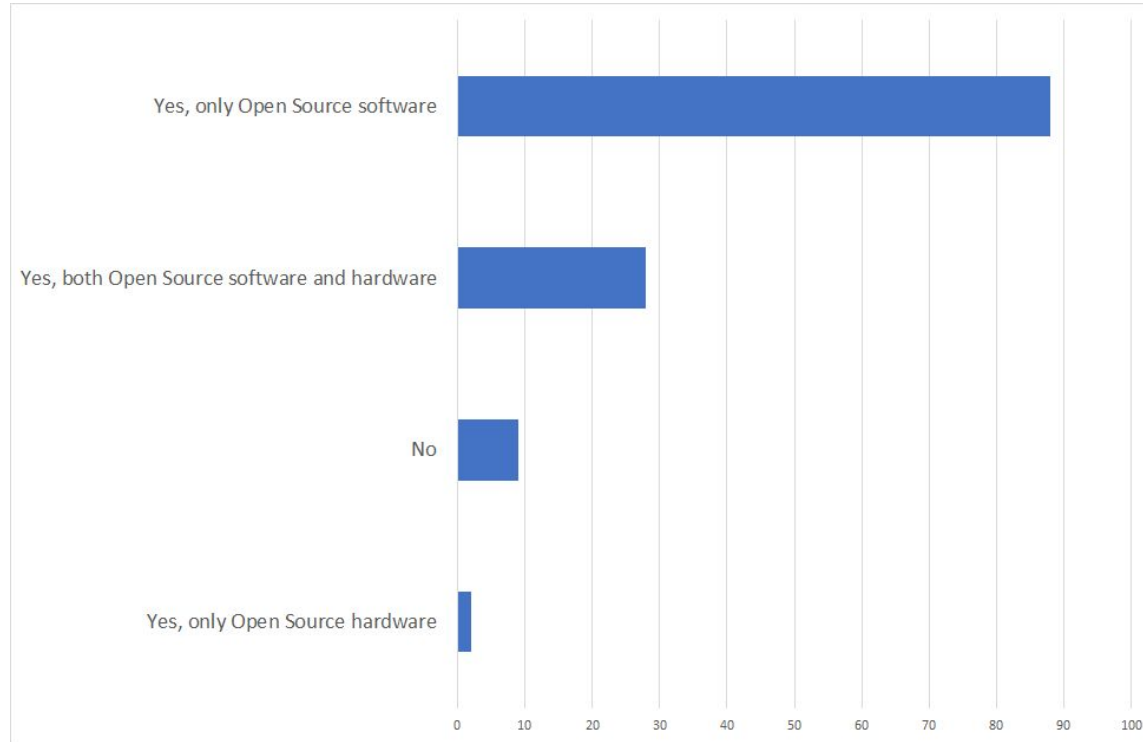
Cost-benefit ratios at the macro level

- Cost-benefit ratios based on the commits: **63:1**, based on the number of contributors: **95:15** assuming that the 260.000 software developers in the EU contributing to GitHub work full time on OSS, but studies report at maximum 10%, i.e. the effort has to be divided by 10 leading to a similar ratio of 60:1
- but contribution of OSS to the GDP in 2018 not only based on code developed in 2018, but also on the code in previous years
- assuming a linear depreciation rate of 10% and the same effort per year, then the effort in 2018 has to be multiplied by five, which leads us to a **cost-benefit ratio of around 12:1**

Stakeholder Survey

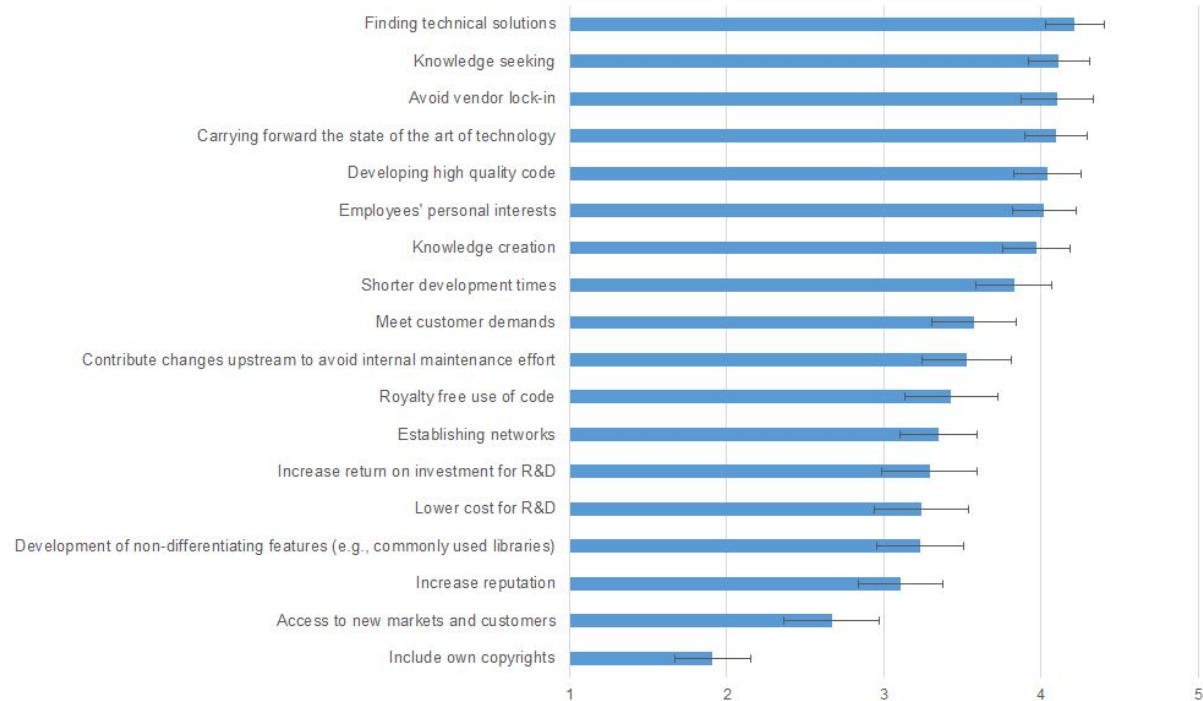
- Objectives
 - Aim is to gather and analyse the views of a broad set of stakeholders on the topic of the impact of OSS, hereby creating a robust empirical representation of the opinions and issues at stake.
 - In addition, we are interested in complementing the literature, data base and case study driven approach to assess impact of OSS and OSH with input from the respondents of the stakeholder survey
- All together, this body of empirical evidence will be used to derive policy recommendations
- Status
 - Wide distribution supported by EC, Eclipse Foundation etc.
 - Feedback: so more than 800 responses, more than 100 complete answers
 - However: **survey is still open for participation** <https://inno.limequery.com/436575>

Contributing to OSS/OSH development



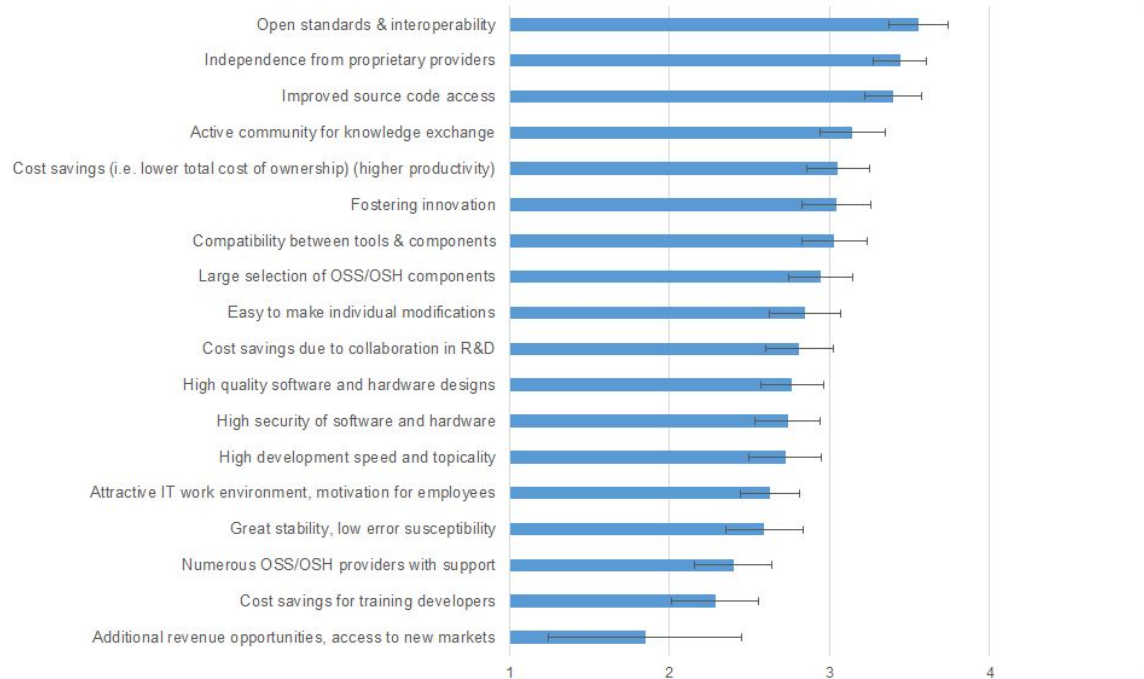
Incentives to join OSS/OSH development

(from 1 very low to 5 very high)



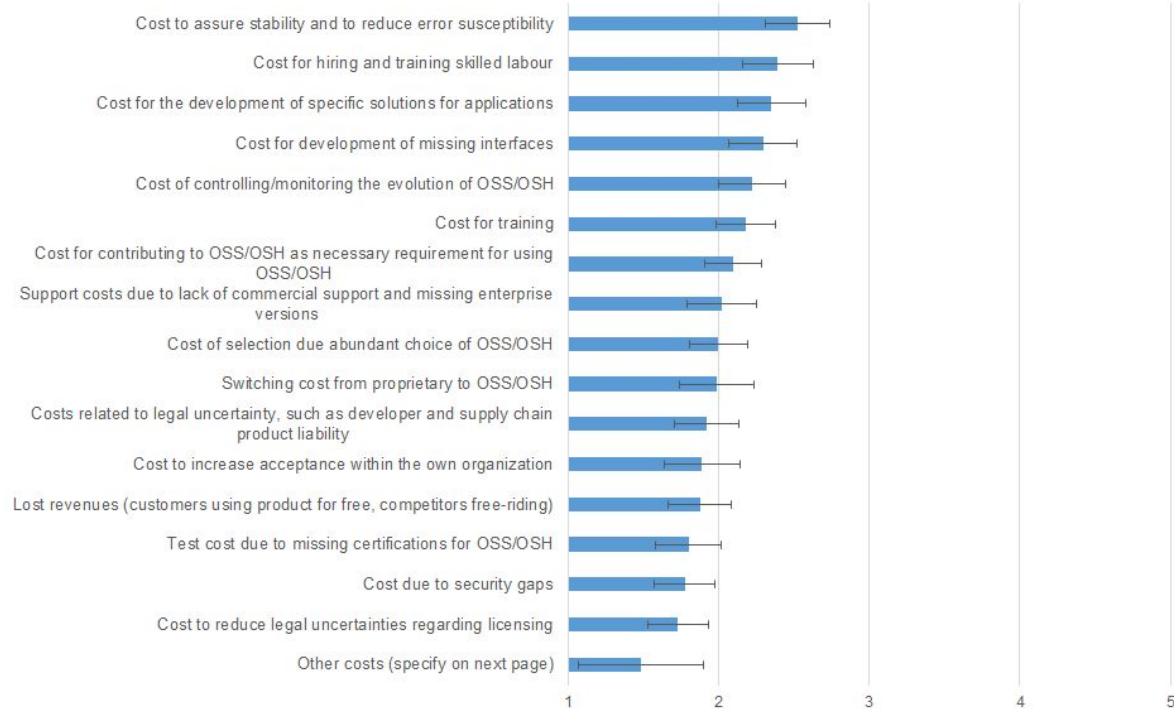
Realised benefits related to OSS/OSH

(from 1 very low to 5 very high)



Realised costs related to OSS

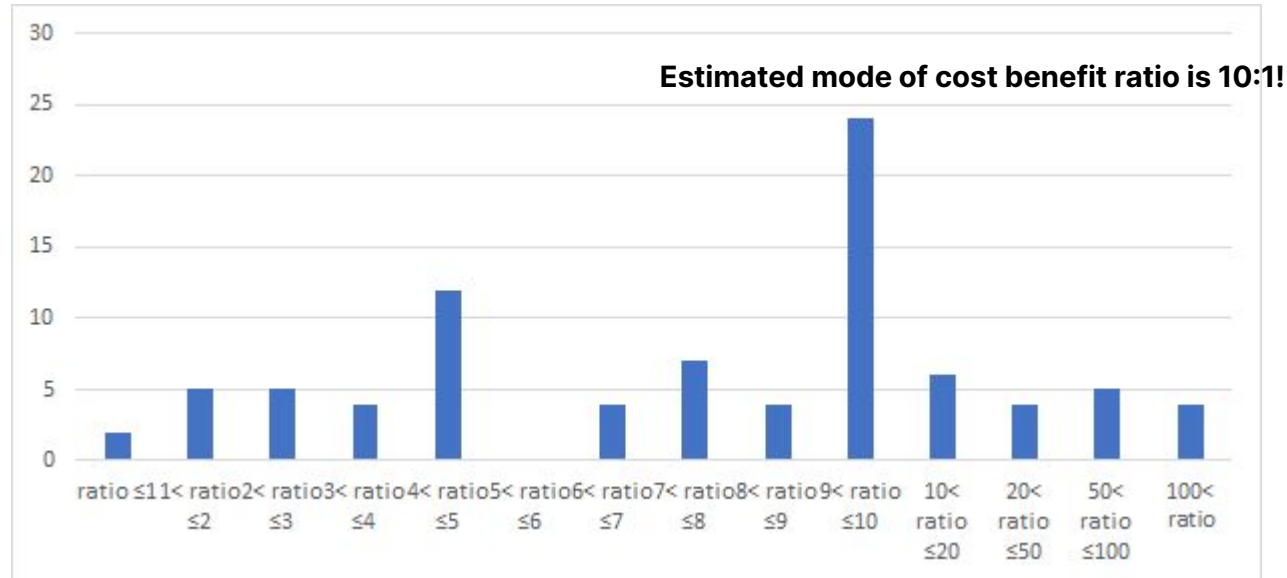
(from 1 very low to 5 very high)



Overall cost-benefit-ratio of OSS: Qualitative assessment

	No costs	Low costs	Medium costs	High costs	Very high costs
No benefits	0.01	0.01	0.01	0.00	0.00
Low benefits	0.01	0.00	0.00	0.00	0.00
Medium benefits	0.02	0.02	0.03	0.00	0.00
High benefits	0.03	0.20	0.11	0.00	0.00
Very high benefits	0.02	0.33	0.17	0.01	0.01

Overall cost-benefit-ratio of OSS: Quantitative assessment



Summary of results of impacts of OSS

- Significant investments by EU countries and companies into Open Source
- Significant contributions to GDP of the EU
- Cost-benefit ratio of around 10:1 from the macroeconomic approach confirmed by the qualitative and quantitative survey responses
- Benefits of Open Source mainly related to openness incl. standards and independence and less to revenue generating and cost savings
- Open Source Hardware not very prominent yet

Core Infrastructure Initiative FOSS Contributor Survey

Frank Nagle, HBS

Qualitative exploration of the impact of Open Source software and hardware on key domains

Mirko Böhm, Andrew Katz

Qualitative exploration of the impact of Open Source software and hardware on key domains

- Case studies on specific European economic domains, including a success case for each domain to support the quantitative analysis by collecting factual data about its adoption and transformative effect
- Insights from the case studies as theory-building foundation to complement the quantitative modelling as well as the policy analysis
- Assessment of the role of Open Source software and hardware as key innovation enablers for Europe
- SWOT analysis of Open Source software and hardware for the European industry and economy

Methodology

- Cases have been researched in the form of embedded multi-case studies
- Data is gathered using semi-structured, open-ended interviews based on a standardized interview guideline
- Individual cases are assessed using a common structure of criteria, making them horizontally comparable
- Cases will be aggregated in a SWOT analysis focusing on the perspective of a policy decision maker

Case studies and relevant input

Domain	Input through expert interview
Maker to manufacturer - process innovations	Arduino, White Rabbit, MyriadRF, RepRap, (Open Compute Project)
Open Hardware computing and infrastructure	RiscV/SiFive, Open Compute Project, White Rabbit
End-user applications	Nextcloud, LibreOffice, CentOS, OW2
Automotive and embedded	Yocto, CentOS
Public sector	XRoad, Software Heritage, OW2

The European Open Source software and hardware ecosystem

- Many key OSSH projects are founded or based in Europe, but not commonly recognized as European innovations
- The European public sector plays an important role in OSSH, e.g. results based on public funding should be in the public domain
- OSSH contributions solve immediate needs and exhibit long tail of value generation, but only immediate impact might be measurable
- OSSH innovations lower barriers to entry for participants and create a bridge between (hobbyist) community and enterprise, this fosters innovation and efficiency of labour market

Domains, funding, differentiation and use cases

- Many OSSH projects represent collaborative research and development reducing duplicate effort and risk of up-front investments
- OSSH impacts a broad spectrum of economic domains and there is no typical domain or sector/subsector specifically influenced by it
- Collaborative R&D aspect reflected in funding sources because majority of projects built on shared funding and not aiming to be profitable
- “Open design” and “open when ready”
- Exceptions are consumer-focused applications aiming to generate revenue in highly competitive environments

Impacts of input factors, focus topics and on specific stakeholders

- Tooling, component availability and legal/regulatory framework commonly mentioned as important for development of ecosystem
- No specific focus topics (cybersecurity, AI, HPC, ...) stand out as specifically impacted by OSSH as general-purpose technologies that "look for their application" in the market
- OSSH bridges community, industry and the public sector, emphasis on industry represent the shift towards corporate contributors
- At individual level, participants highlight the importance of personal skills, knowledge and experience, but lack of teaching with and of OSSH

The state of the OSSH ecosystem

- Both Open Source software and hardware ecosystems highly and efficiently integrated with overlaps, e.g. software support for OSH
- Umbrella organisations provide credibility, reputation-based impact and neutral, pro-competitive governance
- Combination of OSSH licensing with other IPR is often considered toxic for collaboration and not wide-spread, many participants consider licensing an add-on to open collaboration
- Attracting and retaining contributors a challenge for many communities, e.g. multiple projects mention a high attrition rate or contributor fluctuation

Preliminary conclusions

- Multiple invited experts indicate that the EU has a lot of potential to develop the OSSH ecosystem, but some remain sceptical of bureaucratic challenges or lack of collaboration and OSSH adoption
- Real success of OSSH collaboration is not represented in statistics, those only represent the baseline measurable benefits.
Example: "the availability of designs and tools to students so that they can work on the real thing".

What can Governments do? Open Source and Public Policy

Sivan Pättsch

What were our goals?

- Create a framework to compare expansiveness of public policy actions relating to Open Source (not normative!)
- ...and performing that comparison
- Understand why governments engage with Open Source
- Understand what works and what doesn't

About that framework

Criterion	Indicator	Max Mark
Dimension: Public sector		65
Policy existence	Is there a policy on OSS/OSH? If so, what is the most prescriptive level of the policy in force?	
	Norm	5
	Decree	10
	Law	15
Criterion total mark		15
Public procurement	Is a public procurement policy in force which favours OSS/OSH, under which of categories does the policy fall?	
	Advisory (where the use of Open Source software is permitted)	5
	Preference (where the use of Open Source software is given preference, but not mandated)	10
	Mandatory (where the use of Open Source software is required)	15
Criterion total mark		15
Policy implementation	If there is an OSS/OSH policy, how effectively is the policy being implemented?	5
	Is there any enforcement foreseen for the OSS/OSH policy?	5
	Criterion total mark	
OS competence	Does the public administration have an internal strategy on OSS/OSH?	5
	Does the public administration have an open source office?	5
	Does the public administration share its OSS and OSH policies and solutions with other public administrations?	5
	Does the public administration use OSS/OSH in its own developments, including development which it outsources?	5
	Criterion total mark	

Criterion	Indicator	Max Mark
Dimension: Private sector		45
Supporting private sector	Are there any laws or rules that aim to support the private sector in exploiting OSS/OSH?	5
	Are there any laws or rules that aim to encourage the private sector to develop OSS/OSH?	5
	Does a strategy exist to use OSS/OSH for industrial development?	10
	Criterion total mark	
Guidance	Are there services that provide OSS/OSH-related guidance to the private sector (e.g. through explaining: OS licensing schemes, intellectual property rights, equal opportunities, procurement rules and how to participate in OSS/OSH communities)?	5
	Criterion total mark	
Community	Is the public authority nurturing Open Source communities?	5
	Is the public authority a good open community citizen?	5
	Criterion total mark	
OS present in neighbouring policies	To what degree do policy actions in neighbouring fields, such as research & innovation, cybersecurity, telecommunications, AI, HPC etc., take into account OSS/OSH?	10
	Criterion total mark	
Total of achievable mark		110

The framework

Dimension	Criteria
Public policies aimed at the public sector	<ul style="list-style-type: none">• The level of prescriptiveness of a policy, throughout the jurisdiction.• The degree to which public procurement policies take OSS/OSH into account.• How effectively the policy is being executed.• The degree of competence with regard to OSS and OSH within the public authority.
Public policies aimed at the private sector	<ul style="list-style-type: none">• To what degree the jurisdiction supports private actors in adopting and developing OSS and OSH.• To what degree the jurisdiction makes guidance available for private actors.• Whether the jurisdiction's administration takes on a role (and if so, what role) with regard to OSS and OSH communities.• To what degree OSS and OSH is being taken into account in neighbouring policy fields.

What countries have we looked at?

Europe	Americas	Asia
Bulgaria France Germany Italy Poland Spain United Kingdom	Brazil The United States	China India Japan South Korea

What countries will we show today?

Europe	Americas	Asia
Bulgaria France Germany Italy Poland Spain United Kingdom	Brazil The United States	China India Japan South Korea

Brazil

- OSS push in early 2000s
 - Internal lobbying achieved high-level political support
 - Intertwined with political concerns around independence and culture
“Software as a commons”
 - Institutionalisation significant part of effort, but never centralised
- Early 2010s saw end high-level political support
 - Without central function, institutions quickly lost mandate
 - Why did the Software Livre movement lose its power of persuasion on the government?
- What is left today?

Italy

- Italy's OSS policy story revolves around the CAD (“Codice Amministrazione Digital”)
 - From 2012 on, developed into the “perfect” OSS procurement law
 - Comparative assessment, favouring OSS
 - Except nothing really happened
- Why?
 - Unclear responsibilities
 - Lacking awareness
 - No guidance
- Improvement as of late

South Korea

- South Korea's government doesn't procure OSS specifically
- South Korea wants its industry to be sovereign
 - Ministry: "Open Source software [...] the basis of all activities"
 - Coordinates with CJK (China-Japan-Korea) countries on OSS
- Institutionalisation and industrial policy
 - Korea Copyright Commission, License compliance - \$3 mil annual
 - Open Source Software Competence Plaza - \$12 mil annual
 - KOSSLab, an Open Source incubator
 - National IT Promotion Agency - \$360 mil annual

The framework

Dimension	Criteria
Public policies aimed at the public sector itself	<ul style="list-style-type: none">• The level of prescriptiveness of a policy, throughout the jurisdiction.• The degree to which public procurement policies take OSS/OSH into account.• How effectively the policy is being executed.• The degree of competence with regard to OSS and OSH within the public authority.
Public policies aimed at the private sector	<ul style="list-style-type: none">• To what degree the jurisdiction supports private actors in adopting and developing OSS and OSH.• To what degree the jurisdiction makes guidance available for private actors.• Whether the jurisdiction's administration takes on a role (and if so, what role) with regard to OSS and OSH communities.• To what degree OSS and OSH is being taken into account in neighbouring policy fields.

Criterion	Italy	Brazil	South Korea
Dimension: Public sector	63%	14%	31%
Policy existence	10	0	1
Public procurement	15	0	0
Policy implementation	4	0	0
OS competence	12	9	10
Dimension: Private sector	13%	4%	76%
Supporting private sector	0	0	17
Guidance	0	0	5
Community	4	0	6
OS present in neighbouring policies	2	1	6
Total of achievable mark	38%	9%	53%

Comparison

Why do governments engage with OS

Economic concerns

- Cost savings
- Switching costs and network effects
- Underproduction of public goods
- Market competition and technology neutrality

Technical concerns

- Compatibility
- Security
- Customisability
- Localisation

Political concerns

- Governance
- Independence
- Digitalisation

Legal concerns

- Software piracy
- Risks of indemnification
- Difficulty to restrict access
- Compliance with international trade regime

A pattern emerging

- Two waves of government OSS support
 - The first wave: Early 2000s
 - The second wave: Mid 2010s
- What story drives these waves?

Issues and approaches

- Writing a good law is not everything
- Implementation and follow up is difficult
 - Awareness / ease of implementation / education
- It is difficult to force the disinterested to do something
 - External spark, intrinsic motivation
- Political support - changing priorities and governments

Issues and approaches

- Level of prescriptiveness secondary as explanatory factor
- Culture seems most important factor - Open (Source/Innovation/Data/Government) culture
 - The bigger the organisation/scope, the more challenging
 - Only successful examples on regional level
- Institutionalisation common approach, but mixed results
 - Political support necessary if open culture has not set in

Summary

- Changing stories and motivations over time - 2 waves
- Geographical spread in government focus
- Implementation and culture biggest issues



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Thank you.

The Study Team

